From: Mark Robinowitz
To: Columbia River Crossing;
CC:
Subject: Columbia River Crossing DEIS comment - "Peak Traffic"
Date: Tuesday, July 01, 2008 1:44:09 AM
Attachments: transport-energy-war.jpg
nafta-superhighways.jpg
banfield.jpg
high-speed-rail.jpg
amtrak-old-new.jpg
acela.jpg
transrapid.jpg

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www.road-scholar.org - Peak Traffic and freeway fights
Planning NAFTA Superhighways at the End of the Age of Oil
Troubled Bridges Over Water

www.road-scholar.org/peak-traffic.html

This article was originally published May 10, 2006 at From the Wilderness. This was the introduction they wrote for this:

> [In an engaging discussion of the effects of Peak Oil on automobile traffic, Mark Robinowitz examines the ridiculousness of implementing "superhighway" plans while the nation faces an inevitable oil drop-off. Learn how the interstate highway system was originally a military venture of the 1950's after the "streetcar conspiracy," and about methods that are more effective responses to swelling traffic than imposing more oil-heavy highway expansions. Robinowitz tells FTW readers why supposedly-green programs like "inter-modal" transportation or "Smart Growth" serve only to divide and divert activists, while generating more problems than solutions. From Eisenhower, to Clinton, to George W. Bush, read how decades of presidencies have added to the monstrosity of highway systems in America, not for the good of the people, but to line wealthy pockets with profitable pavement and catapult America swiftly towards "the end of suburbia." - FTW]
>
> [In the second part of Mark Robinowitz's discussion of the effects of Peak Oil on automobile traffic, he reveals the ironies of many specific highway laws, including why proposed highway projects have made gravely incorrect estimations of future traffic by excluding Peak Oil as a variable. Read further to learn about the fine print within National Environmental Policy Act (NEPA) regulations that allows for major changes in the focus and allocation of federal transportation funds so that Americans may make use of less energy-expensive forms of transportation. Learn the difference between the façade of the "Power Shift" program, and why Richard Heinberg's "Powerdown" program is brilliantly realistic, yet unsupported by oil elites. Robinowitz provides FTW readers with an extensive compilation of valuable resources, including news, books, articles, websites, and the best names in the Peak Oil discourse. Robinowitz clearly exposes his best-case scenario as to what might happen if America were to turn its oil and traffic troubles around before it's too late. – FTW]

this article was mentioned in The Rock River Times, Rockford, Illinois

www.rockrivertimes.com/index.pl?cmd=viewstory&id=13324&cat=4

Viewpoint: Are we building highways to oblivion?
By Joe Baker, Senior Editor

From the May 31-June 6, 2006, issue

Part 1

Part 2

Transportation planning in the United States -- the epicenter of oil combustion -- has been remarkably impervious to rising gasoline prices and growing awareness of climate change and the geological reality of finite fossil fuel supplies. Hundreds of billions of dollars have been committed for massive expansions of the interstate highway system. The plans for these "NAFTA superhighways" and Outer Beltways assume limitless cheap oil, a trillion dollar mistake that must be corrected if there is a hope for a renewable energy society after petroleum. This article examines transportation planning in the United States and offers a tool that concerned citizens could use to force governments to shift long term plans to prepare to mitigate Peak Oil.

Peak Oil: Personal Impact and Public Policies

Three dollar a gallon gasoline has increased public concern about energy supplies, but this awareness has not translated into changes in public policies. Widespread outrage about astronomical oil company profits has not fueled political pressure to tax excessive profits to fund a European style inter-city rail network, put solar panels on millions of homes or other initiatives designed for a Post-Peak Oil world.

The arrival of Peak Oil and climate change onto the world political stage has not deterred governments from further investments in suburban sprawl, more highways, and other overdevelopment dependent on endless supplies of dollar a gallon petrol.

A large part of the public discussion about Peak Oil is about personal transportation issues, since most people's consciousness of industrial energy systems is focused on purchasing petroleum at the pump. There are many excellent strategies for reducting one's energy consumption: driving less, carpooling, **car sharing** , using public transportation (if available), bicycling, walking, living closer to your job (if possible) and **buying locally made products** to reduce transportation demands. However, an effective response to Peak Oil will require efforts at all levels - family, neighborhood, city, state, nation and planet -- to be useful in the post-Peak era.

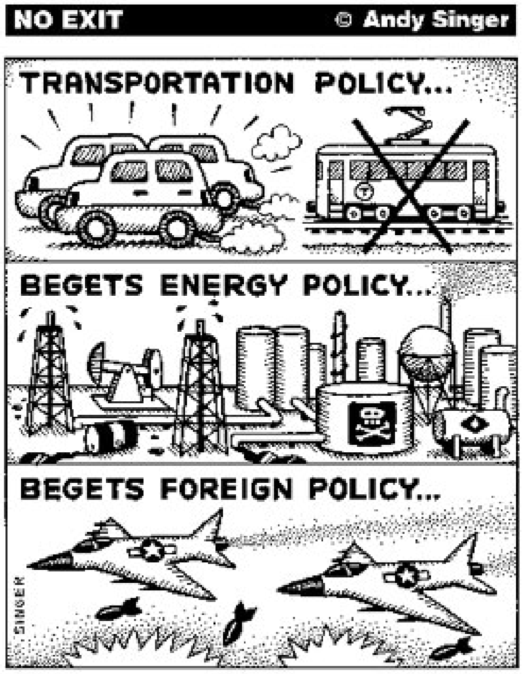
From the Wilderness , **Life After the Oil Crash** , **Energy Bulletin** and many other news sources have documented that the most important issues of Peak Oil are about **food supplies** (especially for metropolitan areas far removed from farms), **civil liberties** , economic instabilities and global conflicts.

A shift in transportation policy that admits to Peak Oil and climate change is needed to spark widespread discussions of needed changes to retool civilization for a post-carbon future.

The Highway Industrial Complex

> "Above all, it is the young who succumb to this magic. They experience the triumph of the motorcar with the full temperment of their impressionable hearts. It must be seen as a sign of the invigorating power of our people that they give themselves with such fanatic devotion to this invention, an invention which provides the basis and structure of our modern traffic."
> -- Adolf Hitler
>
> American way of life (AWOL): a method of consuming non-renewable resources that Vice President Dick Cheney says is "not negotiable"
> -- **Permatopia Dictionary**

Highway construction is a key part of the wealth transfer scheme called "the economy." Road expansion unites powerful interests, including real estate speculators, developers, road construction, sand and gravel mining, and lending institutions. In most communities in North America, these elites are the financial sponsors of local politicians who make zoning and planning decisions to build new highways and the associated development.



If a highway violates too many federal laws, the Federal Highway Administration may decide not to approve a road project even if local governments are vocal supporters (since the FHWA is the agency that gets sued, not local governments who contribute very little toward construction but gain all of the benefits).

Multiple Bypass Surgery

The interstate highway system was created in the 1950s, part of a "National Defense" network promoted by President Eisenhower as a military necessity for moving troops and equipment (similar to the Autobahn network built in Nazi Germany).

This massive construction was a consequence of the conspiracy between General Motors, Firestone Tire and Standard Oil to destroy public transit systems in over 100 cities (partly a result of these companies using their war profits to transform the civilian economy). A websearch on "streetcar conspiracy" will retrieve numerous articles that document this part of American history.

Ironically, the United States is now spending billions to build new light rail and street car networks in cities from coast to coast -- if the rails had been left intact, American cities would not be as car dependent, a tragic mistake that will make coping with Peak Oil much more difficult.

The interstates quickly became fuel for generating vast areas of car-dependent suburbs that created a "donut" form of development, turning some inner cities into semi-abandoned areas.

Martin Luther King, Jr. was one of many who decried the inherent racism of these road schemes. In his speech"Remaining Awake Through a Great Revolution," delivered on March 31, 1968 , King said "These forty million [poor] people are invisible because America is so affluent, so rich; because our expressways carry us away from the ghetto, we don't see the poor." It is surreal that numerous highways are now named after someone who decried the "white flight" fueled by freeways.

During the peak of the civil rights struggle in Washington, D.C., a rallying cry of opponents who spent a decade to stop Interstate 95 from tearing through the inner city was “No White Men's Roads Through Black Men's Homes.” An article that explores this history is“Interview with a Freeway Fighter,” archived at **www.permatopia.com/wetlands/compromise.html**

Cities that had public campaigns that stopped highways include Boston, San Francisco, Memphis, Toronto (Canada), Washington, D.C., Baltimore, Chicago, New Orleans, Portland (OR), Eugene (OR) and Pasadena (CA).

In the wake of the 1960s explosion of freeway fighting, few new major highways were proposed. The focus of many transportation agencies was to complete projects proposed in the 1950s, which were delayed by the rise of citizen activism and increasing construction costs (especially after the 1973 Saudi oil embargo).

In the 1990s, there was a resurgence of plans for new freeways. Several major upgrades to the interstate system were unveiled to help implement the North American Free Trade Agreement (NAFTA), building new and expanded north-south trucking routes between Canada and Mexico. Metastasizing metropolitan areas also made new plans for megaroads, since outer suburbs require more asphalt per capita and are more car dependent than urban cores or inner suburbs built during the street car era (early 1900s).

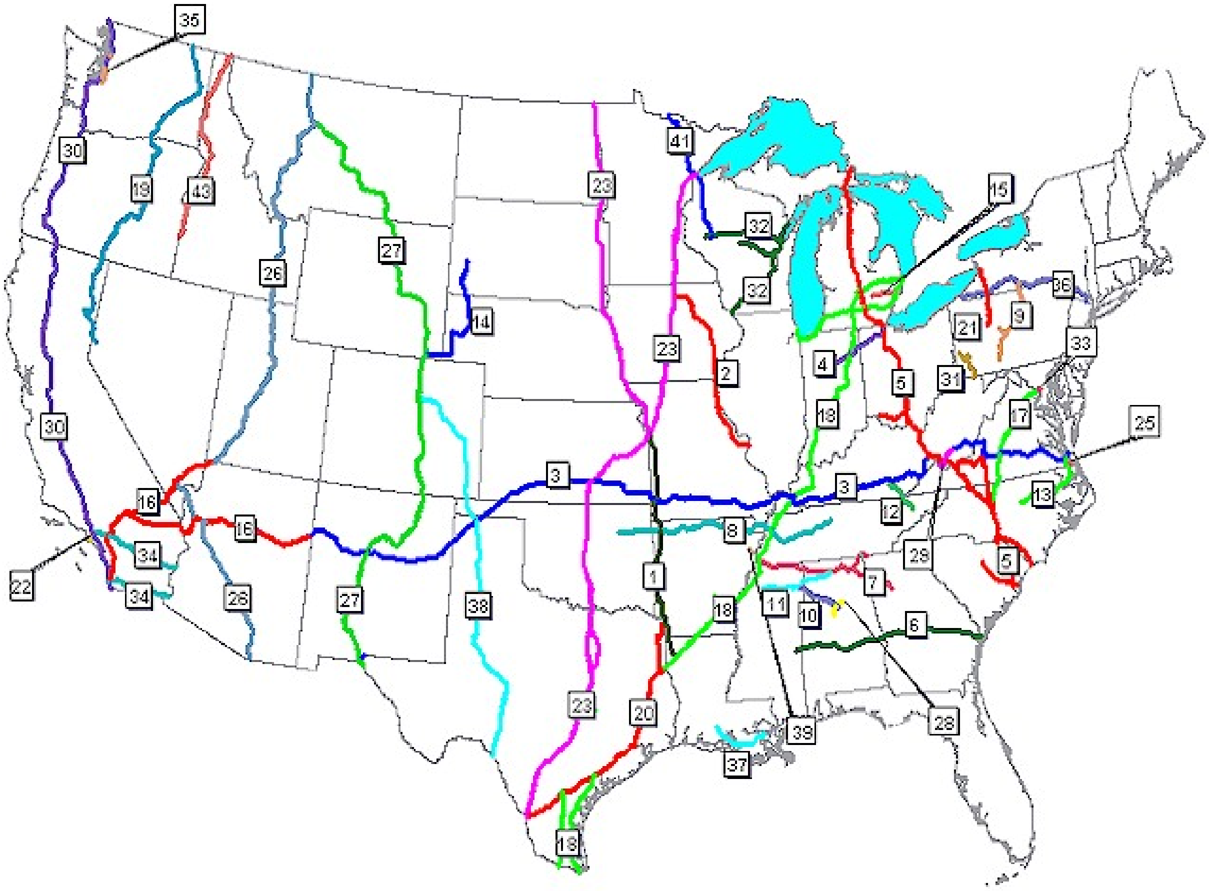
NAFTA Superhighways: Bush, Clinton, Bush

The NAFTA superhighway concept was first included in the 1991 Intermodal Surface Transportation Act (ISTEA). ISTEA was enacted two years before the NAFTA treaty was passed by a Democratic controlled Congress. ISTEA included numerous new and expanded north-south interstate highways to facilitate increased truck traffic between Canada and Mexico, plus dozens of other projects to benefit the highway lobby, national distributors such as Wal-Mart, and the metastasization of suburban sprawl. This was George H. W. Bush’s highway law.

ISTEA’s expansion of the highway network was followed by the 1998 Transportation Equity Act for the 21st Century (TEA-21), which funneled even more pork dollars for bypasses and NAFTA superhighways. Bill Clinton signed TEA-21 into law.

George W. Bush’s turn at the public trough was Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), an even larger expansion than ISTEA or TEA-21.

These full extent of these expansions have received very little public scrutiny, even from most groups that do not want more roads. It is odd that **amateur enthusiasts** who like freeways and want more of them have done a better job of tracking the expansion of the national highway network than the environmental groups. For example, the **Sierra Club’s transportation website** is an excellent resource of the social and environmental impacts from highways, “induced demand” (building more roads creates more traffic jams), and why public transit is beneficial -- but the Sierra Club and their allies do not highlight the new superhighway network that is the largest part of these transportation appropriations.



This map from the Federal Highway Administration shows new and expanded highways proposed in ISTEA and TEA-21. Corridor 18 is the proposed extension of Interstate 69, perhaps the most prominent "NAFTA superhighway" project. Highway boosters in Indiana campaigning to extend I-69 from Indianapolis to Kentucky convinced their allies in other states to band together to make an integrated NAFTA superhighway proposal a national priority to ensure federal funding for their segment. The 2005 SAFETEA-LU law has 80 priority corridors, a massive highway expansion on the cusp of Peak Oil.

Limited Hang Out: "inter-modal" transportation

ISTEA was sold to the national environmental groups as a multi-modal transportation bill, funding not just new and wider roads but also public transit systems and bicycle / pedestrian improvements.

ISTEA did appropriate billions for subways, light rail, buses and required that each State Department of Transportation had to include pedestrian and bicycle issues. Much of the literature from these groups made ISTEA seem like a effort to ensure that every community would have bicycle lanes and effective public transit -- ignoring the fact that most of the money went toward roads.

TEA-21, the Transportation Equity Act was also marketed as a envronmental improvement by most environmental groups. However, the "Equity" did not refer to choice between transportation modes, but to funding levels between the States.

Despite these lopsided funding levels (roads vs. transit), most national environmental groups rallied behind the meager improvements in ISTEA and TEA-21 and ignored the embedded NAFTA superhighway proposals. Many of these organizations are dependent on grants from foundations invested in destructive industries. This dynamic is similar to the **"left gatekeepers" phenomenon** that has keep the liberal "alternative" media from examining issues such as the coup against President Kennedy and the **war games** on 9/11 that confused the air defenses over Washington and New York).

The "inter-modal" emphasis was effective at splitting environmentalists between those who are appeased by inclusion of a bike path along a new highway and those with a holistic perspective who want a paradigm shift.

An example of the compromising approach is a recent action alert from the **Washington Area Bicyclist Association** urging its members to demand inclusion of a bicycle path along the proposed $3 billion Inter County Connector superhighway in Maryland. This campaign did not express solidarity with the many environmental and community groups who have spent years (and decades) in opposition to this enormously destructive project, but focused solely on the side-issue of whether this new segment of the Washington Outer Beltway would have a token parallel bike route or not.

Interstate 84 in Portland, Oregon: six lanes of freeway traffic plus the MAX Light Rail line. The traffic on I-84 is helping to melt the polar ice caps, but at least commuters in this area have a choice of transportation options. (The electricity to run the train is generated by a blend of hydropower, coal, natural gas, nuclear power and wind.)

Environmentalist Myopia

The environmental movement has largely ignored the ecological implications of Peak Oil, despite the fact the solutions to finite fossil fuels and climate change are intertwined and nearly identical.

An example of environmentalist refusal to incorporate Peak Oil into their analyses is the "Region 2040" program in Portland, Oregon. This long term planning effort grew out of the **"Land Use, Transportation, Air Quality (LUTRAQ)"** initiative, one of the more famous examples of "progressive" land use planning. LUTRAQ was an effort that successfully stopped a proposed freeway bypass by showing that a new new rail line combined with land use shifts to encourage transit oriented development was superior to the highway for traffic mitigation and air quality levels. Region 2040 and LUTRAQ are improvements over the traditional suburbia development model, but their omission of Peak Oil suggest they are going to be irrelevant long before the year 2040.

Environmental perspectives are desperately needed to challenge centralized energy conglomerates proposals for a revival of nuclear power, so-called clean coal, oil drilling in wilderness regions and conversion of farmland and forests to biofuel production. These destructive practices are unlikely to be stopped as long we cling to the assumption that we can continue to have endless growth.

Smart Growth versus Sustainability

> "You will change nothing until you change the way that money works"
> -- M. King Hubbert, author of the mathematical model to predict Peak Oil

Sustainability refers to practices that can be continued generation after generation. This word has been co-opted by polluters trying to confuse the public to ensure continued unsustainable extraction, the basis of the modern industrial economic paradigm.

Sustainability does not mean nice words or good intentions -- it refers to practices that your great-great-great-great grandchildren will still be able to do once the oil is gone. By that standard, virtually no one in North America is living "sustainably," with the exception of Amish and some Native American / First Nations communities.

Most of the best practices marketed as "sustainable" are merely efficiency. A 100 mile per gallon car is an efficient use of non-renewable petroleum, but it is not sustainable. Most forms of renewable energy are a means of using non-renewable resources (oil for plastics and transport, minerals) to capture sunlight, wind, etc. It is hard to envision a successful transition from our current industrial paradigm to true sustainability, but honesty is critical for designing any successful outcomes.

"Smart Growth," sometimes called "Sustainable Growth," is another mantra of pseudo-environmentalism. This oxymoronic slogan ignores the realities of overpopulation and overconsumption.

The first politician to use the term "Smart Growth" was Maryland Governor Parris Glendening (1994-2002), a Democrat. In 1997, he embraced the term at the height of his campaign to promote construction of the Inter County Connector (ICC) superhighway, part of the long planned Outer Beltway around Washington. This policy claimed to refocus public subsidies away from sprawling outer suburbs to reinvest in urban areas, but it also allowed connector roads between designated growth areas - a loophole large enough for the entire Outer Beltway."Smart Growth" was embraced by the foundation funded environmental groups but scorned by grassroots who saw it as a distraction from the Governor's superhighway plans. This "greenwash" (the false claim of environmentalism) did not succeed in approving the project, since in 1998 the FHWA quietly concluded that the ICC would not withstand a legal challenge, and the approval process stalled.

The "Smart Growth" is an example of how highway funds are used for social engineering. The Glendening plan directed public subsidies toward the most urban parts of the State which are the most Democratic constituencies. In contrast, outer suburb edge cities and rural areas are more Republican and use more gasoline per capita than Democratic. Oil consumption is a variable that shows whether a community is more likely to vote for the D's or for the R's.

In 2006, former Governor Glendening is now president of the **Smart Growth Leadership Institute** and a board member of **Smart Growth America** , a national coalition of organizations advocating alternatives to urban sprawl. If the Democrats are allowed to take over the White House in 2008, look for Glendening to take a key post promoting "Smart Growth."

The current Republican governor of Maryland revived the ICC, and the Bush administration made it a national priority (since it would connect military and intelligence contractors throughout the Washington area with key federal facilities, especially Fort Meade, home to the **National Security Agency**). On May 29, 2006, the FHWA issued a "Record of Decision" for the ICC and environmental groups plan to sue to block construction through parks and neighborhoods.

New land use and economic paradigms needed

Most who promote "Smart Growth" have good intentions. But this paradigm is an inadequate examination, since it only looks at personal transportation issues and ignores many of the other ecological impacts of cities. Whether people live in apartment buildings served by public transit or dispersed edge cities, they use the same amount of energy to grow and transport the food they eat. Urban areas have an ecological "footprint" that is many times larger than the size of the metropolitan region to extract the raw materials needed to keep the City fed, lit, heated and economically vibrant.

"Smart Growth" won't do much to keep metropolitan areas fed after the peak of petroleum is past. It might keep some farmland near cities from being paved - but urban agriculture will be needed to address food shortages in the future -- which is in contradiction to "Smart Growth's" insistence on greater density in cities. It's hard to have community gardens when cities get too dense, although rooftop gardens are a practical way to supplement urban diets.

A new form of urban planning is needed to integrate transportation and land use planning with ecological footprint analyses. Most ecological efforts to reduce car use and create more livable cities have stressed density as a solution to the transportation crisis, but overbuilt neighborhoods still require lots of delivery trucks bringing in food from distant farms. A genuine solution would balance neighborhood density, intelligent urban design, converting lawns and parking lots to gardens and other efforts to make cities become more locally oriented in their consumption.

Steady state economics are a prerequisite for any sensible strategy to achieve a harmonious balance with the natural world to plan beyond the era of cheap oil.. M. King Hubbert pointed out that the solutions required abandoning the economic paradigm of growth and shifting toward steady -state economics. Several articles about this are linked from **www.permatopia.com/growth.html**

One analogy for a steady state economy is an old growth forest ecosystem. A definition of a mature forest is a system where growth and decay are in balance. The total tonnage of biomass may remain consistent in a given area, but life continues to be dynamic for individual species. A forest in balance is still a dynamic place for the mouse being eaten by an owl, or for a sapling feeding on the soil created by trees that fell over decades ago.

Smart Growth cannot solve exponential growth, overshoot, Peak Oil and other resource depletions. Smart Growth is riding First Class on the Titanic, ecological destruction with good taste.

In nature, endless growth is the ideology of the cancer cell. A truly sustainable society would mimc natural processes, since we live on a finite planet and must change our politics, economics and psychology to adjust to this reality.

An introduction to Highway Laws

Freeway fighting is a complex and obscure topic. It involves arcane laws, reading thick reports, neighborhood association politics and seemingly endless governmental meetings designed to soak up your time. Most of the best guides to stopping unnecessary roads were written in the 1970s, following the “peak” of successful citizen efforts to block highways, and are nearly impossible to find. The best resource this author has seen is the 1977 book “The End of the Road: A Citizen’s Guide to Transportation Problemsolving” from the National Wildlife Federation and Environmental Action (the latter group has been defunct since the late 1990s).

Fortunately, federal transportation laws are some of the strongest environmental laws remaining in the United States. There are many good precedents that even corrupt judges must provide some lip service to. A short guide to some of the most important laws suggests that Peak Oil could be used to force major shifts from new highway construction toward policies that would better prepare communities for the energy crisis.

The **National Environmental Policy Act (NEPA)** was signed by President Nixon, and governs all federal actions that impact the environment, even (acknowledged) military bases. NEPA is sometimes misrepresented as the National Environmental Protection Act, but it is procedural law, not substantive -- it merely requires adequate disclosure of all decisions. If an administration planned to destroy all life on Earth, NEPA would require that they analyze a range of alternatives (perhaps an option to destroy half of the Earth along with a “No Action” option), since NEPA does not require selecting the least destructive alternative.

NEPA is the law that requires Environmental Impact Statements (for large projects) and Environmental Assessments (for smaller projects). The start of an EIS or EA is the drafting of a “Purpose and Need” to identify a problem, followed by “scoping” of a range of reasonable alternatives. The preferred alternative is approved in a “Record of Decision” after the Final EIS, at which time citizens can sue to block the project.

Section 404 of the Clean Water Act, also signed by Nixon, regulates the destruction of wetlands. Most highways destroy wetlands, an activity regulated by the Army Corps of Engineers. Wetland permits need to evaluate whether the action is avoidable before examining how to mitigate the impacts. The highway lobby has worked for many years to attack this law, and the Roberts Supreme Court is likely to reduce its effectiveness.

The **Clean Air Act** regulates highway construction in smoggy urban areas that are polluted beyond officially acceptable levels. Road construction using federal funds in these communities can only be approved in conjunction with promises that the projects will not worsen the smog problems -- often an exercise in statistical manipulation that does not protect public health. A metropolitan area that fails to meet Clean Air standards can be threatened with a loss of federal highway funds. Ironically, the cutoff of those funds would be part of a lasting solution to air pollution, not merely a punishment for regions downplaying the problem.

Perhaps the most powerful and least known highway law is **Section 4(f) of the 1966 Transportation Act**, which prohibits transportation projects through parks and historic sites unless there is not a “prudent and feasible” alternative. (Roads built without federal money or other federal DOT actions are not affected by this restriction.) It was passed as a consequence of citizen anger of highways tearing up parks, since it is much cheaper for the highwaymen to decimate parkland than to compensate people for bulldozing their homes. The 1995 SAFETEA-LU law introduced a “de minimus” standard (too small to notice) to exempt minor impacts from 4(f) consideration.

Some highways also violate the **Endangered Species Act**, but this legal tact has rarely been successful in stopping road construction. The ESA is also under attack, and the environmental community is on the defensive trying to hold onto Nixon-era laws, rather than taking the initiative to create stronger protections to slow down or reverse the destruction of the biosphere. It is incredible that protections for extremely rare species are being eviscerated as climate change, habitat destruction and toxic wastes are leading to the sixth great mass extinction of life in the Earth’s history.

One of the best guides to understand highway law is the **FHWA Environmental Guidebook**, a review of highway laws and regulations written for State transportation planners to ensure they design projects that will withstand legal challenges.

Segmentation and ISTEA: how to use Peak Oil to change transportation policies

The FHWA's implementation of the NEPA law requires that the full impacts of a highway must be analyzed before a Record of Decision is issued. Approving a road that forces additional construction that is ignored in the environmental documentation is **illegal "segmentation"** of the project.

In the 1991 ISTEA law, a provision was added to federal highway approvals that requires all highway plans in a metropolitan area to fit into a regional long range transportation budget to avoid a form of fiscal segmentation. If a metro area wants lots of new roads, they have to show how the projects could be paid for (federal and local funds) over a 20 year period. Approving a project that lacks funding is therefore a form of segmentation. The funds need not be available when construction begins, but the entire project has to fit within a constrained transportation budget - a process similar to buying a home with a mortgage (a home buyer has to show their potential ability to raise all of the funds over the span of the loan).

A few highway officials have privately admitted to this writer that they understand that Peak Oil should be included in transportation planning, the agencies they work for have a "Not See" attitude and do not dare discuss it.

FHWA funded highway projects are designed to meet traffic needs 20 years in the future - not for existing traffic snarls. If Peak Oil were included in these projections, it would force major changes to transportation policies at the local and national levels.

While no one, not even Dick Cheney, knows precisely what will happen with Peak Oil, to ignore it completely and make more "growth" projections and traffic models that assume constant supplies and pricing of petroleum is delusional. When FHWA finally requires energy analyses in NEPA documentation, they could examine a range of scenarios: gasoline at $5 per gallon in 2025, gasoline at $50 per gallon in 2025, and gasoline not available to the public in 2025 (only to elites and the military).

It is impossible to project what oil will cost when annual extraction is roughly half of current levels (as the best estimates project for 2030). When that happens, current traffic demand statistics will probably be worthless.

Peak traffic

The 2005 Final Environmental Impact Statement for the Inter County Connector highway had this response to a comment that referenced Peak Oil as a reason not to build the road:

> It is speculative to assume that increases in gasoline prices will "reduce congestion." Evidence indicates that very substantial price increases might be needed in order to substantially change transportation choices and decisions. Price increases could cause a variety of responses which might not affect highway usage; e.g. production and acquisition of more fuel-efficient vehicles. The travel forecasts were made assuming a cost per mile for operating an automobile. Historically as the price of gasoline has increased the miles traveled per gallon of gas have also increased. In

fact, gas costs less per mile traveled today than it did prior to the first oil embargo in 1974. Petroleum scarcity as a result of consumption in China is speculative.
- Final Environmental Impact Statement, Inter County Connector (I-370)

This EIS is correct to state that planning for rising gas prices is speculative, but planning as if prices will remain constant for the next two decades is even more speculative.

It is not "speculation" to predict that higher gas prices will prevent traffic increases. Here is a small example of how this works, which shows that the price increases likely from Peak Oil will lower traffic demand considerably in the design year of 2030.

www.cnn.com/2006/AUTOS/11/30/gas_prices.reut/index.html
Americans drive less for first time in 25 years
Higher gas prices cut not only sales of SUVs, but also time spent on the road: study.
POSTED: 3:47 p.m. EST, November 30, 2006
HOUSTON (Reuters) -- High gasoline prices not only slowed fuel demand growth and cut sales of gas-guzzling vehicles in 2005, they also prompted Americans to drive less for the first time in 25 years, a consulting group said in a report Thursday.
The drop in driving was small - the average American drove 13,657 miles (21,978.8 km) per year in 2005, down from 13,711 miles in 2004

More riders crowd buses
The rising cost of driving sends record numbers to LTD, where human traffic jams the aisles
BY JEFF WRIGHT
The Register-Guard
Published: Thursday, April 6, 2006

TRAFFIC AT THE YORK TOLLS on the Maine Turnpike - a standard measure of tourism in the state - was down in June and even more in July compared with the same time last year. . . Traffic passing through the York tolls had increased every year until five years ago, when it became stable. This is the first time it has dropped significantly; the decrease was 5.3 percent when comparing June 2004 and June 2005, and 5.8 percent when comparing July numbers. . The national average price for regular unleaded gas was $2.41 a gallon, compared with $1.86 a year ago
http://pressherald.mainetoday.com/news/state/050813gasprices.shtml
http://www.maineturnpike.com/jpgraph/total_by_month.html
http://www.maineturnpike.com/jpgraph/yearly_totals.html

High gasoline prices filling bus, train seats
Tue Apr 25, 2006
By Bernie Woodall, **Reuters**
Some mass transit advocates hesitate to say the price spike has forced drivers onto public transportation, including Amtrak spokesman Cliff Black.
But in some cities where the car is undisputed king of transportation such as Houston and Los Angeles, public transportation ridership is up.
In Houston, home to many oil refineries, ridership was up 10.2 percent in the most recent fiscal year, said Houston's Metropolitan Transit Authority, which has a large bus fleet.
In Los Angeles, Metro Rail ridership rose 11.4 percent and the number of bus passengers increased 7 percent in the first quarter of 2006. About 1.4 million ride Los Angeles County buses and trains daily.

> It's difficult to say how many are on board because of gasoline prices, said Dave Sotero of the Los Angeles County Metropolitan Transportation Authority.
> "When gas prices go up, we do see spikes in ridership," said Sotero. "We're hopeful people who haven't used public transit, they will carry on riding even if gasoline prices drop," said Sotero.
> Last week, the Washington Metropolitan Area Transit Authority in the nation's capital had the two highest ridership days in the Metrorail's 30-year history that were not linked to a special event. The highest day was April 20, with 780,820 riders, up 6.2 percent from a year ago.
> But WMATA spokesman Steven Taubenkibel said it's hard to peg that on gasoline prices -- nice weather last week may have had more to do with it, he said.

These statistics do not suggest a major shift (yet) due to increasing gas prices, but they hint at much larger changes to come on the petroleum downslope.

Peak Asphalt

http://lcog.org/meetings/mpc/0806/MPC%205g1i_OregonianArticleonCostIncreases.pdf
Soaring costs throw Oregon road projects a curve
Rough road - Officials are facing steep price increases for asphalt and other materials
Monday, July 31, 2006
JAMES MAYER
The Oregonian

www.delmarvanow.com/apps/pbcs.dll/article?AID=/20060616/NEWS01/606160303/1002
Asphalt prices delay pressing road repairs
By Joseph Gidjunis
Staff Writer
The Daily Times, Salisbury, Maryland

www.duluthsuperior.com/mld/duluthsuperior/news/politics/14837423.htm
Fri, Jun. 16, 2006
Asphalt prices skyrocket, highway officials scramble to adjust
JOHN HARTZELL
Associated Press

www.ksla.com/Global/story.asp?S=5026843&nav=0RY5
SHREVEPORT, LA
Asphalt Prices May Mean Fewer New Shreveport Street

Peak Oil and transportation planning

There are two ways that Peak Oil could be inserted into highway planning for a large road project. These issues could be raised during the “Scoping” process that is the first step for an Environmental Impact Statement. If this framework was required to include reasonable scenario for energy availability in the year 2030, new highways would be scrapped in favor of better transit, a revitalized train network, and maintaining existing infrastructure (especially aging bridges.

If project is further advanced, NEPA mandates that a “Supplemental” EIS must be prepared if there are "new circumstances" not anticipated when the scoping process was conducted. Surely reaching the peak of petroleum production worldwide is an important circumstance for a transportation project allegedly designed for travel long past the peak of petroleum.

If FHWA included Peak Oil into environmental analyses for highway projects, this could create a seismic shift in transportation planning across the United States, allowing for honest public discussion about energy and transportation policies. There are several ways this shift could happen: a successful Federal lawsuit forces FHWA to include Peak Oil, the start of gasoline rationing makes transportation planners consider alternatives, or a change in national policies (probably the least likely in the near future).

Council on Environmental Quality regulations implementing NEPA

40 CFR 1502.9: Draft, final and supplemental statements.

(c) Agencies:

(1) Shall prepare supplements to either draft or final environmental impact statements if:

(i) The agency makes substantial changes in the proposed action that are relevant to environmental concerns; or

(ii) **There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action** or its impacts.

Federal Highway Administration regulations about NEPA

23 CFR § 771.130 Supplemental environmental impact statements.

(a) A draft EIS, final EIS, or supplemental EIS may be supplemented at any time. An EIS shall be supplemented whenever the Administration determines that:

(1) Changes to the proposed action would result in significant environmental impacts that were not evaluated in the EIS; or

(2) **New information or circumstances relevant to environmental concerns and bearings on the proposed action** or its impacts would result in significant environmental impacts not evaluated in the EIS.

Power Shift or Powerdown?

As Peak Oil awareness continues to spread, supporters of the dominant industrial paradigm will increase their propaganda that technological shifts are sufficient to solve the problems. These efforts to maintain the status quo of growth based economics in the face of resource limitations distract from practical steps our society could have taken to mitigate these impacts.

An egregious example of this limited focus (on demand side solutions) is the **Power Shift** series of conferences across the country, sponsored by a coalition including environmentalists (Natural Resources Defense Council, Union of Concerned Scientists) and warmongers (Center for the Defense of Democracies, a neo-conservative supporter of the "War on Terror"). Power Shift is a carefully crafted means of keeping grassroots who are concerned about these issues from recommending policies and logistics that would be needed to address the problems.

The brochure distributed at the April 8 Power Shift event in Portland, Oregon had pictures of interstate highways and messages about our right to Middle East oil, but there was no mention of relocalization of food production, Amtrak, or converting the bloated military budget for peaceful uses.

Power Shift is a proposal to substitute alternative fuels (other than oil) to maintain car culture and centralized energy systems, even though biofuels, liquified coal and other demand side technologies cannot possibly fill maintain current overconsumption levels.

Powerdown, the title of Richard Heinberg's excellent book, is a more realistic approach. Powerdown includes relocalizing production, renewable energy, efficiency, conservation and reduction of demand. Unfortunately, the elites who fund many energy outreach efforts cannot figure out how to profit as much from this approach, and therefore are not interested in Powerdown.

From the Wilderness published two articles about some of the players behind "Power Shift" and the "Oil Storm" scenario exercise they present to audiences.

> **OIL SHOCKWAVE**:
> Torrance, CA Emergency Simulation Targets Big Business and Local Government Managers
> Ominous Timing in Advance of Hurricane Katrina
> by Zac Evans and Michael C. Ruppert
>
> **WOOLSEYS IN SHEEP'S CLOTHING**
> How Dumb Can the Left Get?
> by Michael C. Ruppert

Reviving the Rails: a best case Peak Oil scenario

> "In the United States, we have a railroad system that the Bulgarians would be ashamed of. We desperately are going to need railroad transport for moving people around, for moving goods around – we don't have that. What we do have is a trucking system that is going to become increasingly dysfunctional, especially as the expense mounts of maintaining the tremendous interstate highway system. It costs so much money every year to maintain what the engineers call a high level of service – which means that the trucks that are delivering things from the central

> valley of California to Toronto don't break their axles while they're bringing those Caesar salads to Toronto. Once you have a certain number of trucks that are breaking their axles in that 3,000 mile journey, that's the end of transcontinental trucking – which also implies that this is the end of certain economic relationships that we have gotten used to."
> -- author **James Howard Kunstler**, from an interview in the film **"The End of Suburbia: Oil Depletion and the End of the American Dream"**
>
> It is serious time to look at the nationalization of America's critical infrastructure industries: oil, gas, electricity, and others that have gouged the American consumer and now deserve to lose their windfall profits in a nationalization effort that will return to them ten cents on the dollar, if they are lucky.
> - **Wayne Madsen Report**, April 25, 2006

In the 1960s, the success of freeway fighters in stopping the Boston Inner Belt spurred Congress to change transportation laws to allow money programmed for Interstate highways to be used for public transit. Several rail systems were created from unused freeway funds, most notably the initial construction phase of the Washington, D.C. Metro.

If the United States ever makes shifts to have an ecological, socially just policy to cope with Peak Oil, it would need to shift money from the NAFTA superhighway program to a serious revival of inter-city rail to efficiently move people and goods with less energy consumption.

A best case scenario for mitigating Peak Oil could include

- bullet train service between cities (with solar panels lining the tracks to provide some of the power),
- light rail and better bus service on major roads,
- major investments in renewable energy and hyper-conservation,
- land use shifts to reduce commuting distances,
- widespread suburban agriculture to convert lawns into food production (which would reduce truck deliveries),
- other steps to reduce our demand for oil, coal, natural gas, uranium, concrete, and mineral ores.

If we continue on the current road of overshoot, the likely consequence will be a "national Katrina" disaster,

rk

g Spanish

nph / 240 kph) - almost as fast as high speed rail

Magnetic Levitation test track in Germany. MagLev trains travel around 300 mph / 480 kph. **Demonstration routes** for ultra high speed trains are proposed between Baltimore and Washington, D.C., Pittsburgh, Atlanta, Florida, and in southern California.

Additional resources:

The Long Emergency: Surviving the End of the Oil Age, Climate Change, and Other Converging Catastrophes of the Twenty-first Century by **James Howard Kunstler**

The **UnPlanning Journal discusses the Oregon Transportation Plan** and some **detailed comments**.

The End of Suburbia: Oil Depletion and the Collapse of the American Dream (movie).

The Power of Community: How Cuba Survived Peak Oil, a film from Community Solution.

Food Not Lawns, Eugene, Oregon

City Farmer, Vancouver, BC

Urban Gardening Help

City Repair, Portland, Oregon

Saving Oil in a Hurry: Oil Demand Restraint in Transport
Workshop on Managing Oil Demand in Transport (2005)
archived at **http://www.permatopia.com/doc/Saving-Oil-in-Hurry.pdf**

Future U.S. Highway Energy Use: A Fifty Year Perspective (DRAFT)
May 3, 2001
Office of Transportation Technologies
Energy Efficiency and Renewable Energy
U.S Department of Energy
archived at **http://www.permatopia.com/doc/DOE-highways-may2001.pdf**

Association for the Study of Peak Oil
334. New roads and a tunnel in Switzerland (March 2004 issue)

> Switzerland operates a devolved form of government seeking to involve its citizens in major issues rather than impose decisions by parliamentarians under the iron grip of party machines, as practised in many so-called democracies. The decision now facing the Swiss people is whether or not to modernise the highway system and build a new tunnel under the Alps. Linear extrapolation of past trends of traffic and goods transport has no doubt been used to justify the mammoth undertaking, but it is meeting strong opposition, partly built on recognition of oil depletion. A cartoon has appeared depicting a future scene of a cyclist and an old man looking down on an empty highway with trees growing through the cracks. The old man comments “In my day we believed in all that” to which the cyclist replies "You still had petrol."
> The Swiss Federal Office of Energy is holding a Workshop on oil and gas resources on February 27th which will be open to the public. ASPO will be represented by Campbell and Bauquis in a discussion with representatives of the IEA, IHS, Schlumberger and Chevron-Texaco. It remains to be seen if it will have any positive outcome, as the accompanying report commissioned by the Federal Office simply contrasts the views of so called “optimists” and “pessimists” to reach a neutral position, absolving the government from the need to take any firm action. The likely outcome is that the investments in roads and tunnels will be neither approved nor rejected but simply delayed – it might indeed be a good political response, given that impact of peak oil will soon be self-evident.

Published on 4 Apr 2005 by New Zealand Herald. **www.energybulletin.net/5112.html**
New Zealand: No easy solutions in sight to keep oil prices in check
by Cameron Pitches

> ... New Zealand’s transport agencies need a contingency plan for the rising price of oil. At US$70 a barrel, the Auckland Regional Transport Authority should be looking to secure options on electric rolling stock for our rail network.
> At US$100, the Government should be suspending all new roading projects. At US$200, Auckland International Airport’s proposals for a second runway should be shelved in favour of a container wharf for shipping.
> Reliance on emerging new energy technologies such as hydrogen won’t help us in the short term, either. The so-called hydrogen economy is a net energy-loss proposition - more energy is put in to the extraction, compression and storage of hydrogen than comes out of it.
> In addition, more than 90 per cent of hydrogen is obtained from fossil fuels, which defeats the purpose of an alternative fuel.

www.sevenoaksmag.com/commentary/63_comm2.html
A bridge too far: Big men and their little toys
May 24, 2005
Am Johal

> ... Building our way out of congestion through highway expansion seems incredibly short-sighted, especially in the context of oil reaching $100 a barrel by 2010 and a public transportation sadly in need of a billion dollar overhaul.

From: Mark Robinowitz

To: Columbia River Crossing;

CC:

Subject: Columbia River Crossing DEIS comment -- Crude oil: the supply outlook

Date: Tuesday, July 01, 2008 2:01:57 AM

Attachments: http-__www.energywatchgroup.org_fileadmin_global_pdf_EWG_Oilreport_10-2007.pdf
ATT5516185.txt

C R U D E O I L
T H E S U P P L Y O U T L O O K
Report to the Energy Watch Group
October 2007

ENERGYWATCHGROUP

CRUDE OIL
THE SUPPLY OUTLOOK

Report to the Energy Watch Group

October 2007

EWG-Series No 3/2007

ABOUT ENERGY WATCH GROUP

This is the third of a series of papers by the Energy Watch Group which are addressed to investigate future energy supply and demand patterns.

The Energy Watch Group consists of independent scientists and experts who investigate sustainable concepts for global energy supply. The group has been initiated by the German Member of Parliament Hans-Josef Fell.

Homepage:

www.energywatchgroup.org

Responsibility for this report:

Dr. Werner Zittel, Ludwig-Bölkow-Systemtechnik GmbH
Jörg Schindler, Ludwig-Bölkow-Systemtechnik GmbH

This report is sponsored by Ludwig-Bölkow-Stiftung, Ottobrunn, Germany

Ottobrunn, October 2007

CONTENT

EXECUTIVE SUMMARY / KEY FINDINGS

Scope

The main purpose of this paper is to project the future availability of crude oil up to 2030. Since crude oil is the most important energy carrier at a global scale and since all kinds of transport rely heavily on oil, the future availability of crude oil is of paramount interest. At present, widely diverging projections exist in parallel which would require completely different actions by politics, business and individuals.

The scope of these projections is similar to that of the World Energy Outlook by the International Energy Agency (IEA). However, no assumptions or projections regarding the oil price are made.

In this paper a scenario for the possible global oil supply is derived by aggregating projections for ten world regions. In order to facilitate a comparison, the definition of the world regions follow the definition used by the International Energy Agency (IEA):

- OECD North America, including Canada, Mexico and the USA.
- OECD Europe, including Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, The Netherlands, Norway, Poland, Slovak Republic, Spain, Sweden, Switzerland, Turkey and the UK.
- OECD Pacific, including
  – OECD Oceania with Australia and New Zealand,
  – OECD Asia with Japan and Korea.
- Transition Economies, including Albania, Armenia, Azerbaijan, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Estonia, Yugoslavia, Macedonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Romania, Russia, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, Cyprus and Malta.
- China, including China and Hong Kong.
- East Asia, including Afghanistan, Bhutan, Brunei, Chinese Taipei, Fiji, Polynesia, Indonesia, Kiribati, The Democratic Republic of Korea, Malaysia, Maldives, Myanmar, New Caledonia, Papua New Guinea, Philippines, Samoa, Singapore, Solomon Island, Thailand, Vietnam and Vanuatu.
- South Asia, including Bangladesh, India, Nepal, Pakistan and Sri Lanka.

- Latin America, including Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominic. Republic, Ecuador, El Salvador, French Guyana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, St. Kitts-Nevis-Antigua, Saint Lucia, St. Vincent Grenadines and Suriname, Trinidad and Tobago, Uruguay and Venezuela.
- Middle East, including Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, the United Arab Emirates, Yemen, and the neutral zone between Saudi Arabia and Iraq.
- Africa, including Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, the Central African Republic, Chad, Congo, the Democratic Republic of Congo, Côte d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, the United Republic of Tanzania, Togo, Tunisia, Uganda, Zambia and Zimbabwe.

However, the scenario results presented in this paper are very different to the scenarios presented by the IEA in their periodic editions of the World Energy Outlook (WEO) where continuing growth of oil supply and as a consequence a continuation of business as usual for decades to come is deemed possible.

Methodology

The analysis in this paper does not primarily rely on reserve data which are difficult to assess and to verify and in the past frequently have turned out to be unreliable. The history of discoveries is a better indicator though the individual data are of varying quality. Rather the analysis is based primarily on production data which can be observed more easily and are also more reliable. Historical discovery and production patterns allow to project future discoveries and – where peak production has already been reached – future production patterns.

The analysis is based on an industry database for past production data and partly also for reserve data for certain regions. As reserve data vary widely and as there is no audited reference, the authors have in some cases made their own reserve estimates based on various sources and own assessments. Generally, future production in regions which are already in decline can be predicted fairly accurately relying solely on past production data.

The projections are based also on the observation of industry behaviour and on "soft" indicators (for instance, the recent turn about in the communication by the IEA and a remarkable quote by King Abdullah of Saudi Arabia).

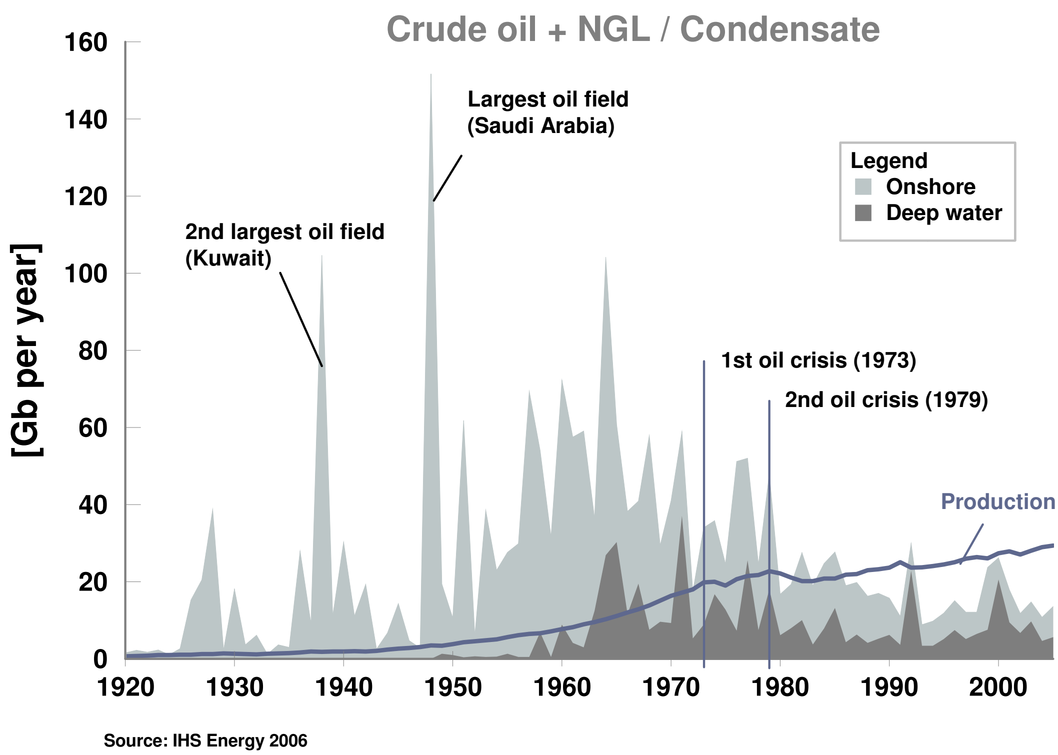
Understanding the future of oil

Only oil that has been found before can be produced. Therefore, the peak of discoveries which took place a long time ago in the 1960s, will some day have to be followed by a peak of production. After peak oil, the global availability of oil will decline year after year. There are strong indications that world oil production is near peak.

The growing discrepancy between oil discoveries and production is shown in Figure 1.

In the period 1960 to 1970 the average size of new discoveries was 527 Mb per New Field Wildcat. This size has declined to 20 Mb per New Field Wildcat over the period 2000 to 2005.

Figure 1: History of oil discoveries (proved + probable) and production



Remaining world oil reserves are estimated to amount to 1,255 Gb according to the industry database [IHS 2006]. There are good reasons to modify these figures for some regions and key countries, leading to a corresponding EWG estimate of 854 Gb. These modifications are explained in the chapters describing the detailed scenarios. The resulting reserve figures are given in in the following Figure 2 and in Table 1 (there described as EWG estimates and shown together with the IHS data). The greatest difference are the reserve numbers for the Middle East. According to IHS, the Middle East possesses 677 Gb of oil reserves, whereas the EWG estimate is 362 Gb.

Figure 2: World oil reserves (EWG assessment)

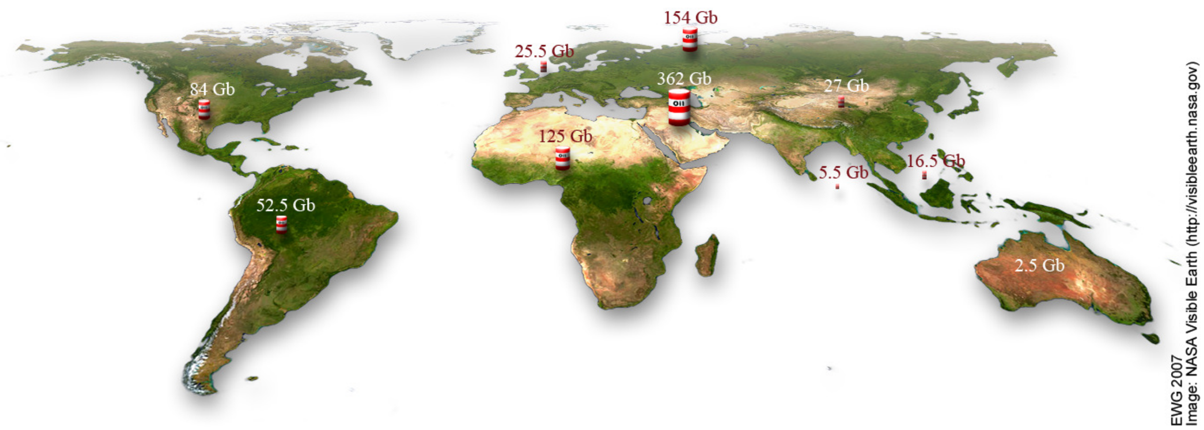
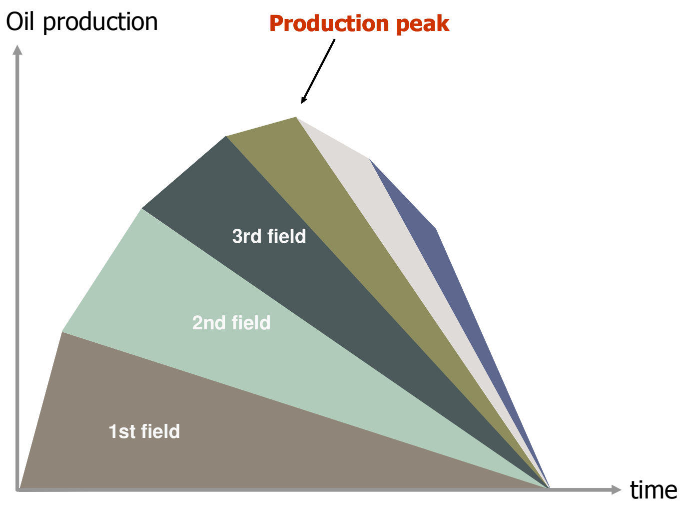


Table 1: Oil reserves and annual oil production in different regions and key countries

Region	Remaining reserves		Production 2005		Consumption 2005 [Gb/yr]
	EWG [Gb]	IHS [Gb]	onshore [Gb/yr]	offshore [Gb/yr]	
OECD North America	84	67.6	3.20	1.71	9.13
Canada	17	15.3	0.89	0.12	0.82
USA	41	31.9	1.93	0.59	7.59
Mexico	26	20.4	0.36	1.00	0.72
OECD Europe	25.5	23.5	0.1	1.94	5.72
Norway	11	11.6	0	1.13	0.08
UK	8	7.8	0.01	0.70	0.65
OECD Pacific	2.5	5.1	0.025	0.18	3.18
Australia	2.4	4.8	0.02	0.17	0.31
Transition Economies	154	190.6	4.1	0.18	2.02
Russian Federation	105	128	3.4	0.13	1.00
Azerbaijan	9.2	14	0.01	0.15	0.04
Kazakhstan	33	39	0.47	0	0.08
China	27	25.5	1.1	0.22	2.55
South Asia	5.5	5.9	0.11	0.16	0.96
East Asia	16.5	24.1	0.3	0.65	1.75
Indonesia	6.8	8.6	0.27	0.11	0.43
Latin America	52.5	129	2.0	0.61	1.74
Brazil	13.2	24	0.075	0.55	0.75
Venezuela	21.9	89	1.17	0	0.20
Middle East	362	678.5	6.97	1.97	2.09
Kuwait	35	51	0.96	0	0.11
Iran	43.5	134	1.19	0.24	0.59
Iraq	41	99	0.67	0	
Saudi Arabia	181	286	2.85	0.86	0.69
UAE	39	57	0.46	0.45	0.14
Africa	125	104.9	2,03	1,53	1.01
Algeria	14	13.5	0.72	0	0.09
Angola	19	14.5	0.01	0.45	
Libya	33	27	0.61	0.02	
Nigeria	42	36	0.39	0.52	
World	**854**	**1,255**	**19.94**	**9.15**	**30.3**

In every oil province the big fields will be developed first and only afterwards the smaller ones. As soon as the first big fields of a region have passed their production peak, an increasing number of new and generally smaller fields have to be developed in order to compensate the decline of the production base. From there on, it becomes increasingly difficult to sustain the rate of the production growth. A race begins which can be described as follows: More and more large oil fields show declining production rates. The resulting gap has to be filled by bringing into production a larger number of smaller fields. However, these smaller fields reach their peak much faster and then contribute to the overall production decline. As a consequence, the region's production profile which results from the aggregation of the production profiles of the individual fields, becomes more and more "skewed", the aggregate decline of the producing fields becomes steeper and steeper. This decline has to be compensated for by the ever faster connection of more and more ever smaller fields, see Figure 20.

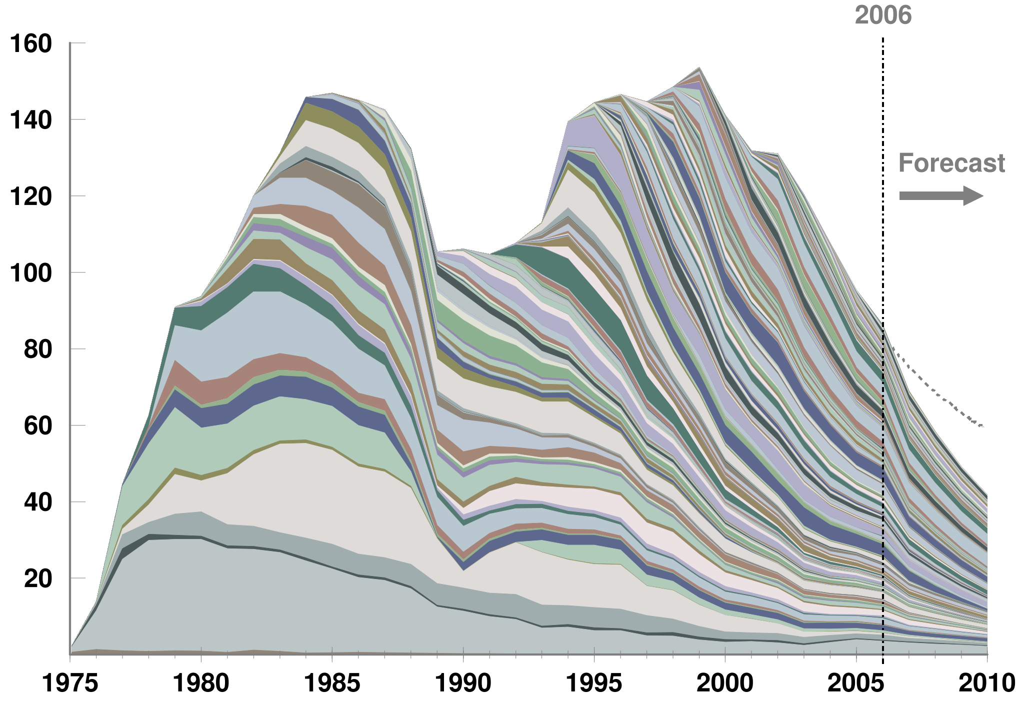
Figure 3: Typical production pattern for an oil region



So, the production pattern over time of an oil province can be characterised as follows: To increase the supply of oil will become more and more difficult, the growth rate will slow down and costs will increase until the point is reached where the industry is not anymore able to bring into production a sufficient number of new fields quick enough. At that point, production will stagnate temporarily and then eventually start to decline.

This pattern can be observed when looking at the oil production in the UK.

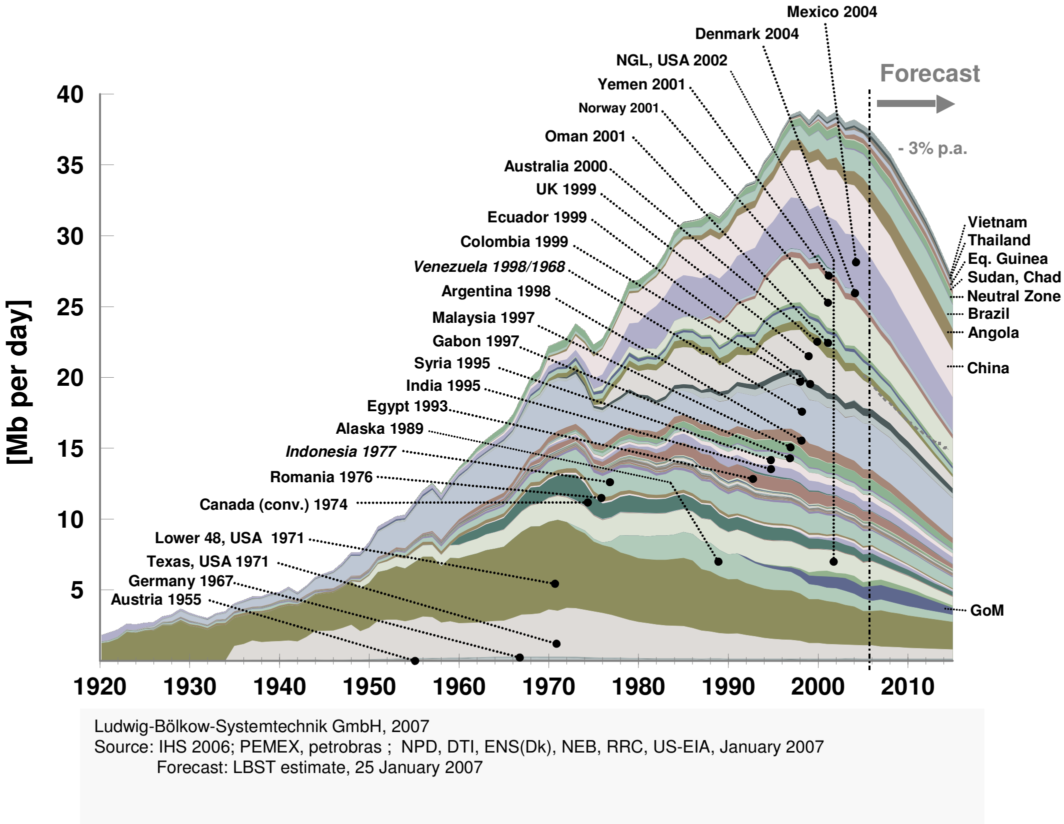
Figure 4: Oil production in the United Kingdom



Source: DTI, May 2007; Forecast: LBST

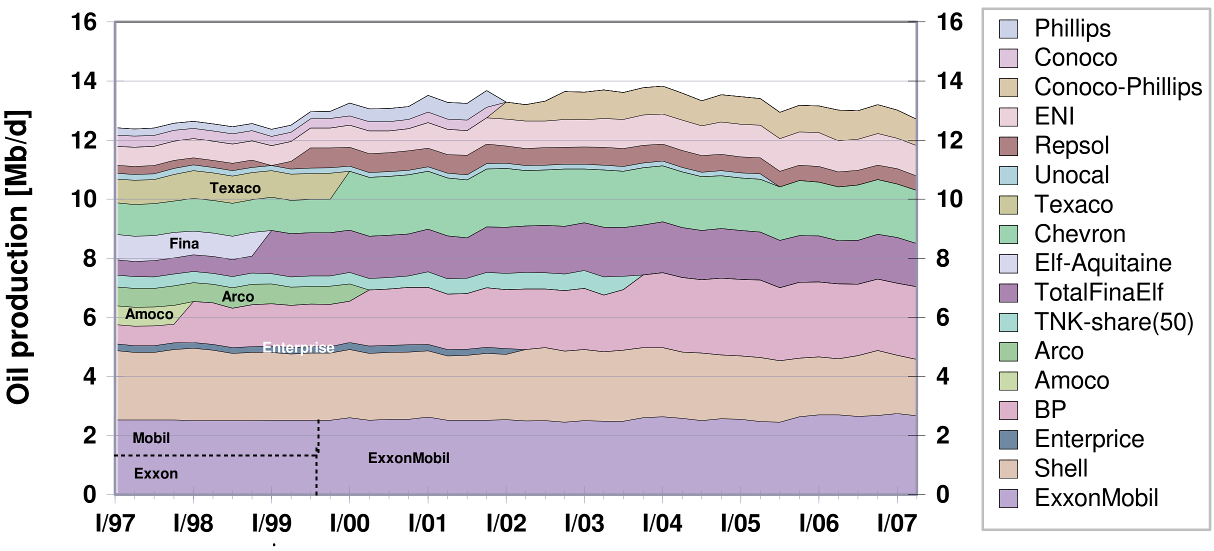
Oil production in regions having passed their peak can be forecasted with some certainty for the next years. The following Figure 5 shows the production pattern of the countries outside OPEC (only Angola is included which has recently joined OPEC) and outside the former Soviet Union. Countries with a year behind their name are countries past peak, stating the year of peak production. On the top of the graph are the few countries in this group which have not reached peak yet. If it is assumed that the remaining regions with growth potential (especially Angola, Brazil and the Gulf of Mexico) will expand their production by the year 2010 (in accordance with the forecasts of the companies operating in these regions), total oil production of this group of countries, however, will continue to decline by about 3% per year, see Figure 5.

Figure 5: Oil producing countries past peak



The difficulties of expanding oil production can also be demonstrated by looking at the performance of the big international oil companies. In aggregate, they were not able to increase their production in the last ten years, despite an unprecedented rise in oil prices.

Figure 6: Oil production of the oil majors from 1997 to 2007



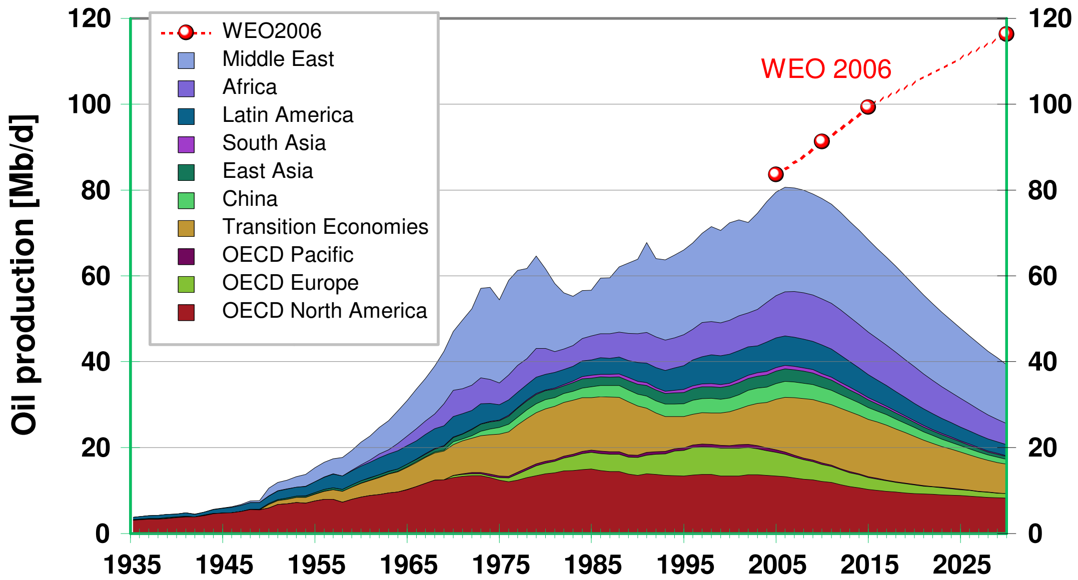
Key findings

- "Peak oil is now".
  For quite some time, a hot debate is going on regarding peak oil. Institutions close to the energy industry, like CERA, are engaging in a campaign trying to "debunk" the "peak oil theory". This paper is one of many by authors inside and outside ASPO (the Organisation for the Study of Peak Oil) showing that peak oil is anything but a "theory", it is real and we are witnessing it already.
  According to the scenario projections in this study, the peak of world oil production was in 2006.
  The timing of the peak in this study is by a few years earlier than seen by other authors (like e.g. Campbell, ASPO, and Skrebowski) who are also well aware of the imminent oil peak. One reason for the difference is a more pessimistic assessment of the potential of future additions to oil production, especially from offshore oil and from deep sea oil due to the observed delays in announced field developments. Another reason are earlier and greater declines projected for key producing regions, especially in the Middle East.

- The most important finding is the steep decline of the oil supply after peak.
  This result – together with the timing of the peak – is obviously in sharp contrast to the projections by the IEA. But the decline is also more pronounced compared with the more moderate projections by ASPO.
  Yet, this result conforms very well with the recent findings of Robelius in his doctoral thesis. This is all the more remarkable because a different methodology and different data sources have been used.

- The global scenario for the future oil supply is shown in the following Figure 7.

Figure 7: Oil production world summary



The projections for the global oil supply are as follows:
- 2006: 81 Mb/d
- 2020: 58 Mb/d (IEA: 105[1] Mb/d)
- 2030: 39 Mb/d (IEA: 116[2] Mb/d)

The difference to the projections of the IEA could hardly be more dramatic.

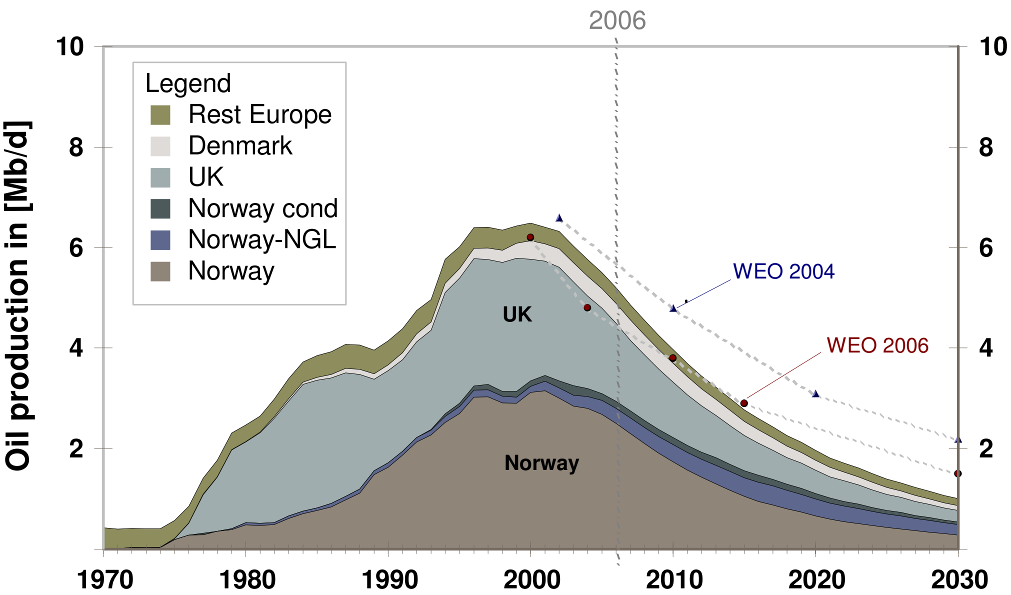
- A regional analysis shows that, apart from Africa, all other regions show declining productions by 2020 compared to 2005.
  By 2030, all regions show significant declines compared to 2005.

[1] Since IEA gives data only for 2015 and 2030, those for 2020 are interpolated; these data include processing gains
[2] Since IEA gives data only for 2015 and 2030, those for 2020 are interpolated; these data include processing gains

Three examples for regional results[1] for key producing regions are given next.

OECD Europe

Figure 8: Oil production in OECD Europe



The projections for the oil supply in OECD Europe are as follows:

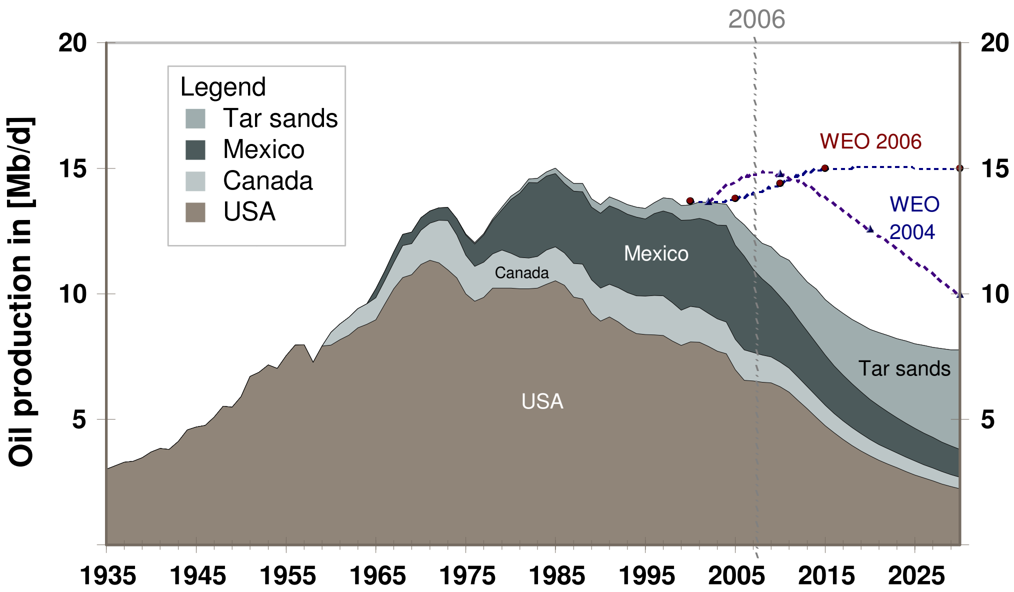
- 2006: 5.2 Mb/d
- 2020: 2 Mb/d (IEA: 3.3[2] Mb/d)
- 2030: 1 Mb/d (IEA: 2.6[3] Mb/d)

---

[1] Since IEA gives data only for 2015 and 2030, those for 2020 are interpolated
[2] For this comparison 2.3 Mb/d crude oil and 25% of OECD NGL are added
[3] For this comparion 1.5 Mb/d crude oil and 25% of OECD NGL are added

OECD North America

Figure 9: Oil production in OECD North America



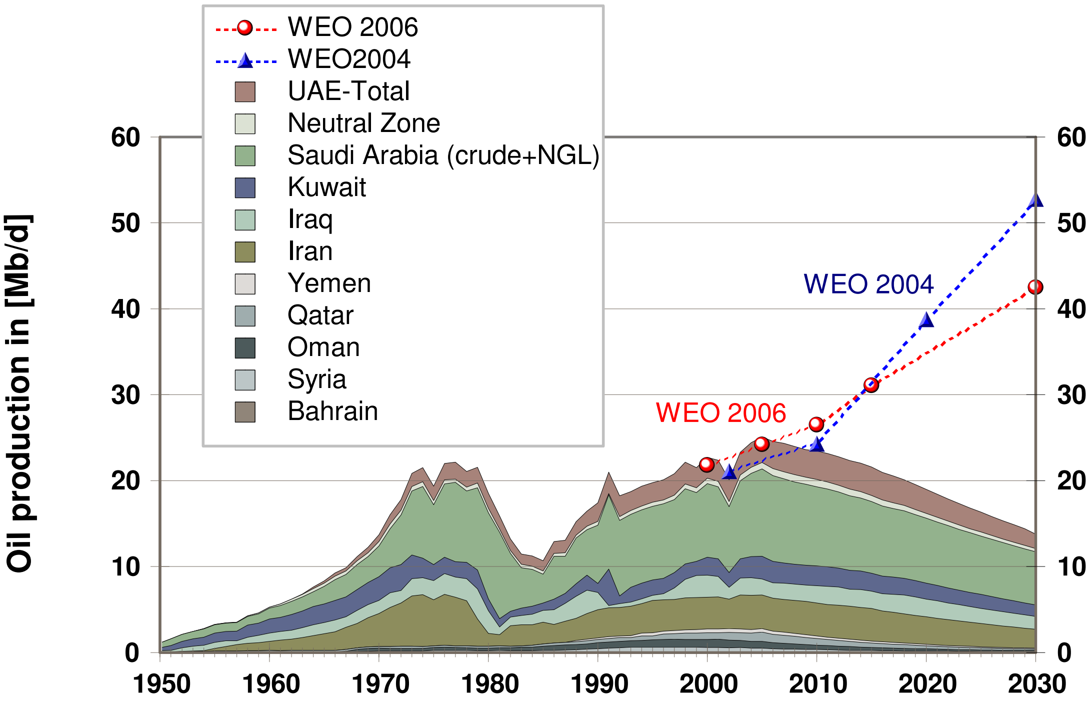
The projections for the oil supply in OECD North America are as follows:

- 2006: 13.2 Mb/d
- 2020: 9.3 Mb/d (IEA: 15.9[1] Mb/d)
- 2030: 8.2 Mb/d (IEA: 15.9[2] Mb/d)

[1] For this comparison 8.6 Mb/d crude oil, Canadian tar sand and 75% of OECD NGL are added
[2] For this comparison 7.8 Mb/d crude oil, Canadian tar sand and 75% of OECD NGL are added

Middle East

Figure 10: Oil production in the Middle East



The projections for the oil supply in the Middle East are as follows:
- 2006: 24.3 Mb/d
- 2020: 19 Mb/d (IEA: 32.3[1] Mb/d)
- 2030: 13.8 Mb/d (IEA: 39.6[2] Mb/d)

This is the region where the assessment in this study deviates most from the projections by the IEA.

Conclusion

The major result from this analysis is that world oil production has peaked in 2006. Production will start to decline at a rate of several percent per year. By 2020, and even more by 2030, global oil supply will be dramatically lower. This will create a supply gap which can hardly be closed by growing contributions from other fossil, nuclear or alternative energy sources in this time frame.

[1] 28.3 Mb/d crude oil and 4 Mb/d NGL
[2] 34.5 Mb/d crude oil and 5.1 Mb/d NGL

The world is at the beginning of a structural change of its economic system. This change will be triggered by declining fossil fuel supplies and will influence almost all aspects of our daily life.

Climate change will also force humankind to change energy consumption patterns by reducing significantly the burning of fossil fuels. Global warming is a very serious problem. However, the focus of this paper is on the aspects of resource depletion as these are much less transparent to the public.

The now beginning transition period probably has its own rules which are valid only during this phase. Things might happen which we never experienced before and which we may never experience again once this transition period has ended. Our way of dealing with energy issues probably will have to change fundamentally.

The International Energy Agency, anyway until recently, denies that such a fundamental change of our energy supply is likely to happen in the near or medium term future. The message by the IEA, namely that business as usual will also be possible in future, sends a false signal to politicians, industry and consumers – not to forget the media.

INTRODUCTION

Crude oil is the most important energy source in a global perspective. About 35 percent of the world's primary energy consumption is supplied by oil, followed by coal with 25 percent and natural gas with 21 percent [WEO 2006]. Transport relies to well over 90 percent on oil, be it transport on roads, by ships or by aircrafts. Therefore, the economy and the lifestyle of industrialised societies relies heavily on the sufficient supply of oil, moreover, probably also on the supply of cheap oil.

Economic growth in the past was accompanied by a growing oil consumption. But in recent years the growth of the supply of oil has been slowing and production has now practically reached a plateau. This is happening despite historically high oil prices. It is very likely that the world has now practically reached peak oil production and that world oil production will soon start to decline at initially probably increasing rates.

Because of the importance of oil as an energy source, and because of the difficulties of substituting oil by other fossil or renewable energy sources, peak oil will be a singular turning point. This will have consequences and repercussions for virtually every aspect of life in industrialised societies. Because the changes will be so fundamental, the whole topic is not popular. Colin Campbell put it this way: "Everybody hates this topic but the oil industry hates it more than anybody else."

However, as facts cannot be ignored indefinitely, also the public perception is changing. The possibility of peak oil is more frequently referenced in the media, though it is still regularly and ritually dismissed as being only a "theory". This is a signal that the conventional ways of explaining what is actually happening are obviously failing. The oil industry is now admitting to the fact that the "era of easy oil" has ended. And the International Energy Agency, in stark contrast to past messages, is now warning of an imminent "oil crunch" in a few years time.

The purpose of this paper is to give some background information for understanding the concepts and data relevant for the assessment of the future supply of oil. This is the basis for detailed projections of future world oil supply up to the year 2030. These projections are performed for the ten world regions as defined by the International Energy Agency (IEA) and then are aggregated into a global scenario.

The scenario results are set into perspective by comparing them with selected prominent studies by other institutions and authors. The scenario described in this paper is painting a completely different picture of the future than the IEA. It is much more in line with the projections by ASPO (Campbell) and by Robelius [Robelius 2007]. The differences are partly due to different methodological approaches (which are described in this paper) but are also due to inherent differences, ambiguities and uncertainties in the databases to which the different authors have access to and which cannot be resolved for the time being..

Last but not least, future developments will be affected by so many different factors like geology (frequently referred to as "below ground" factors) and economics and politics ("above ground factors") that the setup of scenarios is as much an art than a science. However, it appears that "geology" is now dominating economics and politics so that geological limits now define the upper limit of the future possible supply, whereas economic and political factors can only further constrain this boundary. The bandwidth of uncertainty is rapidly getting narrower.

Outline of the paper

In an introductory chapter, the scope of the study is defined and methodological questions regarding the projection of the future supply of oil are discussed. Some aspects are dealt with in greater detail in the Annex.

In the chapter "Assessment of the future oil supply" basic aspect are discussed which are necessary for a better understanding of the reasoning behind the scenario projections. This covers the concept of reserves, discussing definitions, reporting practices, data sources and reliability of data. Of equal importance is the history of the development of discoveries and production in different regions and countries. The analysis of these developments shows patterns which are relevant for the projection of future supplies.

In the chapter "Scenario of future oil supply" detailed results are presented for ten world regions and at a global level. The results are compared with prominent projections by the IEA, ASPO and Robelius. Differences and the reason for them are discussed.

SCOPE AND METHODOLOGY

Types of oil

Oil was created in the geological past by cracking biological hydrocarbon molecules into smaller hydrocarbon molecules. For this process a closed environment, proper source material, long time periods and high temperatures were necessary. When generated, oil was movable (liquid) and escaped from the source rock. In most cases oil escaped to the surface or dissipated somewhere in the ground in very low concentrations. Only when an impermeable rock layer was on top of the source rocks the oil followed the layer until it was trapped below a cap. These traps formed the oil fields with high oil concentrations.

However, the proper combination of all these parameters was rare in the geological past. Today the process of the generation of oil in source rocks and its move to oil fields is well understood by geologists. Therefore, the areas with potential hydrocarbon accumulations are well known and huge surprises can almost be excluded as the world is sufficiently explored.

In the supply projections in this study conventional oil, natural gas liquids (NGL) and oil produced from tar sands are considered.

Conventional oil

There are different classification schemes: based on economic and/or geological criteria.

The economic definition of conventional oil: *Conventional oil is oil which can be produced with current technology under present economic conditions.* The problem with this definition is that (1) it is not very precise, and (2) it describes a moving target. For instance, what were economic conditions e.g. in the former USSR as opposed to Russia now?

Then there are geological classifications, e.g. the one used by ASPO/Campbell. This classification is based on the viscosity of the oil (measured in °API) and on other properties:
- Conventional oil is crude oil having a viscosity above 17°API
- Non-conventional oil:
-- heavy oil between 10-17°API
-- extra heavy oil below 10°API (tar sands belong to this category)
-- oil shale
-- deepsea oil below 500 meter water depth
-- polar oil north or south of the arctic/antarctic circle
-- condensate

There is also a pragmatic definition which is widely used:
- Conventional oil is:
-- crude oil > 17°API

-- heavy oil between 10-17°API
-- all deep sea oil at any depth
-- polar oil
-- condensate
- Non-conventional oil is:
-- NGL
-- extra heavy oil below 10°API
-- synthetic crude oil (SCO) and bitumen from tar sands
-- oil shale

In this study “crude oil” is considered as consisting of “conventional oil” and “non-conventional oil”. “Conventional oil” includes oil >10°API, deepsea oil, polar oil and condensate as well as NGL (since many statistics do not distinguish between crude oil and NGL). SCO and bitumen from tar sands are treated explicitely as “non-conventional oil”. Oil shales are not considered.

Natural gas liquids (NGL)

Natural gas liquids are liquid hydrocarbons being part of the production of natural gas and which are separated at the well.

Tar sands

Tar sands are oil traps which are not deep enough below the surface to allow the generation of conventional oil. The oil was not heated enough to continue the process of cracking in order to get rid of the complex chain-molecules which are responsible for the high viscosity. The hydrocarbons have the characteristics of bitumen, they are close to the surface and are mixed with large amounts of sand. In the best regions in Canada the bitumen containing layer has an oil concentration of about 15-20 percent. The production method of choice is open pit mining. The tar sand is mined, flooded with water in order to separate the sand from the lighter oil, and then processed in special refineries to get rid of the high sulphur content (usually between 3-5 percent) and other particulates. This process needs huge amounts of energy and water. Only oil deposits in deep layers below 75 m are mined in-situ.

Oil production from tar sands in Canada is dealt with in greater detail in the Annex.

Oil shales

Oil shales contain only kerogene and not oil. Kerogene is an intermediate product on the way from biological hydrocarbon cracking to oil formation. The oil shale layer was not hot enough to complete the oil generation. For the final step the kerogene must be heated up to 500 °C and combine with additional hydrogen to complete the oil formation. This final process must be performed in the refinery and needs huge amounts of energy which usually were provided by the environment during oil formation.

The kerogene is still in the source rock and could not accumulate in oil fields. The ratio of kerogene to waste material is very low, making the mining of oil shales unattractive. This holds even more as the shale material contains other ingredients which expose the miners and the environment or health risks (e.g. from hydrosulphide).

Oil shales are not regarded as being a reasonable energy source at large scale. The main reason for this is that the energy balance for extracting the oil is too poor. In combination with environmental and economic aspects it is very unlikely that oil shale mining will ever be performed at large scale, though at some places it is used already today in small quantities.

Scope and methodology

The principal aim of this study is to project future world oil supply up to 2030. These projections are done for the ten world regions as they are defined by the IEA. This enables comparisons with IEA projections also on a regional level so that differences will be more explicit.

Basis for the regional production scenarios are the following data for each country: historical discovery and production patterns, remaining reserves and also known field development projects of the oil industry. The history of discoveries allows to project future discoveries. The analysis of production profiles allows - for countries where peak production has already been reached - to project future production patterns.

The main datasource for the analysis is the IHS database. However, for the USA, Canada, UK, Denmark and Norway detailed government statistics are used with field by field data. (For the UK and Norway a first analysis was carried out in 2001 in "Analysis of UK Oil Production", see article at www.energyshortage.com. For the analysis of the oil production in the Gulf of Mexico the statistics of MMS are used.) Production data for Saudi Arabia, Mexico and Brazil are taken from company statistics.

Furthermore, for some important regions the IHS data on remaining reserves have been replaced by own assessments based on other sources. This has been done especially for USA, Canada, Mexico, Brazil, Middle East countries, and Russia. Also, IHS states proved reserves as “remaining reserves” whereas in this study proved and probable reserves are used wherever possible and available.

For key countries details are discussed on the basis of production profiles that are derived from the individual field production data. For regions (and fields) already in decline the future production profile is derived from a plot of annual production versus cumulative production. Due to physical reasons (e.g. declining field pressure during extraction), the decline of the production profile is approximately linear in such plots (decline is exponential over time, but linear in this plot). From the steepness of the decline the ultimate amount of recoverable oil can be estimated quite accurately. This is a common method widely used in the oil and natural gas industry.

Only for regions where the necessary detailed information was not available, production profiles are estimated from the known largest fields and by assuming a logistic growth concept.

Oil production from tar sands in Canada is projected from announced industry projects and projections of the NEB (National Energy Board) of Alberta.

Accordingly, the projections constitute a quantitative assessment based on various data and sources. There is no single rigid algorithm based on a defined set of numbers valid for all countries and regions. The projections are a result of the judgement of the authors based on the data and information available. This element of seeming arbitrariness is not avoidable in view of the deficiencies of the available data.

This quantitative exercise is necessary to get a better idea of the supply in the next two decades. But the result is not to be interpreted as an exact forecast but rather as an indication of a probable range and should therefore be ultimately interpreted qualitatively. In a way, the qualitative results and interpretations are more important and more relevant (and also more robust) than the exact numbers.

Results will be compared with projections performed by IEA, ASPO and Robelius (to take just some prominent examples from the many projections now available).

Differences in scope and methodology to other studies

ASPO

The methodology used for the ASPO projections is somewhat different. Types of oil considered are conventional oil (onshore), tar sands and heavy oil, offshore and deep offshore oil, polar oil. To each of these oil types a special production profile is attributed based on the already produced amounts and on the ultimate recoverable resource (URR). For instance, deep sea oil is extracted fast with a steep production increase and showing after peak a steep decline (5-12%) while many onshore projects are produced with a much slower decline profile (3-5%). The time horizon of the projections extends to the year 2100.

ASPO scenarios are based on a reserve assessment and Hubbert curves (this is more of a top-down approach).

Data sources are own data bases which are derived from various open and disclosed sources.

The projections are work in progress and are revised whenever better data are available.

Robelius

Robelius in his doctoral thesis [Robelius 2007] addresses the question: when is peak oil? The methodology used by Robelius is based on an analysis of reserves and production profiles of giant oil fields. Additionally, conventional oil production from smaller fields is dealt with in an aggregate manner. Also projections for unconventional oil are made (tar sands in Cannda and heavy oil in Venezuela). The same types of oil are considered as in this paper.

Giant fields are defined as having an ultimate recoverable reserve (URR) of 0.5 Gb or more or have produced more than 100,000 b/d for at least a year. There are, according to Robelius, 507 such fields (i.e. about 1 percent of all known fields) which cover 60-70 percent of known reserves and about 45 percent of current world production (all numbers for 2005). The performance of these fields will determine future oil supply and will therefore also determine the timing of peak oil. An extensive and comprehensive research was undertaken by Robelius to gather relevant data for all giant fields from all available data sources. Accordingly, this database certainly contains the best and most reliable data as far as giant oil fields are concerned.

Results are presented in a range of scenarios. In the work of Robelius the regional distribution of global oil supply was not the primary focus.

International Energy Agency (IEA)

The IEA regularly projects the future world energy supply in its World Energy Outlook. The time horizon for the projections is 2030. The projections are detailed for ten world regions and also for different energy sources.

The principal approach of the IEA is to project future oil demand based on an economic model. Then the oil supply is supposed to equal demand. The possible growth of oil supply is taken for granted based on reserve estimates by the US Geological Survey (USGS) and on supply scenarios by the US Energy Information Agency (EIA). A critique of this approach is given in the Annex.

ASSESSMENT OF FUTURE OIL SUPPLY

Basic concepts – understanding the future of oil

In this subchapter a few basic concepts are introduced in order to better understand the patterns which govern the future availability of oil. These considerations are the basis for the supply scenarios in subsequent chapters.

First, the concept of reserves is explained and how it is used by different players. Then, the history of discoveries and the history of oil production is shortly described. Typical patterns of oil production over time and the influence of technology are discussed.

Only oil that has been found before can be produced. Therefore, the peak of discoveries which took place a long time ago in the 1960s, will some day have to be followed by a peak of production. After peak oil, the global availability of oil will decline year after year. There are strong indications that world oil production is near peak.

Reserves

Reserve definitions

The definition of reserves is in theory quite clear and not controversial. The standard definitions as they are e.g. stated in Wikipedia [Wikipedia 2007] are as follows:

“Oil reserves are primarily a measure of geological and economic risk - of the probability of oil existing and being producible under current economic conditions using current technology. The three categories of reserves generally used are proven, probable, and possible reserves.

Proven Reserves - defined as oil and gas "Reasonably Certain" to be producible using current technology at current prices, with current commercial terms and government consent, also known in the industry as 1P. Some industry specialists refer to this as P90, i.e., having a 90% certainty of being produced. Proven reserves are further subdivided into "Proven Developed" (PD) and "Proven Undeveloped" (PUD). PD reserves are reserves that can be produced with existing wells and perforations, or from additional reservoirs where minimal additional investment (operating expense) is required. PUD reserves require additional capital investment (drilling new wells, installing gas compression, etc.) to bring the oil and gas to the surface.

Probable Reserves - defined as oil and gas "Reasonably Probable" of being produced using current or likely technology at current prices, with current commercial terms and government consent. Some Industry specialists refer to this as P50, i.e., having a 50% certainty of being produced. This is also known in the industry as 2P or Proven plus probable.

Possible Reserves - i.e., "having a chance of being developed under favourable circumstances". Some Industry specialists refer to this as P10, i.e., having a 10% certainty of being produced. This is also known in the industry as 3P or Proven plus probable plus possible."

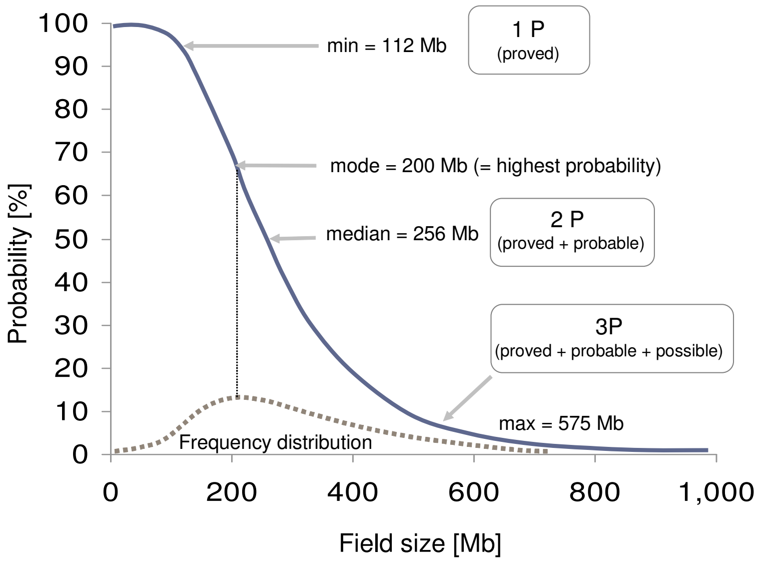
In the actual practice of the industry things are not so clear anymore. In many cases it is not clear how the data are derived. Especially in statistics on global oil reserves there is no transparent or audited procedure. For instance, the statistics published by the Oil & Gas Journal [OGJ 2007] refer to proved reserves but they rely solely on the reporting of oil producing countries. The data of the Oil & Gas Journal are also the basis for the reserve statistics published annually by BP [BP 2006].

In contrast to most of the public domain statistics which refer to proven reserves, industry databases, e.g. by IHS Energy [IHS Energy 2006], use proved and probable (or P50) reserves.

Ideally, for every oilfield discovered a probabilistic analysis is carried out taking account of the following parameters: area, thickness of the oil containing structures, porosity of the structure, oil content in the rock, estimated recovery factor, etc. From these data a probabilistic distribution is generated as shown in the following Figure 11.

In the example illustrated in the figure the field has a size of at least 130 Mb with 90% probability (P90). Most probable, however, the size is 200 Mb with a 30% chance of being smaller and a 70% chance of being larger. With 50% probability the field has a size of at least 250 Mb, having an equal chance of being smaller or larger than estimated. With 5% probability the field size exceeds 575 Mb. Though this definition seems to be quite exact, in reality in many cases it is rather unclear on which definition the estimate is based on and with which certainty the probability distribution matches the reality.

Figure 11: Normal distribution for the assessment of the recoverable oil in a specific oilfield [Petroconsultants 1995]



Reserve assessment and reporting

When analysing oil statistics one has to look at the definitions used. Some statistics only refer to conventional oil defined as oil having a density of >20°API. Some statistics also include natural gas liquids (NGL), a byproduct from the production of natural gas. In other statistics also heavy oil with a density below 20°API is considered and in some cases also unconventional oil – like tar sands – is included.

Oil companies operating in the USA are obliged to adhere to the strict reporting rules set by the Securities and Exchange Commission (SEC) which require the reporting of proved reserves. Internally, companies mostly will use proved and probable (P50) reserves. For instance, BP internally estimated the size of the Prudhoe Bay field in Alaska (the biggest field in the USA) at 15 Gb in 1970 before the start of production there. Yet, according to SEC rules, only 9 Gb were reported. Today, the real size of the field is probably between 13 and 14 Gb.

The United States Geological Survey (USGS) use their own definitions. For instance, heavy oil is regarded as being a conventional reserve. The assessment of reserves also is independent of economic or technological considerations and is carried out according to the "McKelvey-classification". Therefore, reserve data by the USGS [USGS 2005] are much higher than those of other institutions. [Campbell 1995], [Campbell 1997]

The different reporting methods of different institutions account for most of the differences in published reserve data.

Since proved reserves always are much smaller than the initially anticipated proved and probable reserves, over time a re-evaluation of proved reserves is taking place because in the course of producing an oilfield probable reserves are converted into proved reserves. This practice creates the illusion of growing reserves despite growing consumption.

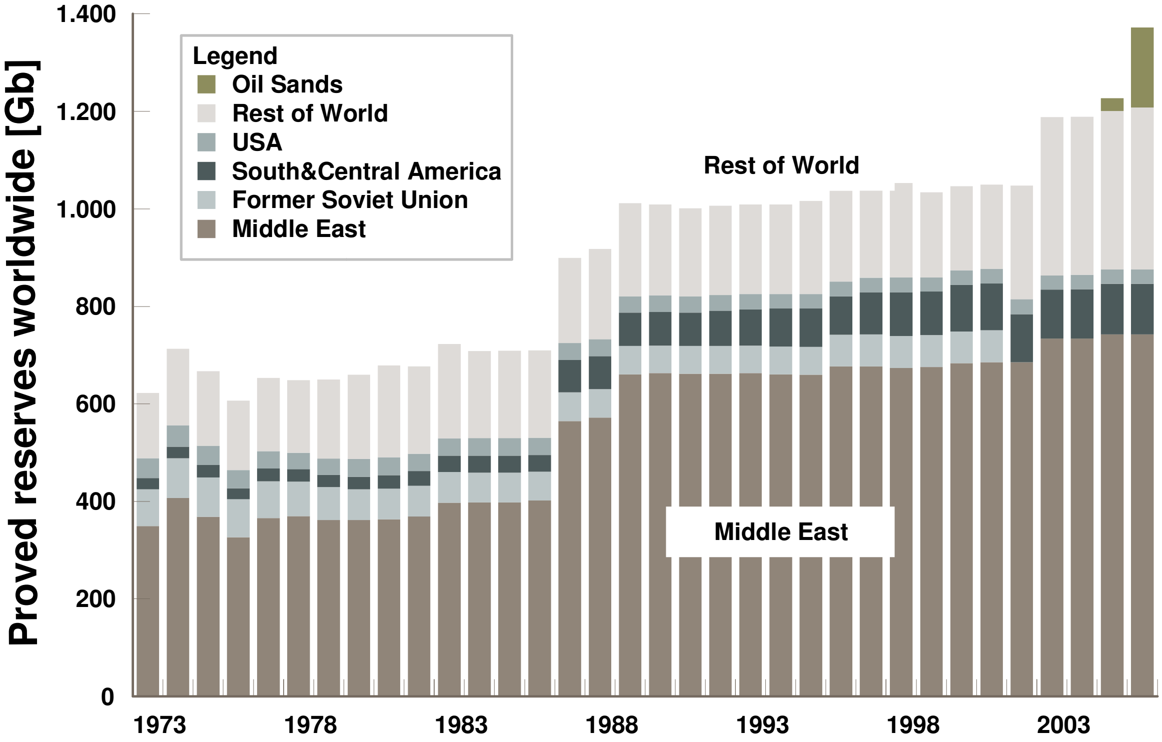
On the other hand, when proved and probable reserves are used, once the yearly consumption exceeds the yearly reserve additions, total reserves will start to decline.

Just a remark relating to the finiteness of fossil energy resources: The term "reserve growth" is a somewhat misleading metaphor. In reality, of course, each barrel of oil burnt irreversibly reduces the original reserves on earth. Just our knowledge of remaining reserves is subject to change. An upward revision of our knowledge of reserves does not increase the actual amount of reserves.

Differentiation between discoveries and re-evaluations

One of the prominent statistics in the public domain is the BP Statistical Review of World Energy [BP 2006]. The oil reserve statistics refer to proven reserves and their development is shown in the following Figure 12.

Figure 12: Development of proved reserves of oil worldwide according to public domain statistics

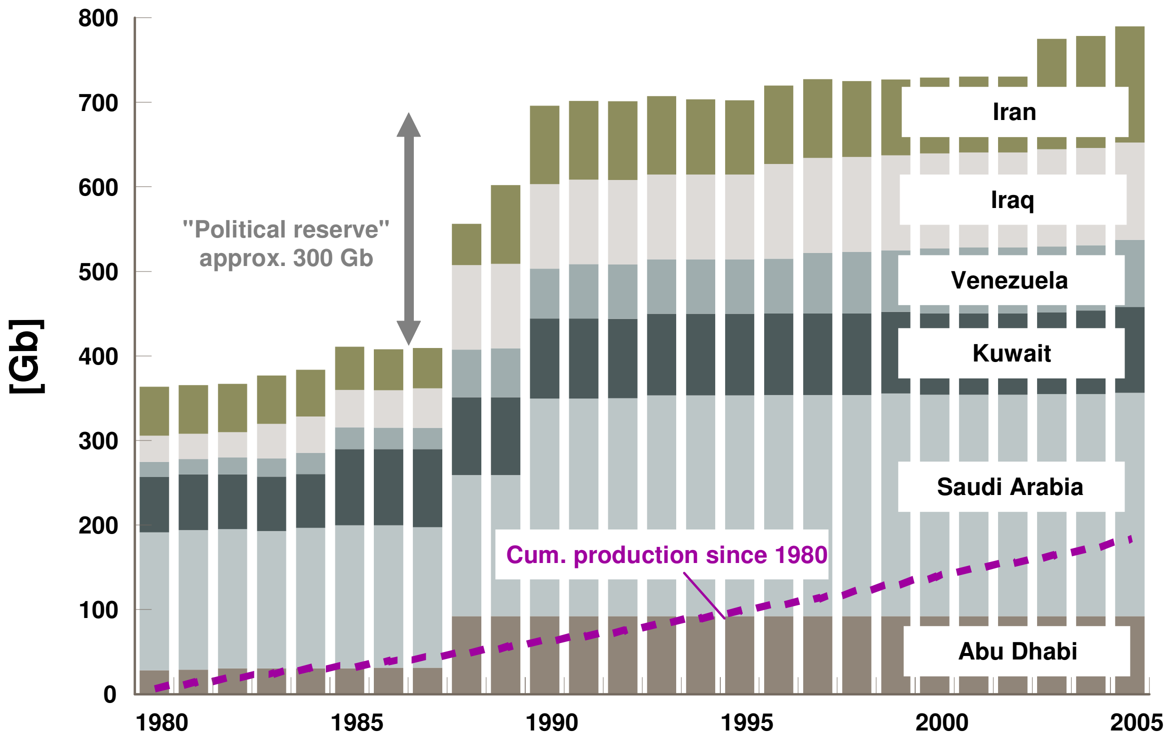


Source: BP Statistical Review of World Energy

Figure 12 shows an overall growth of proved reserves during the last decades (from 600 Gb in 1973 to about 1,400 Gb in 2006). Since consumption of oil also has increased considerably in this period, this is widely seen as a strong indication that a supply problem is not imminent.

The significant rise of proved reserves in the past has occurred within a few years (1987 – 1989) and is confined to few countries. In this period reserves increased by 40% from 700 Gb to more than 1,000 Gb, all due to increases in OPEC countries. the latest increases in 2006 by 163.5 Gb (sic!) account for Canadian tar sands. The details are shown in Figure 13.

Figure 13: Development of proved reserves of oil in OPEC countries according to public domain statistics



Source: BP Statistical Review of World Energy

All major OPEC oil producing countries increased their reserves considerably, despite the fact that there were no new corresponding discoveries reported in this period. The reason given for the re-evaluation of reserves was that the reserve assessments in the past were too low. To a certain extent this may well be justified since before the nationalisation of the oil industry in these countries, private companies perhaps had a tendency to underreport reserves for financial and political reasons.

But there were also other reasons. OPEC production quotas are set according to reserves and also other factors. Therefore, there was an incentive for each country to defend their quota by keeping up with reserves. It is not transparent what the real reserves of OPEC are, especially since reserves have not been adjusted since then in spite of significant production. However, critical observers speak of “political reserves” in this context.

Reported reserves at any point in time are the result of:

  Reserves (as reported at the start of last period)
+ Re-evaluation of existing reserves (in last period)
+ New discoveries (in last period)
– Production (in last period)

= Reserves (as of to date)

In the published statistics the individual elements of the above described reserve calculation are in most cases not transparent. Without this information, it is very difficult to assess the quality of the reserve data.

Field revisions are due to an initial underreporting of reserves. This guarantees that year by year proved reserves are increasing, thus hiding the real situation regarding new discoveries. This is common practice for the reporting of reserves by private oil companies. During the lifetime of a producing field the initially estimated proved reserve is re-evaluated several times and is finally very close to the value that in the beginning was internally known as the P50 reserve.

Also, with the help of these systematic upward revisions, years with disappointing exploration success can be hidden, and the produced quantities smoothly replaced in the company statistics. This accounts for the fact that oil reserves have almost continuously increased for more than 40 years, though each year large quantities were removed by production. The reserve figures used in financial contexts and shareholder meetings are completely different from those that address the question of how much oil has already been found and how much oil will still be found.

The main reason, however, for the apparently unchanged world reserves year after year is the reporting practice of state owned companies. More than 70 countries have reported unchanged reserves for many years, despite substantial production.

World oil reserves are estimated to amount to 1,255 Gb according to the industry database [IHS 2006]. There are good reasons to modify these figures for some regions and key countries, leading to a corresponding EWG estimate of 854 Gb. These modifications are explained in the chapters describing the detailed scenarios. The resulting reserve figures are given in Figure 14 and in Table 2 (there described as EWG estimates and shown together with the IHS data). The greatest differences are the reserve numbers for the Middle East. According to IHS, the Middle East possesses 677 Gb of oil reserves, whereas the EWG estimate is 362 Gb.

Due to ongoing but declining discoveries and reassessments of elder (already discovered), fields the reserve figures will slightly change from year to year. In balance with the annual consumption of about 30 Gb/yr at present, these figures will steadily decline. In Table 2 for each region also the consumption in 2005 is presented [IHS Energy 2006], [BP 2006].

Figure 14: World oil reserves (EWG assessment)

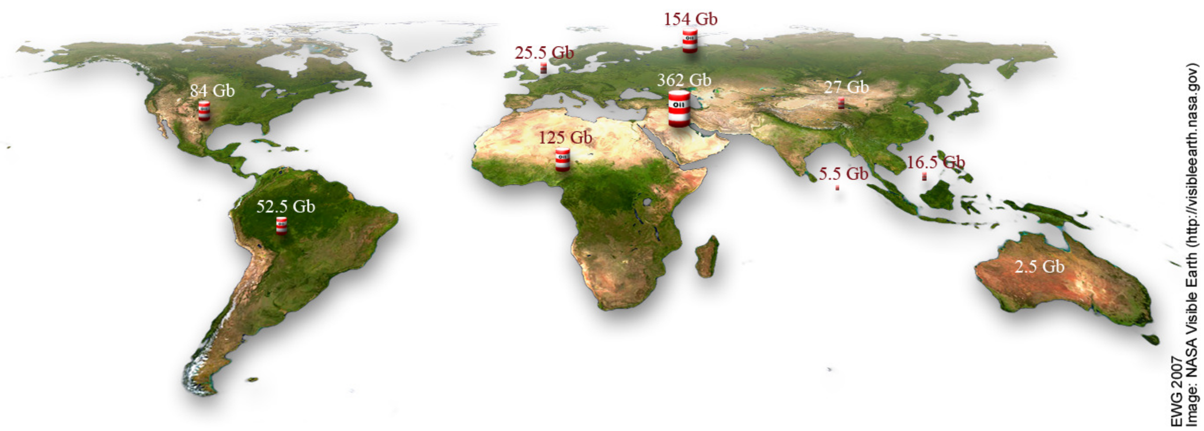


Table 2: Oil reserves and annual oil production in different regions and key countries

Region	Remaining reserves		Production 2005		Consumption 2005 [Gb/yr]
	EWG [Gb]	IHS [Gb]	onshore [Gb/yr]	offshore [Gb/yr]	
OECD North America	84	67.6	3.20	1.71	9.13
Canada	17	15.3	0.89	0.12	0.82
USA	41	31.9	1.93	0.59	7.59
Mexico	26	20.4	0.36	1.00	0.72
OECD Europe	25.5	23.5	0.1	1.94	5.72
Norway	11	11.6	0	1.13	0.08
UK	8	7.8	0.01	0.70	0.65
OECD Pacific	2.5	5.1	0.025	0.18	3.18
Australia	2.4	4.8	0.02	0.17	0.31
Transition Economies	154	190.6	4.1	0.18	2.02
Russian Federation	105	128	3.4	0.13	1.00
Azerbaijan	9.2	14	0.01	0.15	0.04
Kazakhstan	33	39	0.47	0	0.08
China	27	25.5	1.1	0.22	2.55
South Asia	5.5	5.9	0.11	0.16	0.96
East Asia	16.5	24.1	0.3	0.65	1.75
Indonesia	6.8	8.6	0.27	0.11	0.43
Latin America	52.5	129	2.0	0.61	1.74
Brazil	13.2	24	0.075	0.55	0.75
Venezuela	21.9	89	1.17	0	0.20
Middle East	362	678.5	6.97	1.97	2.09
Kuwait	35	51	0.96	0	0.11
Iran	43.5	134	1.19	0.24	0.59
Iraq	41	99	0.67	0	
Saudi Arabia	181	286	2.85	0.86	0.69
UAE	39	57	0.46	0.45	0.14
Africa	125	104.9	2,03	1,53	1.01
Algeria	14	13.5	0.72	0	0.09
Angola	19	14.5	0.01	0.45	
Libya	33	27	0.61	0.02	
Nigeria	42	36	0.39	0.52	
World	**854**	**1,255**	**19.94**	**9.15**	**30.3**

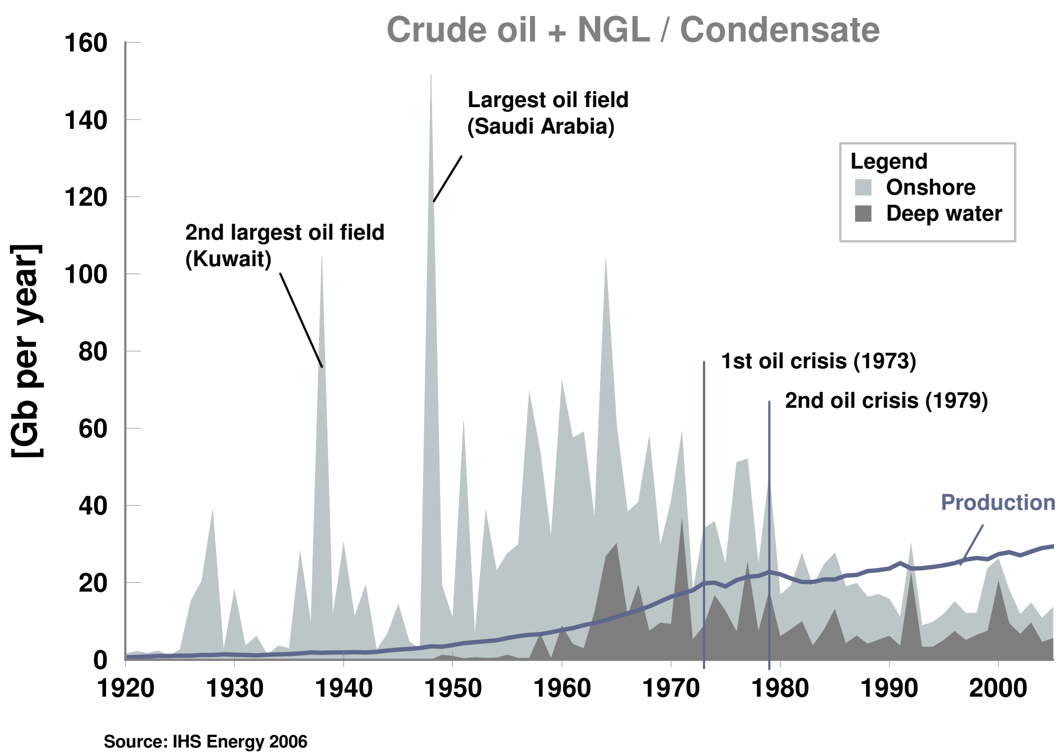
Reserves of crude oil are an important factor in determining future production possibilities. However, they are but one factor and other determinants are equally important. Many assessments which rely solely on reserve data tend to overlook relevant facts. Apart from that, reserve data for many major oil producing regions are not very reliable.

Discoveries

When trying to assess the amount of oil which can be expected to be still discovered in future ("yet to find"), the statistics on proved reserves discussed above are obviously not very helpful. The same is true for the assessment of future production potentials. For these purposes an analysis of past discoveries (measured as proved + probable reserves) and production profiles is far better suited.

Figure 15 shows the annual oil discoveries since 1920 and also the annual production rates [IHS Energy 2006]. Past discoveries are stated according to best current knowledge (and not as the reserve assessments at the time of discovery) – a method described as "backdating of reserves". Therefore, the graph shows what "really" was found at the time and not what people thought what they had found at the time.

Figure 15: History of oil discoveries (proved + probable) and production



Since about 1980, annual production exceeds annual new discoveries. This is obviously not sustainable. The peak of discoveries must eventually be followed by a peak of production.

Table 3: Summary of worldwide oil discoveries

Period	Average oil discoveries [Gb/yr]	
	onshore	offshore
2004/2005	7	5
2002/2003	5	8
2000/2001	7	10
1990-1999	8	7.1
1980-1989	14	6.9
1970-1979	24	14.8
1960-1969	42	13.4
1950-1959	31	1.2
1940-1949	26	0.3

Figure 15 shows the long-term trend in discoveries: The big oilfields were found rather early – in 1938 the world's second largest field, Burgan (32-75 Gb), was found in Kuwait, in 1948 the world's largest field with 66-150 Gb, Ghawar, was discovered in Saudi Arabia [Robelius 2007]. Today, more than 43,000 oilfields are known, but the two largest fields contain already about 8% of all the oil found to date. Later on, with better exploration technology, many more fields have been discovered in many parts of the world. The maximum of discoveries was in the 1960s. However, the average size of new discoveries was declining with time. Higher oil prices in the wake of the oil price crises in the 1970s could not reverse this trend. One important lesson can be learnt: there is no empirical relation between oil price and the rate of discoveries (contrary to the assumptions of many economists).

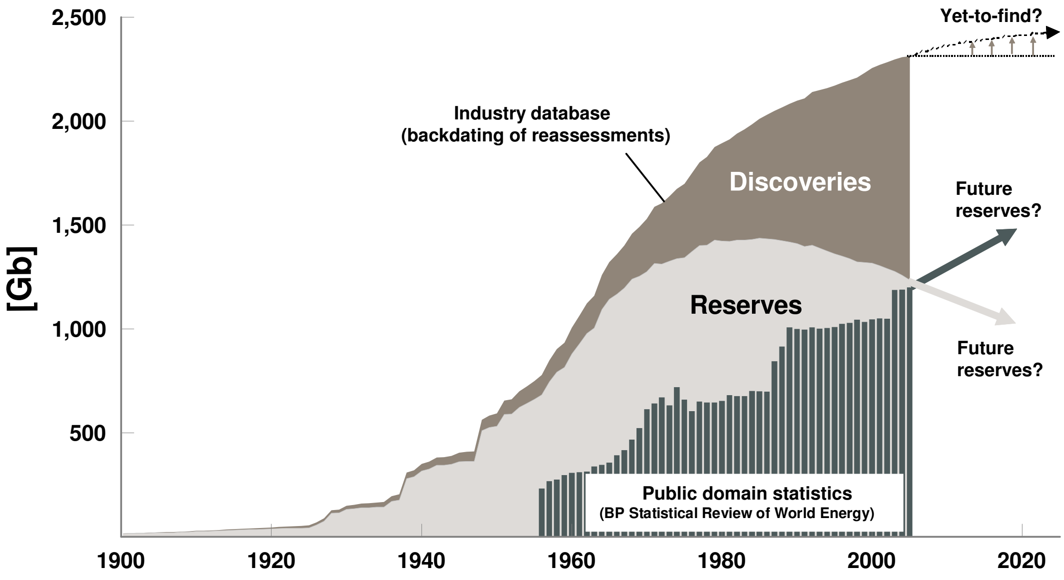
At the end of the 1990s, there was a new increase in discoveries due to exploration successes in the deep offshore regions in the Gulf of Mexico, off Brazil and off Angola and the discovery of the field Kashagan with 6-10 Gb in the Caspian Sea. Meanwhile, deep sea exploration seems to have peaked already and discoveries are declining again.

The difference between the history of proved reserves (the preferred view by "economists") and the history of proved + probable reserves (the preferred view by "geologists") is shown in Figure 16. The different views show opposing trends: Proved reserves look as if they can stay constant or even grow in future, whereas proved + probable reserves are steadily approaching a limit with the possibility of perhaps 200 – 300 Gb "yet to find" eventually.

A possible criticism of the cumulative curve showing proved + probable reserves is the fact that re-evaluations of past discoveries are included, but possible future re-evaluations are not accounted for. Therefore, future reserve assessments might lead to an upward shift of the curve. This criticism is valid, but it will not affect the estimate of the yet-to-find amount of oil and it will not affect possible future production profiles much.

When subtracting the cumulative production from the cumulative proved + probable reserves, one gets the history of remaining reserves. Remaining reserves (proved + probable) are decreasing since about 1980. Even when assuming constant future consumption, remaining reserves will decrease faster in future because of declining new discoveries.

Figure 16: History of proved reserves, proved + probable reserves, production and remaining proved + probable reserves



Source: IHS Energy 2006

Discrepancies between public domain statistics (e.g. BP) – which attribute reserve reassessments to the year of the reassessment – and industry data bases (e.g. IHS Energy) – which backdate reassessments – are a major reason for the differences in the assessment of future oil discoveries and also production between conventional forecasts (e.g. by IEA) and the approach presented in this paper. The relevance for production forecasts is the fact that reserve reassessments usually are done for producing fields. However, these reassessments do not influence the production pattern of the field and, especially when production is already declining, the decline is not affected by upward revisions of reserves.

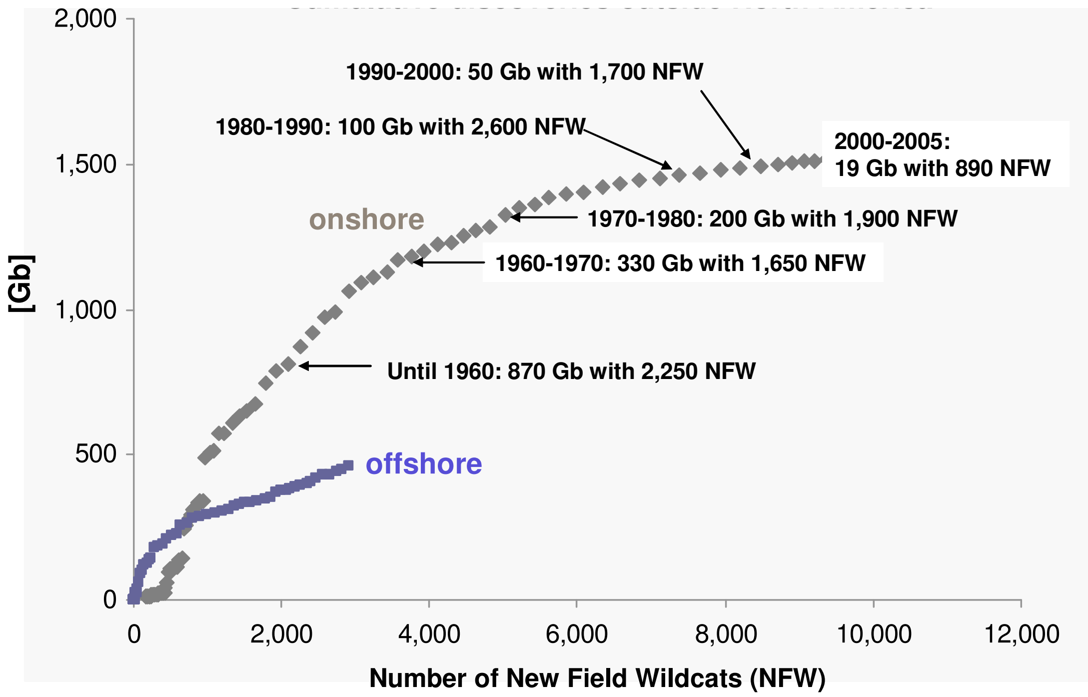
Future production growth mainly can only be the result of the development of yet undeveloped discoveries. Therefore, the distinction of reassessments of reserves and new discoveries is so important.

Discovery patterns and estimated ultimate recovery (EUR)

There is another reason why the difference between proved and proved + probable reserves is important. Upward revisions of field sizes usually are made when the production of the field is past peak. This pattern is also true for regions and countries. An example is the case of the reserve estimates for the US, which are reassessed each year resulting in almost constant oil reserves over many years, though each year oil is removed by production. Despite these reassessments, the US oil production has been in decline for 30 years. These re-evaluations, therefore, do not affect the timing of the aggregate peak production of a region, a country or, for that matter, of the world.

The derived historical pattern of discoveries displays a trend that helps to extrapolate into the future and to assess the prospects for future discoveries in a given basin in coming years. Such an analysis is essential for the geologists' decision as to where it is still worth looking for oil and where not. In nearly all oil provinces, the same pattern can be observed: Large discoveries are made early and with minimal effort. In later years the size of individual and annual discoveries gets smaller and smaller. Ever more boreholes have to be drilled to add new discoveries to the resources. The cumulative discoveries over the years saturate and approach an asymptotic value, which might be seen as the estimated ultimate potential for the oil recovery of a region. This pattern is called "creaming curve" and is shown in Figure 17.

Figure 17: Oil discoveries and drilling activity outside North America



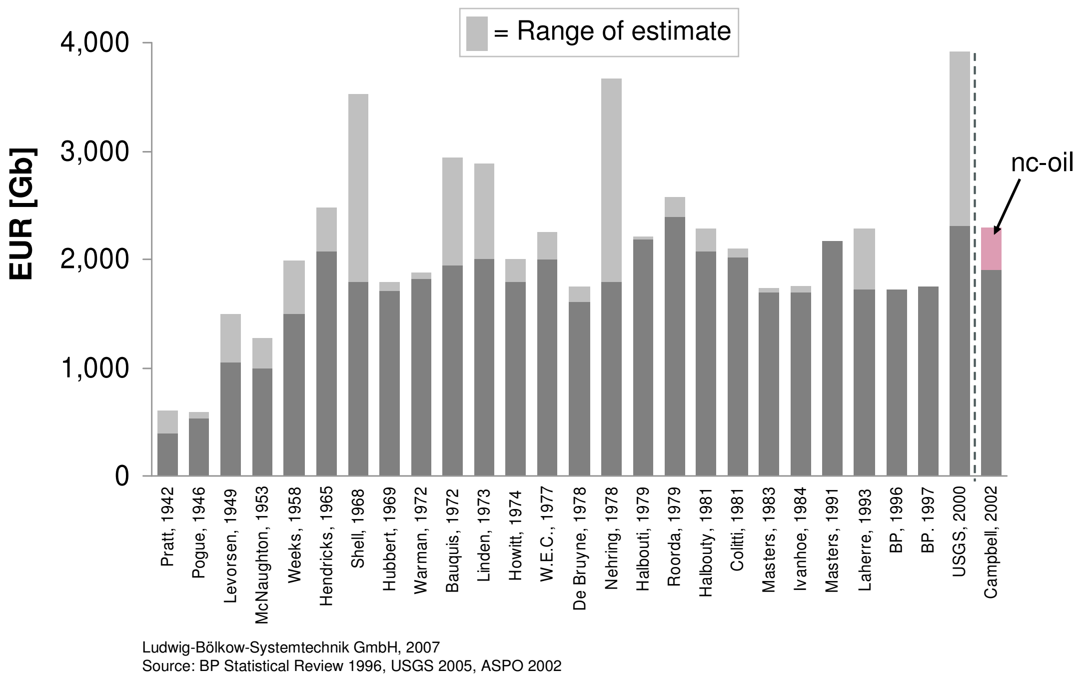
Ludwig-Bölkow-Systemtechnik GmbH, 2007
Source: IHS Energy 2006

In the period 1960 to 1970 the average size of new discoveries was 527 Mb per New Field Wildcat. This size has declined to 20 Mb per New Field Wildcat over the period 2000 to 2005. From that figure the effort to add new oil to reserves can be calculated by estimating the probable number of necessary wildcats and the associated costs.

Estimates of the ultimate recovery

The following Figure 18 shows historic estimates of the „estimated ultimate recovery" (EUR) of oil [BP 2006], [USGS 2005], [ASPO 2002]. This is the total amount of oil geologists deem to be recovered eventually, i.e. the sum of past and future oil production.

Figure 18: Estimates of ultimate oil recovery (EUR)

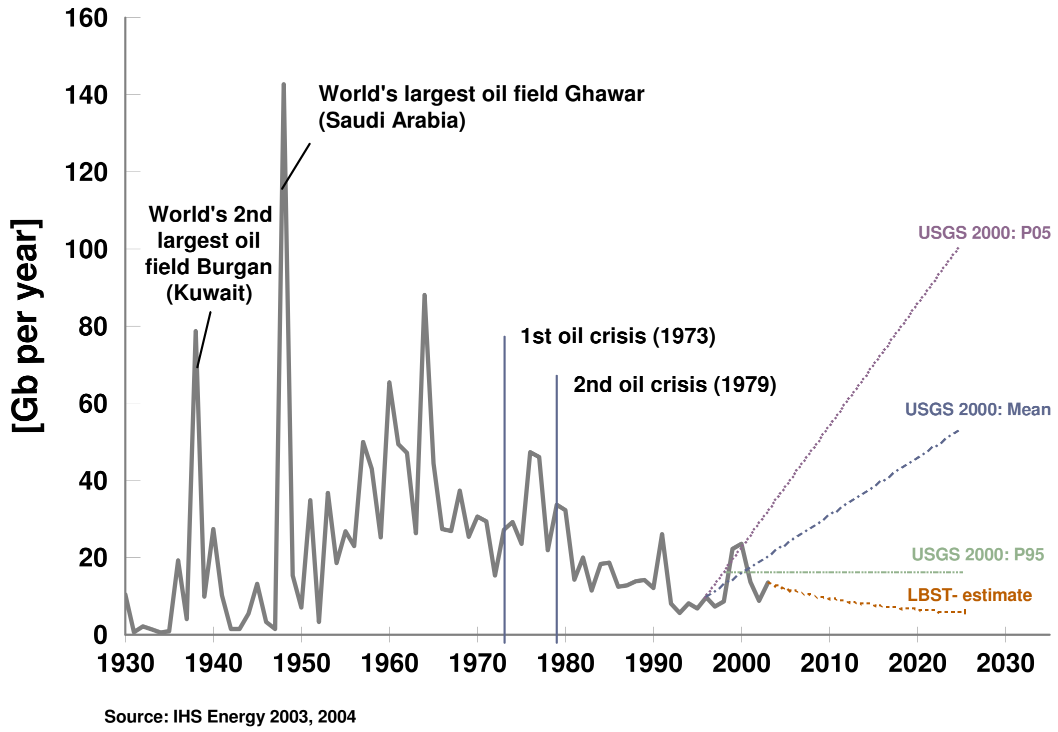


At the end of the 1940s, estimates of EUR of some hundred Gb were very moderate. With the exploration successes in the following years also the estimates of the EUR were rising. Since about the end of the 1960s the EUR estimates remained more or less constant. This is not very surprising since after the peak of discoveries the estimates became much better.

The data for BP 1996 and BP 1997 only cover past production and past discoveries, but not an estimate of the amount "yet-to-find" [BP 1996], [BP 1997].

Remarkable are the estimates by the US Geological Survey (USGS) published in 2000 [USGS 2000]. The lower estimate with a supposed probability of 95% states an EUR of approx. 2,300 Gb, well in the range of the other estimates. However, the upper estimate with a supposed probability of 5% gives an EUR of about 4,000 Gb which is way beyond all other estimates. This scenario would require a complete reversal of the trend in discoveries observed in the last decades. This is illustrated in Figure 19.

Figure 19: World oil (and NGL) discoveries and USGS projections for "yet-to-find"



Even the P95 estimate looks at being rather optimistic. The other two USGS scenarios are just fantasy.

The method how the mean value is derived is based on two extreme cases: How much oil will be found with 95% probability, and how much oil will be found with 5% probability. Applying statistical mathematics on these two cases to generate a new value yields a spurious "mean" value which obviously is biased by the 5% value. The USGS mean value has nothing to do with a P50 estimate (or best estimate) as has been described earlier on. In papers and reports referring to the USGS study, mostly only this mean value is used, not addressing the underlying assumptions. A detailed discussion can be found in Annex 2.

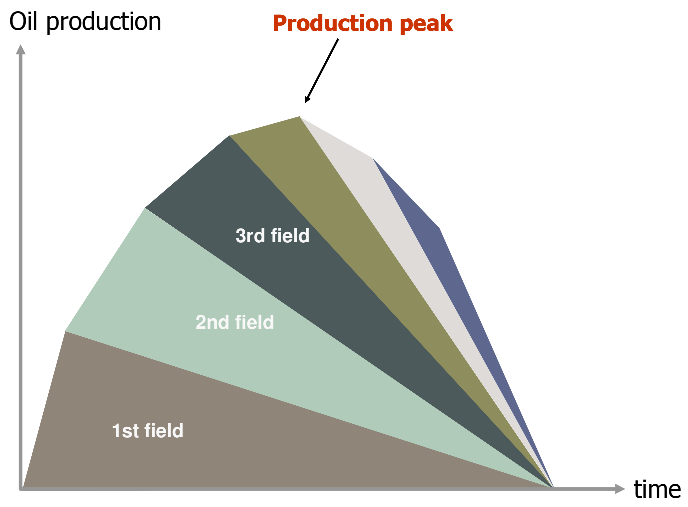
Production patterns

The general pattern

The different phases of oil production can be described schematically by the following pattern: In the early phase of the search for oil, the easily accessible oil fields are found and developed. With increasing experience the locations of new oil fields are detected in a more systematic way. This leads to a boom in which more and more new fields are developed, initially in the primary regions, later on all over the world. Those regions which are more difficult to access, are explored and developed only when sufficient new oil can not be found anymore in the easily accessible regions. As nobody will look for oil without also wanting to produce it, in general, shortly after the finding of new promising fields their development will follow.

In every oil province the big fields will be developed first and only afterwards the smaller ones. As soon as the first big fields of a region have passed their production peak, an increasing number of new and generally smaller fields have to be developed in order to compensate the decline of the production base. From there on, it becomes increasingly difficult to sustain the rate of the production growth. A race begins which can be described as follows: More and more large oil fields show declining production rates. The resulting gap has to be filled by bringing into production a larger number of smaller fields. However, these smaller fields reach their peak much faster and then contribute to the overall production decline. As a consequence, the region's production profile which results from the aggregation of the production profiles of the individual fields, becomes more and more "skewed", the aggregate decline of the producing fields becomes steeper and steeper. This decline has to be compensated for by the ever faster connection of more and more ever smaller fields, see Figure 20.

Figure 20: Typical production pattern for an oil region



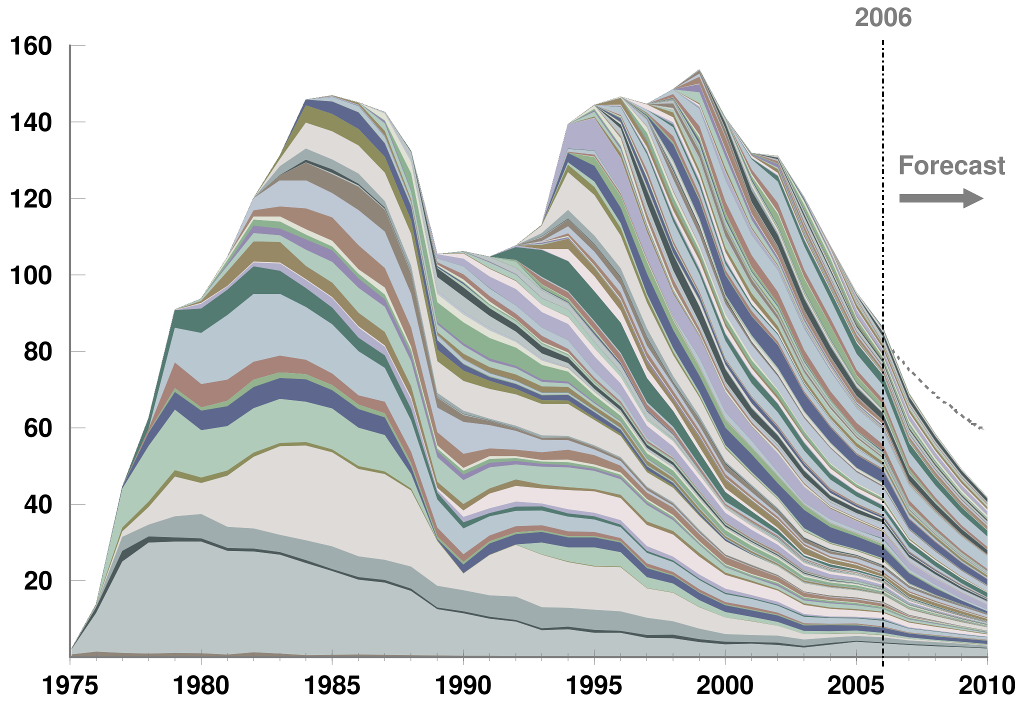
So, the production pattern over time of an oil province can be characterised as follows: To increase the supply of oil will become more and more difficult, the growth rate will slow down and costs will increase until the point is reached where the industry is not anymore able to bring into production a sufficient number of new fields quick enough. At that point, production will stagnate temporarily and then eventually start to decline.

This pattern can be observed very well in many oil provinces. But in some regions this general pattern was not prevalent, either because the timely development of a "favourable" region was not possible for political reasons, or because of the existence of huge surplus capacities so that production was held back for longer periods of time (this beeing the case in many OPEC countries). However, the more existing surplus capacities were reduced, the closer the production profile follows the described pattern.

Production in key regions

Figure 21 shows the oil production in the United Kingdom. It is a good illustration of the production pattern described above. Similar patterns can be shown for many regions in the world.

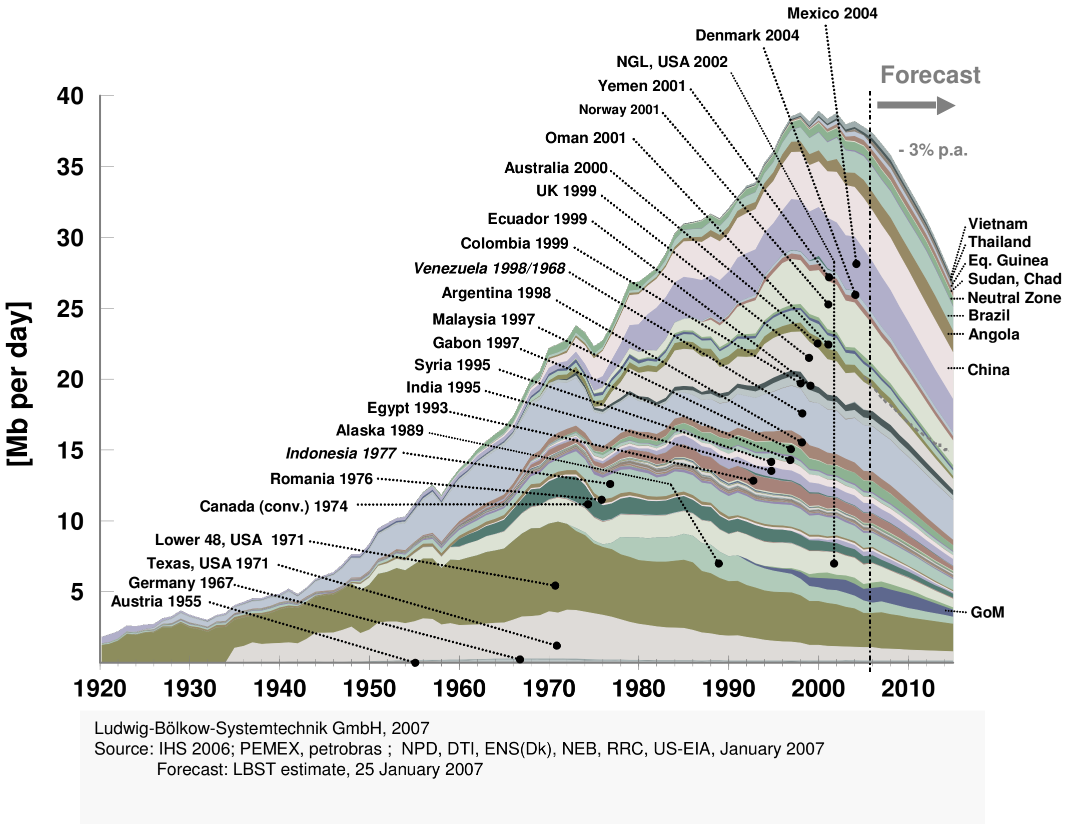
Figure 21: Oil production in the United Kingdom



Source: DTI, May 2007; Forecast: LBST

Oil production in regions having passed their peak can be forecasted with some certainty for the next years. If it is assumed that the remaining regions with growth potential (especially Angola, Brazil and the Gulf of Mexico) will expand their production by the year 2010 (in accordance with the forecasts of the companies operating in these regions), total oil production of this group of countries, however, will continue to decline by about 3% per year, see Figure 22.

Figure 22: Oil producing countries past peak



The influence of technology

With increasing production the pressure of an oil field diminishes and the water levels rise, and after some time the production rate begins to decline. This trend can be controlled to a certain extent so that the decline in production rate is delayed or reduced: by injecting gas or water into the reservoir in order to increase the pressure, by heating the oil or by injecting chemicals in order to reduce the viscosity of the oil.

These methods are known as „enhanced oil recovery" (EOR) and are widely applied in ageing fields. These measures are often cited as a reason for being optimistic regarding future oil production rates. However, for various reasons one should not overestimate the influence of these measures:

- EOR measures have already been applied for more than 30 years, and these measures are accounted for in production forecasts. There will not be any sudden changes in the future.
- EOR measures are mainly applied after peak production when the pressure level is low. These measures cannot reverse a decline into an upward production profile for any substantial period of time.

A prominent example is the production at the field Prudhoe Bay in Alaska, the largest field in the US. This field has been produced with the best technology available in the industry and every possible new measure was applied to avoid the decline (which was not possible) and to enhance production after peak (which was successful). Today, more water is extracted from the wells than oil, water that was injected into the field to increase the pressure.

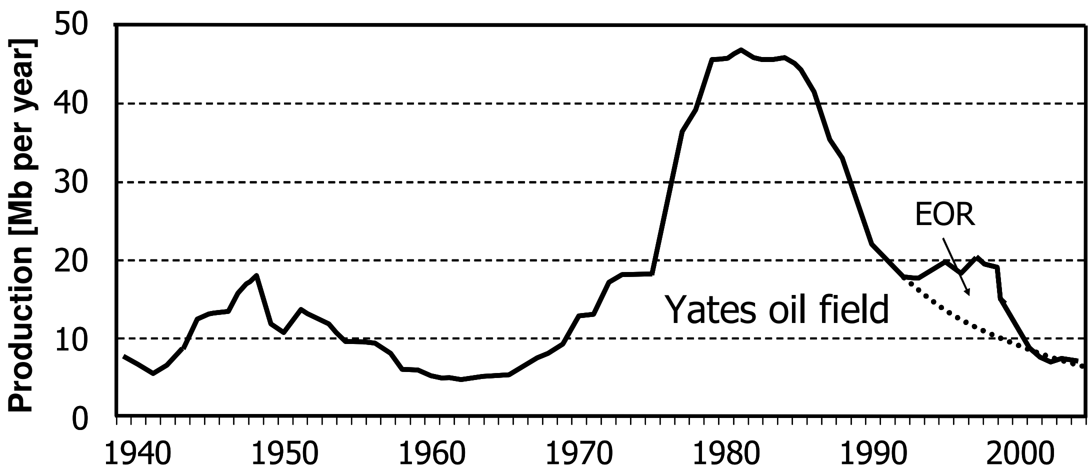
The already discussed production profile of UK fields also proves that total production is in steep decline, despite the fact that in some old fields the production rate could be increased to a small extent due to EOR measures and that permanently new (small) fields are added to the production base.

EOR measures are most effective in certain fields with complex geology which exhibit a low recovery factor.

Usually these measures increase the production rate for a short period of time, but increase the decline after a certain point in time – the oil is extracted faster, but the overall oil recovery is not increased.

To illustrate this further, the influence of EOR measures at one of the largest US fields is shown in Figure 23. The Yates field, which was discovered in 1926 in Texas, has produced since 1929. Since peak production in 1970 the production rate has declined by more than 75%. In 1993 hot steam and chemicals were injected to enhance the production rate. This measure was successful for about four years. Afterwards the decline was even steeper, exceeding 25% per year instead of 8.4% as before. Today, the production rate is even below the level it would be at without these measures. To assess the overall influence of this measure, out of the 1.4 billion barrels of oil that have been produced since 1929, only 40 million are due to enhanced oil recovery – an increase of about 3%.

Figure 23: Oil production at Yates field



Source: LBST analysis with data by Texas Railroad Commission

The use of technology, as discussed, will not change the overall picture. The decline of the oil production in the USA since 1970 could not be avoided. And, just to give a recent example, also not the production decline in the North Sea since 2000.

The use of "aggressive" production methods aimed at producing fields at a maximum rate possibly poses a problem regarding the future global oil supply. Once the inevitable decline sets in, decline rates probably will be much higher than without the prior use of these methods. The decline rates in offshore regions past peak set an ominous example.

Performance of International Oil Companies

Looking at the operation of major international oil companies over the period of the last 10 years, two developments are striking:

- the wave of mergers, and
- the inability of these companies to substantially raise their aggregate production.

This is shown in detail in Annex 4.

Peak oil is now

Indications of an imminent peak are discussed in this chapter. But let it be said that the question of the exact timing of peak oil is less important than many people think. There is sufficient certainty that world oil production is not going to rise significantly anymore and that world oil production soon will definitely start to decline.

Production in countries outside OPEC and Former Soviet Union (FSU)

On a global level, the development of different oil regions took place at different times and at varying speeds. Therefore, today we are able to identify production regions being in different maturity stages and with this empirical evidence we can validate with many examples the simple considerations which were described in the previous paragraph.

Looking at the countries outside of the Former Soviet Union and OPEC, it can be noticed that their total production incrased until about the year 2000, but since then total production has been declining. A detailed analysis of the individual countries within this group shows that most of them have already reached their production peaks and that only a very limited number of countries will still be able to expand production, particularly Brazil and Angola.

Responsible for the stagnation of the oil production in this group of countries was the peaking of the oil production in the North Sea which occurred in 2000 (1999 in Great Britain, 2001 in Norway). Global onshore oil production had reached a plateau much earlier and has been declining since the mid 1990ies. This decline could be balanced by the fast development of offshore fields which now account for almost 50% of the production of all countries in this group. The North Sea alone has a share of almost 40% of the total offshore production within this group. The peaking of the North Sea was decisive because the production decline could not be compensated anymore by a timely connection of new fields in the remaining regions – it was only possible to maintain the plateau for a few years.

There is a growing supply gap developing in coming years in the countries outside OPEC and the FSU. This gap will have to be compensated by a rising supply coming from OPEC and/or the FSU. The chances of this happening are marginal. This will be discussed in the following analysis and in the chapter describing supply scenarios for world regions.

Also, a steady degradation of the quality of the oil produced can be observed in almost all regions having passed peak and poses an additional challenge for the existing downstream infrastructures: refineries have to operate with oil of decreasing quality. The share of lesser oil qualities is steadily increasing – this will additionally drive upwards the prices for the remaining good oil grades.

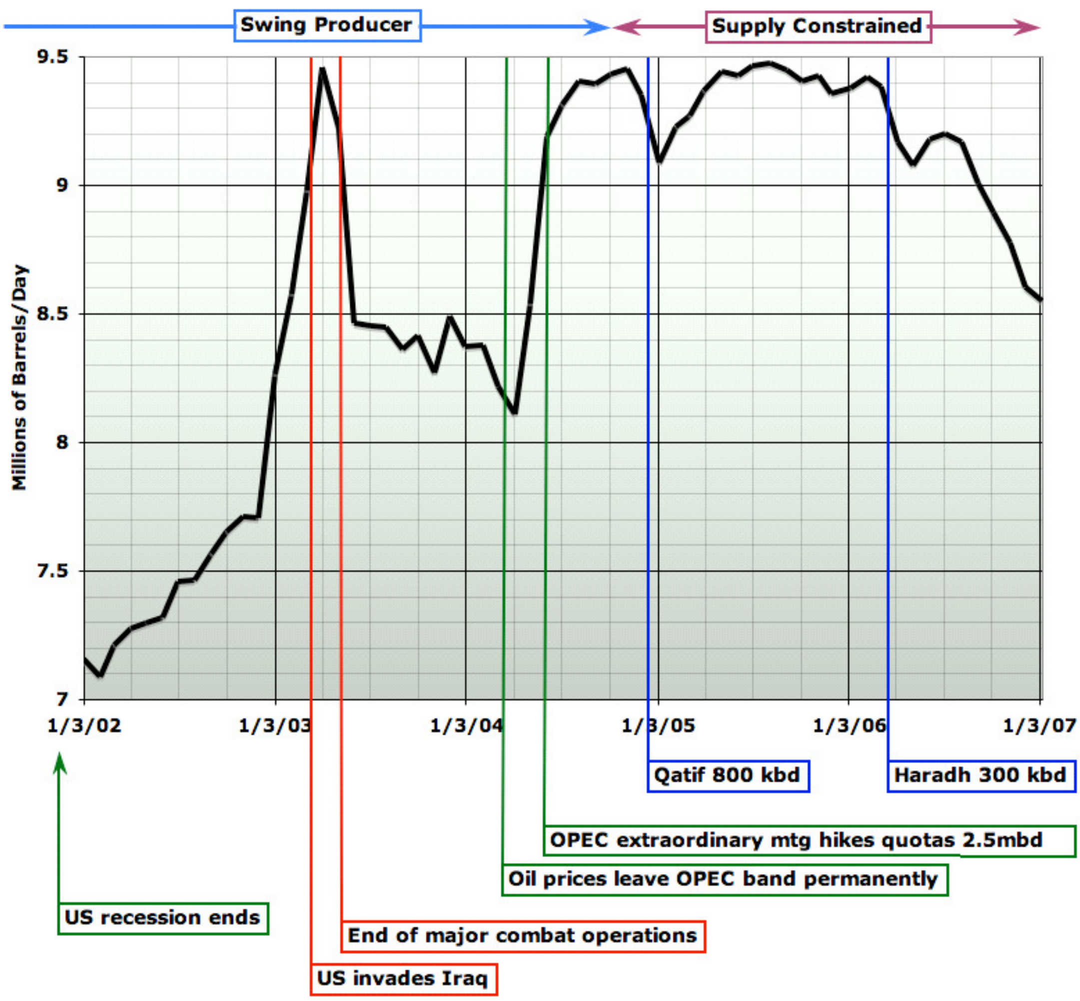
Saudi Arabia in decline?

One of the big questions still waiting for an answer is the state of the oil production in the Kingdom of Saudi Arabia (KSA). Most likely, this issue will decide the timing of world peak oil. Production in the KSA has declined since December 2005 by about 1 Mb/d as can be seen from the graph in Figure 24 taken from a post by Stuart Staniford at www.theoildrum.com on May 19, 2007 [Staniford 2007]. Data sources are [EIA 2007], [IEA 2007], [JODI 2007] and [OEPC 2007]. One possible interpretation is that Ghawar, the world's largest field, is now in terminal decline. In this case Saudi Arabia, and as a consequence also OPEC as a whole, would have lost its capacity of being a swing producer. Because of the secrecy surrounding the oil production in the KSA, only the future will show whether the current decline in production is voluntary or not.

Saudi Arabia has said it would be able to raise production in coming years to 12 Mb/d, and, if necessary, even to 15 Mb/d. This seems very ambitious but is well below the projections of the US EIA and the IEA which both assume a production of about 20 Mb/d in 2030. Our assessment is that the KSA will not be able to increase its production significantly for any meaningful period of time.

Recently, there has been a significant statement by King Abdullah of Saudi Arabia which perhaps can remove the remaining uncertainties: "The oil boom is over and will not return," Abdullah told his subjects. "All of us must get used to a different lifestyle." [Christian Science Monitor, Aug 15, 2007]

Figure 24: Saudi Arabian oil production, Jan 2002-Jan 2007, average of four different sources. Annotations show important events causally influencing production, including all documented mega projects for new supply in the time period. Graph is not zero-scaled to better show changes [Staniford 2007]



World's biggest fields in decline

Crucial for the further development was the production peak of Cantarell in Mexico, the world's biggest offshore field and one of the four top producing fields in the world. This field, discovered in 1978, even today contributes one half to the Mexican oil production. It has reached a plateau for some years and started to decline in 2005. The field then declined dramatically from 2 Mb/d in January 2006 to 1.5 Mb/d in December 2006, and double digit year over year decline rates are expected in the coming years.

With Cantarell, now 3 of the 4 biggest producing fields are in decline: the others being Daquin in China and Burgan in Kuwait. The status of Ghawar in Saudi Arabia is not known for sure – but the field is very likely also in decline now.

Once production in the largest fields is declining, it gets more and more difficult to keep up overall production (as has been pointed out before).

Peak oil based on an analysis of giant oilfields

A very comprehensive analysis of the future oil production potential based on the analysis of the world's giant oilfields has been carried out by Robelius [Robelius 2007]. According to his analysis, peak oil will happen somewhere between 2008 and 2018, depending on several circumstances. With regard to recent experiences in the industry which has seen delays in many major projects, the earlier dates are more likely than the later ones.

High oil prices

The growth of production has come to a standstill and production now is more or less on a plateau.

This has happened despite historically high oil prices. Prices started their rise in 2000, this was when the North Sea reached peak production. Also about that time, all producing regions outside OPEC and outside the countries of the Former Soviet Union reached their aggregate peak. It is not very likely that this was a random coincidence.

In the public debate, however, the price rises were attributed to all sorts of causes: speculation, political tensions in oil producing regions, greed of oil companies, strikes, hurricanes, rising demand in China and India, etc. Yet, global supply reaching a limit is still not considered as being a possible cause.

It is noteworthy how the perception of the level of oil prices has changed in recent years. Five years ago, an oil price above $60 per barrel was unthinkable. Today, oil prices below $60 are regarded as being "cheap".

The pricing behaviour of OPEC has also changed in the period since 2000. At first, OPEC pledged to defend a price corridor of $22-28 per barrel in order to defend the stability of the world economy. After this had failed and prices moved above $40, OPEC talked less and less about a target price and eventually quietly dropped the price band. OPEC had learnt that the world economy will not break down with higher oil prices. And the world is learning that OPEC is not any more in a position to control the maximum price of oil by increasing its output (by the way, probably nobody is anymore able to do this). Recently, OPEC spokesmen have described an oil price of $60 per barrel as being "fair".

Was peak oil already in 2005?

In the history of oil production, which is now extending over more than 150 years, we can identify some fundamental trends:

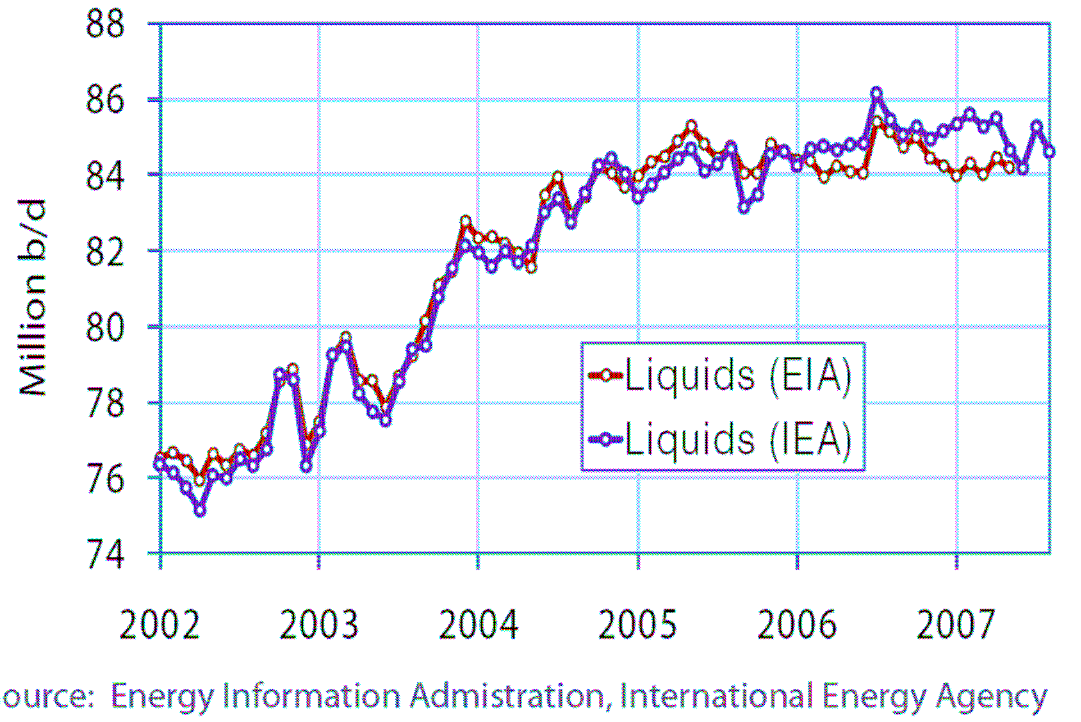
- The world's largest oil fields were all discovered more than 50 years ago.

- Since the 1960s, annual oil discoveries tend to decrease.
- Since 1980, annual consumption has exceeded annual new discoveries.
- Till this day more than 47,500 oil fields have been found, but the 400 largest oil fields (1 percent) contain more than 75 percent of all oil ever discovered.

The historical maximum of oil discoveries after some time has to be followed by a maximum of oil production (the "peak").

Oil production (for crude and condensate) already shows a peak in May 2005 as can be seen in Figure 25 [The Oil Drum 2007]. Probably, the world oil production has peaked already, but we cannot be sure yet. However, with every month passing without showing higher production levels, the probability increases that the peak already can be seen in the "rear mirror" (as Matthew Simmons likes to express it). The regional EWG scenarios presented later in this paper endorse this view.

Figure 25: Production of crude oil and condensates



The position of the IEA and industry

International Energy Agency

In its World Energy Outlook 2004, the International Energy Agency (IEA) projected world oil production until 2030. This projection (shown in the following figure) assumes a growth in production to 120 Mb/d.

Figure 26: WEO 2004 production profile between 1971 – 2030 (figure 3.20 in the original report) [WEO 2004]

The light blue area shows the expected decline of existing production capacities assumed at amounting to approx. 6% per year.

The dark blue area is based on the projected development of existing reserves which are assumed to contain between 1,050 – 1,150 Gb of oil, depending on the data source. However, these reserves include about 350 Gb of so called "political reserves" in OPEC countries which are at least questionable. If these political reserves are subtracted, future production volumes must be much smaller than anticipated as the projected cumulative production between 2002 and 2030 amounts to 650 Gb, leaving zero remaining reserves by 2030. Therefore, the shown production profile from known reserves seems not to be realistic.

The green area shows the expected production growth due to enhanced oil recovery measures. However, enhanced oil recovery measures are in operation for more than 25 years and are not an innovation to enhance future production. Experience shows that these measures are most successful in geologically complex fields with low extraction rates. These fields are not the average and, at world level, the influence of enhanced oil recovery is much smaller than sketched here.

The yellow area shows the production from non-conventional oil fields, predominantly from Canadian tar sands. The production from these fields cannot be increased fast and therefore cannot substitute for the more rapidly declining production at other places. This assessment is consensus.

Finally, the red area indicates production from new discoveries yet to be made. The basis for this projection is the mean value of possible discoveries as outlined in the USGS study 'World Petroleum Assessment 2000' [USGS 2000]. As is shown in Annex 2: Critique of Oil Supply Projections by USGS, EIA and IEA, the authors of this study regard this projection as being completely unrealistic.

At a first glance, this graph seems to describe a positive vision of the future, yet careful reading of the report leads to a contrary impression. The following statements are extracted from the report to illustrate this point. They should be kept in mind when analysing the graph:

- „By 2030, most oil production worldwide will come from capacity that is yet to be built.“ (WEO 2004, p.103)
- „The rate at which remaining ultimate resources can be converted to reserves, and the cost of doing so, is, however, very uncertain.“ (WEO 2004, p. 95)
- „The reliability and accuracy of reserve estimates is of growing concern for all who are involved in the oil industry.“ (WEO 2004, p. 104)
- „In the low resource case, conventional production peaks around 2015.“ (WEO 2004, p. 102)

Though the 2006 report does not address these problems again, the changes of production profiles from report to report indicate that the projections have been continuously revised downward.

Concerning oil, the present report puts the focus more on the aspect that higher prices might result in more discoveries helping to satisfy the forecasted rising demand.

In summary, the projections by the IEA are not a very reliable basis for planning the future. The caveats in the report suggest that the future might be completely different, and even peak oil might be round the corner. This view is backed by recent interviews and statements by Fatih Birol (chief economist) and Claude Mandil (executive director) of the IEA in which they gave blunt warnings of an impending “energy crunch” in a few years time (e.g. in: Le Monde, 27.06.2007).

Oil industry

In general, the communications by the big energy agencies (most prominently IEA and US EIA) and by the oil industry all assume unabated growth of oil production in the foreseeable future. (But the recent shifting of the IEA position should be noted.)

Major turning points in the past, like the peaking of Prudhoe Bay, the peaking of the North Sea and most recently Cantarell, were not foreseen, and were in some cases even denied for years after the event. This casts some doubt on the quality of the forecasts of these institutions and the industry.

Within the oil industry there is one notable exception, namely the communication by Chevron at www.WillYouJoinUs.com. Chevron states that “the era of easy oil is over” and points out that 33 of the 48 largest oil producing countries have already passed peak [Chevron 2007].

Meanwhile, the debate on peak oil is getting hotter. Institutions close to the energy industry like CERA (Cambridge Energy Research Associates) are engaging in a campaign trying to “debunk” the “peak oil theory” [CERA 2006]. This has to be seen as a sign of considerable nervousness in view of historically high oil prices and a stagnating world oil production in the last two years. The concept of peak oil and the reasoning behind it is in important respects misrepresented by CERA and the arguments put forward do not stand up to a critical scrutiny (see Skrebovsky for a prominent example of a rebuttal [Skrebowski 2006]). Also the authors at CERA are not prepared to lay open their sources and to enter into a direct and public discussion.

SCENARIO OF FUTURE OIL SUPPLY

Regional scenarios

This subchapter discusses the domestic oil production in the ten world regions as defined by the IEA and selected key countries in some detail.

The IEA in its World Energy Outlook classifies the world into the following ten regions:

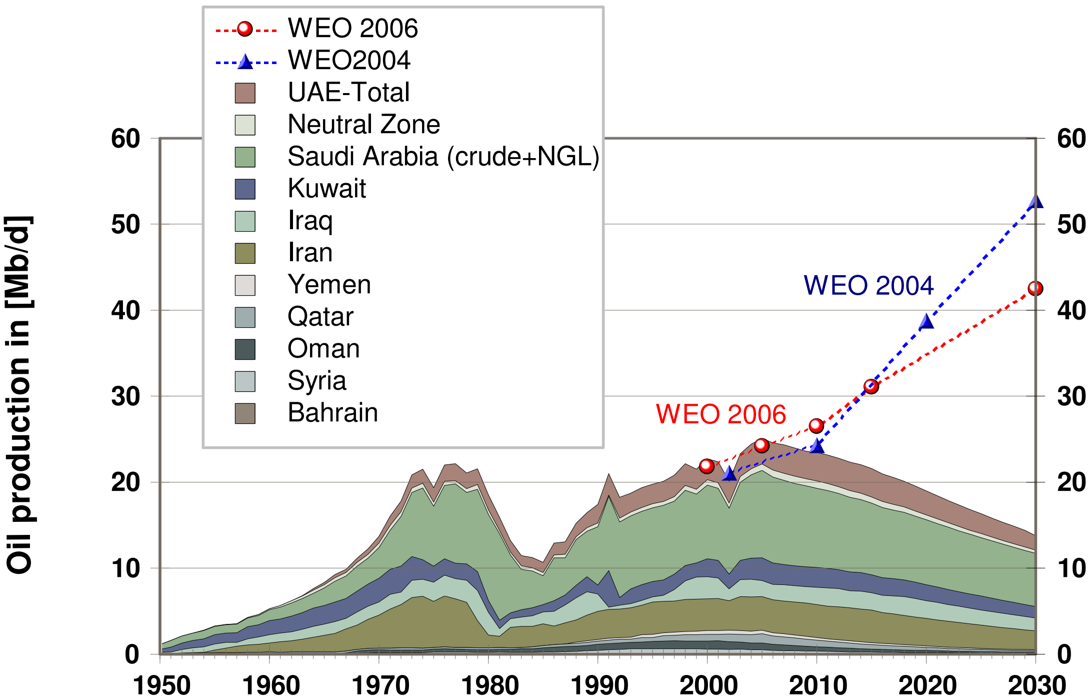
- **OECD North America**, including Canada, Mexico and the USA.
- **OECD Europe**, including Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, The Netherlands, Norway, Poland, Slovak Republic, Spain, Sweden, Switzerland, Turkey and the UK.
- OECD Pacific, including
  – OECD Oceania with Australia and New Zealand,
  – OECD Asia with Japan and Korea.
- **Transition Economies,** including Albania, Armenia, Azerbaijan, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Estonia, Yugoslavia, Macedonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Romania, Russia, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, Cyprus and Malta.
- **China,** including China and Hong Kong.
- **East Asia,** including Afghanistan, Bhutan, Brunei, Chinese Taipei, Fiji, Polynesia, Indonesia, Kiribati, The Democratic Republic of Korea, Malaysia, Maldives, Myanmar, New Caledonia, Papua New Guinea, Philippines, Samoa, Singapore, Solomon Island, Thailand, Vietnam and Vanuatu.
- **South Asia,** including Bangladesh, India, Nepal, Pakistan and Sri Lanka.
- **Latin America,** including Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominic. Republic, Ecuador, El Salvador, French Guyana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, St. Kitts-Nevis-Antigua, Saint Lucia, St. Vincent Grenadines and Suriname, Trinidad and Tobago, Uruguay and Venezuela.
- **Middle East,** including Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, the United Arab Emirates, Yemen, and the neutral zone between Saudi Arabia and Iraq.

- **Africa,** including Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, the Central African Republic, Chad, Congo, the Democratic Republic of Congo, Côte d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, the United Republic of Tanzania, Togo, Tunisia, Uganda, Zambia and Zimbabwe.

Middle East

Although the Middle East region is the world's largest oil producer, oil production is expected to decline in this region in the near future. Figure 27 shows the oil production profile between 1950 and 2006 and the extrapolation up to 2030. The figure also shows the forecasts by the International Energy Agency (IEA) in its World Energy Outlook (WEO) [WEO 2004], [WEO 2006].

Figure 27: Oil production in the Middle East



The problem of assessing the realistic reserves of the Middle Eastern (ME) oil producing countries is reflected in Table 4. While the Oil&Gas Journal and BP mainly rely on published 'official' figures (which are often inflated), the estimates by Campbell and Bakhtiari are based on detailed evidence (see: *ASPO Newsletter*, 63, March 2006). Bakhtiari, who until his recent retirement worked for the National Iranian Oil Company, is one of the most reliable experts on Middle East oil reserves.

Table 4: Remaining proven oil reserves for 'ME Five', according to various estimates

Country	Oil & Gas Journal [a]	BP Statistical Review [b]	Campbell [c]	Bakhtiari [d]	IHS	EWG
Iran	132.5	132.5	69	35-45	134.0	44
Iraq	115.0	115.0	61	80 - 100	99.0	41
Kuwait	101.5	99.0	54	45 - 55	51.6	35
Saudi Arabia	264.3	262.7	159	120 - 140	286.0	181
U.A.E	97.7	97.8	44	40 - 50	56.6	39
TOTAL	**711.0**	**707.0**	**387**	**320 - 390**	**627.2**	**340**

Sources: [a] *O&GJ*, 19 December 2005 (for 1 January 2006); [b] BP, June 2005 (until end of 2004); [c] *ASPO Newsletter*, 62, February 2006; [d] Bakhtiari, February 2006.

In the Middle East region, Saudi Arabia (apart from Iraq) is the only country that is widely supposed to be able to increase its oil production significantly. In assessing the future production potential of Saudi Arabia, Ghawar, the world's largest oil field, plays a key role. This field was discovered in 1948 and has now been producing oil for more than 50 years. It is a fact that more water is pumped into the field than oil is extracted, and it seems quite possible that the production rate will decline in the near future. Anyway, it is certain that Ghawar cannot contribute to an expansion of the Saudi Arabian production.

There is an ongoing debate whether Saudi Arabia will at all be able to increase its production significantly. This debate was initiated in early 2004 by Matthew R. Simmons, an American investment banker from Houston [Simmons 2004]. Simmons very much doubts the possibility of a significant growth of production. His assessment is based on a comprehensive in-depth analysis of technical papers in the public domain addressing the problems of oil production in Saudi Arabia, and on a great number of interviews with engineers working on site and also a visit to the oil fields in Saudi Arabia [Simmons 2005].

Simmons has provoked comments by Abdul-Baqi and Nansen Saleri, senior executives of the state-owned company Saudi Aramco. But their comments have rather fuelled existing fears instead of assuring the world. First, it was admitted that the big old oil fields are in decline, and that by now the Abqaiq field is depleted by 73%, and Ghawar by 48%. Moreover, it was indirectly confirmed that the proven reserves do not amount to 262 Gb, as is widely assumed. The proven reserves amount to only 130 Gb while another 130 Gb have been counted as reserves already because it is regarded probable that they can be developed eventually. If one would apply the same criteria which are common practice with western companies, then Saudi Aramco's statement of proven reserves should be devalued by 50%. This was confirmed indirectly by another Saudi Aramco executive. (In the light of this debate the EWG estimate of reserves amounting to about 180 Gb seems to be rather conservative.)

Furthermore, Saudi Aramco executives tried to counter the fears of Simmons by stating that a production of 10 Mb/day could be upheld until 2042. In doing this they had to assume that the above mentioned reserves of 260 Gb are proved reserves (which they definitely are not).

Saudi Aramco went on to state that in case of a more aggressive development of the remaining reserves, production could be increased to 12 Mb/day by 2016 and then could be maintained constant until 2033. But even this scenario put forward by the Saudis is hardly reassuring in view of the projections by the International Energy Agency (IEA) which assume that in the longer term an additional 20 Mb/day are supposed to come from those regions.

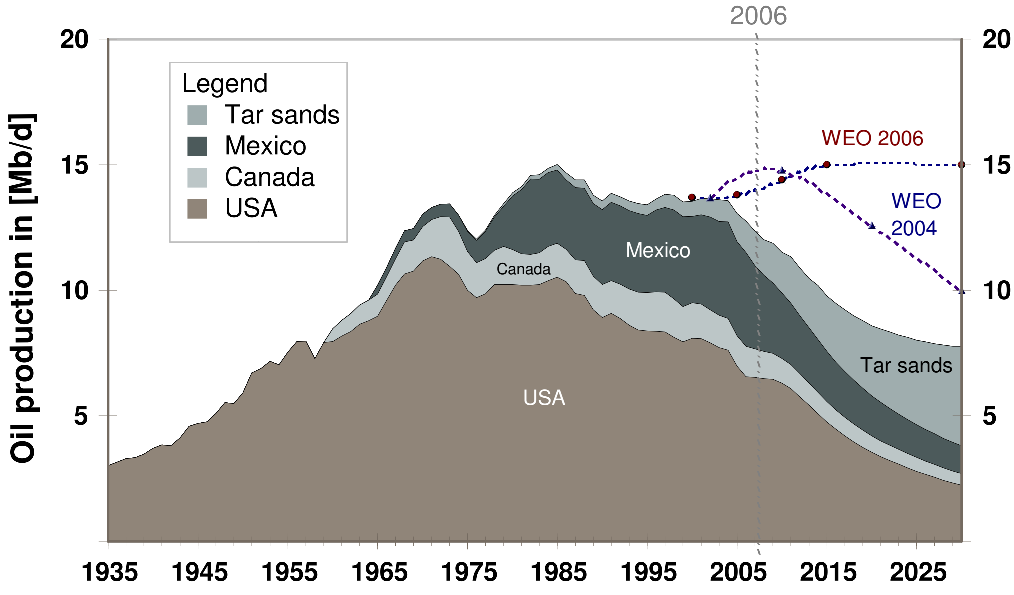
The EWG scenario of the future production is only partly based on the estimate of remaining reserves which are very uncertain as has been pointed out. Equally important are additional facts, like information regarding the production share of giant fields, the production share onshore / offshore, the rising sulfur content in the oil produced, and also political and economic long term goals, and as a result, production targets by individual nations.

The scenario presented here assumes that (1) an increase of production is not in the long term interest of the Middle Eastern countries, (2) the giant fields in the region have peaked or are about to peak and (3) production therefore will decline in the coming years. Saudi oil production is projected to decline by 2 percent per year.

OECD North America

Oil production in OECD North America peaked in 1984 (the peak in the USA was in 1970, but production in Canada and Mexico was still rising in the following years thus compensating the US decline). It is believed that total conventional oil production will decline until 2030 by about 80%. When the rising contribution from non-conventional Canadian tar sands is included, this decline will be lowered to 50%. Figure 28 summarises the different regional contributions to the total oil production in OECD North America. Also included in the figure are production profiles used by the International Energy Agency in WEO 2004 and WEO 2006.

Figure 28: Oil production in OECD North America



USA

Forty years ago, the USA were the world's largest oil producer, contributing almost 50% to world oil production. However, since 1970 the conventional production is in decline. The development of Alaska with the by far largest oil field in the USA (Prudhoe Bay) could stop this decline for a few years, until this region also passed peak production. Offshore oil from the continental shelf is produced since 1949, but turned into decline around 1995.

Since about 1980, deep water areas in the Gulf of Mexico are explored. This led to the discovery of various large fields. However, these fields were only developed in the late 1990s and early 2000. These fields are developed so fast that peak production often occurs within the first year of production. In 2001, an early peak of production in the Gulf of Mexico was reached. The present production volume is a factor of two below the forecasts made in 2002. The region with its exposure to hurricanes is difficult to produce and costs are high, therefore, current production is trailing far behind the original plans. It is not even clear whether present total production can still be increased. Probably around 2010 at the latest, the production in the Gulf of Mexico will turn into decline. For more details on Alaska and the Gulf of Mexico see Annex 1.

There is a final frontier left in the USA, the Arctic National Wildlife Refuge (ANWR). The discussion whether this environmentally sensitive area should be opened to oil exploration is repeated almost every year in the US senate. But even in case the ANWR should be developed, according to data by the USGS this might add another 5-6 Gb of oil reserves. These might be developed with first oil flows about 5 years after the start of the development and production then will peak about 10 years later. In the scenario presented here, such a production profile for the ANWR is also included. At best, this production might compensate for the additional decline of the Gulf of Mexico deepwater production, but it never can compensate for the decline in the mature fields in the USA. Natural gas liquids contribute with about 2 Mb/d to the US oil production. Also included in the figure is the production profile according to WEO 2006 for crude oil (excluding NGLs).

Figure 29: Oil production in the USA

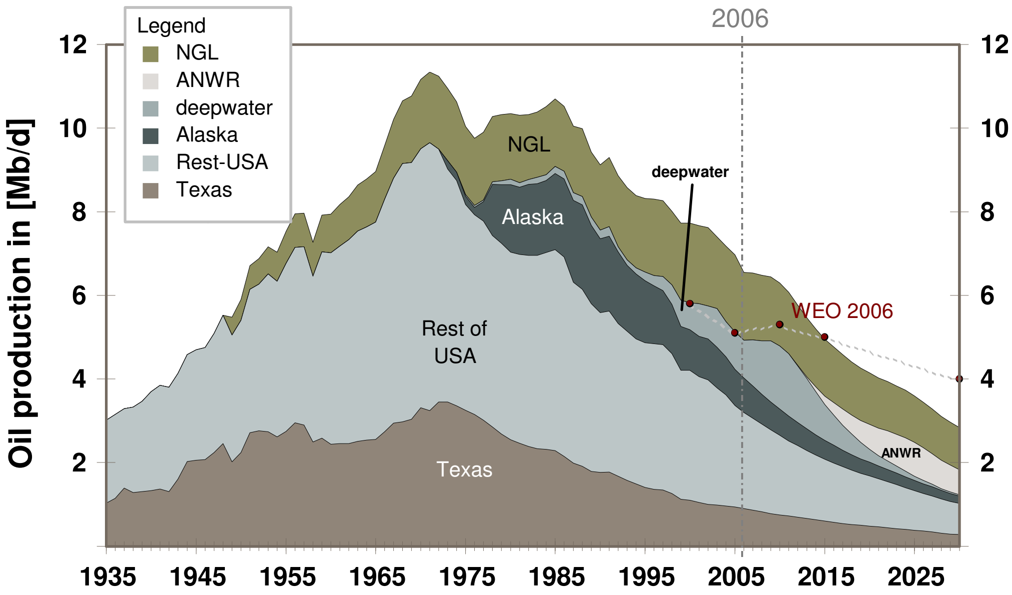
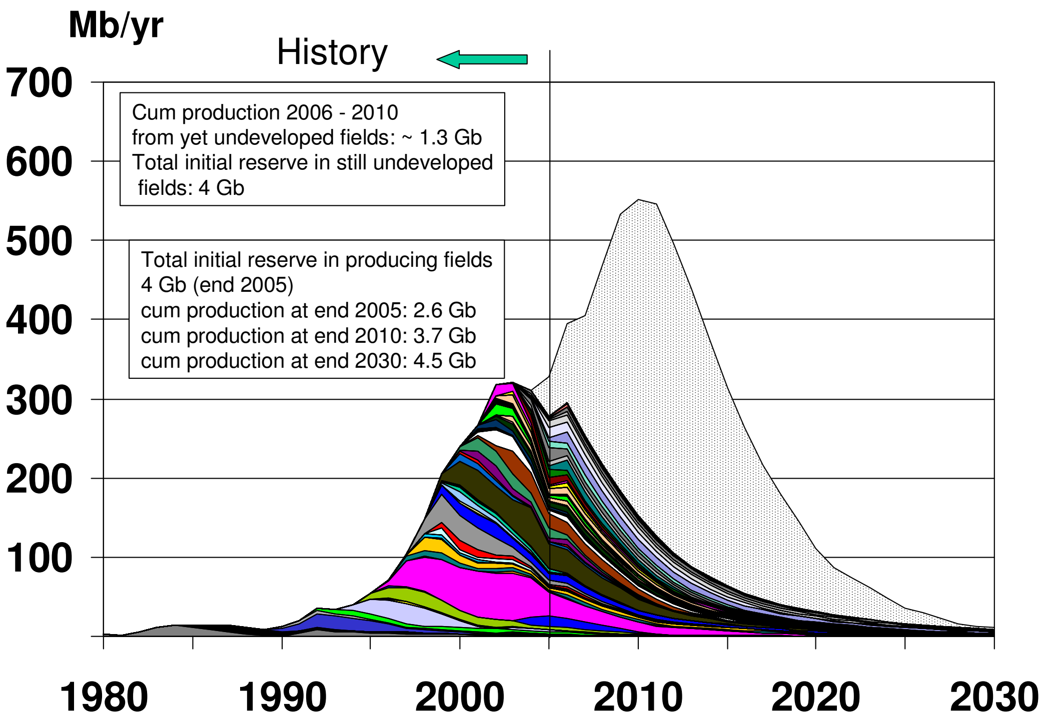


Figure 30 provides some details of the Gulf of Mexico deepwater development. All producing fields are shown individually. The steep production decline which sometimes starts already in the first year puts a huge pressure on future developments. Any delay of new field developments will result in an overall production decline and the originally estimated peak production will be lower. The steep production decline in 2005 is due to severe damages by the hurricanes Rita and Katrina. The sketched future production profile with peak production around 2011 might be optimistic in view of these problems. For a more detailed analysis of the oil production in the Gulf of Mexico see Annex 1.

Figure 30. Field by field analysis of the oil production in the Gulf of Mexico



Source: History: MMS 2006; Forecast LBST 2006

Canada

In Canada conventional oil production (including heavy oil) peaked in 1973. Offshore oil production started at the end of the 1990s with rising contributions, sufficient to compensate the decline of onshore oil until about 2003. However, the known discoveries are too small to continue this trend. Now the beginning decline of the offshore production adds to the decline of the onshore production. Figure 31 shows some details of the oil production in Canada.

Figure 31: Oil production in Canada

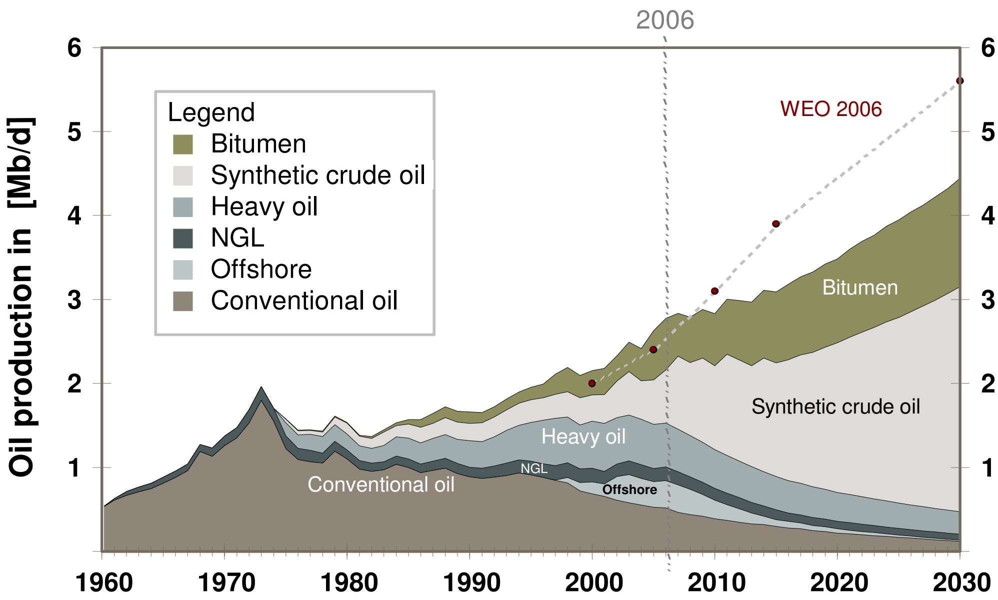


Figure 31 shows the contributions from the different regions and sources, especially from non-conventional tar sands. Production of natural gas liquids (NGL) roughly parallels the natural gas production. However, its contribution is too small to have a significant influence. Also, heavy oil production from Alberta and Saskatchewan contributes since 1973 with rising shares.

Finally, non-conventional synthetic crude oil and bitumen from tar sands are produced since 1967 with steadily rising contributions. By 2030, almost 90% of all Canadian oil will come from this source. The projections for tar sands is based on studies and forecasts by the Canadian National Energy Board for the time horizon up to 2025, the further extrapolation to 2030 is by the authors of this study.

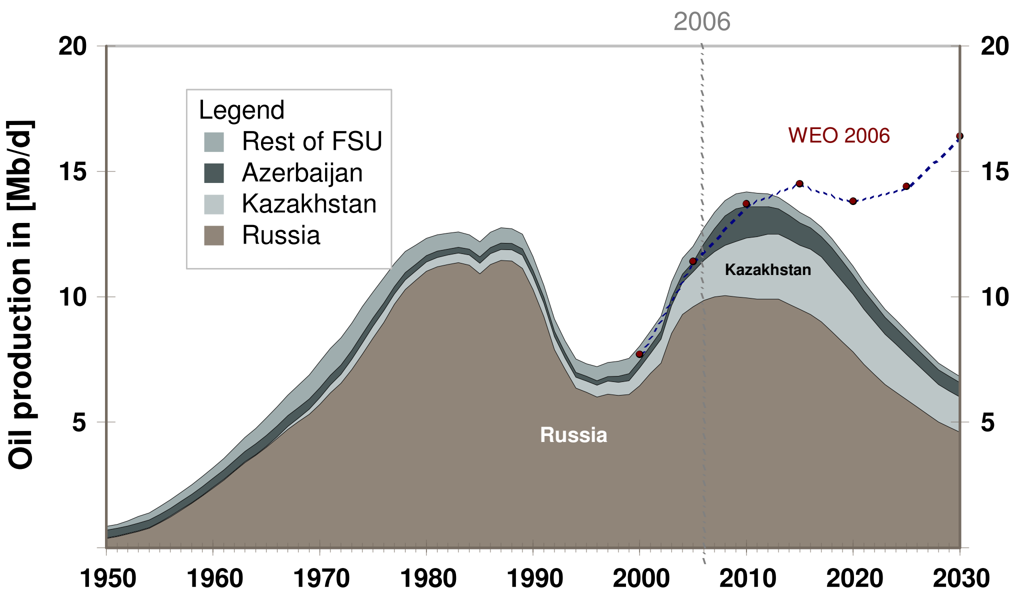
Mexico is the third country belonging to OECD North America according to the IEA classification. By far the largest contribution comes from the offshore field Cantarell which contains about 12 – 15 Gb of oil. Its production started to decline already in 1994. However, with huge investments in nitrogen injection plants and additional production wells the field's production could be increased again for a few years. In 2004 Cantarell contributed more than 50% to the total oil output since other fields are already in decline since some years. The production projection is based on the assumption that Cantarell started to decline in 2006 at a rate of 10% per year and that the contribution from other fields can be held at the present level. In this case, total production will decline by 70% by 2030.

Transition Economies

The Transition countries are among the important oil producing and exporting countries, dominated by the large fields in Russia, and there especially in Siberia. At the end of the 1980s the production declined by 40% within five years. This decline was caused by the decline of the largest producing fields while new fields were not developed in the years of the economic transformation. By around 1995, new economic structures had been established and the known remaining fields were developed with the help of foreign investment. However, remaining opportunities are becoming smaller and therefore the fast revival of the Russian oil production is slowing down, leading to a second production peak probably around 2010.

The production peak at the end of the 1980s had been forecasted by western geologists based on the depletion patterns of the largest oil fields [Masters 1990]. However, the following production collapse during the economic break down turned out to be much steeper than expected. After the liberalisation of the oil market, Russian companies were able to stop this decline and to increase production levels again – at double-digit rates in some years during the last 5 years - with the help of international cooperation and investments.

Figure 32: Oil production in Transition Economies



The two other important oil regions of the Former Soviet Union are Azerbaijan and Kazakhstan. Several discoveries between 1995 and 2000 led to the expectation that the development of large fields (e.g. Tengiz, Kashagan, Azeri, Chirag, Guneshli) can maintain the present production increase up to 2010 to 2015 before the unavoidable decline starts (see Figure 32).

Azerbaijan is the oldest industrial oil region of the world. Today, we can expect an expansion of production only in the offshore areas. Especially the field complex Azeri-Chirag-Guneshli has to be mentioned. Once fully developed, this field probably will reach its maximum in 2008 or 2009 with a production rate of 1 Mb/day. Soon thereafter the production rate will decline very fast to almost negligible amounts within 10-15 years. The total production of this region, however, will increase by a smaller amount as some oil is already produced from Azeri-Chirag-Guneshli today and as the production from other fields will drop noticeably in coming years.

For some years Kazakhstan was considered to be a potential counterbalance to Saudi Arabia. We now know that these expectations were exaggerated. They were nurtured by speculations by the US federal agency EIA which estimated the oil and gas reserves in the Caspian Sea region to amount to up to 300 Gb of oil equivalent. Realistically, only about 45 Gb of oil are likely to be recoverable, about half of this amount is located in already developed fields.

High expectations regarding their future production potential are concentrated on three fields: Tengiz, Kamchagarak and Kashagan. Tengiz and Kamchagarak are already producing oil for some years. All three fields contain oil with a high sulphur content, the development of which jeopardises the environment and is very expensive. In Tengiz alone, more than 4,500 tons of sulphur are separated from the produced oil each day and stored in the surrounding area polluting the environment. Plans for a production extension are delayed due to high costs and difficult geological conditions.

In 2000, Kashagan, the largest of the three big oil fields, was discovered. Production schedules had to be be revised many times. Original targets for production to start in 2006 are now deferred to 2010. Difficult environmental conditions in the Caspian Sea, a high sulphur content of the oil, and extremely high deposit pressures of more than 1000 bar make the field difficult and expensive to develop. It is certainly no coincidence that two of the big companies involved in the discovery of the field (BP and Statoil) have withdrawn from the consortium which develops the field.

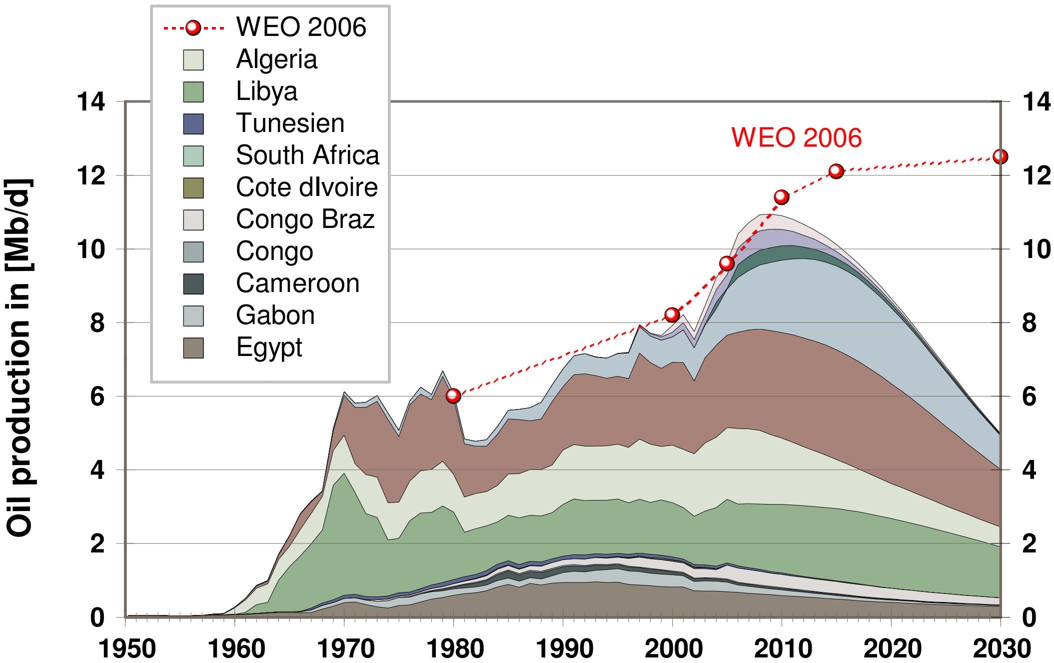
Azerbaijan and Kazakhstan will, in the best case, be able to double their production rate by 2015, from 1.3 Mb/d to about 2.5 Mb/d.

Africa

Oil production can be increased in Angola, Libya and Nigeria. Oil production is expected to decline in Africa after 2010. In almost all African countries the oil production will peak between 2010 and 2015. The main reason is the slow rate of new fields coming on stream. The remaining reserves allow for a production profile as shown in Figure 33. It should be noted that the remaining reserves for Africa assumed here (125 Gb) are higher than the reserves stated by IHS (102 Gb).

Figure 33 shows also the forecasts by the IEA in the WEO 2006. The IEA projection obviously implies reserve estimates which must be higher by far.

Figure 33: Oil production in Africa



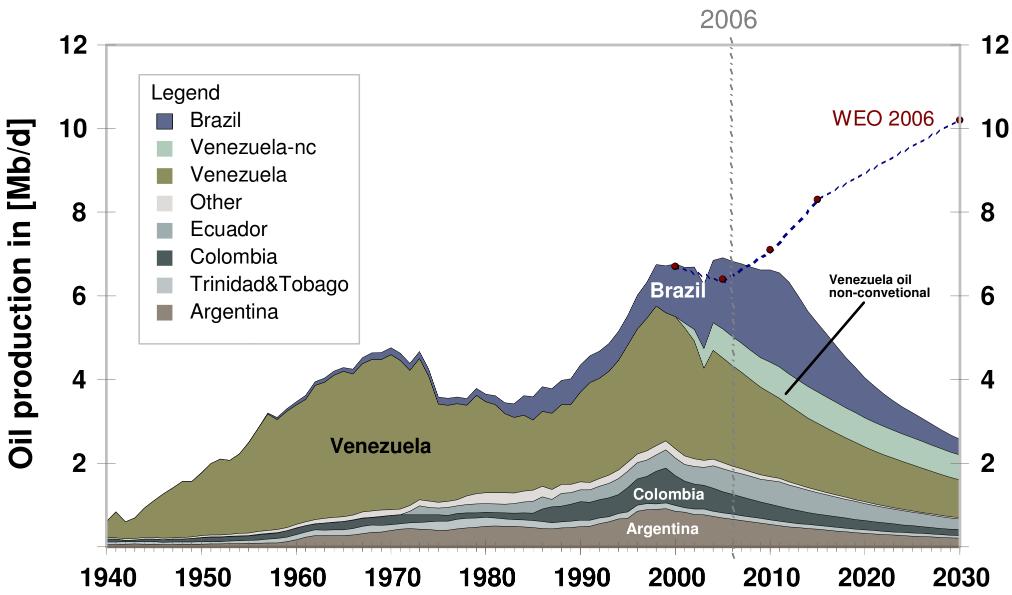
Latin America

As indicated in Figure 34, oil production in Latin America will most likely decline in future. Oil production in Venezuela, being the largest oil producer in Latin America, started to decline after 1970 but picked up again in the mid 1980s. Now a peak has been reached in 2000, since when production is declining. Even with increased non-conventional oil production, Venezuela will not be able to maintain its present production rate.

Since the 1980s, Brazil, the second largest oil supplier in Latin America, has increased its oil production up to 1.5 Mb/d. Peak production of around 2.2 Mb/d is expected to be reached by the end of this decade.

Figure 34 also shows the IEA forecast for the future oil production in Latin America.

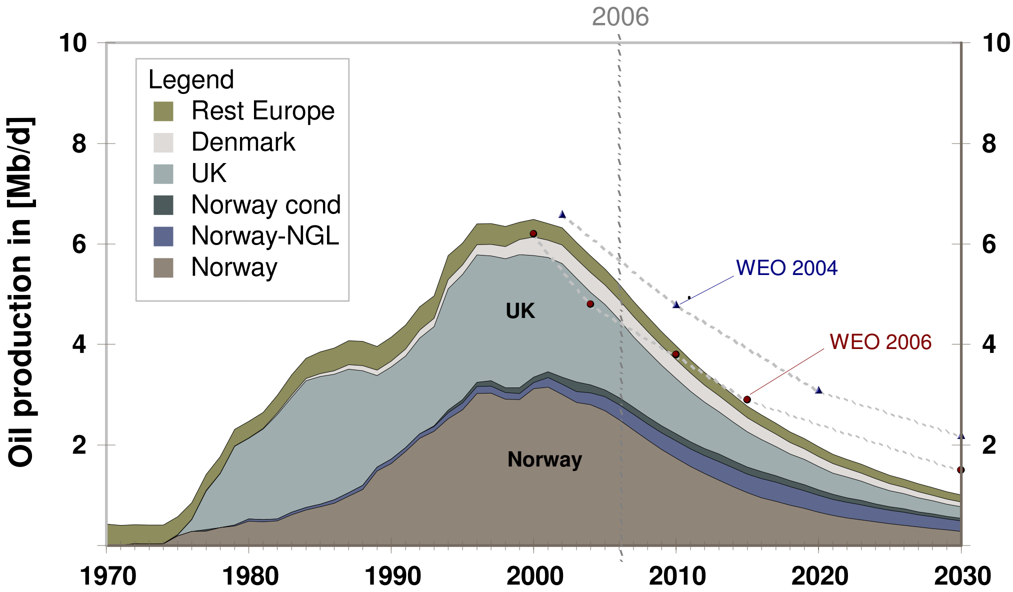
Figure 34: Oil production in Latin America



OECD Europe

Oil production in OECD Europe has peaked around 2000, see Figure 35. This was already confirmed in the IEA reports WEO 2004, and WEO 2006. Probably production in 2015 will be down by about 50% compared to 2005 production. The peak of European oil production in 2000 marked a turning point insofar as the largest oil province found in the last 50 years experienced peak. At peak level, the region contributed about 40% to the world offshore production – the only area where production still is growing. However, this peak reduced the global growth rate and coincided with the peak of the oil production outside former Soviet Union countries and outside OPEC countries.

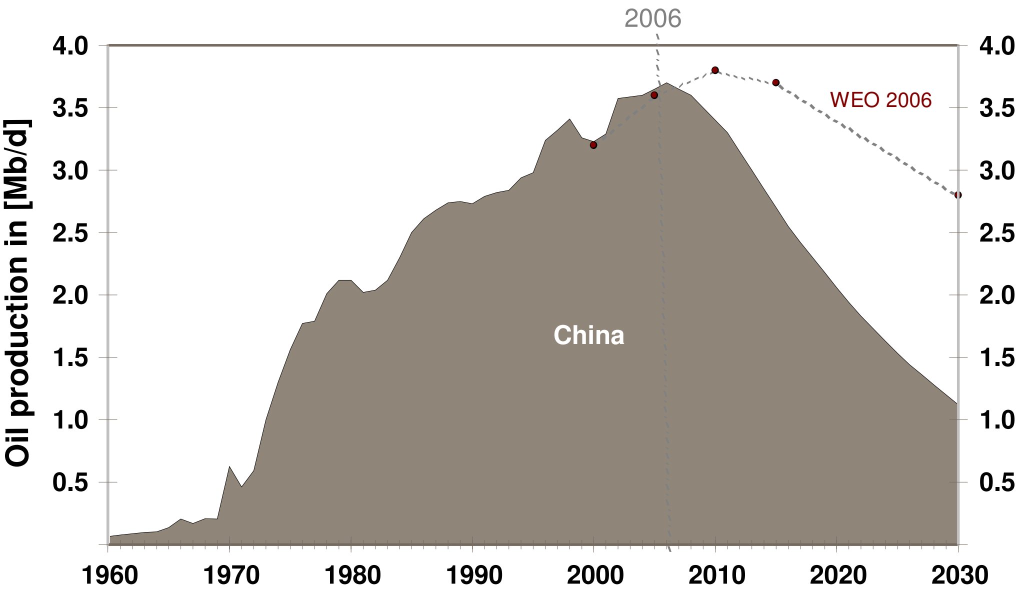
Figure 35: Oil production in OECD Europe



China

Daqing is the largest oil field in China and already in decline. Today, this field produces about 1 Mb/d. To compensate this decline, China has been increasing its efforts to develop offshore oil production. As shown in Figure 36, it is expected that oil production in China will peak before 2010 and then decline by around 5% per year on average until 2030. Also, the IEA in its WEO 2006 expects oil production in China to peak by the beginning of the next decade.

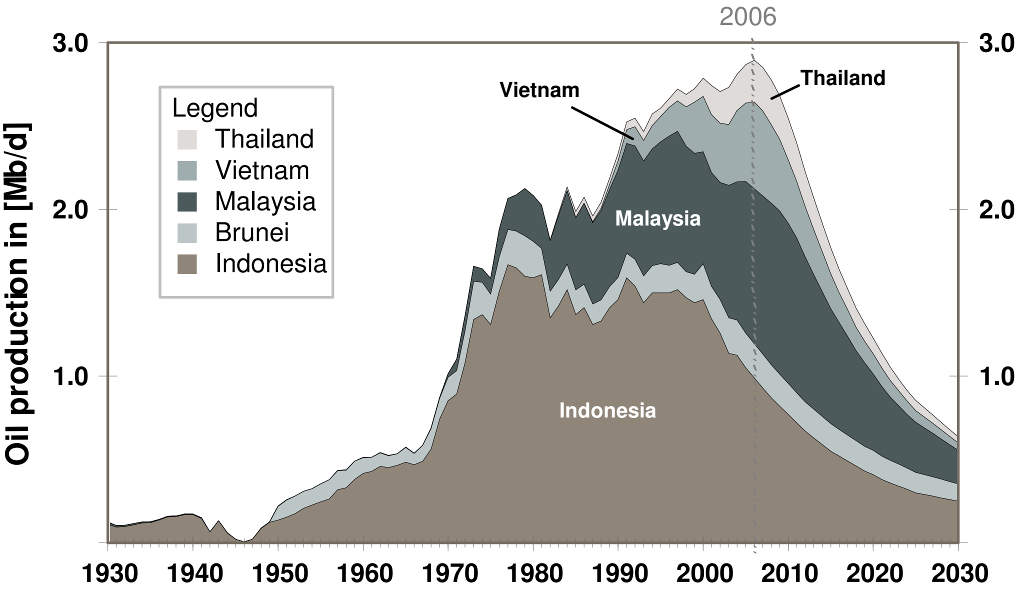
Figure 36: Oil production in China



East Asia

Oil production in East Asia is expected to peak before 2010. In Indonesia, the largest producer in the region, production has been declining since 1990 by around 30%. Production in Malaysia, the second largest producer in the region, is close to peak. It is expected that oil production in Malaysia, Vietnam and Thailand will peak before 2010. Figure 37 shows that a sharp fall of oil production in East Asia is projected until 2030.

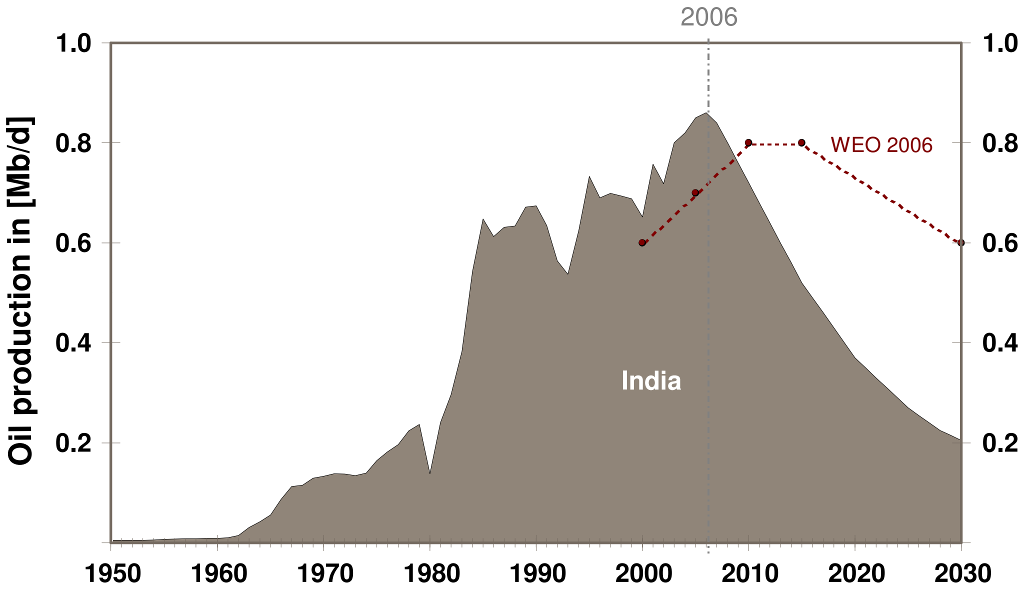
Figure 37: Oil production in East Asia



South Asia

India is the only oil producing country in South Asia. The scenario assumes that South Asia reached peak oil production in 2006 which will be followed by a steep decline. As indicated in Figure 38, IEA assumes oil production to peak some time before 2020.

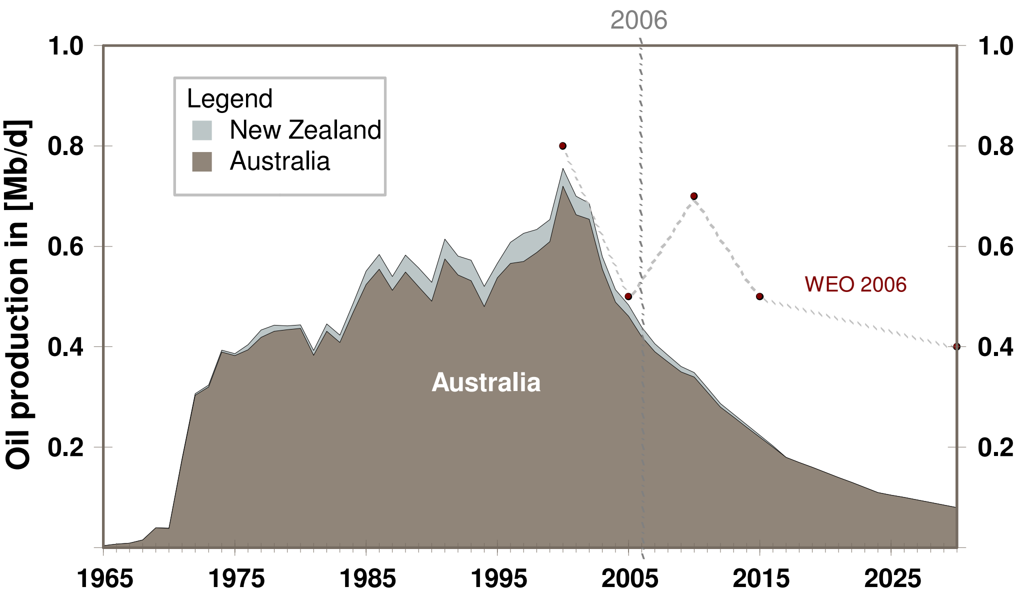
Figure 38: Oil production in South Asia



OECD Pacific

Almost all oil of the region comes from Australia which experienced peak production in 2000, followed by decline rates of around 10% per year (see Figure 39). Such steep decline rates are typical when aggressive modern extraction methods like horizontal drilling or early gas or water injection are applied. The recent decline since 2000 is well acknowledged. The IEA assumes that it will be possible to increase production again to almost the peak level of 2000, at least for a short time period. This assumption is based on the expectation of very fast developments of the deepwater discoveries made in recent years. However, this projection seems to ignore the ongoing decline of the production base which will have an ever greater effect with progressing time.

Figure 39: Oil production in OECD Pacific



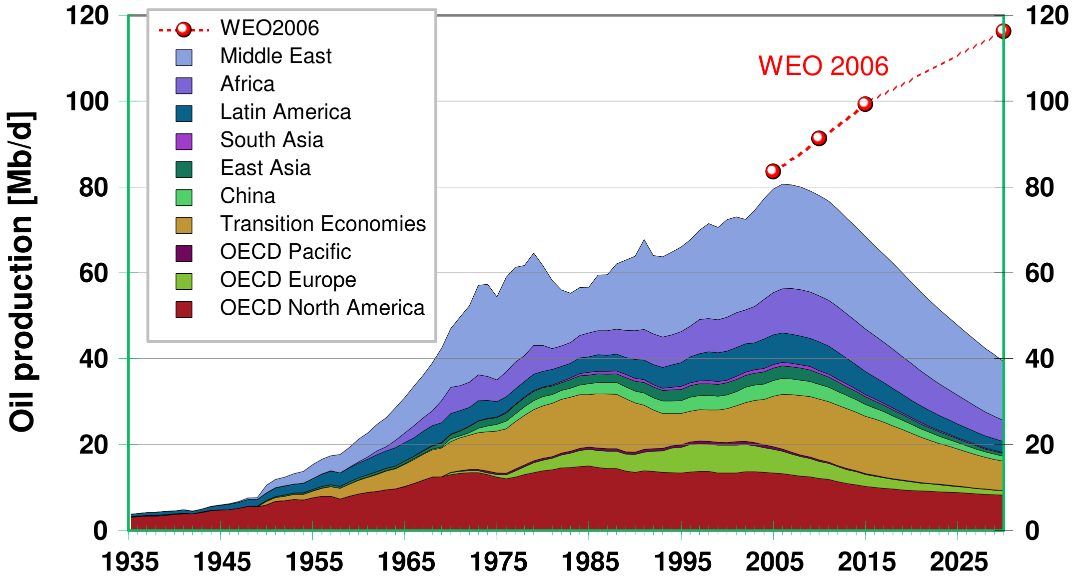
World scenario

EWG scenario

World oil production between 1935 and 2005 and the extrapolation up to 2030 as projected by the authors is sketched in Figure 40. This includes natural gas liquids (NGL) and oil from tar sands.

According to this scenario, peak oil occured in 2006 with a peak production of 81 Mb/d.

Figure 40: Oil production world summary



According to the scenario calculations, oil production will decline by about 50% until 2030. This is equivalent to an average annual decline rate of 3%, well in line with the US experience where oil production from the lower 48 states declined by 2-3% per year.

However, it must be noted that this is a moderate assumption as today a large fraction of the oil is produced offshore. Offshore fields are produced by very aggressive modern extraction methods, e.g. injection of water, gas, heat and surfactants – in order to increase the pressure and decrease the viscosity – and horizontal drilling – in order to extract the oil faster. These methods allow the faster extraction of the oil for a limited time. The horizontal wells allow to extract more oil per time, but as soon as the water level reaches the horizontal well, oil production switches to water production almost within several months. These production methods lead to decline rates after peak of 10% per year or even more (e.g. 14% per year in Cantarell (Mexico), 8-10% in Alaska, UK and Norway, more than 10% in Oman and possibly 10% or more in Ghawar, the world's largest oil field in Saudi Arabia).

Comparison of EWG scenario results with other projections

World Energy Outlook by the IEA

The EWG scenario is compared with the reference scenario by the International Energy Agency (IEA) in its latest World Energy Outlook [WEO 2006] as shown in figure.

The global projections for the oil supply are as follows:

- 2006 81 Mb/d

- 2020 EWG: 58 Mb/d (IEA: 105[1] Mb/d)
- 2030 EWG: 39 Mb/d (IEA: 116[2] Mb/d)

The differences to the projections by the IEA could hardly be more dramatic.

The alternative policy scenario by the IEA results in a slightly reduced production (about 10%) but does not really deviate from the general trend of the referenc scenario which more or less extrapolates the development observed from 1980 to 2005.

The WEO foresees no peaking of oil production in the period up to 2030.

The difference is of course due to the different methodologies and assumptions (for a more detailed dicussion regarding the differences see Annex 2).

ASPO scenario

The EWG scenario results differ also from the ASPO projections. Taking the estimates of the ASPO newsletter #80, August 2007:

- Peak oil will be reached around 2011 at about 90 Mb/d (against 81 Mb/d in 2006 in the EWG scenario).
- Production in 2020 will be at 75 Mb/d (against 58 Mb/d in the EWG scenario).
- Production in 2030 will be at 65 Mb/d (against 39 Mb/d in the EWG scenario).

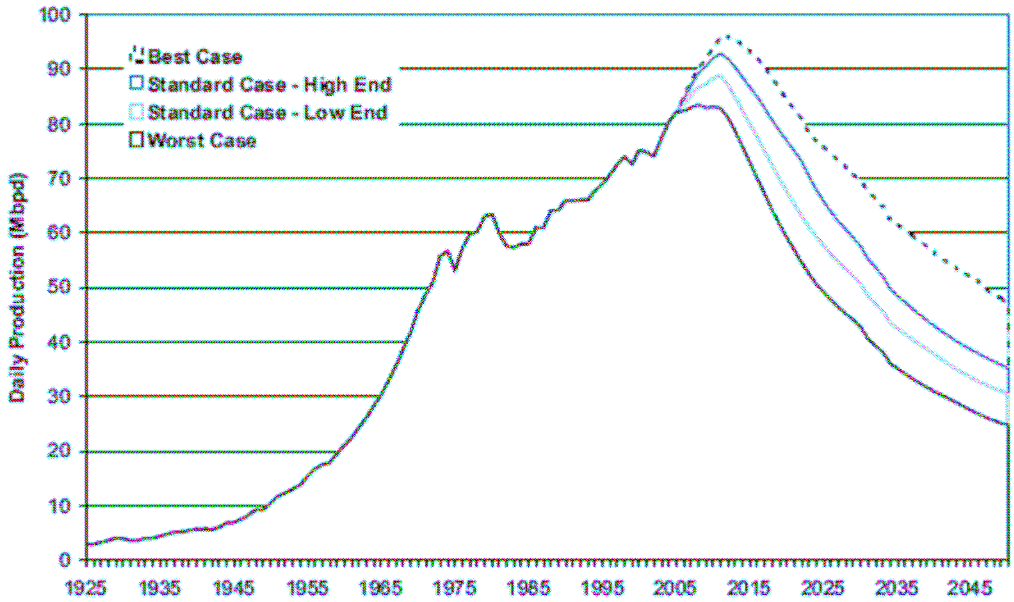
The difference in the timing of peak is perhaps not really important. More important is the higher volume of peak production assumed by ASPO. However, the differences in decline rates and production levels after peak are quite significant. They are – apart from the higher level of the peak - mainly due to a different assessment of oil production in the Middle East in the coming decades (ASPO expects production in the Middle East to decline by about 10% after peak until 2030 whereas EWG expects a decline of more than 40%).

Robelius scenarios

Robelius has four basic scenarios ranging from worst case to best case, and a demand adjusted scenario for the best case [Robelius 2007]. In the basic scenarios peak occurs between 2008 and 2013 with peak production ranging from 83 to 94 Mb/d. The demand adjusted best case scenario has a peak in 2018 at 94 Mb/d.

[1] Since IEA gives data only for 2015 and 2030, data for 2020 are interpolated; data include processing gains
[2] Since IEA gives data only for 2015 and 2030, data for 2020 are interpolated; data include processing gains

Figure 41: Results for the Robelius basic scenarios ([Robelius2007] p. 132)



All scenarios show a steep decline of production after peak:

- In the worst case, production at peak remains on a plateau for a few years and then declines to 60 Mb/d by 2020, and to 43 Mb/d by 2030.
- In the basic best case, production declines to 85 Mb/d by 2020, and to 70 Mb/d by 2030 (the decline from peak production of 94 Mb/d in 2013 to 70 Mb/d in 2030 occurs in the span of 17 years).

Again, it seems that this decline pattern is a significant result, though this aspect is not elaborated in the study. This steep decline after peak is perhaps even more important than the exact timing of peak oil.

The results for the worst case scenario are very close to the results of the EWG scenario. Looking at current developments, at the moment it seems that these scenarios probably are the most realistic.

CONCLUSIONS

The major result from this analysis is that world oil production has peaked in 2006. Production will start to decline at a rate of several percent per year. By 2020, and even more by 2030, global oil supply will be dramatically lower. This will create a supply gap which can hardly be closed by growing contributions from other fossil, nuclear or alternative energy sources in this time frame.

The world is at the beginning of a structural change of its economic system. This change will be triggered by declining fossil fuel supplies and will influence almost all aspects of our daily life.

Climate change will also force humankind to change energy consumption patterns by reducing significantly the burning of fossil fuels. Global warming is a very serious problem. However, the focus of this paper is on the aspects of resource depletion as these are much less transparent to the public.

The now beginning transition period probably has its own rules which are valid only during this phase. Things might happen which we never experienced before and which we may never experience again once this transition period has ended. Our way of dealing with energy issues probably will have to change fundamentally.

The International Energy Agency, anyway until recently, denies that such a fundamental change of our energy supply is likely to happen in the near or medium term future. The message by the IEA, namely that business as usual will also be possible in future, sends a false signal to politicians, industry and consumers – not to forget the media.

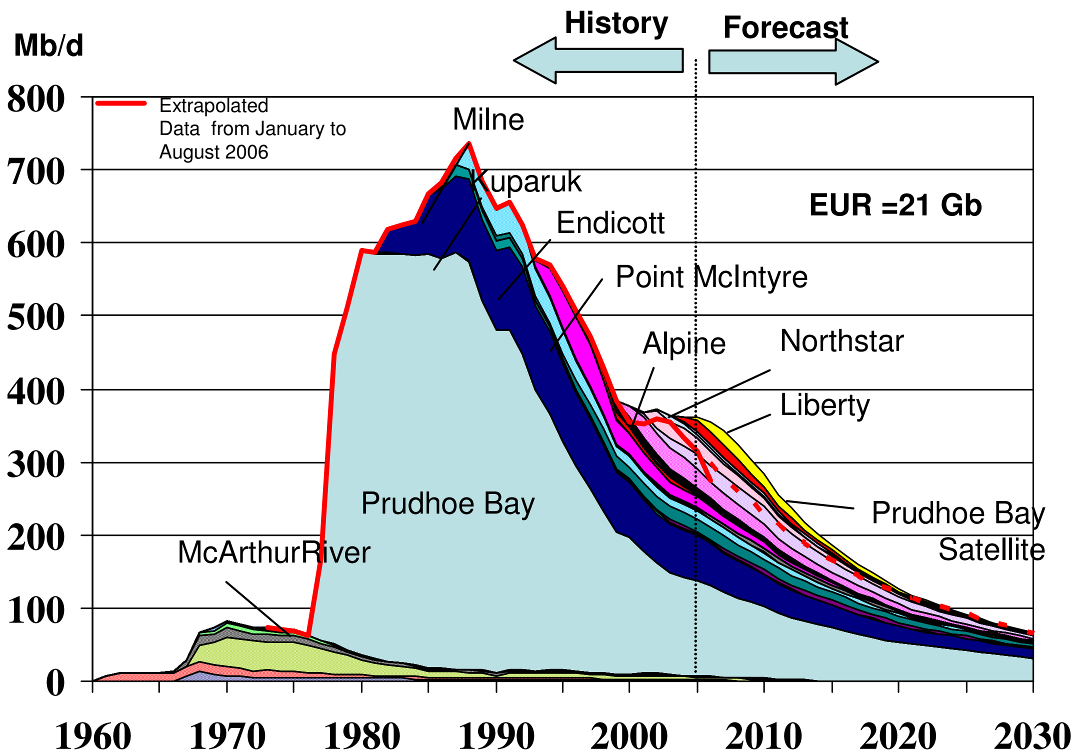
ANNEX

Annex 1: US oil production in Alaska and the Gulf of Mexico

Alaska

Figure 42 shows the field by field production history of the crude oil production in Alaska. The forecast is based on the assumption that beyond peak production the production rate declines with declining field pressure. This results in a linear decline rate when the annual production is plotted against the cumulative production.

Figure 42: Field by field analysis of the oil production in Alaska



Source: Department of Natural Resources, Division of Oil and Gas
2000 Annual Report
New data: EIA, October 2006

The forecast until 2010 is prepared by the Department of Natural Resources in 2000. The extrapolation until 2030 is by LBST.

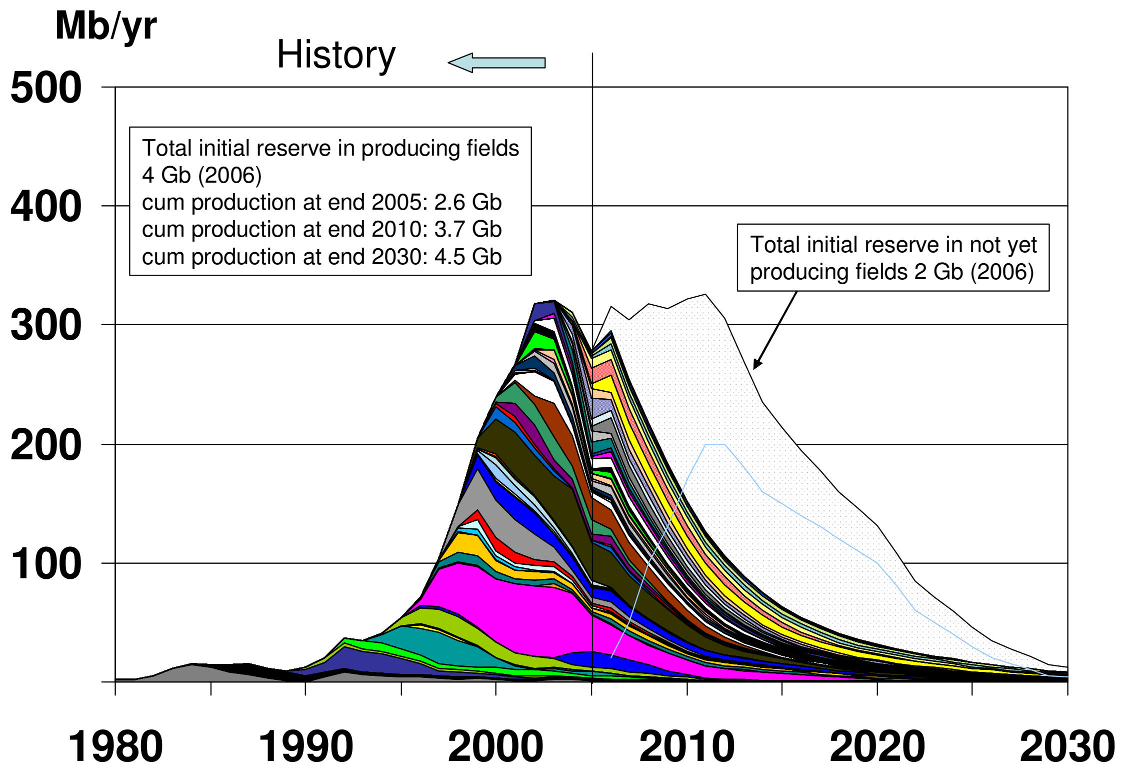
Since 1989 the decline of the oil fields in Alaska adds to the decline rate of the lower 48 states. However, since around 1990 deep water fields in the Gulf of Mexico were developed which help to compensate declining oil production elsewhere - at least partially. However, these fields are developed rapidly. Since oil is scarce, these fields are brought to their peak production rates as fast as possible, sometimes even within or slightly after the first year of connection.

Gulf of Mexico

The Figure 43 shows the production profiles of the connected deep water fields in the Gulf of Mexico. These fields enter into decline very fast. According to a forecast by the Minerals and Mines Service (MMS) in 2002, production from the Gulf of Mexico (outer continental shelf) was expected to be between 2 and 2.47 Mb/day by the end 2006. But actually, in 2002 production peaked and turned into steady decline since then. At end 2005 the production was at 1.27 Mb/day, production frome wells below 1000 feet water depth even less. These fields are displayed in the following graphics, exhibiting the field by field development. Many fields reached peak production much faster than anticipated before. Partly this is due to severe damages to some oil platforms after the hurricanes Ivan, Katrina and Rita. The dotted area includes the estimated production profile of all known but not yet developed fields. These fields are expected to contain about 3.5 Gb, which together with the oil in already developed fields adds to about 5 Gb of total reserves. This is by far more than the proven reserves of 3.5 Gb at end 2004. If some key fields developed in time the present production decline might be reserves and turned into a peak around 2010. But a considerable increase of the production to 2 Mb/day seems almost impossible. When the development of these fields is delayed due to technical problems, peak production might be even lower.

The development of Thunderhorse North which was expected to contribute with 250 kb/day from late 2006 on is already in delay and will not be completed before 2008.

Figure 43: Field by field analysis of the oil production in the Gulf of Mexico



Source: History: MMS 2005; Forecast LBST 2005

Recently developed fields peak very fast and enter into decline sometimes even after the first year of connection [MMS 2006]. This figure is based on the field production data and expected field developments as published.

Annex 2: Critique of Oil Supply Projections by USGS, EIA and IEA

US Geological Survey (USGS)

The latest survey of resources is the “US Geological Survey World Petroleum Assessment 2000” and was published in June 2000 [USGS 2000a].

In the executive summary of the resource survey 2000 the following phrases deserve attention: purpose of the study is “... to assess resources ... which have the potential to be added to reserves within a 30-year timeframe (1995-2025)...” [USGS 2000a]. It is stated explicitly that those oil findings can be expected in the time between 1995 and 2025. Until today, one third of this time span has elapsed, so that now we are able to compare the estimates of the study with reality.

Moreover the wording “to assess resources... which have the potential to be added to reserves” is so vague that its exact interpretation is left to the reader.

In brief the results of the survey can be summed up as follows:

- Outside of the USA up to 334 Gb of oil can be found between 1995 and 2025 at a probability of 95%, and 1107 Gb at a probability of 5%. By using extensive Monte-Carlo simulations a “mean” value of 649 Gb is calculated.
- Furthermore between 95 Gb (5% probability) and 378 Gb (95% probability) of natural gas liquids (NGLs) can be found.
- In contrast to previous analyses a new factor - called “reserve growth” - is introduced. The factor for the reserve growth is calculated from the experience in the USA during the last decades, extrapolated for the next 30 years and then applied on the rest of the world.

This method of adjusting reserves by a growth factor must be criticised in two respects:

The upward revision of reserves in the past is caused in most cases by an initial underestimation of the size of the old and large fields. These fields were so large that it wasn’t necessary for their efficient development to determine their exact size. And some of these fields are so old (up to 100 years and more) so that the methods of reserve estimation at the time of discovery were very simple and unprecise.

Today, the growth of reserves tends to be much smaller, partly because newly found fields are so small that a precise estimate is needed, but also because modern exploration methods are much more precise than in the past. Nowadays it happens quite often that reserves also have to be adjusted downwards instead of upwards (as lately the example of Shell has shown).

The second point of critique refers to the fact that – as is known to all experts - the growth of reserves in the USA in the past was much higher than elsewhere. This is a direct consequence of the regulations by the Securities Exchange Commission (SEC), which for financial reasons call for very conservative evaluations at the beginning of the development of an oil field. This US practice leads to systematic underestimations.

For these reasons this marked reserve growth in the past was only observed in the USA and can not be extrapolated into the next 30 years, nor even less can this pattern be applied to the whole world.

But apart from this important aspect, it seems very strange that a scientific geological institute makes estimates of the geological potential of oil findings and then additionally applies a growth factor which only reflects the economic rules of "reserve reporting". It is obvious that the reporting of reserves can only extend within the boundaries of the geologically possible. The USGS study mixes different categories of reserve evaluation which are not compatible. The results can not be regarded as scientifically sound and are all but reliable.

To arrive at a global picture, US data have to be added to the world's oil resources outside the US. For this purpose the USGS draws on its own analysis of the US from 1996 [USGS 1996]. The aggregate results of the USGS study are shown in the following Table 5.

Table 5: USGS estimate of potential oil findings between 1995 and 2025 and reserve growth in already found fields [USGS 2000a]

Discoveries	5% Probability	Mean	95% Probability
Crude oil (outside USA)	1107	649	334
NGL (outside USA)	378	207	95
Crude+NGL (USA)	104	83	66
Total	**1589**	**939**	**495**
Reserve growth			
Crude oil (outside USA)	1031	612	192
NGL (outside USA)	71	42	13
Crude+NGL (USA)	(76)	(76)	76
Total	**1178**	**730**	**281**

Moreover, the study quotes figures of proven reserves and cumulative production from other statistics. It is particularly interesting that the USGS takes the values for non-US countries from the industry database (formerly Petroconsultants, today IHS-Energy). This very database, however, is also used by Campbell and others for their analyses.

Table 6: Cumulative production by 01/01/1996 and proved reserves, as quoted in the USGS study [USGS 2000a]

	Crude+NGL (USA)	Crude (outside USA)	NGL (outside USA)	Total
Cum. production	171 Gb	539 Gb	7 Gb	717 Gb
Reserves	32 Gb	859 Gb	68 Gb	959 Gb

Using these figures the USGS calculates the total potential of past and future world oil production (Estimated Ultimate Recovery – EUR) to be: 3,012 Gb being the mean value, 2,269 Gb with a probability of 95% and 3,919 Gb with a probability of 5%. In addition, the total amount of liquified natural gas outside of the US is estimated to be in the range of 183 to 324 Gb. For the US the NGLs are already accounted for in the table above.

To give an insight into the methodology of the analysis, two regions will be examined in greater detail: the Falkland Islands and the basin of the Greenlandic Sea.

The USGS study identifies as the region with the largest potential of oil discovery the sea area east of Greenland which is estimated to contain as much oil as the North Sea. In this region certain geological analogies exist to the shelf ridge off Middle Norway, but only certain analogies... With a probability of 95% no oil at all will be found, according to the USGS, with a probability of 5% 117 Gb will be found. Based on these estimates, it is calculated via complex mathematical models that probably 47 Gb of oil could be found in the region. (Incidentally in the shelf off Middle Norway 10 Gb have yet been found after many years of intensive exploration – with the significant contribution of Colin Campbell.)

Until today there hasn't been any single exploration drilling in the Greenlandic Sea. It will be interesting to see which oil company will take the risk to drill in an area where oil is expected to be found with a probability of 5%.

For to the Falkland Islands, the potential for “undiscovered” oil is estimated to be 5,8 Gb. This number was calculated as the mean value assuming that at 95% probability no oil at all will be found and with a probability of 5% about 17 Gb will be found.

In contrast to this estimate, the sobering reality is described in the following quotation of Marshall DeLuca in OFFSHORE, one year before the completion of the USGS study [De Lucia 1999]:

“The most recent frontier project was the offshore Falkland Islands area. This exploration project has turned out to be a disappointment – thus far. The operators have tried six wells in the area ... and have encountered some oil shows, but did not strike anything close to commercial levels. It has been estimated that the group will need a discovery with at least 140 Mb of oil to justify development of the Falklands. With the harsh environment of the Falklands, well costs are currently estimated at between $25 and $30 million per well. The FOSA drilling program is now complete, and the operators are evaluating well data. No plans for the future have been announced."

So far no single oil field containing approximately 140 Mb has been found. Where to look for the 5,800 Mb of which the USGS assumes that they can be found?

As the study indicates, the time frame 1995 to 2025 for the new discoveries of oil, one can easily calculate how much oil per year on average should be found.

Table 7: Calculation of average discoveries per year until 2025 based on USGS assumptions

Probability	Discoveries (crude+NGL)		Reserve growth		Total
	1995-2025	Gb/yr	1995-2025	Gb/yr	Gb/yr
95%	495 Gb	16.5	281 Gb	9.4	25.9
Mean	939 Gb	31.3	730 Gb	24.3	55.6
5%	1589 Gb	53.0	1178 Gb	39.3	92.3

Just taking this table, the lack of realism of the study becomes apparent. If we take seriously the values indicated as "mean", this would mean that every year 55 Gb of new oil would have to be added to the reserves, originating either from new discoveries or from reassessments of existing fields. In fact, however, reported reserves have been staying roughly constant. Currently discoveries and reassessments correspond approximately with annual consumption - which amounted to about 29.5 Gb in 2005. Hence, the USGS study assumes that in future on average this value will be at least twice as high than in the past.

As a matter of fact, between end of 1995 and end of 2005 in total only 146 Gb were discovered and 312 Gb were added by reassessing existing fields[1]. According to the USGS projections ("mean"), however, in this period 313 Gb should have been found and 243 Gb should have been added due to reassessments, whereas the amounts to be expected with a probability of 95% did materialize. After one third of the forecasting period has now passed, the real development lags far behind the USGS projections. In order to achieve the "mean" projections even roughly, in future much more oil than ever before has to be found. This

[1] Discoveries are taken from the industry data base of IHS Energy. These provide data of crude oil and NGL/condensates. The upgradings were calculated from reserve figures shown by the BP Statistical Review of World Energy, by accounting cumulative production in this period and the IHS designated findings.

seems to be the most unlikely of all possible future developments! There is not a single indication that the USGS estimates, apart from the 95% probability values, have anything to do with reality.

The US "Energy Information Administration" (EIA)

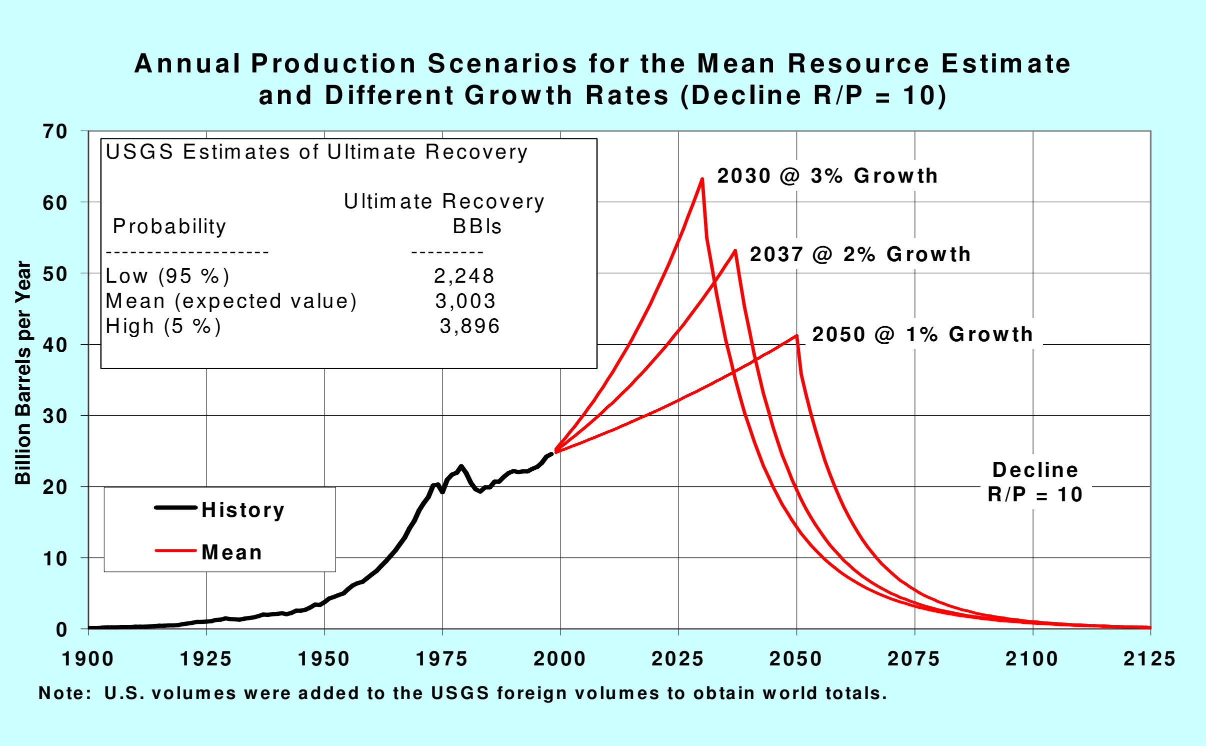
The Energy Information Administration, which belongs to the US Department of Energy, publishes many energy statistics and analyses which draw worldwide attention.

The publication of the USGS resource study discussed above was used as a basis by the EIA to forecast the world's oil production. As an example for many analyses of EIA the study "Long Term World Energy Supply" will be examined in greater detail [EIA 2000].

Based on the resource data of the USGS study different supply scenarios until 2010 and beyond are outlined. In the summary it is pointed out that all 12 analyzed scenarios see the production peak, depending on different assumptions, between 2021 and 2112. Also included, but not mentioned in the text of the summary is the chart "Annual Production Scenarios with 2 Percent Growth Rates and Different Decline Methods" which shows the peak in the year 2016 based on 2% decline after peak and an EUR of 3003 Gb.

Moreover, the only realistic - from our point of view - scenario is not mentioned. This is a scenario based on the USGS resource figures at 95% probability (2,248 Gb) and assuming a production increase of 2% per year until the peak is reached and thereafter a production decline of 2% per year. In this scenario the peak would already be reached before 2010, consistent with the claim of the "pessimists". Instead of this the pessimistic scenario formulated in the EIA presentation is based on the USGS "mean" with a total oil production potential of 3,003 Gb.

Figure 44: Annual Production Scenarios for the Mean Resource Estimate and the Different Growth Rates (Decline R/P = 10) [EIA 2000]



The methodological approach for the construction of the "Annual Production Scenarios for the Mean Resource Estimate and the Different Growth Rates (Decline R/P = 10)" is strange. First of all: Why is there a production curve based on the "Mean" case of the USGS study and not also one for the "Low" case (with a probability of 95 %)? Later in the study for the most part only graphs are shown which are based on the USGS "High" values with a probability of 5%. However, as already mentioned, if we calculate the production profile with a growth rate of 2% before and a decline rate of 2% after the maximum based on the "Low" case, then production would peak before 2010 – fully consistent with the estimates of the "Pessimists".

Assuming the peak of production takes place very late in time obviously leads to very unrealistic "catastrophic scenarios": a long period of growth is necessarily followed by a steep decline, i.e. a total break down of oil production within a few years after the peak.

This steep production decline is generated by assuming a constant reserve/production ratio of 10 years (R/P = 10). It is argued that such a constant R/P–ratio was observed empirically in the US after production peaked in 1971.

In fact, production each year declined at an average rate of 2%, but reserves were also adjusted each year in such a way that the R/P-ratio was almost unchanged. (This is a consequence of the concept of "reserve growth": Even though reserves were adjusted downwards each year, they were adjusted by less than the actual production of the year in question.)

A consistent calculation would have to be in line with the observed 2% decline rate of the production. EIA, however, uses the constant R/P=10 ratio based on the final EUR as basis which results in a 10% annual decline rate. But the real praxis was to arrive at R/P=10 by annually upward revising EUR.

However, much more important is another criticism. How realistic are the future production scenarios as described by EIA? These scenarios are quite implausible as already today most of the regions in the world have either reached or passed their production peak. Once more and more regions experience a shift from growing to declining production it is getting increasingly difficult for the ever fewer remaining countries to compensate for this decline, let alone to add to total production. For instance, if we take the scenario with the peak in 2030 (based on a yearly production growth of 3%), this curve tells us the following: In the last 50 years the world has managed to increase global production per year from about 5 Gb by about 20 Gb to 25 Gb; in little more than half of this period it is thought to be possible to increase yearly production by about twice that amount from 25 Gb to 65 Gb – by another 40 Gb! This is incredible.

In view of the remaining production potentials it is much more likely that global oil production will never be able to exceed the 30 Gb level significantly, and not for longer than a few years if at all.

The International Energy Agency (IEA)

The IEA was founded by the OECD nations after the oil shocks in the 1970s as a counterweight to OPEC. Since that time the IEA is regarded as the "energy watchdog" of the western world and is supposed to help to avoid future crises. Until 2004 the IEA published the "World Energy Outlook" (WEO) every two years, since then every year. The WEO forecasts the development of the coming two decades. These reports are considered by many people to be something like a "bible". The IEA also publishes monthly reports covering the current situation of the oil markets.

IEA methodology

The usual basis for demand and supply forecasts is the World Energy Outlook (WEO) biannually prepared by the International Energy Agency (IEA). The 2004 edition of the WEO will be reviewed in this chapter, contrasting results from the 1998 edition with those of the 2004 report which is very close to the 2005 update.

The World Energy Outlook classifies the world into the following ten regions:

- OECD North America, including Canada, Mexico and the USA
- OECD Europe, including Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, The

Netherlands, Norway, Poland, Slovak Republic, Spain, Sweden, Switzerland, Turkey and the UK

- OECD Pacific, including
  –OECD Oceania with Australia and New Zealand
  – OECD Asia with Japan and Korea
- Transition Economies, including Albania, Armenia, Azerbaijan, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Estonia, Yugoslavia, Macedonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Romania, Russia, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, Cyprus and Malta
- China, including China and Hong Kong
- East Asia, including Afghanistan, Bhutan, Brunei, Chinese Taipei, Fiji, Polynesia, Indonesia, Kiribati, The Democratic Republic of Korea, Malaysia, Maldives, Myanmar, New Caledonia, Papua New Guinea, Philippines, Samoa, Singapore, Solomon Island, Thailand, Vietnam and Vanuatu,
- South Asia, including Bangladesh, India, Nepal, Pakistan and Sri Lanka
- Latin America, including Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominic. Republic, Ecuador, El Salvador, French Guyana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, St. Kitts-Nevis-Antigua, Saint Lucia, St. Vincent Grenadines and Suriname, Trinidad and Tobago, Uruguay and Venezuela
- Middle East, including Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, the United Arab Emirates, Yemen, and the neutral zone between Saudi Arabia and Iraq
- Africa, including Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, the Central African Republic, Chad, Congo, the Democratic Republic of Congo, Côte d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, the United Republic of Tanzania, Togo, Tunisia, Uganda, Zambia and Zimbabwe.

The International Energy Agency's WEOs are demand based forecasts. Based on economic developments and geopolitical assumptions the energy demand is forecasted.

Resource restrictions are not included as natural resources per definition are regarded as being cost free and practically "unlimited". Only costs for extraction, conditioning, transport and distribution enter into the calculations. A possible resource restriction could enter into these calculations only via rising extraction costs. But these are not adequately modelled. In reality, extraction costs even of a single producing oil or gas field rise year over year, simply due to rising efforts (e.g. water injection, additional wells) and shrinking production volumes (e.g. the oil to water share of the extracted volume is declining continuously).

Based on these demand forecasts, another chapter deals with the supply situation. In almost every IEA report, the question is never raised if the projected demand could be met with an adequate supply. All these forecasts are usually based on “business as usual” scenarios not projecting disruptions on the supply side.

The energy projections are based on a complex World Energy Model (WEM). In short, the model contains the three modules “final energy demand”, “power generation and refinery”, and “fossil fuel supply”. According to the model philosophy, the scenario calculations are demand oriented. This means that starting point for the scenario calculations are basic assumptions regarding population growth, economic growth and fuel prices.

These assumptions are used to calculate the economic activity and the corresponding final energy demand. From the sector specific demand for heat, electricity and fuels the energy consumption of the power generation and the whole transformation sector (refineries) is calculated. These calculations end up in total primary energy supplies for each region.

In almost independent sections the primary energy supply from various fuels is calculated.

- Economic growth assumption

Gross domestic product grew between 1971 – 2004 at an average rate of 3.2% per year.

The basic assumption for the energy projections is that this growth will continue over the next 20 to 30 years. The 2004 report [WEO 2004] used an average growth rate of 3.2% per year between 2002 and 2030. This is slightly higher than in the previous [WEO 2002] report (3%), but considerably lower than in the [WEO 1998] report (3.8%). The report of 2005 is again based on an economic growth rate of about 3.2%. The latest report [WEO 2006] assumes an average growth rate of 3.4% over the next 25 years.

- Population growth assumption

The second assumption on which the forecasts are based on, is the future population growth. Around 1980 the world population grew with a maximum rate of about 1.85% per year. The present growth rate is about 1.2%. This rate is projected to decline further to about 1% between 2000 and 2030. This assumption is not changed in WEO 2002, 2004, 2005 and 2006, though in former reports (WEO 1998) this rate was assumed to stay higher at 1.2% per year.

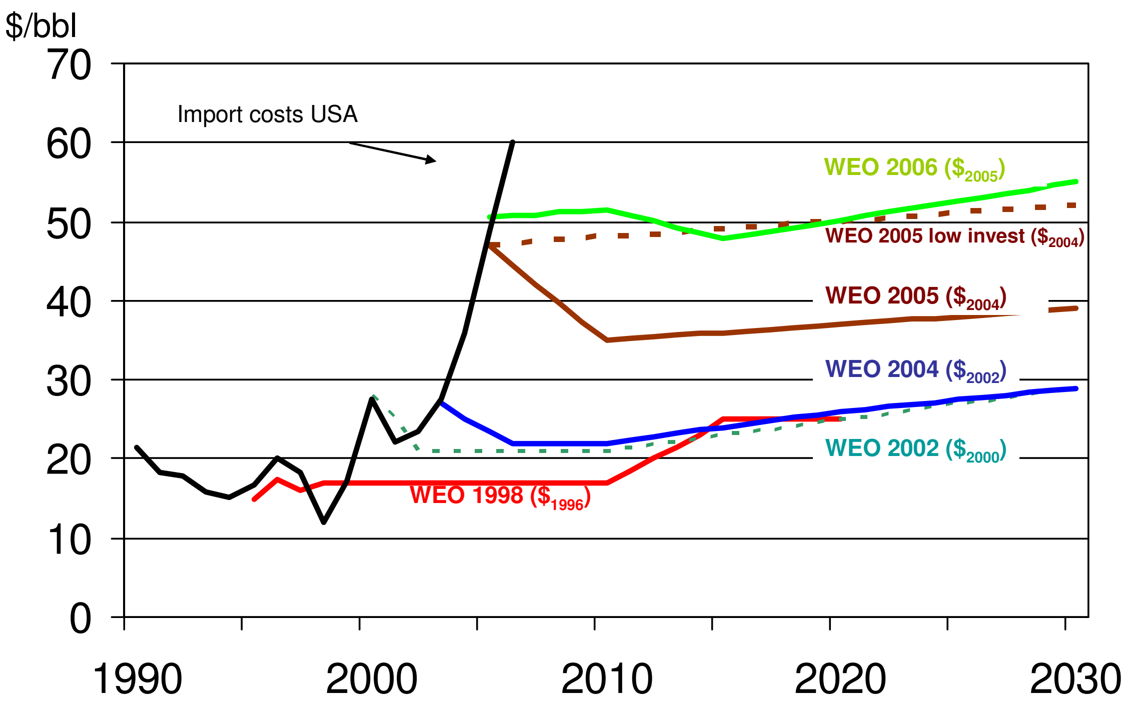
- Oil price assumption

Figure 45 illustrates the changing oil price assumptions. In the 1998 edition a slight increase to 25$/bbl in 2015-2020 was assumed, as sketched with the red line in the figure (WEO 1998). Real prices, however, started to rise in 2000. But this influenced the 2002 report only marginally: A decline from 27$/bbl down to 22$/bbl was expected for 2003 followed by a moderate increase to 25$/bbl by 2020 (as in the previous study) and to 29$/bbl by 2030 (dashed line). However, prices remained high. The 2004 report still expected declining oil prices for the near future to around 22$/bbl with a modest increase to 29$/bbl by 2030 (blue line). Continuing high oil prices presumably forced the International Energy Agency to deviate from its biannual publication rhythm and to publish late in 2005 an additional report (WEO 2005). The major differences to the preceeding report are higher oil price projections.

The latest price developments are marked in the figure with the bold dark line. In 2005 IEA import prices for crude oil averaged at about 50$/bbl – USA with 48.8$/bbl at the low end and UK with 53.8$/bbl at the high end –, and the present trend indicates a price of about 60$/bbl in 2006.

The explanations for the price development are quite simple: according to the IEA, today's high oil prices will foster the investment of oil companies into upstream activities. This will result in an expanded supply which in turn will reduce prices. This was the justification for the price decline around 2010 in the WEO 2005 report. The 2006 report delays the response time until 2015 and calculates only with a modest decline by then which will be followed by a price increase of 10% above today's oil price by 2030.

Figure 45: IEA crude oil import price projections according to WEO 1998 (red line), WEO 2002 (dashed line) and WEO 2004 (blue line). The black line shows the historic development of the IEA crude oil import prices.



The big differences between projected and observed crude oil prices make the price projections very doubtful. Since these projections, however, influence the energy demand forecasts, these must also be regarded with caution. According to an independent report of the

International Energy Agency, each price increase by $10/bbl might result in a drop of GDP by about 0.5%. Therefore, a 30$/bbl price increase, as already experienced since the publication of the WEO 2004 might result in an economic slow down of ~1.5%. This in turn could dampen the energy consumption correspondingly.

The whole methodological approach is questionable. The modelling is based on the following sequence:

- Make assumptions for the future development of GDP, population and oil prices up to 2030.
- Calculate from the level of economic activities the corresponding final energy demand.
- Calculate the primary energy demand required for the final energy demand.
- Match the projected primary energy demand with a corresponding supply.
- Provide arguments to show that the projected supply increases are feasible.

In reality, however, restrictions on the supply side determine the availability of energy, energy prices, and of course, economic development and GDP growth. Therefore, once there are limits on the supply side, this modelling sequence must be reversed: The available supply determines the possible energy demand which in turn is closely linked to the possible economic growth. The IEA model is only adequate if there are – for all practical reasons - no supply restrictions, i.e. when the peaking of a finite energy source is still far in the future.

Discussion of various IEA reports

The "IEA World Energy Outlook 1998" did forecast that world oil demand will increase by 50% to 120 Mb/day by 2020. It was correctly seen that production outside of OPEC would reach its maximum in the year 2000 and soon after would start to decline. Almost 20% or 17 Mb/day of the total consumption in 2020 was explicitly defined as "not yet identified unconventional oil" – a hidden warning which could be translated to "the IEA has no idea of where this oil is going to come from". This study did also discuss the different views on the future production potential by dedicating 5 pages to a review of the "Pessimists'" position.

The following report „IEA World Energy Outlook 2000" was already influenced by the USGS Resource Assessment 2000. This influence can also be seen in the later report „IEA world Energy Outlook 2002" [WEO 2002]. While the 1998 report still discussed the different views later reports simply ignored differing views.

The "IEA world Energy Outlook 2000" and "IEA world Energy Outlook 2002" have an almost opposite message compared with the report of 1998. According to the 2002 report world oil demand will reach the level of 120 Mb/day by 2030 instead of by 2020. But the hint at "yet unidentified sources" in the 1998 report has been dropped. Quite the reverse, based on the USGS study, now almost any production rate is considered to be possible. Even the production of non-OPEC states, which according to the 1998 report was supposed to decline to 27 Mb/day by 2020, is expected to grow from 43 Mb/day in 2000 to 46 Mb/day in 2020.

Table 8: Aggregate figures of table 3.5 in "The world Energy Outlook 2002" [WEO 2002]

	Amount of Oil	IEA Comment
Remaining reserves	959 Gb	Reserves are effective 1/1/96
Undiscovered resources	939 Gb	Resources effective 1/1/2000 are mean estimates
Total production to date	718 Gb	
2001 Production	75.8 Mb/day	

The stated sources are USGS (2000) and IEA databases.

In fact, all figures except those for the current production are derived from the USGS 2000 study. However, in the USGS study all data refer to January 1st 1996 including still undiscovered resources and total production to date. This is a first methodical error. It would have been correct to adjust all figures in the IEA table to the new base year 2000, i.e. to extrapolate the remaining reserves to 2000, to reduce the findings still to be obtained and to adjust the historic production (after all, 132 Gb have to be added in the period from 1996 to 2000).

Moreover, the figures are not consistent as the following examples show.

Table 9: Daily production in 2000 and 2030 as well as reserves and undiscovered in selected countries, according to the report "IEA World Energy Outlook 2002", cumulative production between 1996 and 2030 calculated from these figures, and real discoveries between 1996 and 2005

	Production		Cum. Production 1996-2030 (Gb)	Reserves 1995 (Gb)	Undiscovered 1996-2025 (Gb)	Discoveries 1996-2005 (Gb)
	2000 (Mb/d)	2030 (Mb/d)				
Indonesia	1.4	1.7	19.5	10	10	2.6
China	3.2	2.1	35	25	17	8.0
Brasil	1.3	3.9	29	9	55	6.3
UK	3.3	1.1	27	13	7	1.9
Norway	3.4	1.4	32	16	23	2.5
Mexico	3.5	2.7	44	22	23	1.1

The first two columns show the daily production in 2000 and 2030 according to the assumptions in [WEO 2002]. The study gives also intermediate values which allow to calculate the total production over the period 1996 to 2030 (column “Cum. production 1996 – 2030”). In this calculation the year 1995 has to be taken as the base since the assumed reserve data in this study (column “Reserves 1995”) and expected discoveries (column “Undiscovered 1995-2025”) refer to this year. For comparison, the real discoveries made in these countries between 1996 and 2005 are listed in the last column “Discoveries 1996-2005”. These are the discoveries after a third of the forecasting period.

It is obvious that the production forecast by the IEA cannot be attained by Indonesia, UK and Mexico, even if we accept the optimistic assumptions regarding discoveries, since the assumed reserves are not sufficient.

When we compare the real discoveries between 1996 and 2005 with the expected discoveries between 1996 and 2025, the rate of expected discoveries for all these states except for Indonesia and China is in total contrast to the observed development. Particularly striking are the discrepancies for Brazil, Norway and Mexico – there after all more than 100 Gb were expected to be found until 2025, but in fact only 10 Gb were discovered between 1996 and 2005.

If we assume that the present discovery rates can be held constant over the remaining forecasting period (which is very optimistic, because according to past experience discoveries decrease with time), then in every country (maybe except for China) production would be down to zero in 2030.

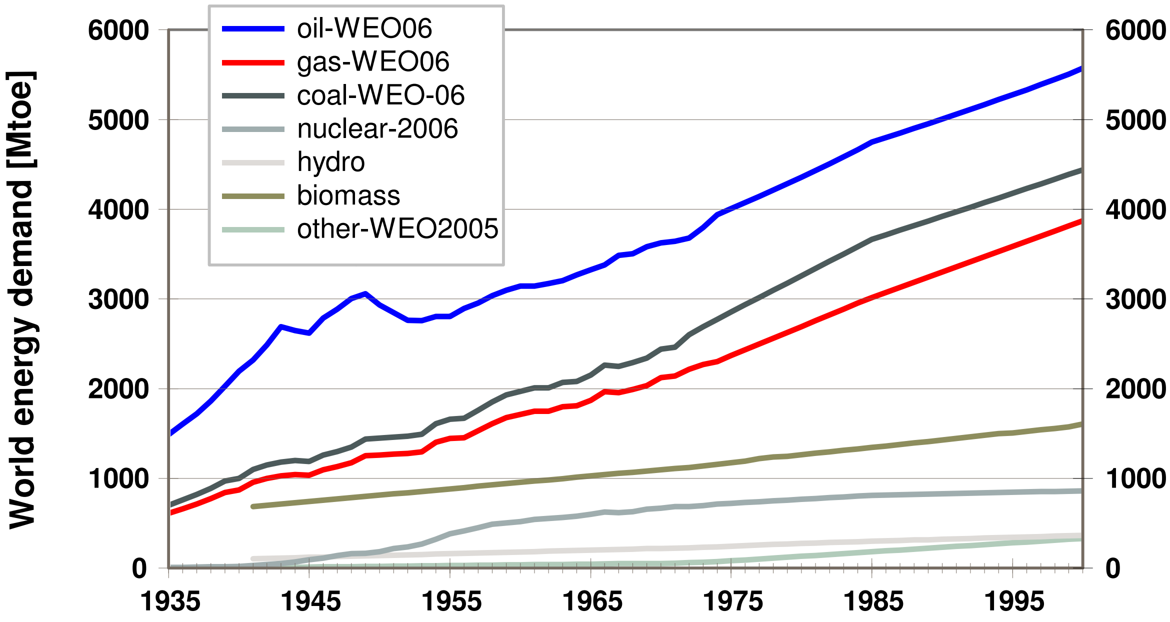
Also in Germany, the Bundesanstalt für Geowissenschaften und Rohstoffe (i.e. the German federal agency for earth sciences and raw materials) has dealt critically with the scenarios of the IEA and comes to the conclusion [BGR 2002]: “The forecasts of EIA and IEA assume a continuous growth in oil consumption, without assessing sufficiently the real supply of oil and the production potential.”

Comment on the "World Energy Outlook 2005"

Breaking the usual biannual rhythm, the IEA in October 2005 published the report “World Energy Outlook 2005” [WEO 2005], covering the period until 2030. The reason for this unexpected publication probably was the unprecedented rise of oil prices during the preceding year causing growing public concern.

In its „reference scenario“ the IEA report describes the most probable development of energy markets until 2030. In addition, two alternative scenarios are considered, a “low investment scenario” (if investment in upstream activities is much lower than expected) and an “alternative scenario” (if policy measures are introduced to cut energy demand). For details see the following Figure.

Figure 46: Development of oil, gas and coal demand and the use of wind, solar and geothermal energy (=other) in accordance to the reference scenario of the "World Energy Outlook 2005"



These scenarios include also renewable energy. Solar, wind and geothermal energy will increase their contribution in the reference case until 2030 and will reach a share of 2% of primary energy supply. The "alternative scenario" will increase this contribution by 30% above the reference case and reaches a share of 2.6% for the renewable energies.

In face of the expected growing demand for oil and gas until 2030 the IEA raises the question where the necessary additional upstream capacity could come from. The IEA sees the potential for a considerable increase of oil production capacity in the Middle East and in North Africa. According to the IEA, these countries still hold large reserves which are sufficient to match the expected future demand. But there is a caveat: the known reserves are sufficient only by their absolute size, in order to sustain growth huge additional reserves must be added in the coming years -otherwise world oil production will peak before 2030. Translated into plain language that is to say that, contrary to the initial statement, known reseves in these countries are not a sufficient basis for the projected production increases. Nevertheless, the impression is given that the projected capacity increases are feasible. The alternative scenario discusses the option of reducing the demand growth by political measures. This is seen by the IEA as being possible and desirable, however the effect on the demand is minimal leading only to a reduction of less than 10%.

According to the IEA, energy consumption in the oil and gas producing countries in the Middle East and North Africa will rise as a consequence of the growing population. However, this additional demand pressure is expected to be an incentive to extend production capacities.

This then will also lead to an increase of the net export capacity of these countries - a conclusion which probably will not be shared by many.

A necessary precondition for expanding the production in these countries are increased investments in exploration and production. According to the report, a doubling of present budgets is necessary.

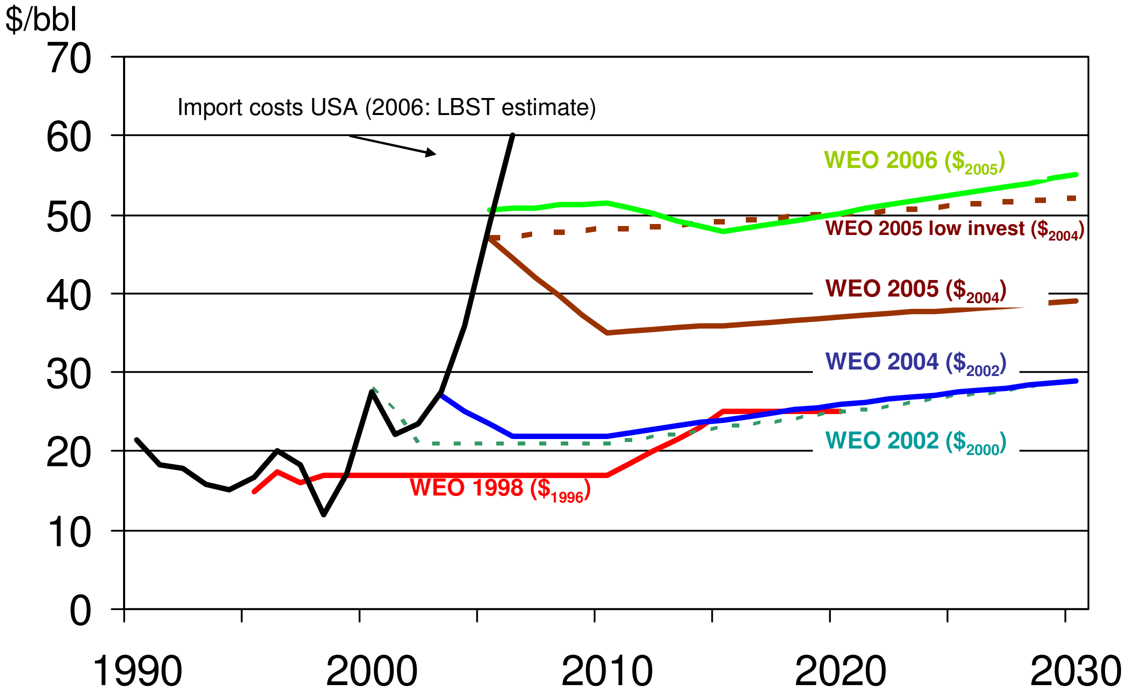
After describing the conditions for supply extensions, the IEA addresses possible problems. It could turn out that the countries in question are either not able or not willing to increase their investments. In this case it would be necessary to open these countries for foreign investments.

A second problem mentioned by the IEA is that all scenario calculations and conclusions are based on data which are completely unreliable: "Uncertainties about just how big reserves are and the true costs of developing them are casting shadows over the oil market outlook and heightening fears of higher costs and prices in future."

Rather unexpectedly at this point, the IEA casts doubts on the feasability of growing oil supplies in future. However, instead of addressing the problem of lacking or uncertain reserves, the IEA concentrates on the problem of insufficient investments.

The IEA puts much effort into arguing that production extensions effected by huge investments are in the interest of the oil producing countries in the Middle East and North Africa. It is argued that higher investments will result in higher overall income for these countries. This result is achieved by assuming different oil prices for the alternative cases of big and small capacity extensions (see Figure 47). The assumed price levels leading to this result are far below present oil market prices and are completely arbitrary. Obviously, the IEA intends to convince the OPEC that huge investments in oil exploration and production are in their best own interest.

Figure 47: Forecast of oil import prices according to various editions of the World Energy Outlook (stated in real prices for the quoted base years)



It remains to be seen whether these arguments will convince the OPEC countries. One should be sceptical, however, in view of the experiences the OPEC countries made in the last years in which they saw prices rise far beyond the "automatic price band" of \$22-\$28, a development which did not lead to a shrinking of oil demand and had no dramatic effects on the world economy, contrary to the predictions of western sources. By the way, presently nobody seems to be able to increase supplies to control crude oil prices.

The key messages of the World Energy Outlook 2005 are:

- The oil reserves of the world are sufficient to supply a considerable demand growth until 2030. Only the necessary investments for the increases of exploration and production must be ensured. If this can be achieved there will be no "peak oil" problem before 2030.
- The main difference to the preceding reports is the expectation of a considerable increase in oil import prices until 2030. From the chosen wording it can be concluded that the IEA regards not the "reference scenario" as the most probable, but the "low investment" scenario which projrcts an increase of oil import prices up to \$52/barrel by 2030.
- Renewable energies will not reach a significant market share within the next 25 years.

The negligible role attributed to renewable energies by the IEA even in the long term is an obvious attempt to influence the energy policy of governments, a position which meets strong criticism especially in Europe. Why does the IEA not investigate what effect an investment level as proposed for the oil industry would have when applied to renewable energies? The answer points to the interests to which the IEA seems to be obliged.

Fundamental and - according to our opinion - much more important questions are not addressed by the [WEO 2005], especially:

- Are oil production extensions in the Middle East countries and North Africa really possible even when the investment is doubled? This is rather doubtful with regard to the size structure, the age, and the depletion status of the producing fields.
- Is it really in the long term interest of oil producing and consuming countries still to increase the production? This would result in a higher maximum production which will necessarily be followed by a steeper decline. Because the ultimate recoverable amount is a fixed quantity only the production profile over time can be influenced. The inevitable transition from oil to renewable energies will not be made easier and the energy problems will be exacerbated.

Final remark

The projections presented by USGS, EIA and IEA regarding the future availability of oil give reason to grave concerns because the comforting messages of these studies unfortunately are not based on valid arguments.

These studies ignore future limitations in the supply of oil which are meanwhile apparent, and by doing this they send misleading political signals.

It should also be noted how these studies build on each other. The supporting ground floor has been built by the USGS 2000 study: it describes, how much oil the world has at its disposal - it just needs to be found. On this the EIA has built a first floor which describes the future production potential. The result is that in fact any conceivable future growth of production will be possible - with growth rates exceeding everything that could be observed in the past. On top of this, the IEA constructs a second floor: the predicted growth in oil demand for the next decades will not be restricted by any limits of supply. This is a house of cards.

Annex 3: Non-conventional oil

Canadian tar sands and oil shales – hope or nightmare

It is the hope of many people, that non-conventional oil might substitute conventional oil. To the degree that conventional oil is getting scarce and more expensive, the production of non-conventional oil should be extended to assure a smooth substitution in the supply of high-quality oil for fuel, chemistry and heating purposes.

Indeed, many economists adhere to this point of view and so does the oil industry. For many observers the increase of the oil reserves in 2002 is evidence of this development. At that time the world oil reserves were upgraded by about 16% by ExxonMobil in their statistics publication. The comparative production costs of non-conventional tar sands, it was said, meanwhile justify the transfer of these resources, well known since decades, into the category of "proven reserves". This inclusion of the Canadian tar sands into the oil reserves was followed in Germany by the Mineralölwirtschaftsverband, the association of the German oil industry. A few years later, in 2007, also the BP Statistical Review of World Energy followed suit.

How realistic is this approach? There are indeed huge resources of non-conventional oil. Especially tar sands in Canada, heavy oil in Venezuela and oil shales in many other places in the world.

Oil shales will not be discussed here in detail (for a more comprehensive discussion see e.g. Blendinger in www.energiekrise.de/forum). Just two aspects should be mentioned:

- In California, oil shales are exploited since more than 100 years. In Germany, oil shales were produced at the Schwäbische Alb during World War II for military purposes. Then, production was conducted under inhuman conditions employing forced labour – but oil was hardly extracted.
- A supposedly promising project for the production of oil shales was started in Australia a few years ago by the Canadian Oil Company Syncrude which produces oil from tar sands. Meanwhile Syncrude has retreated from the Australian project (and has – instead? – invested in the construction of wind parks in Canada).

More realistic is the upscaling of the oil production from tar sands in Canada. About 40 Gb of bitumen from tar sands are regarded as recoverable (at present costs and using known technologies). Tar sands in Canada are produced at increasing rates since about 40 years. About two thirds of the produced bitumen are processed into so called synthetic crude oil.

Tar sand formations originate from organic sediment layers which were not transformed into liquid oil in the geological past, as these formations were not isolated enough and also were not sufficiently heated at great depth. In geological and chemical terms tar sands constitute a precursor to crude oil. The organic substances were preserved in the form of bitumen admixed with lots of sand.

The most extensive bitumen reservoir is located in Athabaska. A thick layer, measuring up to several ten meters and extending over about 77,000 square kilometres, contains 20 percent bitumen at best.

The bitumen is produced in conventional open pit mines. First, the covering upper layer containing no bitumen has to be removed. In some areas close to the Athabaska river this cover layer is just 10 – 20 meters thick. These easily accessible areas have been tapped first by the companies Suncor and Syncrucde in the late 1960s.

But in most cases the cover layer is considerably thicker where open pit mining would be far too expensive. Therefore, those bitumen deposits have to be produced with so called "in-situ" processes. This is achieved by heating the mixture of bitumen and sand in the deposit up to a temperature where the bitumen gets liquid. Then the liquid bitumen can be pumped to the surface. Today, about 10,000 barrels of bitumen per day are produced with "in-situ" processes in pilot plants. (for more details on on-situ production processes see [Busby 2004]. In-situ production is expected to have a maximum share of about 10 percent of total bitumen production from tar sands even by 2015. The following analyses up to the year 2015 are therefore limited to open pit mining.

After the cover layer is removed, the tar sand is extracted with shovel excavators and transported by huge trucks to conveyor belts.

By adding great amounts of water the tar sand is transformed into a liquid mixture before it is transported with conveyor belts to subsequent conditioning stages. In the liquid mixture the sand settles at the bottom whereas the lighter bitumen accumulates at the surface and is separated for further cleaning and conditioning. Canadian tar sands contain on average about 2-3 percent sulphur. Today, in the separation process 2,000 to 3,000 tons of sulphur are produced daily and are in part converted to plaster. A third of the cleaned bitumen is transported to the USA for further processing. Two thirds are further processed in so called "upgraders" close to the mining sites. There the hydrocarbon molecules of the bitumen are split up and with hydrogen from natural gas are processed into synthetic crude oil.

The described processes are complex, expensive and damage the environment. A report by the Canadian National Energy Board from May 2004 states the following facts:

- For each cubic meter of bitumen produced about 2 to 4 cubic meters of fresh water are required even though some purification and recycling of the water is already done. (Note: Today nearly ¼ of the entire fresh water of the Alberta province is used for the extraction of oil-sands.)

- Today, about 4 percent of the West Canadian gas production is used for the extraction and further processing of bitumen to synthetic crude oil. (Note: The use of natural gas for the oil production from tar sands competes with the direct marketing of natural gas. The natural gas used by the tar sands industry often is derived from wells at or close to bitumen containing layers. The Canadian Energy Board decided that some natural gas fields may not be tapped because otherwise the pressure of the gas deposit would get too low and would endanger future in-situ extraction of the bitumen deposits in the area of the natural gas fields. This is a first visible consequence of the competiting natural gas uses.)
- The emissions resulting from the mining of bitumen and processing it to synthetic crude oil are indicated to be per cubic meter of synthetic crude oil 741 kg of CO_2 and 50 kg of CO_2-equivalent of which 42 kg are caused by methane emissions and 8 kg by N_2O emissions. (Note: Related to the energy content, emissions per kWh of synthetic crude oil amount to about 82 g of CO_2. At least another 30 g of CO_2 per kWh have to be added for the processing of the synthetic crude oil into fuel. The combustion of the fuel in a vehicle results in emissions of about 270 g CO_2 per kWh leading to total emissions for fuel production and use of about 380 g CO_2 per kWh. This is as much as the combustion of coal releases and nearly twice as much as is released by the extraction, transport and combustion of natural gas.)

About 1.2 Mb/day of bitumen were produced in Canada in 2006. About 60 percent of this amount will be processed to synthetic crude oil and the remaining bitumen is mainly sold to refineries in the USA. Extending the tar sand production capacities needs big investments and is time-consuming. In the latest oil sands report of the National Energy Board, Canada, it is assumed that the production rate probably will be raised to 3 Mb/day by 2015 with an uncertainty range of between 1.9 Mb/day to 4.4 Mb/day [NEB 2006]. This evaluation is based on the analysis of existing, already started, approved and disclosed projects. The latest update of these projects is summarized in Table 10 according to [Dunbar 2007]. The capacity of the expected new projects until 2015 adds up to 2 Mb/day and would equal about 2 percent of the world oil production. However, the real production might be 10-20 percent below the capacity extensions.

The development of tar sands follows the same pattern as the production of conventional oil - the easy prospects are developed first, but the production rate remains almost constant for several decades.

Table 10: Expected Capacity extensions until 2015 if all projects under construction, approved, disclosed, filed an application or announced will start their operation in time [Dunbar 2007]

Status	Bitumen Upgrading [kb/d]		Mining [kb/d]	In-Situ [kb/d]	Total [kb/d]
	Input	Output			
Operation	885	768	863	520	1,383
Construction	467	407	158	90	248
Approved					
<=2015	550	459	840	409	1,249
>2015				180	180
Disclosed					
<=2015	573	509	220	345	565
>2015	382	376	200	80	280
Application					
<=2015	492	432	164	260	424
>2015	50	45	50	0	50
Announced					
<=2015	628	533	331	825	1,156
>2015	445	377	262	334	596
Total under operation, construction, approved or disclosed until 2015		2,143	2,081	1,364	3,445
Total until 2015 (incl. application, announced)		3,108	2,576	2,449	5,025

Despite the increasing tar-sand production, total Canadian oil production will just rise by about 10-20 percent until 2015 due to the declining production of conventional oil.

Summary of the production assessment for Canadian tar-sands:

- Until 2015, the Canadian tar sand extraction will probably increase by about 1.9 Mb/day up to 3 Mb/day. This will increase total Canadian oil production only by about 10-20 percent.
- Therefore, CO_2 emissions will rise significantly and amount up to 100 million tons/year in 2015.
- About 10 percent of today's natural gas production in Western Canada will be used for the extraction and the processing of the tar sands. As natural gas production in Western Canada has already peaked, the share of natural gas production will presumably be about 20 – 30 percent in 2015. Due to increasing gas prices the tar sand production will rise.
- By 2015 the consumption of fresh water will be about 300 – 500 million m^3 per year. This is equivalent to a river with a flowing speed of two meters per second, with a cross section of 10 – 15 m^2 (at two meters water depth and 5 – 7.5 m width) just for the tar sand production.

- Because of the demonstrated limitations it is not likely that unconventional oil sources in Canada will compensate for the future decline in worldwide conventional oil production. It is much more probable that the further expansion of the production capacities will encounter similar difficulties as observed in the conventional oil production.

The automobile industry might perceive higher greenhouse gas emissions of fuels from non-conventional oil sources as a nightmare.

Annex 4: International oil companies

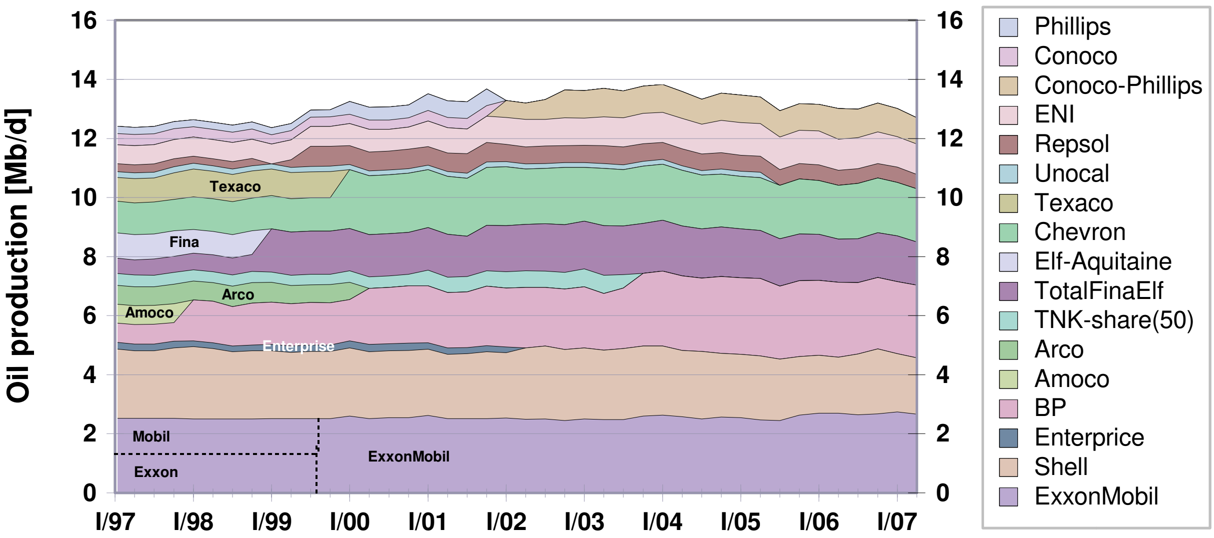
In this annex the production performance and the financial behaviour of major international oil companies in recent years is analysed.

Looking at the operation of major international oil companies over the period of the last 10 years, two developments are striking:

- the wave of mergers, and
- the inability of these companies to substantially raise their aggregate production.

This can be seen in Figure 48.

Figure 48: Oil production of the oil majors from 1997 to 2007



The mergers were necessary to compensate for declining production in individual companies.

Rising expenditures, especially for production, just led to a not very marked peak in 2004 of aggregate production, but production has declined since then. The repeated announcements of the super majors since 2000 to increase their production significantly never did materialise.

Recently, the "lacking access" to more promising oil regions has been blamed by the international oil companies for their disappointing performance regarding production volumes.

It seems that the fact that most of the oil has already been found is also accepted by most oil companies. This can be inferred by analysing their annual budgets for exploration and production which are listed for ExxonMobil, BP, Shell and Eni in the following Table 11. Over the last seven years the exploration expenses were reduced by between 30 to 50%. But the expenses for maintaining the production, in most cases increased considerably. Expenses for production also include the acquisition cost for acquiring other companies with their production capacities. Therefore, this analysis leads to the conclusion that companies prefer to expand their production by mergers and acquisitions instead of by exploring new fields.

Table 11: Company expenses for exploration and production as well as annual production for large western oil companies as published in their annual reports [source: quarterly company reports]

	1998	1999	2000	2001	2002	2003	2004	2005
ExxonMobil								
Expenses for exploration [bn$]	2.2	1.9	1.5	1.7	1.3	1.017	1.119	0.969
Expenses for production [bn$]	13.3	11.4	9.7	10.6	12.7	10.971	10.596	13.501
Production [Mboe/day]	4.272	4.235	4.277	4.255	4.238	4.203	4.215	4.066
BP								
Expenses for exploration [bn$]	0.921	0.548	0.599	0.48	0.644	0.542	0.637	0.684
Expenses for production [bn$]	5.302	3.646	5.784	8.381	9.055	14.828	10.556	9.553
Production [Mboe/day]	3.05	3.107	3.24	3.419	3.519	3.606	3.997	4.014
Shell								
Expenses for exploration [bn$]	1.595	1.062	0.753	0.857	0.915	1.059	1.123	0.815
Expenses for production [bn$]	4.879	3.075	3.048	6.018	12.231	7.070	7.264	10.043
Production [Mboe/day]	3.709	3.634	3.69	3,773	3.997	3.905	3.772	3.518
Eni								
Expenses for exploration [bn$]	0.755	0.636	0.811	0.757	0.902	0.712	0.543	0.656
Expenses for production [bn$]	2.127	2.632	2.728	3.519	4.713	4.969	4.378	4.308
Production [Mboe/day]	1.038	1.064	1.187	1.369	0.921	0.981	1.624	1.737

This is also shown in Figure 49 for the three largest private western oil companies ExxonMobil, BP and Shell.

This is even better illustrated by the example of Shell which ten years ago was the largest private western oil company (see Figure 50). Production has declined since 1998 by 20% despite the fact that the expenses for E&P have quadrupled, that a medium size company (Enterprise) was added to the production base and that first production from Canadian tar sands started in 2003.

Figure 49: Exploration and production expenditures of super major and buy back of shares

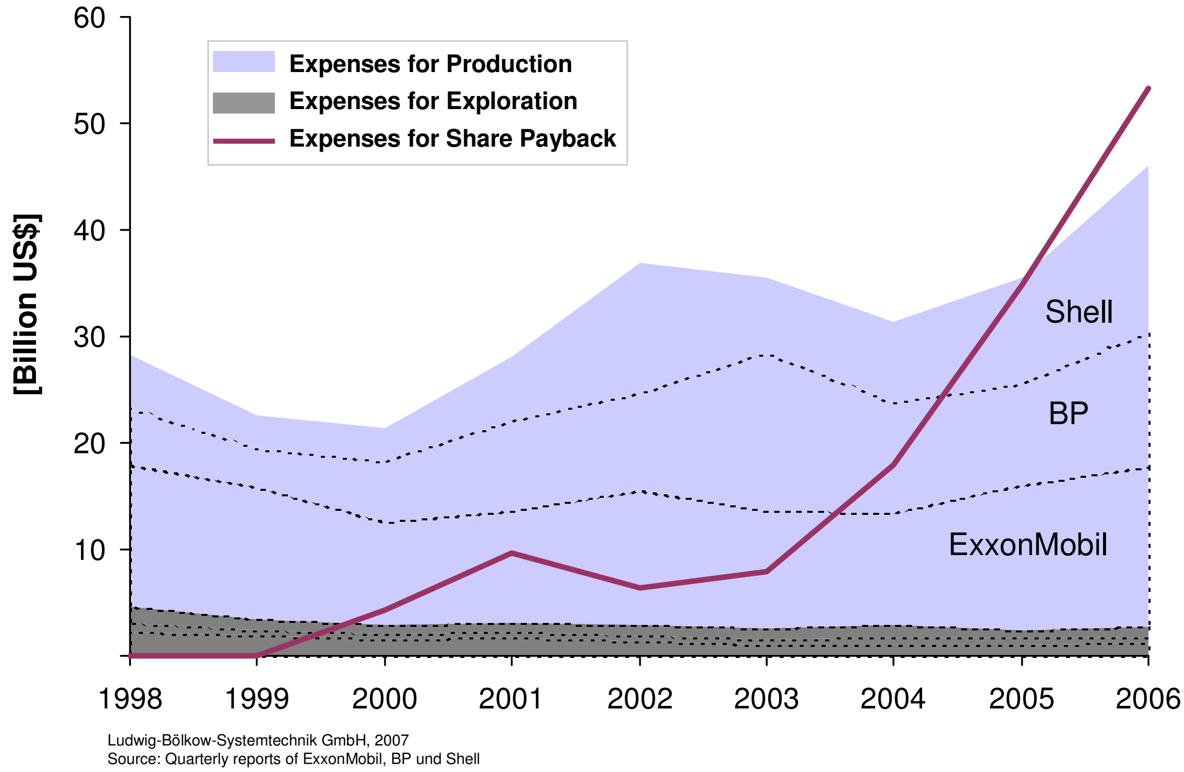
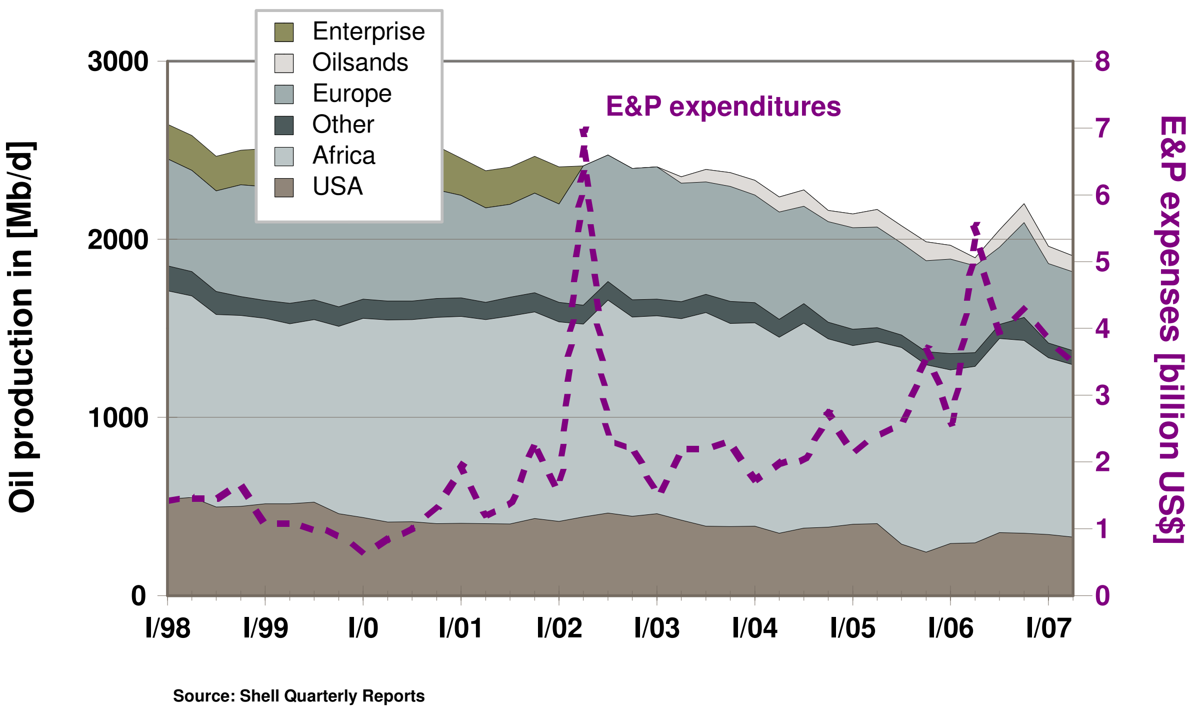


Figure 50: Shell – oil production and exploration and production (E&P) expenditures



LITERATURE

[Bakhtiari 2004] Samsam Bakhtiari „World oil production capacity model suggest output peak by 2006-07“, Oil & Gas Journal. April 26th, 2004

[BGR 2002] Reserven, Ressourcen und Verfügbarkeit von Energierohstoffen 2002, Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover 2003, p. 104.

[BP 2004] BP Statistical Review of World Energy 2004, (www.bp.com)

[BP 2006] BP Statistical Review of World Energy

[Busby 2004] John Busby, "Canadian Tarsands", ASPO Newsletter No 37, December 2004

[Campbell 1998] C.Campbell, J. Laherrere, The imminent Peak of World Oil Supply, Scientific American March 1998

[CERA 2006] CERA (Cambridge Energy Research Associates), "Why the 'Peak Oil' Theory Falls Down – Myths, Legends, and the Future of Oil Resources", Cambridge Mass., November 2006

[De Lucia 1999] Marshall De Lucia, Offshore, April 1999, p. 40-42

[Dunbar 2007] R.B. Dunbar, "Existing and Proposed Canadian Commerical Oil Sand Projects", Strategy West Inc. June 2007, www.strategywest.com

[EIA 2000] US-EIA Presentation : Long Term World Oil Supply, (http://www.eia.doe.gov/pub/oil_gas/petroleum/presentations/2000/long_term_supply/index.htm)

[EIA 2004] US Annual Energy Outlook 2004, Energy Information Administration, (http://www.eia.doe.gov/oiaf/aeo/index.html)

[IHS 2006] Petroleum Exploration and Production Statistics (PEPS), IHS Energy, Geneva and London 2006

[Masters 1990] C.D. Masters, D.H. Root, E.D. Attanasi, World Oil and Gas Resources – Future Production Realities, US Geological Survey, in Ann. Rev. Energy 1990, vol. 15, p. 23-51

[NEB 2006] Canada's Oil Sands, Opportunities and Challenges to 2015: An Update, An Energy Market Assessment, June 2006, National Energy Board, Canada, (www.neb.ca)

[Petroconsultants 1995] C.J. Campbell, J.H. Laherrere, "The World's Oil Supply 1930-2050", Petroconsultants (ed.) Geneva 1995

[Robelius 2007] Fredrik Robelius, “Giant Oilfields – The Highway to Oil], Uppsala, 2007

[Simmons 2004] M. R. Outlook 1998”, Paris, 1998

[WEO 2000] International Energy Agency, “World Energy Outlook 2000”, Paris, 2000

[WEO 2002] International Energy Agency, “World Energy Outlook 2002”, Paris, 2002

[WEO 2004] International Energy Agency, “World Energy Outlook 2004”, Paris, 2004

[WEO 2005] International Energy Agency, “World Energy Simmons, “The Saudi Arabian Oil Miracle”, presentation at the Center for Strategic and International Studies (CSIS), Washington, 24 February, 2004

[Simmons 2005] M. R. Simmons, “Twilight In The Desert – The Coming Saudi Oil Shock And The World Economy”, John Wiley & Sons, 2005

[Skrebowski 2006] Chris Skrebowski, “Open letter to Peter Jackson of CERA”, Oil Depletion Analysis Center (ODAC), 21 Dec 2006

[Söderberg 2007] A Crash Program Scenario for the Canadian Oil Sands Industry, B. Söderberg, F. Robelius, K. Aleklett, Energy Policy, volume 35, issue 3, march 2007, pp 1931-1947

[Staniford 2007] Stuart Staniford, “A Nosedive towards the Desert”, www.theoildrum.com/ node/2331

[USGS 1996] D.L. Gautier, G.L. Dolton, K.I. Takahashi, K.L. Varnes, eds. 1996, „National assessment of United States oil and gas resources---Results, methodology , and supporting data: U.S. Gelogical Survey Digital Data Series DDS-30, Release 2

[USGS 2000a] USGS World Petroleum Assessment 2000; (www.usgs.gov)

[USGS 2000b] „USGS Reassesses the Potential World Petroleum Resources: Oil estimates up, gas down“, USGS press release and US-DoE from March 22nd, 2000

[WEO 1998] International Energy Agency, “World Energy Outlook 2005”, Paris, 2005

[WEO 2006] International Energy Agency, “World Energy Outlook 2006”, Paris, 2006

From: Mark Robinowitz

To: Columbia River Crossing;

CC:

Subject: Columbia River Crossing DEIS Comments attachments - "Saving Oil in a Hurry" "Powerdown" "Dept of Energy Future U.S. Highway Energy Use: A Fifty Year Perspective"

Date: Tuesday, July 01, 2008 2:09:03 AM

Attachments: DOE-highways-may2001.pdf
powerdown-intro.pdf
ATT5516209.txt
Saving-Oil-in-Hurry.pdf
ATT5516210.txt

Saving Oil in a Hurry: Oil Demand Restraint in Transport

Workshop on Managing Oil Demand in Transport

Bob Noland
Centre for Transport Studies
Imperial College London

Imperial College London

Background

- Oil supply security a core mission
- Transport the biggest oil consuming sector
- IEA countries required to develop measures to conserve oil on very short notice
- In last 30 years many innovative transport policy experiments have occurred

Key issues

- How flexible is transport demand?
- Does this vary under emergency conditions?
- What variation might there be between IEA regions?
- Which policies are most effective and how cost effective they?
- What methods can IEA countries use to develop their own plans and policies?

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Flexibility of transport demand (1)

- Demand for travel is relatively insensitive to many of the policies implemented
  - car trips and trip length continue to increase
  - most policies implemented have only minor impact
  - however, these are mainly focussed on providing increased choice rather than increasing restraints

Flexibility of transport demand (2)

- Recent experience suggests flexibility exists – when policies or conditions increase constraints
  - British fuel crisis in 2000
  - Congestion Charging in London
  - Road closures and suppression of demand

What happens under emergency conditions?

- One would expect increased flexibility
  - altruistic behaviour, actual shortages, price spikes
  - more restrictive policies may be more politically acceptable, especially if short-term
- Policy measures must be able to save oil quickly, on short notice
  - however, in some cases, significant pre-planning is necessary
  - up-front costs may be substantial for some measures

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Rationale for short-term restraint

- Most measures aim to allow a greater reaction by consumers to supply shortage or price spikes than would otherwise occur
- Increased responsiveness can save consumers money, reduce negative impacts, shorten duration of emergency
- Pricing measures not especially relevant, particularly if oil prices already high
  - however, governments should not reduce existing taxes as this could lead to increased demand

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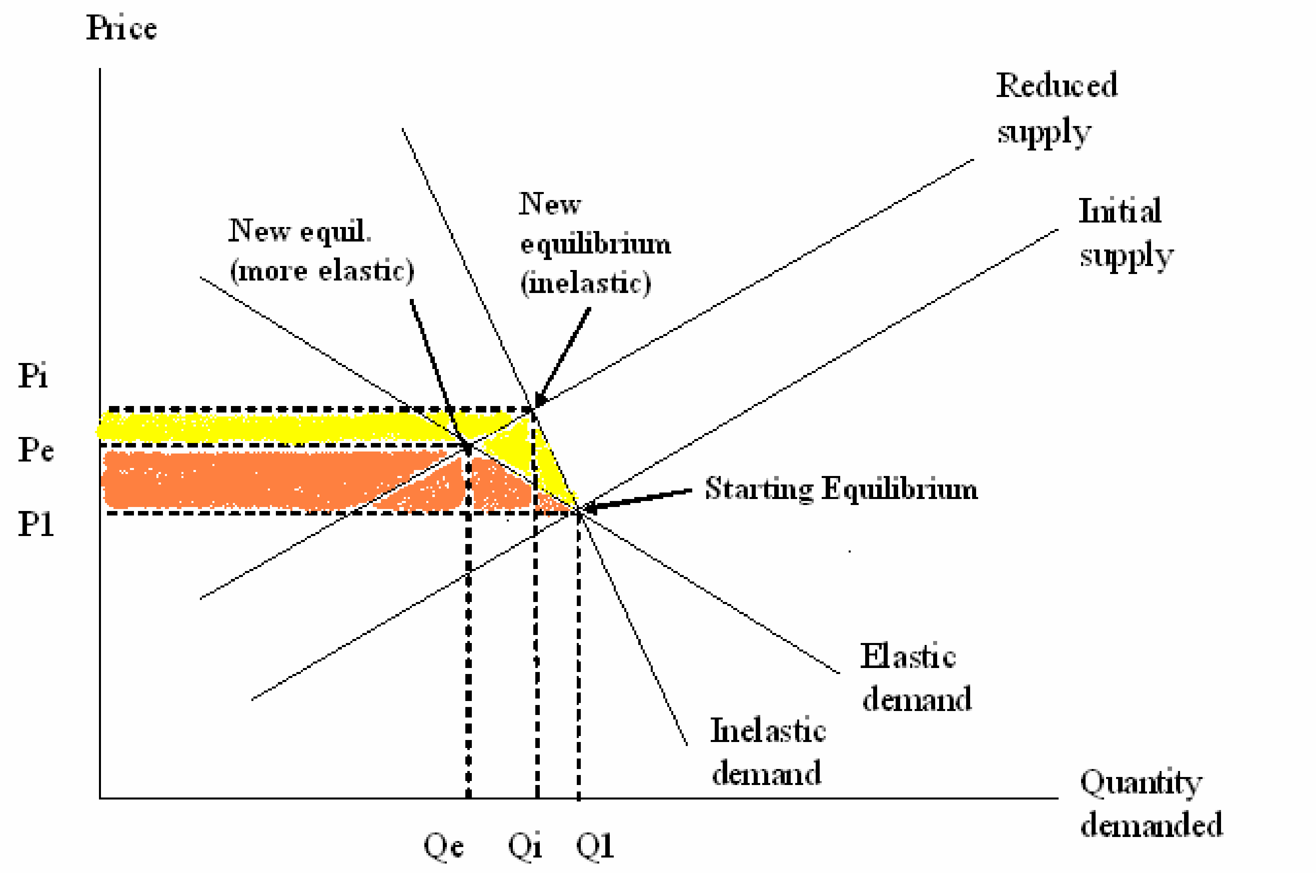
Effects of increasing elasticity of demand response during price spike

(loss in consumer surplus is orange area instead of yellow + orange…)



Measures Considered

- Increases in public transport usage
- Carpooling
- Telecommuting / work schedule changes
- Driving bans / restrictions
- Speed limit reductions
- Information on tyre pressure effects

Methodology

- Relatively simple methods were developed
- Based on data from each country or region, where available
- review of how similar policies have affected behaviour
  - mode split, carpooling effectiveness, telecommuting potential, etc.
  - these are based on non-emergency conditions, so may be low estimates of effectiveness

Sample calculation: Telecommuting potential (1)

- Difficult to connect actual policy to outcome
  - promotion campaign, home computer subsidies, company commitment for emergency circumstances (or sign-up)
- Approach is to measure potential for telecommuting, based upon existing knowledge
  - not all jobs are ‘telecommutable’
  - telecommuting is a transient phenomenon

Sample calculation: Telecommuting potential (2)

- **Step 1:** Examine existing studies
  - US DOE (1994) estimates that information workers will be 61.1% of all workers by 2010
  - and potentially 44.9% will telecommute
  - but not all the time, and not forever, based on recent work of Mokhtarian
  - some evidence that non-work driving increases for those telecommuting

Sample calculation: Telecommuting potential (3)

- **Step 2:** Estimate potential ‘telecommutable’ jobs
  - examined US data on job categories and number of employees in each
  - led to estimate that 58% could telecommute
  - this detail was not available for other countries, but EU estimates of fraction of employment in service sector jobs was comparable

Sample calculation: Telecommuting potential (3)

- **Step 3:** Need data on
  - average commute length
  - private car trips
  - average car occupancy
  - total employment
  - fuel economy by country
  - current telecommute levels

	Japan/ RK	IEA Europe	US/ Canada	Australia/ NZ
Average commute length (km)	14	9	17	13
Percent private car trips	42%	49%	86%	79%
Total employed (millions)	85.0	133.0	144.6	8.4

Sample calculation: Telecommuting potential (4)

- **Step 4:** Calculate Maximum Telecommuting Fuel Savings (*MTFS*)
  - *TE = Total number employees who could feasibly start to telecommute*
  - *L = Average commute trip length (km)*
  - *C = Modal share of commute trips currently done by car (%)*
  - *R = Average car occupancy rate*
  - *F = Average fuel intensity of vehicle fleet (liters/100km)*

$$MTFS = \frac{TE \cdot L \cdot C \cdot F}{R \cdot 100} (litres)$$

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Telecommuting Fuel Savings Potential – Results (1)

- 6 potential scenarios:
  - telecommute everyday
    - 100%, 50% and 25% take-up among "telecommutable" job holders
  - telecommute twice a week
    - 100%, 50% and 25% take-up
  - all assume a 25% increase in non-work driving
- Other scenarios easy to calculate

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Telecommuting Fuel Savings Potential – Results (2)

Percent Total Fuel Saved	Japan/ RK	IEA Europe	US/ Can	Aus/ NZ	Total, IEA
Telecommute every day					
Maximum potential fuel savings (all regions), 100% take-up	5.8%	2.9%	8.5%	7.1%	6.4%
Low estimate, 25% up-take	1.5%	0.7%	2.1%	1.8%	1.6%
High estimate, 50% up-take	2.9%	1.4%	4.2%	3.6%	3.2%
Telecommute only 2 times/week					
Maximum potential fuel savings (all regions), 100% take-up	2.3%	1.2%	3.4%	2.9%	2.6%
Low estimate, 25% up-take	0.6%	0.3%	0.9%	0.7%	0.6%
High estimate, 50% up-take	1.2%	0.6%	1.7%	1.4%	1.3%

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Telecommuting Fuel Savings Potential – Results (3)

- Consensus estimate (based on previous results):
  - assumes employers are supportive of telecommuting and have provided resources to employees

	Japan / RK	IEA Europe	US / Can	Aus / NZ	Total
Thousand barrels saved per day	88	102	523	21	734
% transport fuel saved	4.2%	1.8%	4.4%	4.0%	3.7%
% total fuel saved	2.3%	1.2%	3.4%	2.9%	2.6%

Sample calculation: Driving ban (1)

- Driving bans will normally allow drivers to only use their car on certain days of the week (e.g. based on licence plate numbers)
- Has been used in Mexico City and Athens for air pollution reduction
  - evasive behaviour has undermined effectiveness as a long-term policy
- Very effective during short-term use during Paris pollution crisis in 1997
  - one day reduction of about 30%
  - evasive behaviour more difficult, altruistic effect, other modes available

Sample calculation: Driving ban (1)

- **Step 1:** Examine existing studies
  - – other than studies showing the failure of the Mexico City policy, there was little information
  - – web information showed that short-term policy was effective in Paris
  - – driving bans were under active consideration during the 1970’s crisis
  - – DIW study in 1996 did not consider behavioural effects

Sample calculation: Driving ban (2)

- **Step 2**: Consider behavioural mechanisms
  - As household car ownership increases, ability to evade ban increases
    - Probability of car availability can be expressed as $P=B^n$
      - *B=percent vehicles available on a given day*
      - *n=number of vehicles owned in a given household*
    - Availability of other modal choices makes policy more feasible
  - Assumptions:
    - all trips previously taken are made if vehicle allowed on that day
    - no increase in driving from giving rides to those without car
    - further adjustment assumes all work VKT still occurs (i.e., some people are driven by others to work, more circuitous routing occurs, etc.)
    - Overall, off-sets represent some increase in driving when it is allowed

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Sample calculation: Driving ban (3)

- **Step 3**: Data on car ownership distribution
  - not readily available, so needed to make assumptions for most regions based on limited data

	City of San Francisco (1990)	Bay Area excluding City of San Francisco (1990)	without zero-vehicle house-holds	UK data (2001)	without zero-vehicle house-holds
Zero vehicle	30.7%	7.4%		27.0%	
One vehicle	41.6%	32.5%	34.5%	44.0%	60.3%
Two vehicle	21.1%	3.9%	41.4%	23.0%	31.5%
Three-Plus vehicles	6.6%	22.6%	24.1%	6.0%	8.2%

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Sample calculation: Driving ban (4)

- **Step 4**: Calculate off-sets to maximum VKT reduction
  - Estimate of VKT reduction and off-sets with odd/even ban (billion VKT and percentages)

	Japan/RK	IEA Europe	US/ Canada	Aus/NZ
50% VKT reduction applied to all VKT	1.5	4.2	6.6	0.3
Adjust for HH vehicle ownership	1.1	3.3	4.0	0.2
Assume all commute VKT still made	0.7	2.7	2.1	0.2
Off-set to maximum savings	21.9%	21.9%	38.8%	21.9%
Off-set with all commute VKT still made	49.5%	34.2%	68.1%	48.6%

Odd/even driving ban - Results

Percent total fuel saved	Japan/ RK	IEA Europe	US/ Can	Aus /NZ	Total
50% VKT reduction applied to all VKT	27.2%	31.0%	37.2%	34.3%	33.9%
adjust for HH vehicle ownership	21.2%	24.2%	22.8%	26.8%	23.1%
assume all commute VKT still made	13.7%	22.4%	9.5%	14.7%	14.2%

Estimated fuel savings of policy measures

- Estimates contain many assumptions and caveats on actual reductions
  - However, good confidence of the order of magnitude of various policy measures
    - **VERY LARGE**: more than one million barrels/day
    - **LARGE**: more than 500 thousand barrels/day
    - **MODERATE**: more than 100 thousand barrels/day
    - **SMALL**: less than 100 thousand barrels/day

Estimated fuel savings of policy measures: **VERY LARGE savings**

Carpooling: large programme to designate emergency carpool lanes along all motorways, designate park-and-ride lots, inform public and match riders
Driving ban: odd/even licence plate scheme. Provide police enforcement, appropriate information and signage
Speed limits: reduce highway speed limits to 90km/hr. Provide police enforcement or speed cameras, appropriate information and signage

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Estimated fuel savings of policy measures: **LARGE savings**

Transit: free public transit (set fares to zero)
Telecommuting: large programme, including active participation of businesses, public information on benefits of telecommuting, minor investments in needed infrastructure to facilitate
Compressed work week: programme with employer participation and public information campaign
Driving ban: 1 in 10 days based on licence plate, with police enforcement and signage

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Estimated fuel savings of policy measures: **MODERATE savings**

Transit: 50% reduction in current public transit fares
Transit: increase weekend and off-peak transit service and increase peak service frequency by 10%
Carpooling: small programme to inform public, match riders
Tyre pressure: large public information programme

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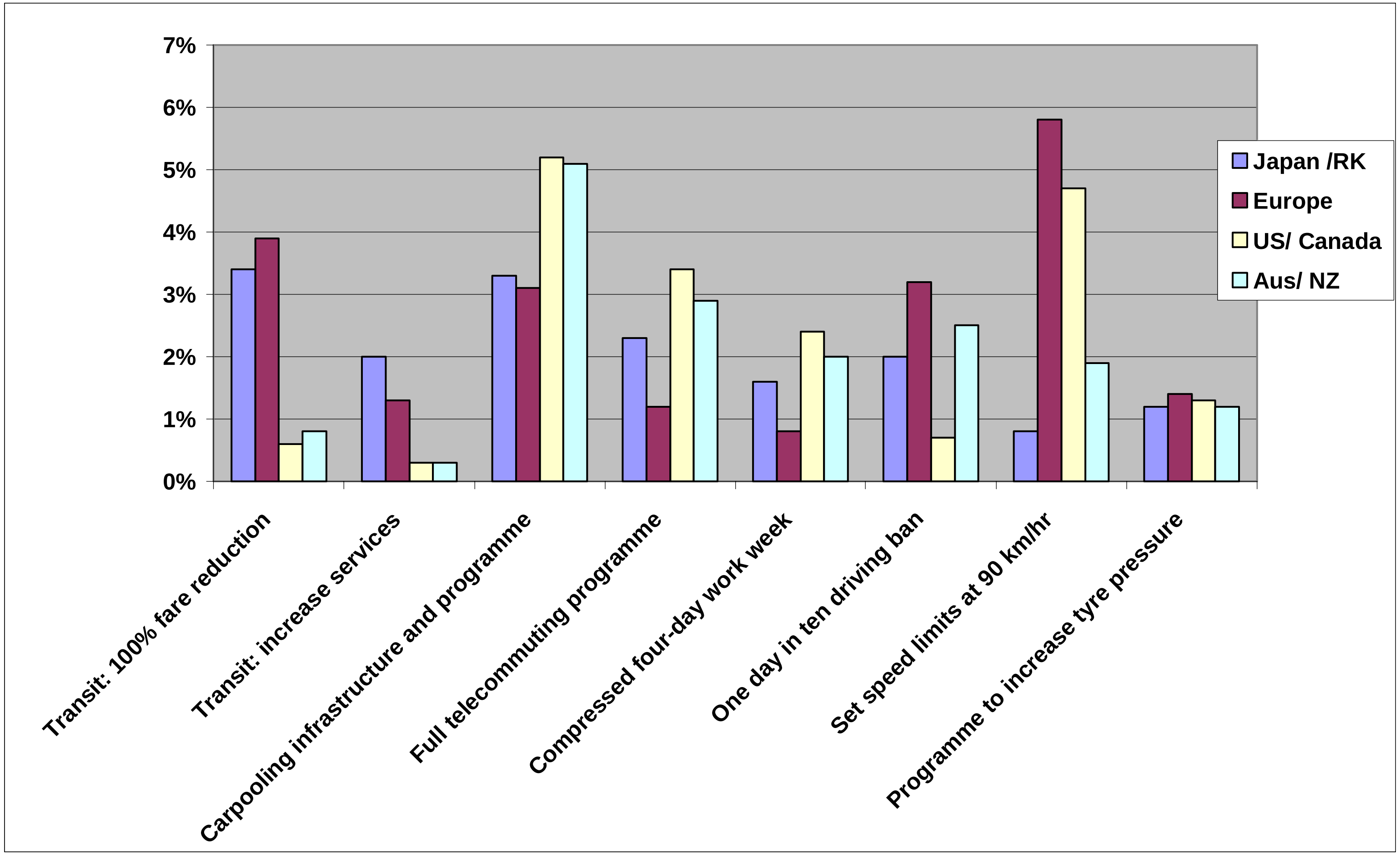
Estimated fuel savings of policy measures: **SMALL savings**

Bus priority: convert all existing carpool and bus lanes to 24-hour bus priority usage and convert some other lanes to bus-only lanes

Percent reduction in total fuel use by IEA region, selected measures



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Cost Effectiveness Calculations

- Main Assumptions:
  - Costs are those borne by governments (i.e., transfer payments not excluded)
  - Includes cost of planning and investment to be prepared for emergency
  - Includes costs undertaken during emergency
  - Most important caveat: consumer indirect costs (time, safety) not included – and these can be very large!
    - Consumer mobility benefits may be large if measure provides alternative travel or non-travel options
  - Emergency situation assumed to last 90 days
  - No linkage between amount of outreach and consumer response

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Cost effectiveness - Results

- Categorised as follows:
  - **VERY INEXPENSIVE**: less than $1 per barrel saved
  - **INEXPENSIVE**: less than $10 per barrel saved
  - **MODERATE**: less than $50 per barrel saved
  - **EXPENSIVE**: more than $100 per barrel saved
- Effectiveness shown as: Very Large, Large, Moderate, Small

  - note: no measures were between $50-$100 per barrel saved

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VERY INEXPENSIVE measures

	Other Potential Impacts
Carpooling: large programme to designate emergency carpool lanes along all motorways, designate park-and-ride lots, inform public and match riders	
Driving ban: odd/even licence plate scheme. Provide police enforcement, appropriate information and signage	Possibly high societal costs from restricted travel
Telecommuting: large programme, including active participation of businesses, public information on benefits of telecommuting, minor investments in needed infrastructure to facilitate	
Compressed work week: programme with employer participation and public information campaign	
Tyre pressure: large public information programme	Likely safety benefits
Carpooling: small programme to inform public, match riders	

INEXPENSIVE measures

	Other Potential Impacts
Speed limits: reduce highway speed limits to 90km/hr. Provide police enforcement or speed cameras, appropriate information and signage	Safety benefits but time costs
Driving ban: 1 in 10 days based on licence plate, with police enforcement and signage	Possibly high societal costs from restricted travel

MODERATE COST measures

Bus priority: convert all existing carpool and bus lanes to 24-hour bus priority usage and convert other lanes to bus-only lanes

EXPENSIVE measures

Telecommuting: Large programme with purchase of computers for 50% of participants
Transit: free public transit (set fares to zero); 50% fare reduction similar cost
Transit: increase weekend and off-peak transit service and increase peak service frequency by 10%

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Conclusions

- *Those policies that restrict driving are most effective*
  - driving ban, mandatory carpooling, speed limit reduction are all cost effective
  - more restrictive policies are politically unpopular
  - may be “expensive” in terms of reduced mobility
- Voluntary carpooling also effective and cost effective, but not when expensive infrastructure needed
- Telecommuting and compressed work weeks could be effective and cost effective, if businesses are supportive
- Transit options are generally expensive with small to moderate savings
  - would need long-term pre-planning to significantly increase transit service (which may provide other benefits)

Other Conclusions / Next Steps

- Analysis has been reasonably thorough, but…
  - Behavioural reactions very difficult to estimate; many simplifying assumptions have been made
  - Some costs very difficult to measure (e.g. time, safety)
  - Effect of varying outreach costs should be considered, but no evidence available
  - Synergistic effects not considered!
- Countries should expand on this analysis in their own context
- More empirical evidence would be helpful! When disruptions do occur, countries should carefully monitor the success of their actions – *need to be ready to measure and analyze effects*

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INTRODUCTION

When I was a boy in the countryside — fifty years ago and more — people [gardened] for self-sufficiency, for it would not have occurred to them to do otherwise. People were self-reliant because they had to be: it was a way of life. They were doing what generations had done before them; simply carrying on a traditional way of life. Money was a rare commodity: far too valuable to be spent on things you could grow or make yourself. It was spent on tools or fabric for clothes or luxury foods like tea or coffee. They would have laughed at a diet of store-bought foods. . . .

—John Seymour, *The Self-Sufficient Gardener* (1979)

I am in the cabin of an MD80 jetliner en route from San Francisco to Dallas. It is night, and as I look out the airplane window I see a dense web of lights spread upon the darkened landscape. It is a beautiful sight, and yet a profoundly disturbing one. Aside from streetlamps, nearly every one of those tiny lights emanates from a house, or from a car crawling across the landscape.

Each tells an individual human story of struggle for survival and prosperity. And each is in some way connected back to a fossil-fuel energy source.

That source has its own story — one that began hundreds of millions of years ago, but that will end within the lifetime of children now living, as our fossil-fuel inheritance is burned once and for all. What will then happen to all of these lights — and to the lives to which they are tied?

It is a poignant thought, and an ironic one given the context in which it appears. I am looking out and down from the interior of a machine that is being forcibly thrust up into the sky — again by the burning of fossil fuels. The walls and fabrics that surround me are mostly made of fossil fuels. So too, to a large degree, is the computer on my lap.

As I think about my computer, the irony deepens. Just as I can look down from this airplane and take in a hundred square miles at a glance, I can take in information through my computer (when it is Internet-connected) and look down, as it were, on current events, human history, and human cultural geography as few humans could have hoped to do only decades ago.

And what a view one gets from this information pinnacle! A century ago our recent ancestors were riding in horse-drawn carts; today we have photos taken from the surface of Mars. We have landed humans on the Moon. We have covered huge expanses of our planet with seas of concrete on which to drive and park our billion cars. We have built skyscrapers and diverted great rivers. There are roughly as many humans alive now as existed cumulatively throughout all of the millennia prior to the Industrial Revolution. That means that a large proportion of all of the geniuses — and monsters — who have ever lived are alive today. And whenever one of these extraordinary individuals does something, we can hear about it instantly via our global communications networks.

Most of this edifice of modernity has been constructed within a single human lifetime: I still occasionally speak with people who can recall seeing the first automobile arrive in their town. And we are seeing the brief flowering of industrialism, in all its magnificence, with our own eyes, in real time. What a show!

But that's not all we see.

We have climbed very high, but also very far out on a spindly ecological limb. We may live, as Paul Simon once put it, in "an age of miracles and wonders," but we also live in a time in which several "storms" are colliding, as in the book and movie *The Perfect Storm:*

- **Resource depletion:** From the standpoint of the global economy, probably the most immediate threat comes from the depletion of fossil fuels (both oil and, in North America and Britain, natural gas). But fresh water resources, wild oceanic fish stocks, phosphates (necessary for agriculture), and topsoil are also dwindling.
- **Continued population growth:** While the rate of global population growth shows signs of slowing, the total reached six billion in 1998, and in the six years since that time we have added an additional 400 million humans — nearly the population of North America.
- **Declining per-capita food production:** For nearly the entire 20th century, food production outpaced population growth. However, world grain harvests for the past five years reveal a frightening trend: it appears that the trajectory of per-capita grain production has leveled off and may be beginning to fall, probably for a variety of reasons (including loss of arable land to urbanization, fresh water shortages, and bad weather).
- **Global climate change and other signs of environmental degradation:** Agricultural civilizations have developed over just the past few thousand years — an eyeblink in geological time. This has been a period characterized by a relatively stable, benign global climatic regime. Now that regime appears to be coming to an end, almost certainly as the result of a human-induced enhancement of the atmospheric greenhouse effect. It is unclear whether civilization can persist in a less favorable and less stable climate, as food production could be

even further imperiled. If the world's sea levels rise significantly, as they are predicted to do as a result of the partial melting of polar ice, many coastal cities would be inundated. Moreover, concerns are now being raised that cold, fresh water from melting Greenland glaciers may halt the Gulf Stream and plunge Europe and much of North America into a new ice age.[1]

- **Unsustainable levels of US debt and a potential dollar collapse:** Since World War II, the world has relied on the US dollar as the basis for monetary stability. Increasingly, the US has taken advantage of this situation by running up ever-larger trade deficits and more foreign-financed government debt. The current level of American debt — internal and external — is unprecedented and unsustainable, and US Treasury officials have made efforts in 2003 and early 2004 to gently lower the value of the dollar in relation to other currencies. However, if the dollar is devalued too much, other nations (including China and Japan) may decide to cease investing their savings in American stocks and Treasury securities; this in turn could trigger a dollar collapse. In short, the global monetary system that has maintained relative stability for the past several decades appears to be fraying. Just when the nations of the world need to invest heavily in renewable energy systems, efficiency measures, and sustainable agricultural production in order to deal with problems previously mentioned, investment capital may disappear altogether in a global financial crisis.[2]
- **International political instability:** The recent declaration by the US that it has a right to preemptive war, and its use of that "right" as a rationale for its invasion of Iraq, could potentially plunge international affairs into a new era of lawlessness. Henceforth, an attack by any nation on any other could be justifiable as self-protection against imagined future threats. Meanwhile, the development and proliferation of new space-based, electronic, genetic, and micro-nuclear weapons opens

> the possibility for ever deadlier forms of warfare, of which some have the potential to wipe out entire ethnic populations or to render whole continents uninhabitable.

These problems are related to one another in complex, often mutually reinforcing ways. Taken together, they constitute the most severe challenge our species has ever faced. They represent not merely a likely culmination of human history; in their ongoing and potential environmental impacts, they also may collectively signal one of the most momentous events in all of geological time.

This confluence of unprecedented achievements and threats — which most of us have learned to take for granted as being the ordinary state of affairs for humanity — is overwhelming when one contemplates it *in toto,* as if seeing from above. But usually we see it only one bit at a time, and we prefer *not* to think about how the parts may combine into one terrible whole.

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Everyone knows the classic scene from a dozen Westerns: a self-reliant, grizzled geezer is taken to see a doctor, perhaps for the first time in his life. He knows the prognosis intuitively and is prepared for the worst. "Tell me the truth, Doc."

That's how some of us feel when we read about climate change or the ongoing degradation of the world's coral reefs. *Give it to me straight: I'd rather know than live in denial.*

But most of the leaders of government and industry feel differently. They are more like the character Colonel Jessup, played by Jack Nicholson, in *A Few Good Men* (1992). In that film's climactic courtroom scene, Lieutenant Kaffee (Tom Cruise), cross-examining Jessup, insists, "I want the truth." Jessup shouts back, "You can't handle the truth!"

Nor, it seems, can we — at least not in the estimation of the masters of the corporate media. And so we tend to receive only sanitized versions of the news about our world. Occasionally, disturbing information does appear on television or in the newspapers, but the offending story usually shows up buried in the same broadcast, or on the same page, as others about relatively ephemeral political developments, local murders, the lives of entertainment stars, or scores in sports games.

A recent example: on May 15, 2003, nearly every newspaper in the world headlined the disturbing results of a study published that day in the prestigious British science journal, *Nature*. In their article titled "Rapid worldwide depletion of predatory fish communities," Ransom A. Myers and Boris Worm had reported, "Our analysis suggests that the global ocean has lost more than 90 percent of large predatory fishes." Most of this depletion is attributable to the fishing industry. In many species, when populations are reduced beyond a certain point, recovery becomes impossible. Many fish species appear to be beyond, at, or close to that point of no return. With this news story, the world human community was effectively put on notice that the oceans may be dying.

That same day, other newspaper headlines included: "Menem Pulls Out of Argentina Race," and "Israeli Forces Kill Five in Gaza Raid." Argentinean politics and the ongoing Israeli occupation of Palestine certainly deserved whatever coverage they got that day, but how was the average reader to weigh the relative importance of the three news items? In the following days there were more headlines about the Argentinean elections, and about further violence in occupied Palestine. But the story about the oceans largely vanished from view, and it is likely that only a tiny percentage of the population understood its importance enough to go out of their way to seek out follow-up items during the following weeks and months. Most people likely did not notice, for example, an article by Richard Sadler and Geoffrey Lean titled "Fish Stocks and Sea Bird Numbers Plummet as Soaring Water Temperatures Kill Off Vital Plankton," published on October 19th of the same year in the British newspaper, *The Independent*. As a result of global warming, "the North Sea is undergoing 'ecological meltdown,'" the authors reported, according to startling new research. Scientists say that they are witnessing "a collapse in the system," with devastating implications for fisheries and wildlife. Record sea temperatures are killing off the plankton on which all life in the sea depends, because they underpin the entire marine food chain. Fish stocks and sea bird populations have slumped.[3]

On the day it was published, this story was generally drowned out by "Pope Beatifies Mother Teresa," and "Blair Back at Work after Heartbeat Scare." Perhaps the folks in charge are right: maybe we *can't* handle the truth (though it's nice to be given the chance). Most of us do seem to enjoy our pleasant illusions, after all.

We get plenty of help in this regard from the relentlessly cheery entertainment industry, but also from politicians of every stripe. Trying to tell the public truly awful news is considered impolite — unless it is news about something that can be blamed on an opposing political group or some foreign enemy. While leftists sometimes highlight certain ecological crises as a way of blaming corporations and right-wing governments, they often make sure to frame their complaints in a way that suggests that the problems can be solved by implementing a plan being put forward by liberal politicians or NGOs. Meanwhile, commentators on the political right revile "environmental alarmists" for allegedly exaggerating the seriousness of ecological dilemmas to suit their own ideological purposes.

So, as leftists make skewed and half-hearted attempts to discuss ecological crises, the attacks from the right have their intended chilling effect. Mainstream environmentalists these days often tend reflexively to pull their punches and temper their warnings. There are serious problems facing us, they say again and again, but if we just make the right choices those problems will painlessly vanish. When they are at their most baleful, environmental scientists tell us that we have the current decade in which to make fundamental changes; if we don't, then the slide into ecological ruin will be irreversible. On the first Earth Day we were told we had the decade of the 1970s in which to change course; but for the most part we didn't. Then we had the '80s . . . ditto. During the 1992 Earth Summit in Rio we heard that humanity had the '90s to reform itself; after that, there might be no turning back. There was still no fundamental change in direction, and here we are a dozen years on. I expect any day now to read an official pronouncement to the effect that we have the remainder of the first decade of the new century in which to make changes, *or else*. How many warnings do we get? Isn't it reasonable by now to assume that we are living on borrowed time?

The environmentalists' timidity about saying that we are past the expiration date on facile hope is understandable. No one wants to be viewed as Chicken Little. In *The Population Bomb* (1968), biologist Paul Ehrlich wrote that it was then already too late: "In the 1970s the world will undergo famines — hundreds of millions of people are going to starve to death in spite of any crash programs embarked upon now." Throughout the book, he made other specific — and, in retrospect, very unwise — forecasts. Of course, the Great Famine of the 1970s never happened. To be sure, millions of people starved during that decade, but not in a dramatic enough way to justify Ehrlich's Jeremiad. Ever since then, whenever an environmentalist releases a new time-stamped warning, some commentator chirps, "We've heard it before: those prophecies of doom are always wrong. Why should we listen now?" Most environmentalists are scientists, and scientists are accustomed to couching their assertions in cautious terms anyway. Add to this the Chicken Little factor, and one can hardly blame them for shying away from plain talk about the inevitable consequences of our present pattern of existence.

In his immediate predictions, Ehrlich was indeed mistaken. But in principle he was undeniably correct: if we don't voluntarily reverse human population growth, nature will do it for us.

During the past three decades, industrial civilization has managed to pull a rabbit out of a hat: food production mostly stayed ahead of population growth. We *seemed* to have dodged the bullet. But now, instead of the 3.5 billion humans who were around when *The Population Bomb* was published, we are 6.4 billion — a far larger target — and our ability to duck and weave is quickly waning. World per-capita grain production is falling and ecosystems are failing. Still, today almost no one talks about the need for population reduction in the courageous and straightforward way that Ehrlich did back in the late 1960s. No, we've learned to be more cautious and nuanced in our comments about the coming demographic holocaust.

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I cannot help but write precisely the kind of book that I myself would want to read. And I am one of those grizzled geezers who would rather know the truth, however alarming it may be. I can only trust that there will be others similarly inclined.

For the past couple of decades I have been a full-time independent information worker — a journalist, editor, newsletter publisher, researcher, and college professor. Though I teach a course in human ecology, I have no formal specialty: I am a generalist. My goal is simply to gain an accurate overview of what is happening in the world. In order to do this, I have had to learn how to prioritize information. I have developed the habit of asking, *what is the most important thing to know in order to understand this situation?* This effort to prioritize has led me to realize the crucial role of energy in ecosystems and human societies, and of fossil fuels in modern industrial societies. And this realization in turn led me to write my recent book, *The Party's Over: Oil, War and the Fate of Industrial Societies.* There, I recounted how the Industrial Revolution grew out of our increasing use of fossil fuels — first coal, then oil. I described the 20th century as the Petroleum Century, a one-time special event in human history. During this spectacular period, total global commercial energy production increased by about 9 times, and efficiency gains doubled that figure in terms of utilized energy, yielding an overall 18-fold rise in energy available to human beings. It was this energy windfall that enabled us to transform our way of life from oxcarts and Pony Express messengers to jetliners and cell phones. Meanwhile the human population quadrupled during the "century of progress" to take advantage of its unprecedented energy subsidy.

This was only the prologue to my real message, which was a pointed warning. We have always known in theory that fossil fuels are non-renewable, and are therefore finite in quantity. Now signs are appearing that the rate of global oil extraction may peak and begin to subside *within the next few years* as a result of geological conditions that cannot be altered by any expected technical advances in exploration or recovery. The consequences are likely to be calamitous. (Many of the most important ideas in *The Party's Over* are summarized and updated in Chapter 1.)

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By this time the reader has likely surmised that the purpose of this book is not to provide yet another cheerful manual on how to save the (human) world (as we know it). But neither is it my goal to helplessly bemoan our inevitable collective fate. Rather, it is to explore realistically our options for the next century. When I say "realistically," I mean that I take as my starting point the belief — arrived at reluctantly after years of reflection and study — that we have already advanced so far in certain directions as to have foreclosed possibilities that we would all prefer were available.

I take it as a given that we have already overshot Earth's long-term carrying capacity for humans — and have drawn down essential resources — to such an extent that some form of societal collapse is now inevitable. I intend the word "collapse" in a somewhat technical sense that is borrowed from the work of Joseph Tainter, author of *The Collapse of Complex Societies.*[4] Tainter defines "collapse" as a substantial reduction in social complexity. This can occur either relatively quickly and chaotically, or in a more gradual and managed fashion. In the best case, this would amount to a planned contraction, in which population levels and per-capita resource usage would be scaled back dramatically over decades.

But of course the word *collapse* is fraught with dire implications. Many of us tend to think of a civilization's collapse as being sudden and complete, but this has usually not tended to be the case in past instances — ancient Rome, Minoan Crete, the Western Chou Empire, and the like. Collapses of historical societies have usually occurred over a period of 100 to more than 500 years. Also, collapse may or may not result in the destruction of a society's primary institutions. Often it is difficult to pinpoint the exact moment of the commencement of collapse, and the process may be clearly under way only decades after the society in question has reached its pinnacle of extent and achievement (we will examine the process of collapse in more detail in Chapter 5).

In the present instance, we are already seeing the first phases of collapse, as signaled by the disruption of global climate, the decline of oceanic ecosystems, energy resource depletion, and the peaking of per-capita global grain production; however, it is unlikely that anyone now alive will see the end of the process. From a sufficiently distant temporal perspective, future historians will likely view the period from roughly 1800 to 2000 as the growth phase of industrial civilization, and the period from 2000 to 2100 or 2200 as its contraction or collapse phase.

Even if a reversal of growth is inevitable, the form it will take is as yet unclear, and will be determined by the actions of the present generation. We have weapons and other technological means to end human life forever. We also have the knowledge and skills necessary to build small-scale, decentralized, sustainable communities capable of providing a high level of human satisfaction and cultural attainment while degrading the environment to only a relatively minor extent over time.

THIS IS HOW I FEEL SOMETIMES

Imagine yourself in the following circumstance: You have just awakened from sleep to find yourself on a tarpaper raft floating away from shore. With you on the raft are a couple of hundred people, most of whom seem completely oblivious to their situation. They are drinking beer, barbecuing ribs, fishing, or sleeping. You look at the rickety vessel and say to yourself, "My God, this thing is going to sink any second!"

Miraculously, seconds go by and it is still afloat. You look around to see who's in charge. The only people you can find who appear to have any authority are some pompous-looking characters operating a gambling casino in the middle of the raft. In back of them stand heavily armed soldiers. You point out that the raft appears dangerous. They inform you that it is the safest and most wonderful vessel ever constructed, and that if you persist in suggesting otherwise the guards will exercise their brand of persuasion on you. You back away, smiling, and move to the edge of the raft. At this point, you're convinced (and even comment to a stranger next to you) that, with those idiots at the helm, the raft can't last more than another minute or so.

A minute goes by and still the damn thing is afloat. You turn your gaze out to the water. You notice now that the raft is surrounded by many sound-looking canoes, each carrying a family of indigenous fishers. Men on the raft are systematically forcing people out of the canoes and onto the raft at gunpoint, and shooting holes in the bottoms of the canoes. This is clearly insane behavior: the canoes are the only possible sources of escape or rescue if the raft goes down, and taking more people on board the already overcrowded raft is gradually bringing its deck even with the water line. You reckon that there must now be four hundred souls aboard. At this rate, the raft is sure to capsize in a matter of seconds.

A few seconds elapse. You can see and feel water lapping at your shoes, but amazingly enough the raft itself is still afloat, and nearly everyone is still busy eating, drinking, or gambling (indeed, the activity around the casino has heated up considerably). You hear someone in the distance shouting about how the raft is about to sink. You rush in the direction of the voice only to see its source being tossed unceremoniously overboard. You decide to keep quiet, but think silently to yourself, "Jeez, this thing *can't* last more than another couple of minutes! What the hell should I do?"

You notice a group of a dozen or so people working to patch and reinforce one corner of the raft. This, at least, is constructive behavior, so you join in. But it's not long before you realize that the only materials available to do the patching with are ones cannibalized from elsewhere on the raft. Even though the people you're working with clearly have the best of intentions and are making some noticeable improvements to the few square feet on which they've worked, there is simply no way they can render the entire vessel "sustainable," given its size, the amount of time required, and the limited availability of basic materials. You think to yourself that there must be some better solution, but can't quite focus on one.

As you stand there fretting, a couple of minutes pass. You realize that every one of your predictions about the fate of the raft has been disconfirmed. You feel useless and silly. You are about to make the only rational deductions — that there must be some mystical power keeping the raft afloat, and that you might as well make the most of the situation and have some barbecue — when a thought comes to you: The "sustainability" crowd has the right idea . . . except that, as they rebuild their corner of the raft, they should make it easily detachable, so that when the boat as a whole sinks they can simply disengage from it and paddle toward shore. But then, what about the hundreds of people who won't be able to fit onto this smaller, reconditioned raftlet?

You notice now that there is a group of rafters grappling with the soldiers who've been shooting holes in canoes. Maybe, if some of the canoes and their indigenous occupants survive, then the scope of the impending tragedy can be reduced. But direct confrontation with the soldiers appears to be a dangerous business, since many of the protesters are being shot or thrown into the water.

You continue working with the sustainability group, since they seem to have the best understanding of the problem and the best chances of survival. At the same time, your sympathies are with the protesters and the fisher families. You hope and pray that this is all some nightmare from which you will soon awaken, or that there is some means of escape — for everyone — that you haven't seen yet.

My goal in writing this book is to provide readers with information that will help them understand the constraints and opportunities of our unique moment in time, so that they can help themselves and the rest of humanity weather the century ahead.

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The book begins with an overview of oil and natural gas depletion and their likely impacts — a summary and updating of the information in *The Party's Over.* This updated material includes startling information about the current natural gas supply in North America, and the likely geopolitical consequences of attempts by the US to deal with the problem by importing liquefied natural gas from overseas.

In the next four chapters, we explore the four principal options available to industrial societies during the next few decades:

- **Last One Standing — The path of competition for remaining resources.** If the leadership of the US continues with current policies, the next decades will be filled with war, economic crises, and environmental catastrophe. Resource depletion and population pressure are about to catch up with us, and no one is prepared. The political elites, especially in the US, are incapable of dealing with the situation. Their preferred "solution" is simply to comandeer other nations' resources, using military force.
- **Powerdown — The path of cooperation, conservation, and sharing.** The only realistic alternative to resource competition is a strategy that will require tremendous effort and economic sacrifice in order to reduce per-capita resource usage in wealthy countries, develop alternative energy sources, distribute resources more equitably, and humanely but systematically reduce the size of the human population over time. The world's environmental, anti-war, anti-globalization, and human rights organizations are pushing for a mild version of this alternative, but for political reasons they tend to de-emphasize the level of effort required, and to play down the population issue.
- **Waiting for a Magic Elixir — Wishful thinking, false hopes, and denial.** Most of us would like to see still another possibility — a painless transition in which market forces

come to the rescue, making government intervention in the economy unnecessary. I discuss why this rosy hope is extremely unrealistic, and serves primarily as a distraction from the hard work that will be required in order to avert violent competition and catastrophic collapse.

- **Building Lifeboats — The path of community solidarity and preservation.** This fourth and final option begins with the assumption that industrial civilization cannot be salvaged in anything like its present form, and that we are even now living through the early stages of disintegration. If this is so, it makes sense for at least some of us to devote our energies toward preserving the most worthwhile cultural achievements of the past few centuries.

In the final chapter, "Our Choice," I explore how three important groups within global society — the decision-making elites of government, finance, and industry; the opposition to the elites, including the anti-war and anti-globalization movements — the "other superpower"; and ordinary people — are likely to choose among these four options. I suggest that the most fruitful response is likely to be a combination of Powerdown (in its most vigorous form) and Lifeboat Building. This chapter ends with a plea for the conservation of our highest human values and ideals during what is likely to be the most challenging century of all our history.

I believe that attempting to maintain business as usual during the coming decades will merely ensure catastrophic collapse. However, we *can* preserve the best of what we have achieved, while at the same time easing our way as peacefully and equitably as possible back down the steep ramp of increasing scale and complexity our society has been climbing for the past couple of centuries. These are the options we face, and the sooner we acknowledge that this is the case and choose wisely, the better off we and our descendants will be.

From: Mark Robinowitz
To: Columbia River Crossing;
CC:
Subject: Columbia River Crossing comments - attachment: "the Hirsch Report"
Date: Tuesday, July 01, 2008 2:34:13 AM
Attachments: hirsch-report.pdf
ATT5516234.txt

PEAKING OF WORLD OIL PRODUCTION:
IMPACTS, MITIGATION, & RISK MANAGEMENT
Robert L. Hirsch, SAIC, Project Leader
Roger Bezdek, MISI
Robert Wendling, MISI
February 2005

(a report prepared by Science Applications International Corporation for the US Department of Energy - it concluded that we would need 20 years of full scale efforts to mitigate the impacts of Peak Oil. Peak Oil is here, now.)

PEAKING OF WORLD OIL PRODUCTION: IMPACTS, MITIGATION, & RISK MANAGEMENT

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February 2005

DISCLAIMER

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EXECUTIVE SUMMARY

The peaking of world oil production presents the U.S. and the world with an unprecedented risk management problem. As peaking is approached, liquid fuel prices and price volatility will increase dramatically, and, without timely mitigation, the economic, social, and political costs will be unprecedented. Viable mitigation options exist on both the supply and demand sides, but to have substantial impact, they must be initiated more than a decade in advance of peaking.

In 2003, the world consumed just under 80 million barrels per day (MM bpd) of oil. U.S. consumption was almost 20 MM bpd, two-thirds of which was in the transportation sector. The U.S. has a fleet of about 210 million automobiles and light trucks (vans, pick-ups, and SUVs). The average age of U.S. automobiles is nine years. Under normal conditions, replacement of only half the automobile fleet will require 10-15 years. The average age of light trucks is seven years. Under normal conditions, replacement of one-half of the stock of light trucks will require 9-14 years. While significant improvements in fuel efficiency are possible in automobiles and light trucks, any affordable approach to upgrading will be inherently time-consuming, requiring more than a decade to achieve significant overall fuel efficiency improvement.

Besides further oil exploration, there are commercial options for increasing world oil supply and for the production of substitute liquid fuels: 1) Improved Oil Recovery (IOR) can marginally increase production from existing reservoirs; one of the largest of the IOR opportunities is Enhanced Oil Recovery (EOR), which can help moderate oil production declines from reservoirs that are past their peak production: 2) Heavy oil / oil sands represents a large resource of lower grade oils, now primarily produced in Canada and Venezuela; those resources are capable of significant production increases;. 3) Coal liquefaction is a well-established technique for producing clean substitute fuels from the world's abundant coal reserves; and finally, 4) Clean substitute fuels can be produced from remotely located natural gas, but exploitation must compete with the world's growing demand for liquefied natural gas. However, world-scale contributions from these options will require 10-20 years of accelerated effort.

Dealing with world oil production peaking will be extremely complex, involve literally trillions of dollars and require many years of intense effort. To explore these complexities, three alternative mitigation scenarios were analyzed:

- Scenario I assumed that action is not initiated until peaking occurs.
- Scenario II assumed that action is initiated 10 years before peaking.
- Scenario III assumed action is initiated 20 years before peaking.

For this analysis estimates of the possible contributions of each mitigation option were developed, based on an assumed crash program rate of implementation.

Our approach was simplified in order to provide transparency and promote understanding. Our estimates are approximate, but the mitigation envelope that results is believed to be directionally indicative of the realities of such an enormous undertaking. The inescapable conclusion is that more than a decade will be required for the collective contributions to produce results that significantly impact world supply and demand for liquid fuels.

Important observations and conclusions from this study are as follows:

1. When world oil peaking will occur is not known with certainty. A fundamental problem in predicting oil peaking is the poor quality of and possible political biases in world oil reserves data. Some experts believe peaking may occur soon. This study indicates that "soon" is within 20 years.

2. The problems associated with world oil production peaking will not be temporary, and past "energy crisis" experience will provide relatively little guidance. The challenge of oil peaking deserves immediate, serious attention, if risks are to be fully understood and mitigation begun on a timely basis.

3. Oil peaking will create a severe liquid fuels problem for the transportation sector, not an "energy crisis" in the usual sense that term has been used.

4. Peaking will result in dramatically higher oil prices, which will cause protracted economic hardship in the United States and the world. However, the problems are not insoluble. Timely, aggressive mitigation initiatives addressing both the supply and the demand sides of the issue will be required.

5. In the developed nations, the problems will be especially serious. In the developing nations peaking problems have the potential to be much worse.

6. Mitigation will require a minimum of a decade of intense, expensive effort, because the scale of liquid fuels mitigation is inherently extremely large.

7. While greater end-use efficiency is essential, increased efficiency alone will be neither sufficient nor timely enough to solve the problem. Production of large amounts of substitute liquid fuels will be required. A number of commercial or near-commercial substitute fuel production technologies are currently available for deployment, so the production of vast amounts of substitute liquid fuels is feasible with existing technology.

8. Intervention by governments will be required, because the economic and social implications of oil peaking would otherwise be chaotic. The experiences of the 1970s and 1980s offer important guides as to government actions that are desirable and those that are undesirable, but the process will not be easy.

Mitigating the peaking of world conventional oil production presents a classic risk management problem:

- Mitigation initiated earlier than required may turn out to be premature, if peaking is long delayed.
- If peaking is imminent, failure to initiate timely mitigation could be extremely damaging.

Prudent risk management requires the planning and implementation of mitigation well before peaking. Early mitigation will almost certainly be less expensive than delayed mitigation. A unique aspect of the world oil peaking problem is that its timing is uncertain, because of inadequate and potentially biased reserves data from elsewhere around the world. In addition, the onset of peaking may be obscured by the volatile nature of oil prices. Since the potential economic impact of peaking is immense and the uncertainties relating to all facets of the problem are large, detailed quantitative studies to address the uncertainties and to explore mitigation strategies are a critical need.

The purpose of this analysis was to identify the critical issues surrounding the occurrence and mitigation of world oil production peaking. We simplified many of the complexities in an effort to provide a transparent analysis. Nevertheless, our study is neither simple nor brief. We recognize that when oil prices escalate dramatically, there will be demand and economic impacts that will alter our simplified assumptions. Consideration of those feedbacks will be a daunting task but one that should be undertaken.

Our study required that we make a number of assumptions and estimates. We well recognize that in-depth analyses may yield different numbers. Nevertheless, this analysis clearly demonstrates that the key to mitigation of world oil production peaking will be the construction a large number of substitute fuel production facilities, coupled to significant increases in transportation fuel efficiency. The time required to mitigate world oil production peaking is measured on a decade time-scale. Related production facility size is large and capital intensive. How and when governments decide to address these challenges is yet to be determined.

Our focus on existing commercial and near-commercial mitigation technologies illustrates that a number of technologies are currently ready for immediate and extensive implementation. Our analysis was not meant to be limiting. We believe that future research will provide additional mitigation options, some possibly superior to those we considered. Indeed, it would be appropriate to greatly accelerate public and private oil peaking mitigation research. However, the reader must recognize that doing the research required to bring new technologies to commercial readiness takes time under the best of circumstances. Thereafter, more than a decade of intense implementation will be required for world scale impact, because of the inherently large scale of world oil consumption.

In summary, the problem of the peaking of world conventional oil production is unlike any yet faced by modern industrial society. The challenges and uncertainties need to be much better understood. Technologies exist to mitigate the problem. Timely, aggressive risk management will be essential.

I. INTRODUCTION

Oil is the lifeblood of modern civilization. It fuels the vast majority of the world's mechanized transportation equipment – Automobiles, trucks, airplanes, trains, ships, farm equipment, the military, etc. Oil is also the primary feedstock for many of the chemicals that are essential to modern life. This study deals with the upcoming physical shortage of world conventional oil -- an event that has the potential to inflict disruptions and hardships on the economies of every country.

The earth's endowment of oil is finite and demand for oil continues to increase with time. Accordingly, geologists know that at some future date, conventional oil supply will no longer be capable of satisfying world demand. At that point world conventional oil production will have peaked and begin to decline.

A number of experts project that world production of conventional oil could occur in the relatively near future, as summarized in Table I-1.[1] Such projections are fraught with uncertainties because of poor data, political and institutional self-interest, and other complicating factors. The bottom line is that no one knows with certainty when world oil production will reach a peak,[2] but geologists have no doubt that it will happen.

Table I-1. Predictions of World Oil Production Peaking

Projected Date	Source of Projection
2006-2007	Bakhitari
2007-2009	Simmons
After 2007	Skrebowski
Before 2009	Deffeyes
Before 2010	Goodstein
Around 2010	Campbell
After 2010	World Energy Council
2010-2020	Laherrere
2016	EIA (Nominal)
After 2020	CERA
2025 or later	Shell
No visible Peak	Lynch

[1]A more detailed list is given in the following chapter in Table II-2.
[2] In this study we interchangeably refer to the peaking of world conventional oil production as "oil peaking" or simply as "peaking."

Our aim in this study is to

- Summarize the difficulties of oil production forecasting;

- Identify the fundamentals that show why world oil production peaking is such a unique challenge;

- Show why mitigation will take a decade or more of intense effort;

- Examine the potential economic effects of oil peaking;

- Describe what might be accomplished under three example mitigation scenarios.

- Stimulate serious discussion of the problem, suggest more definitive studies, and engender interest in timely action to mitigate its impacts.

In Chapter II we describe the basics of oil production, the meaning of world conventional oil production peaking, the challenge of making accurate forecasts, and the effects that higher prices and advanced technology might have on oil production.

Because of the massive scale of oil use around the world, mitigation of oil shortages will be difficult, time consuming, and expensive. In Chapter III we describe the extensive and critical uses of U.S. oil and the long economic and mechanical lifetimes of existing liquid fuel consuming vehicles and equipment.

While it is impossible to predict the impact of world oil production peaking with any certainty, much can be learned from past oil disruptions, particularly the 1973 oil embargo and the 1979 Iranian oil shortage, as discussed in Chapter IV. In Chapter V we describe the developing shortages of U.S. natural gas, shortages that are occurring in spite of assurances of abundant supply provided just a few years ago. The parallels to world oil supply are disconcerting.

In Chapter VI we describe available mitigation options and related implementation issues. We limit our considerations to technologies that are near ready or currently commercially available for immediate deployment. Clearly, accelerated research and development holds promise for other options. However, the challenge related to extensive near-term oil shortages will require deployment of currently viable technologies, which is our focus.

Oil is a commodity found in over 90 countries, consumed in all countries, and traded on world markets. To illustrate and bracket the range of mitigation options, we developed three illustrative scenarios. Two assume action well in advance of the onset of world oil peaking – in one case, 20 years before peaking and in another case, 10 years in advance. Our third scenario assumes that no action is taken prior to the onset of peaking. Our findings illustrate the magnitude of the problem and the importance of prudent risk management.

Finally, we touch on possible market signals that might foretell the onset of peaking and possible wildcards that might change the timing of world conventional oil production peaking. In conclusion, we frame the challenge of an unknown date for peaking, its potentially extensive economic impacts, and available mitigation options as a matter of risk management and prudent response. The reader is asked to contemplate three major questions:

- What are the risks of heavy reliance on optimistic world oil production peaking projections?
- Must we wait for the onset of oil shortages before actions are taken?
- What can be done to ensure that prudent mitigation is initiated on a timely basis?

II. PEAKING OF WORLD OIL PRODUCTION[3]

A. Background

Oil was formed by geological processes millions of years ago and is typically found in underground reservoirs of dramatically different sizes, at varying depths, and with widely varying characteristics. The largest oil reservoirs are called “Super Giants,” many of which were discovered in the Middle East. Because of their size and other characteristics, Super Giant reservoirs are generally the easiest to find, the most economic to develop, and the longest lived. The last Super Giant oil reservoirs discovered worldwide were found in 1967 and 1968. Since then, smaller reservoirs of varying sizes have been discovered in what are called “oil prone” locations worldwide -- oil is not found everywhere.

Geologists understand that oil is a finite resource in the earth’s crust, and at some future date, world oil production will reach a maximum -- a peak -- after which production will decline. This logic follows from the well-established fact that the output of individual oil reservoirs rises after discovery, reaches a peak and declines thereafter. Oil reservoirs have lifetimes typically measured in decades, and peak production often occurs roughly a decade or so after discovery. It is important to recognize that oil production peaking is not “running out.” Peaking is a reservoir’s maximum oil production rate, which typically occurs after roughly half of the recoverable oil in a reservoir has been produced. In many ways, what is likely to happen on a world scale is similar to what happens to individual reservoirs, because world production is the sum total of production from many different reservoirs.

Because oil is usually found thousands of feet below the surface and because oil reservoirs normally do not have an obvious surface signature, oil is very difficult to find. Advancing technology has greatly improved the discovery process and reduced exploration failures. Nevertheless, oil exploration is still inexact and expensive.

Once oil has been discovered via an exploratory well, full-scale production requires many more wells across the reservoir to provide multiple paths that facilitate the flow of oil to the surface. This multitude of wells also helps to define the total recoverable oil in a reservoir – its so-called “reserves.”

B. Oil Reserves

The concept of reserves is generally not well understood. “Reserves” is an estimate of the amount of oil in a reservoir that can be extracted at an assumed cost. Thus, a higher oil price outlook often means that more oil can be produced, but geology places an upper limit on price-dependent reserves growth; in well

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[3]Portions of this chapter are taken from Hirsch, R.L. "Six Major Factors in Energy Planning". U.S. Department of Energy. National Energy Technology Laboratory. March 2004.

managed oil fields, it is often 10-20 percent more than what is available at lower prices.

Reserves estimates are revised periodically as a reservoir is developed and new information provides a basis for refinement. Reserves estimation is a matter of gauging how much extractable oil resides in complex rock formations that exist typically one to three miles below the surface of the ground, using inherently limited information. Reserves estimation is a bit like a blindfolded person trying to judge what the whole elephant looks like from touching it in just a few places. It is not like counting cars in a parking lot, where all the cars are in full view.

Specialists who estimate reserves use an array of methodologies and a great deal of judgment. Thus, different estimators might calculate different reserves from the same data. Sometimes politics or self-interest influences reserves estimates, e.g., an oil reservoir owner may want a higher estimate in order to attract outside investment or to influence other producers.

Reserves and production should not be confused. Reserves estimates are but one factor in estimating future oil production from a given reservoir. Other factors include production history, understanding of local geology, available technology, oil prices, etc. An oil field can have large estimated reserves, but if the field is past its maximum production, the remaining reserves will be produced at a declining rate. This concept is important because satisfying increasing oil demand not only requires continuing to produce older oil reservoirs with their declining production, it also requires finding new ones, capable of producing sufficient quantities of oil to both compensate for shrinking production from older fields and to provide the increases demanded by the market.

C. Production Peaking

World oil demand is expected to grow 50 percent by 2025.[4] To meet that demand, ever-larger volumes of oil will have to be produced. Since oil production from individual reservoirs grows to a peak and then declines, new reservoirs must be continually discovered and brought into production to compensate for the depletion of older reservoirs. If large quantities of new oil are not discovered and brought into production somewhere in the world, then world oil production will no longer satisfy demand. That point is called the peaking of world conventional oil production.

When world oil production peaks, there will still be large reserves remaining. Peaking means that the rate of world oil production cannot increase; it also means that production will thereafter decrease with time.

[4]U.S. Department of Energy, Energy Information Administration, *International Energy Outlook – 2004*, April 2004.

The peaking of world oil production has been a matter of speculation from the beginning of the modern oil era in the mid 1800s. In the early days, little was known about petroleum geology, so predictions of peaking were no more than guesses without basis. Over time, geological understanding improved dramatically and guessing gave way to more informed projections, although the knowledge base involves numerous uncertainties even today.

Past predictions typically fixed peaking in the succeeding 10-20 year period. Most such predictions were wrong, which does not negate that peaking will someday occur. Obviously, we cannot know if recent forecasts are wrong until predicted dates of peaking pass without incident.

With a history of failed forecasts, why revisit the issue now? The reasons are as follows:

1. Extensive drilling for oil and gas has provided a massive worldwide database; current geological knowledge is much more extensive than in years past, i.e., we have the knowledge to make much better estimates than previously.

2. Seismic and other exploration technologies have advanced dramatically in recent decades, greatly improving our ability to discover new oil reservoirs. Nevertheless, the oil reserves discovered per exploratory well began dropping worldwide over a decade ago. We are finding less and less oil in spite of vigorous efforts, suggesting that nature may not have much more to provide.

3. Many credible analysts have recently become much more pessimistic about the possibility of finding the huge new reserves needed to meet growing world demand.

4. Even the most optimistic forecasts suggest that world oil peaking will occur in less than 25 years.

5. The peaking of world oil production could create enormous economic disruption, as only glimpsed during the 1973 oil embargo and the 1979 Iranian oil cut-off.

Accordingly, there are compelling reasons for in-depth, unbiased reconsideration.

D. Types of Oil

Oil is classified as “Conventional” and “Unconventional.” Conventional oil is typically the highest quality, lightest oil, which flows from underground reservoirs with comparative ease. Unconventional oils are heavy, often tar-like. They are not readily recovered since production typically requires a great deal of capital investment and supplemental energy in various forms. For that reason, most current world oil production is conventional oil.[5] (Unconventional oil production will be discussed in Chapter VI).

E. Oil Resources[6]

Consider the world resource of conventional oil. In the past, higher prices led to increased estimates of conventional oil reserves worldwide. However, this price-reserves relationship has its limits, because oil is found in discrete packages (reservoirs) as opposed to the varying concentrations characteristic of many minerals. Thus, at some price, world reserves of recoverable conventional oil will reach a maximum because of geological fundamentals. Beyond that point, insufficient additional conventional oil will be recoverable at any realistic price. This is a geological fact that is often misunderstood by people accustomed to dealing with hard minerals, whose geology is fundamentally different. This misunderstanding often clouds rational discussion of oil peaking.

Future world recoverable reserves are the sum of the oil remaining in existing reservoirs plus the reserves to be added by future oil discoveries. Future oil production will be the sum of production from older reservoirs in decline, newer reservoirs from which production is increasing, and yet-to-be discovered reservoirs.

Because oil prices have been relatively high for the past decade, oil companies have conducted extensive exploration over that period, but their results have been disappointing. If recent trends hold, there is little reason to expect that exploration success will dramatically improve in the future. This situation is evident in Figure II-1, which shows the difference between annual world oil reserves additions minus annual consumption.[7] The image is one of a world moving from a long period in which reserves additions were much greater than consumption, to an era in which annual additions are falling increasingly short of annual consumption. This is but one of a number of trends that suggest the world is fast approaching the inevitable peaking of conventional world oil production.

F. Impact of Higher Prices and New Technology

Conventional oil has been the mainstay of modern civilization for more than a century, because it is most easily brought to the surface from deep underground reservoirs, and it is the most easily refined into finished fuels. The U.S. was endowed with huge reserves of petroleum, which underpinned U.S. economic

[5] U.S. Department of Energy, Energy Information Administration, *International Energy Outlook – 2004,* April 2004.

[6] Total oil in place is called the "resource." However, only a part of the resource can be produced, because of geological complexities and economic limitations. That which is realistically recoverable is called "reserves," which varies within limits depending on oil prices.

[7] Aleklett, K. & Campbell, C.J. *"The Peak and Decline of World Oil and Gas Production".* Uppsala University, Sweden. ASPO web site. 2003.

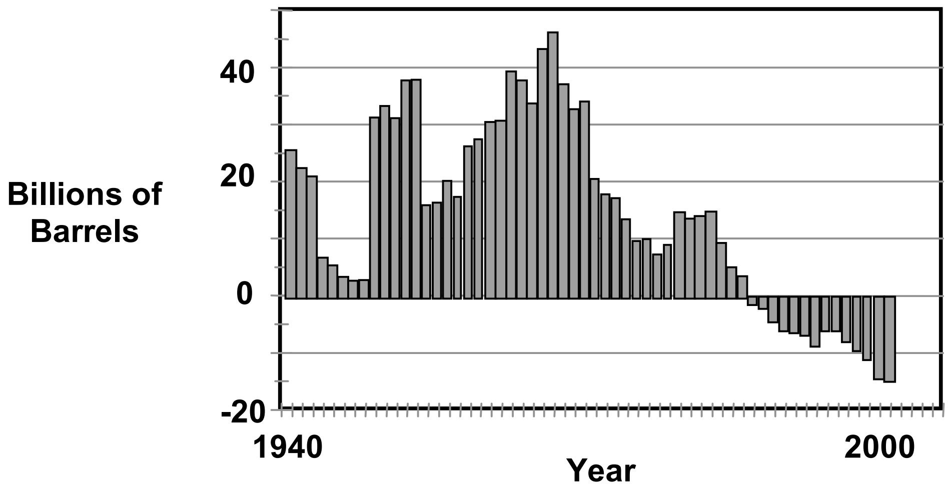

Figure II-1. Net Difference Between Annual World Oil Reserves Additions and Annual Consumption

growth in the early and mid twentieth century. However, U.S. oil resources, like those in the world, are finite, and growing U.S. demand resulted in the peaking of U.S. oil production in the Lower 48 states in the early 1970s. With relatively minor exceptions, U.S. Lower 48 oil production has been in continuing decline ever since. Because U.S. demand for petroleum products continued to increase, the U.S. became an oil importer. Today, the U.S. depends on foreign sources for almost 60 percent of its needs, and future U.S. imports are projected to rise to 70 percent of demand by 2025.[8]

Over the past 50 years, exploration for and production of petroleum has been an increasingly more technological enterprise, benefiting from more sophisticated engineering capabilities, advanced geological understanding, improved instrumentation, greatly expanded computing power, more durable materials, etc. Today's technology allows oil reservoirs to be more readily discovered and better understood sooner than heretofore. Accordingly, reservoirs can be produced more rapidly, which provides significant economic advantages to the operators but also hastens peaking and depletion.

Some economists expect higher oil prices and improved technologies to continue to provide ever-increasing oil production for the foreseeable future. Most geologists disagree because they do not believe that there are many huge new oil reservoirs left to be found. Accordingly, geologists and other observers believe that supply will eventually fall short of growing world demand – and result in the peaking of world conventional oil production.

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[8]U.S. Department of Energy, Energy Information Administration, *International Energy Outlook – 2004,* April 2004.

To gain some insight into the effects of higher oil prices and improved technology on oil production, let us briefly examine related impacts in the U.S. Lower 48 states. This region is a useful surrogate for the world, because it was one of the world's richest, most geologically varied, and most productive up until 1970, when production peaked and started into decline. While the U.S. is the best available surrogate, it should be remembered that the decline rate in US production was in part impacted by the availability of large volumes of relatively low cost oil from the Middle East.

Figure II-2 shows EIA data for Lower 48 oil production,[9] to which trend lines have been added that will aid our scenarios analysis later in the report. The trend lines show a relatively symmetric, triangular pattern. For reference, four notable petroleum market events are noted in the figure: the 1973 OPEC oil embargo, the 1979 Iranian oil crisis, the 1986 oil price collapse, and the 1991 Iraq war.

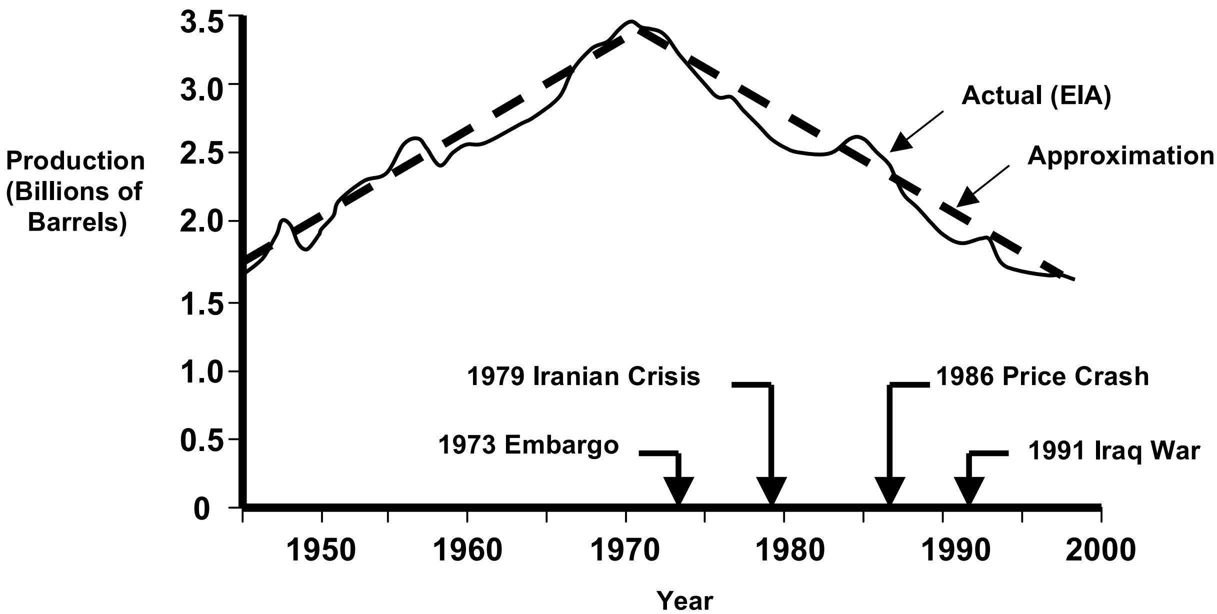

Figure II-2. U.S. Lower 48 Oil Production, 1945-2000

Figure II-3 shows Lower 48 historical oil production with oil prices and technology trends added. In constant dollars, oil prices increased by roughly a factor of three in 1973-74 and another factor of two in 1979-80. The modest production up-ticks in the mid 1980s and early 1990s are likely responses to the 1973 and 1979 oil price spikes, both of which spurred a major increase in U.S exploration and production investments. The delays in production response are inherent to the implementation of large-scale oil field investments. The fact that the

[9] U.S. Department of Energy, Energy Information Administration, *Long Term World Oil Supply*, April 18, 2000.

production up-ticks were moderate was due to the absence of attractive exploration and production opportunities, because of geological realities.

Beyond oil price increases, the 1980s and 1990s were a golden age of oil field technology development, including practical 3-D seismic, economic horizontal drilling, and dramatically improved geological understanding. Nevertheless, as Figure II-3 shows, Lower 48 production still trended downward, showing no pronounced response to either price or technology. In light of this experience, there is good reason to expect that an analogous situation will exist worldwide after world oil production peaks: <u>Higher prices and improved technology are unlikely to yield dramatically higher conventional oil production.</u>[10]

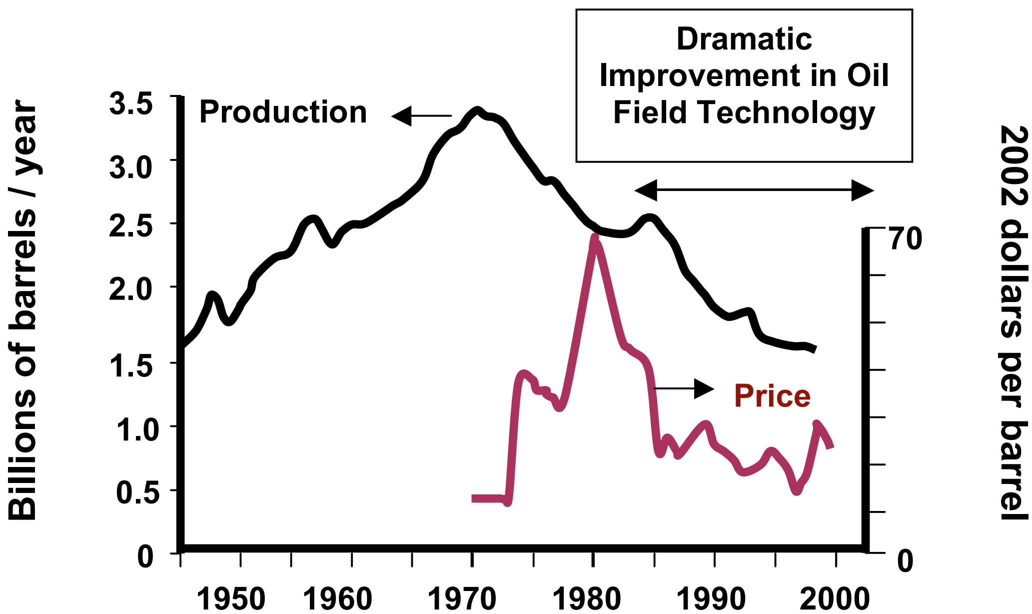

Figure II-3. Lower 48 Oil Production and Oil Prices

G. Projections of the Peaking of World oil Production

Projections of future world oil production will be the sum total of 1) output from all of the world's then existing producing oil reservoirs, which will be in various stages of development, and 2) all the yet-to-be discovered reservoirs in their various states of development. This is an extremely complex summation problem, because of the variability and possible biases in publicly available data. In practice, estimators use various approximations to predict future world oil

[10] The US Lower 48 experience occurred over a long period characterized at different times by production controls (Texas Railroad Commission), price and allocation controls (1970s), free market prices (since 1981), wild price swings, etc., as well as higher prices and advancing technology. Nevertheless, production peaked and moved into a relatively constant rate of decline.

production. The remarkable complexity of the problem can easily lead to incorrect conclusions, either positive or negative.

Various individuals and groups have used available information and geological estimates to develop projections for when world oil production might peak. A sampling of recent projections is shown in Table II-1.

Table II-1. Projections of the Peaking of World Oil Production

Projected Date	Source of Projection	Background & Reference
2006-2007	Bakhitari, A.M.S.	Iranian Oil Executive[11]
2007-2009	Simmons, M.R.	Investment banker [12]
After 2007	Skrebowski, C.	Petroleum journal Editor [13]
Before 2009	Deffeyes, K.S.	Oil company geologist (ret.) [14]
Before 2010	Goodstein, D.	Vice Provost, Cal Tech [15]
Around 2010	Campbell, C.J.	Oil company geologist (ret.) [16]
After 2010	World Energy Council	World Non-Government Org.[17]
2010-2020	Laherrere, J.	Oil company geologist (ret.) [18]
2016	EIA nominal case	DOE analysis/ information[19]
After 2020	CERA	Energy consultants [20]
2025 or later	Shell	Major oil company [21]
No visible peak	Lynch, M.C.	Energy economist[22]

[11]Bakhtiari, A.M.S. "World Oil Production Capacity Model Suggests Output Peak by 2006-07." *OGJ*. April 26, 2004.
[12]Simmons, M.R. ASPO Workshop. May 26, 2003.
[13]Skrebowski, C. "Oil Field Mega Projects - 2004." *Petroleum Review*. January 2004.
[14]Deffeyes, K.S. *Hubbert's Peak-The Impending World Oil Shortage*. Princeton University Press. 2003.
[15]Goodstein, D. *Out of Gas – The End of the Age of Oil*. W.W. Norton. 2004
[16]Campbell, C.J. "Industry Urged to Watch for Regular Oil Production Peaks, Depletion Signals." *OGJ*. July 14, 2003.
[17]*Drivers of the Energy Scene*. World Energy Council. 2003.
[18]Laherrere, J. Seminar Center of Energy Conversion. Zurich. May 7, 2003
[19]DOE EIA. "Long Term World Oil Supply." April 18, 2000. See Appendix I for discussion.
[20]Jackson, P. et al. "Triple Witching Hour for Oil Arrives Early in 2004 – But, As Yet, No Real Witches." *CERA Alert*. April 7, 2004.
[21]Davis, G. "Meeting Future Energy Needs." *The Bridge.* National Academies Press. Summer 2003.
[22]Lynch, M.C. "Petroleum Resources Pessimism Debunked in Hubbert Model and Hubbert Modelers' Assessment." *Oil and Gas Journal,* July 14, 2003.

III. WHY THE TRANSITION WILL BE SO TIME CONSUMING

A. Introduction

Use of petroleum is pervasive throughout the U.S. economy. It is directly linked to all market sectors because all depend on oil-consuming capital stock. Oil price shocks and supply constraints can often be mitigated by temporary decreases in consumption; however, long term price increases resulting from oil peaking will cause more serious impacts. Here we examine historical oil usage patterns by market sector, provide a summary of current consumption patterns, identify the most important markets, examine the relationship between oil and capital stock, and provide estimates of the time and costs required to transition to more energy efficient technologies that can play a role in mitigating the adverse effects of world oil peaking.

B. Historical U.S. Oil Consumption Patterns

After the two oil price shocks and supply disruptions in 1973-74 and 1979, oil consumption in the U.S. decreased 13 percent, declining from nearly 35 quads in 1973 to 30 quads in 1983. However, overall consumption continued to grow after the 1983 low and has continuously increased over the last 20 years, reaching over 39 quads in 2003, as shown in Figure III-1. Of particular note are changes in three U.S. market sectors: 1) Oil consumption in the residential sector declined from eight percent of total oil consumption in 1973 to four percent in 2003, a decrease of 50 percent; 2) Oil consumption in the commercial sector declined from five percent to two percent, decreasing 58 percent; and 3) Consumption in the electric power sector fell from 10 percent in 1973 to three percent in 2003, decreasing 70 percent. These three market sectors currently account for 1.3 quads of oil consumption annually, representing nine percent of U.S. oil demand in 2003.

Oil consumption in other market sectors did not decrease. A 140 percent growth in GDP over the 1973-2003 period made it difficult to decrease oil consumption in the industrial and transportation sectors.[23] In particular, personal transportation grew significantly over the past three decades, and total vehicle miles traveled for cars and light trucks more than doubled over the period.[24] From 1973 to 2003, consumption of oil in the industrial sector stayed relatively flat at just over nine quads, and the industrial sector's share of total U.S. consumption remained between 24 and 26 percent. In sharp contrast to all other sectors, U.S. oil consumption for transportation purposes has increased steadily every year, rising from just over 17 quads in 1973 to 26 quads in 2003. By 2003, the transportation sector accounted for two-thirds of the oil consumed in the U.S.

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[23]U.S. Department of Commerce, Bureau of Economic Analysis, *National Income and Product Accounts*, 2004.
[24]U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics*, 2004.

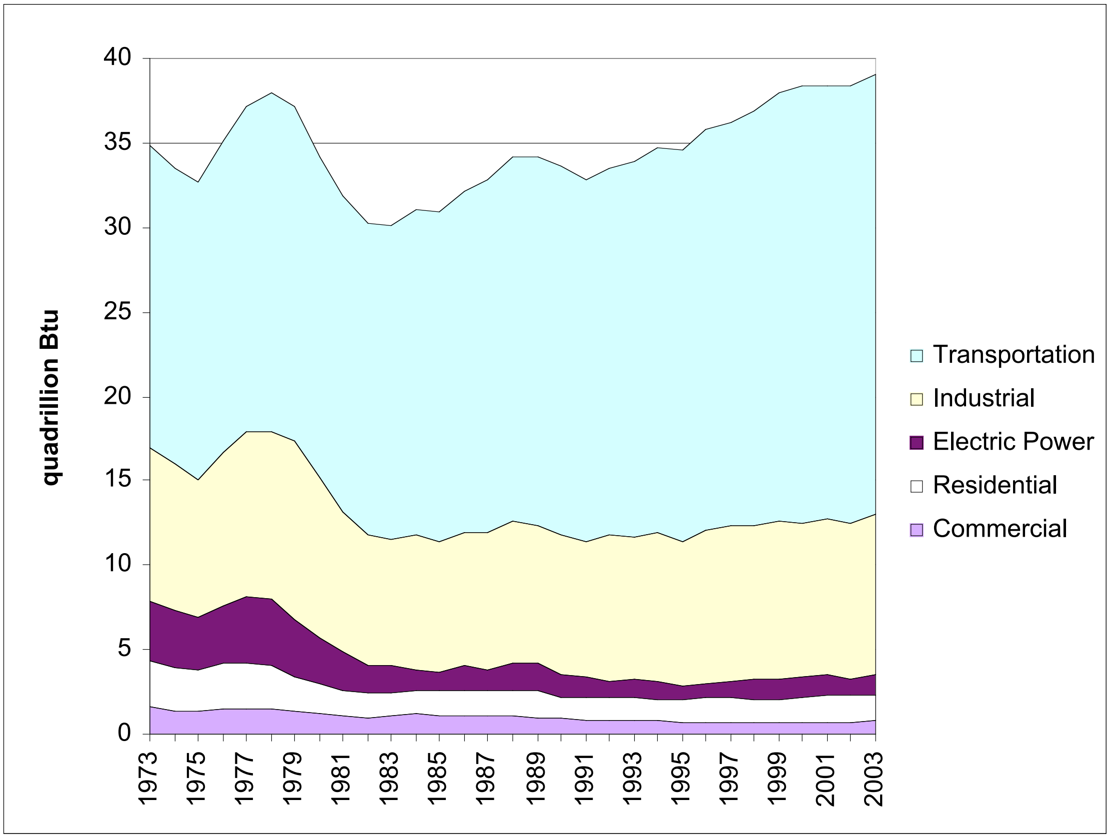

Figure III-1. U.S. Petroleum Consumption by Sector, 1973-2003[25]

C. Petroleum in the Current U.S. Economy

The 39 quad consumption of oil in the U.S. in 2003 is equivalent to 19.7 million barrels of oil per day (MM bpd), including almost 13.1 MM bpd consumed by the transportation sector and 4.9 MM bpd by the industrial sector, as shown in Table III-1. This table also shows the petroleum fuel types consumed by each sector. Motor gasoline consumption accounted for 45 percent of U.S. daily petroleum consumption, nearly 9 MM bpd, almost all of which was used in autos and light trucks. Distillate fuel oil was the second-most consumed oil product at almost 3.8 MM bpd (19 percent of consumption), and most was used as diesel fuel for medium and heavy trucks. Finally, the third most consumed oil product was liquefied petroleum gases, at 2.2 MM bpd equivalent (11 percent of total consumption), most of which was used in the industrial sector as feedstock by the chemicals industry. Only two other consuming areas exceeded the 1 MM bpd level: kerosene and jet fuel in the transportation sector, primarily for airplanes, and "other petroleum" by the industrial sector, primarily petroleum

[25]U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, 2004.

feedstocks used to produce non-fuel products in the petroleum and chemical industries.

Table III-1.
Detailed Consumption of Petroleum in the U.S.
by Fuel Type and Sector - 2003[26]
(Thousand of barrels per day)

	Residential	Commercial	Industrial	Transportation	Electric Power	Total
Motor Gasoline	-	20	159	8,665	-	8,844
Distillate Fuel Oil	421	236	603	2,455	51	3,766
LPG	429	76	1,648	10	-	2,163
Kerosene/Jet Fuel	27	9	7	1,608	-	1,651
Residual	-	30	87	250	291	658
Asphalt & Road Oil	-	-	513	-	-	513
Petroleum Coke	-	-	398	-	61	459
Lubricants	-	-	78	73	-	151
Aviation Gas	-	-	-	18	-	18
Other Petroleum	-	-	1,435	-	-	1,435
Total	877	371	4,928	13,079	403	19,658

D. Capital Stock Characteristics in the Largest Consuming Sectors

Energy efficiency improvements and technological changes are typically incorporated into products and services slowly, and their rate of market penetration is based on customer preferences and costs. In the 1974-1983 period, oil prices ratcheted up to newer, higher levels, which lead to significant energy efficiency improvements, energy fuel switching, and other more general technological changes. Some changes came about due to legislative mandates (corporate average fuel economy standards, CAFE) or subsidies (solar energy and energy efficiency tax credits), but many were the result of economic decisions to reduce long-term costs. Under a normal course of replacement based on historical trends, oil-consuming capital stock has been replaced in the U.S. over a period of 15 to 50 years and has cost consumers and businesses trillions of dollars, as discussed below.

Automobiles represent the largest single oil-consuming capital stock in the U.S. 130 million autos consume 4.9 MM bpd, or 25 percent of total consumption, as shown in Table III-2. Autos remain in the U.S. transportation fleet, or rolling stock, for a long time. While the financial-based current-cost, average age of autos is only 3.4 years, the average age of the stock is currently nine years.

[26]U.S. Department of Energy, Energy Information Administration, Detailed annual petroleum consumption accounts by fuel and sector at www,eia.doe,gov, 2004

Recent studies show that one half of the1990-model year cars will remain on the road 17 years later in 2007. At normal replacement rates, consumers will spend an estimated $1.3 trillion (constant 2003 dollars) over the next 10-15 years just to replace one-half the stock of automobiles.[27]

Table III-2.
U.S. Capital Stock Profiles

	Autos	**Light Trucks**	**Heavy Trucks**	**Air Carriers**
Oil consumption (MM bpd)[28]	4.9	3.6	3.0	1.1
Share of the U.S. total	***25%***	***18%***	***16%***	***6%***
Current cost of net capital stock (billion $)[29]	$571 B	$435 B	$686 B	$110 B
Fleet size[30]	130 MM	80 MM	7 MM	8,500
Number of annual purchases	8.5 MM	8.5 MM	500,000	400
Average age of stock (years)	9	7	9	13
Median lifetime (years)	**17**	**16**	**28**	**22**

A similar situation exists with light trucks (vans, pick-ups, and SUVs), which consume 3.6 MM bpd of oil, accounting for 18 percent of total oil consumption. Light trucks are depreciated on a faster schedule, and their financial-based current-cost average age is 2.9 years. However, the average physical age of the rolling stock is seven years, and the median lifetime of light trucks is 16 years. At current replacement rates, one-half of the 80-million light trucks will be replaced in the next 9-14 years at a cost of $1 trillion.

Seven million heavy trucks (including buses, highway trucks, and off-highway trucks) represent the third largest consumer of oil at 3.0 MM bpd, 16 percent of total consumption. The current-cost average age of heavy trucks is 5.0 years,

[27] Because of the lack of national average "replacement value" estimates, current-cost net capital stock provides a suitable substitute for the estimates. Given the capital equipment depreciation schedule used, the total replacement value of the capital stock is projected to be 4.5 times higher than the current-cost net value

[28] U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook - 2004*, and Oak Ridge National Laboratory, *Transportation Energy Data Book #23*, 2003.

[29] U.S. Department of Commerce, Bureau of Economic Analysis, *Fixed Asset Tables, 1992-2002*. The estimate of net stock includes an adjustment for depreciation, defined as the decline in value of the stock of assets due to wear and tear, obsolescence, accidental damage, and aging. For most types of assets, estimates of depreciation are based on a geometric decline in value.

[30] Oak Ridge National Laboratory, *Transportation Energy Data Book #23*, 2003; and U.S. Department of Transportation, Bureau of Transportation Statistics, *Active Air Carrier Fleet*; and Management Information Services, Inc., 2004.

but the median lifetime of this equipment is 28 years. The disparity in the average age and the median lifetime estimates indicate that a significant number of vehicles are 40-60 years old. At normal replacement levels, one-half of the heavy truck stock will be replaced by businesses in the next 15-20 years at a cost of $1.5 trillion.

The fourth-largest consumer of oil is the airlines, which consume the equivalent of 1.1 MM bpd, representing six percent of U.S. consumption. The 8,500 aircraft have a current-cost average age of 9.1 years, and a median lifetime of 22 years. Airline deregulation and the events of September 11, 2001, have had significant effects on the industry, its ownership, and recent business decisions. At recent rates, airlines will replace one-half of their stock over the next 15-20 years at a cost of $250 billion.

These four capital stock categories cover most transportation modes and represent 65 percent of the consumption of oil in the U.S.[31] The three largest categories of autos, light trucks, and heavy trucks all utilize the internal combustion engine, whether gasoline- or diesel-burning. Clearly, advancements in energy efficiency and replacement in this capital stock (for instance, electric-hybrid engines) would help mitigate the economic impacts of rising oil prices caused by world oil peaking. However, as described, the normal replacement rates of this equipment will require 10-20 years and cost trillions of dollars. We cannot conceive of any affordable government-sponsored "crash program" to accelerate normal replacement schedules so as to incorporate higher energy efficiency technologies into the privately-owned transportation sector; significant improvements in energy efficiency will thus be inherently time-consuming (of the order of a decade or more).

When oil prices increase associated with oil peaking, consumers and businesses will attempt to reduce their exposure by substitution or by decreases in consumption. In the short run, there may be interest in the substitution of natural gas for oil in some applications, but the current outlook for natural gas availability and price is cloudy for a decade or more. An increase in demand for electricity in rail transportation would increase the need for more electric power plants. In the short run, much of the burden of adjustment will likely be borne by decreases in consumption from discretionary decisions, since 67 percent of personal automobile travel and nearly 50 percent of airplane travel are discretionary.[32]

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[31]The largest remaining oil-consuming capital stock resides in the industrial sector. Oil consumption in the industrial sector is diverse, making it difficult to target specific capital stock and identify potential efficiency efforts or potential technology advancements. The largest oil-consuming industries include the chemical, lumber and wood, paper products, and petroleum industry itself. Functional usage of oil in the industry includes heat, process heat, power, feedstock, and lubrication. Finally, the equipment spans hundreds of disparate types of in situ engines, turbines, and agricultural, construction, and mining machinery.

[32]U.S. Department of Transportation, Bureau of Transportation Statistics, *American Travel Survey Profile* and Oak Ridge National Laboratory, *Transportation Energy Data Book - 2003.*

E. Consumption Outside the U.S.

Oil consumption patterns differ in other countries. While two-thirds of U.S. oil use is in the transportation sector, worldwide that share is estimated about 55 percent. However, that difference is narrowing as world economic development is expanding transportation demands at an even faster pace. A portion of non-transportation oil consumption is switchable. As stated by EIA, “Oil’s importance in other end-use sectors is likely to decline where other fuels are competitive, such as natural gas, coal, and nuclear, in the electric sector, but currently there is no alternative energy sources that compete economically with oil in the transportation sector.”[33] Because sector-by-sector oil consumption data for many counties is unavailable, a detailed analysis of world consumption was beyond the scope of this report. Nevertheless, it is clear that transportation is the primary market for oil worldwide.

F. Transition Conclusions

Any transition of liquid fueled, end-use equipment following oil peaking will be time consuming. The depreciated value of existing U.S. transportation capital stock is nearly $2 trillion and would normally require 25 – 30 years to replace. At that rate, significantly more energy efficient equipment will only be slowly phased into the marketplace as new capital stock gradually replaces existing stock. Oil peaking will likely accelerate replacement rates, but the transition will still require decades and cost trillions of dollars.

[33] U.S. Department of Energy, Energy Information Administration. *International Energy Annual, 2004.* April 2004.

IV. LESSONS AND IMPLICATIONS FROM PREVIOUS OIL SUPPLY DISRUPTIONS

A. Previous Oil Supply Shortfall and Disruptions

There have been over a dozen global oil supply disruptions[34] over the past half-century, as summarized in Figure IV-1.

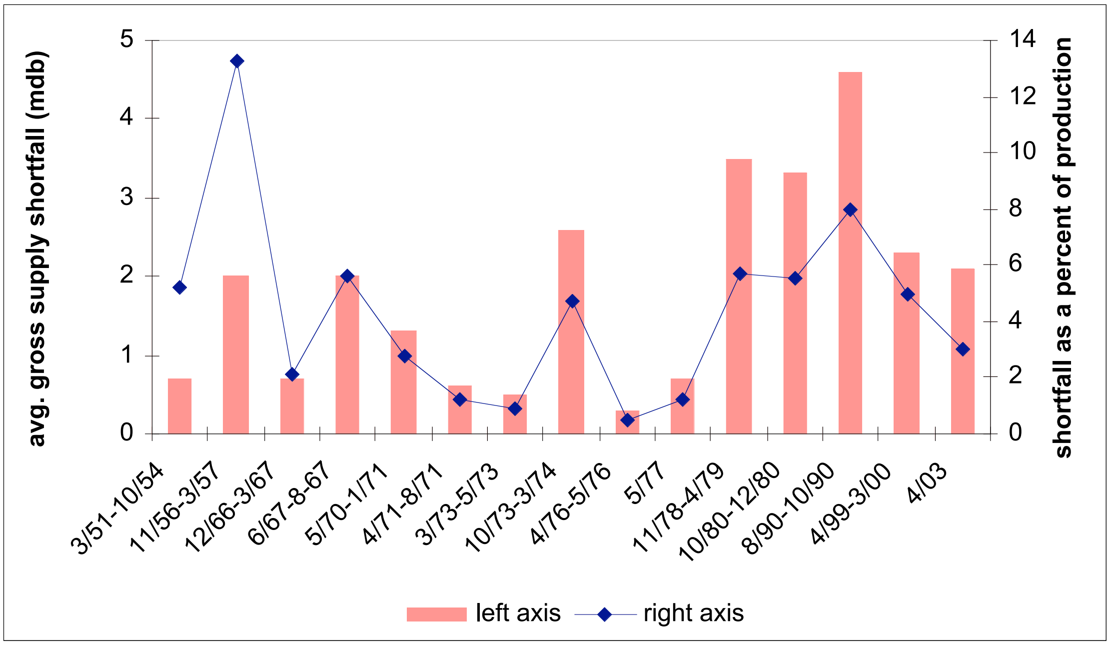

Figure IV-1. Global Oil Supply Disruptions: 1954-2003

Briefly,

- Disruptions ranged in duration from one to 44 months. Supply shortfalls were 0.3 - 4.6 MM bpd, and eight resulted in average gross supply shortfalls of at least 2 MM bpd.

- Percentage supply shortfalls varied from roughly one percent to nearly 14 percent of world production.

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[34]U.S. Department of Energy, Energy Information Administration, "Latest Oil Supply Disruption Information," eia.doe.gov, 2004; U.S. Department of Energy, Energy Information Administration,. "World Oil Market and Oil Price Chronologies: 1970-2003," March 2004; U.S. Department of Energy, Energy Information Administration, "Global Oil Supply Disruptions Since 1951", 2001; U.S. Department of Energy, Energy Information Administration, *Annual Energy Review*, 2002;U.S. Department of Energy, Energy Information Administration, *International Petroleum Monthly*, April 2004.

- The most traumatic disruption, 1973-74, was not the most severe, but it nevertheless lead to greatly increased oil prices and significant worldwide economic damage.

- The second most traumatic disruption, 1979, was also neither the longest nor the most severe.

For purposes of this study, the 1973-74 and 1979 disruptions are taken as the most relevant, because they are believed to offer the best insights into what might occur when world oil production peaks.

B. Difficulties in Deriving Implications From Past Experience

Over the past 30 years, most economic studies of the impact of oil supply disruptions assumed that the interruptions were temporary and that each situation would shortly return to "normal." Thus, the major focus of most studies was determination of the appropriate fiscal and monetary policies required to minimize negative economic impacts and the development of policies to help the economy and labor market adjust until the disruption ended.[35] Few economists considered a situation where the oil supply shortfall may be long-lived (a decade or more).

Since 1970, most large oil price increases were eventually followed by oil price declines, and, since these cycles were expected to be repeated, it was generally felt that "the problem will take care of itself as long at the government does nothing and does not interfere."[36] The frequent and incorrect predictions of oil shortfalls have been often used to discredit future predictions of a longer-term problem and to discredit the need for appropriate long-term U.S. energy policies.

C. How Oil Supply Shortfalls Affect the Global Economy

Oil prices play a key role in the global economy, since the major impact of an oil supply disruption is higher oil prices.[37] Oil price increases transfer income from

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[35]This is verified by the extensive literature review conducted by Donald W. Jones and Paul N. Leiby, "The Macroeconomic Impacts of Oil Price Shocks: A Review of the Literature and Issues," Oak Ridge National Laboratory, January 1996, and by Donald W. Jones, Paul N. Leiby, and Inja K Paik, "Oil Price Shocks and the Macroeconomy: What Has Been Learned Since 1996, *The Energy Journal*, 2003.
[36]See, for example, Leonardo Maugeri, "Oil: Never Cry Wolf – Why the Petroleum Age is Far From Over, " *Science*, Vol. 304, May 21, 2004, pp. 1114-1115; Michael C. Lynch, "Closed Coffin: Ending the Debate on 'The End of Cheap Oil,' A Commentary," DRI/WEFA, September 2001; Michael C. Lynch "Farce This Time: Renewed Pessimism About Oil Supply, 2000; Bjorn Lomborg, "Running on Empty?" *Guardian*, August 16, 2001; Mark Mills, "Stop Worrying About Oil Prices," 2001, fossilfuels.org; Jerry Taylor, "Markets Work Magic," Cato Institute, January 2002; *Rethinking Emergency Energy Policy*, U.S. Congressional Budget Office, December 1994.
[37]This is the consensus of virtually every rigorous analysis of the problem; see, for example, the International Monetary Fund study conducted by Benjamin Hunt, Peter Isard, and Douglas

oil importing to oil exporting countries, and the net impact on world economic growth is negative. For oil importing countries, increased oil prices reduce national income because spending on oil rises, and there is less available to spend on other goods and services.[38] Not surprisingly, the larger the oil price increase and the longer higher prices are sustained, the more severe is the macroeconomic impact.

Higher oil prices result in increased costs for the production of goods and services, as well as inflation, unemployment, reduced demand for products other than oil, and lower capital investment. Tax revenues decline and budget deficits increase, driving up interest rates. These effects will be greater the more abrupt and severe the oil price increase and will be exacerbated by the impact on consumer and business confidence.

Government policies cannot eliminate the adverse impacts of sudden, severe oil disruptions, but they can minimize them. On the other hand, contradictory monetary and fiscal policies to control inflation can exacerbate recessionary income and unemployment effects. (See Appendix II for further discussion of past government actions).

D. The U.S. Experience

As illustrated in Figure IV-2, oil price increases have preceded most U.S. recessions since 1969, and virtually every serious oil price shock was followed by a recession. Thus, <u>while oil price spikes may not be necessary to trigger a recession in the U.S., they have proven to be sufficient over the past 30 years.</u>

E. The Experience of Other Countries

1. The Developed (OECD) Economies

Estimates of the damage caused by past oil price disruptions vary substantially, but without a doubt, the effects were significant. Economic growth decreased in most oil importing countries following the disruptions of 1973-74 and 1979-80, and the impact of the first oil shock was accentuated by inappropriate policy responses.[39] Despite a decline in the ratio of oil consumption to GDP over the past three decades, oil remains vital, and there is considerable empirical evidence regarding the effects of oil price shocks:

Saxton, "The Macroeconomic Effects of Oil Price Shocks," *National Institute Economic Review* No. 179, January 2002.

[38] "The Impact of Higher Oil Prices on the World Economy," OECD Standing Group on Long-Term Cooperation, 2003.

[39] See Lee, Ni, and Ratti, op. cit., and J.D. Hamilton and A.M. Herrera "Oil Shocks and Aggregate Macroeconomic Behavior: The Role of Monetary Policy," *Journal of Money, Credit and Banking*, 2003.

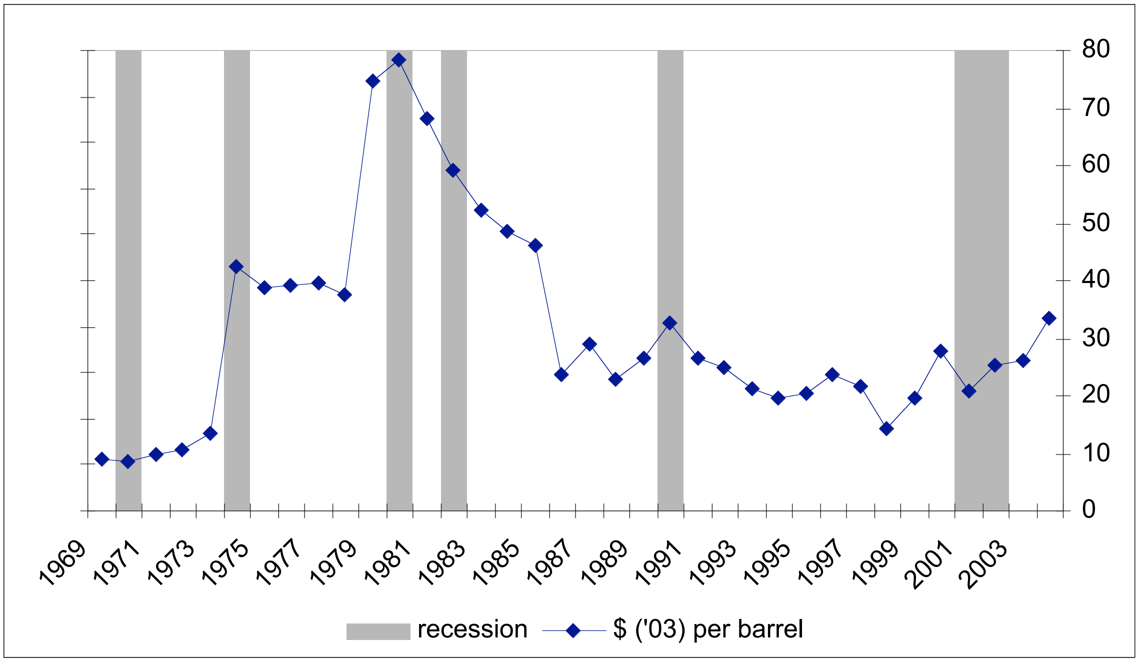

Figure IV-2. Oil Prices and U.S. Recessions: 1969-2003[40]

- The loss suffered by the OECD countries in the 1974/-75 recession amounted to $350 billion (current dollars) / $1.1 trillion 2003 dollars, although part of this loss was related to factors other than oil price.[41]
- The loss resulting from the 1979 oil disruption was about three percent of GDP ($350 billion in current dollars) in 1980 rising to 4.25 percent ($570 billion) in 1981, and accounted for much of the decline in economic growth and the increase in inflation and unemployment in the OECD in 1981-82.[42]
- The effect of the 1990-91 oil price upsurge was more modest, because price increases were smaller; they did not persist; and oil intensity in OECD countries had declined.

[40] U.S. Joint Economic Committee and Management Information Services, Inc., 2004.

[41] This totals about $1.1 trillion in 2003 dollars and was equivalent to a once-and-for-all reduction in real GDP of about seven percent; however, part of that loss was likely attributable to structural and cyclical economic factors unrelated to the oil-price shock. See Faith Bird, "Analysis of the Impact of High Oil Price on the Global Economy," International Energy Agency, 2003.

[42] These losses totaled about $700 billion and $1.1 trillion, respectively in 2003 dollars. Losses of this magnitude are significant and represent the difference between vibrant, growing economies and economies in deep recession. There is considerable debate as to precisely how much of these losses was attributable to the oil price shocks, to fiscal and monetary policies, and to other factors.

- Although oil intensity and the share of oil in total imports have declined in recent years, OECD economies remain vulnerable to higher oil prices, because of the “life blood” nature of liquid fuel use.

2. Developing Countries

Developing countries suffer more than the developed countries from oil price increases because they generally use energy less efficiently and because energy-intensive manufacturing accounts for a larger share of their GDP. On average, developing countries use more than twice as much oil to produce a unit of output as developed countries, and oil intensity is increasing in developing countries as commercial fuels replace traditional fuels and industrialization/urbanization continues.[43]

The vulnerability of developing countries is exacerbated by their limited ability to switch to alternative fuels. In addition, an increase in oil import costs also can destabilize trade balances and increase inflation more in developing countries, where financial institutions and monetary authorities are often relatively unsophisticated. This problem is most pronounced for the poorest developing countries.

F. Implications

1. The World Economy

A shortfall of oil supplies caused by world conventional oil production peaking will sharply increase oil prices and oil price volatility. As oil peaking is approached, relatively minor events will likely have more pronounced impacts on oil prices and futures markets.

Oil prices remain a key determinant of global economic performance, and world economic growth over the past 50 years has been negatively impacted in the wake of increased oil prices. The greater the supply shortfall, the higher the price increases; the longer the shortfall, the greater will be the adverse economic affects.

The long-run impact of sustained, significantly increased oil prices associated with oil peaking will be severe. Virtually certain are increases in inflation and unemployment, declines in the output of goods and services, and a degradation of living standards. Without timely mitigation, the long-run impact on the developed economies will almost certainly be extremely damaging, while many developing nations will likely be even worse off.[44]

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[43]See Bird, op. cit., and OECD Standing Group on Long-Term Cooperation, op. cit.

[44]A $10/bbl. increase in oil prices, if sustained for a year, will reduce global GDP by 0.6 percent, ignoring the secondary effects on confidence, stock markets, and policy responses; see Bird, op. cit. A sustained increase of $10/bbl. would reduce economic growth by 0.5 percent in the

The impact of oil price changes will likely be asymmetric. The negative economic effects of oil price increases are usually not offset by the economic stimulus resulting from a fall in oil prices. The increase in economic growth in oil exporting countries provided by higher oil prices has been less than the loss of economic growth in importing countries, and these effects will likely continue in the future.[45]

2. The United States

For the U.S., each 50 percent sustained increase in the price of oil will lower real U.S. GDP by about 0.5 percent, and a doubling of oil prices would reduce GDP by a full percentage point. Depending on the U.S. economic growth rate at the time, this could be a sufficient negative impact to drive the country into recession. Thus, assuming an oil price in the $25 per barrel range -- the 2002-2003 average, an increase of the price of oil to $50 per barrel would cost the economy a reduction in GDP of around $125 billion.

If the shortfall persisted or worsened (as is likely in the case of peaking), the economic impacts would be much greater. Oil supply disruptions over the past three decades have cost the U.S. economy about $4 trillion, so supply shortfalls associated with the approach of peaking could cost the U.S. as much as all of the oil supply disruptions since the early 1970s combined.

The effects of oil shortages on the U.S. are also likely to be asymmetric. Oil supply disruptions and oil price increases reduce economic activity, but oil price declines have a less beneficial impact.[46] Oil shortfalls and price increases will cause larger responses in job destruction than job creation, and many more jobs may be lost in response to oil price increases than will be regained if oil prices were to decrease. These effects will be more pronounced when oil price volatility increases as peaking is approached. The repeated economic and job losses experienced during price spikes will not be replaced as prices decrease. As these cycles continue, the net economic and job losses will increase.

Sectoral shifts will likely be pronounced. Even moderate oil disruptions could cause shifts among sectors and industries of ten percent or more of the labor force.[47] Continuing oil shortages will likely have disruptive inter-sectoral, inter-

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industrialized countries and by 0.75 percent or more in the developing countries; see Ibid., OECD Standing Group on Long-Term Cooperation, op. cit., and International Monetary Fund, *World Economic Outlook*, September 2003. Larger oil price increases will have even more severe economic effects.

[45] K.A. Mork, "Business Cycles and the Oil Market," *Energy Journal*, special issue, 1994, pp. 15-38.

[46] See Mark Hooker, "Are Oil Shocks Inflationary? Asymmetric and Nonlinear Specification Versus Changes In Regime," Federal Reserve Board, December 1999.

[47] Hillard Huntington, "Energy Disruptions, Interfirm Price Effects, and the Aggregate Economy," Energy Modeling Forum, Stanford University, September 2002; S.J. Davis, and J. Haltiwanger,

industry, and inter-regional effects, and the sectors that are (both directly and indirectly) oil-dependant could be severely impacted.[48]

Monetary policy is more effective in controlling the inflationary effects of a supply disruption than in averting related recessionary effects.[49] Thus, while appropriate monetary policy may be successful in lessening the inflationary impacts of oil price increases, it may do so at the cost of recession and increased unemployment. Monetary policies tend to be used to increase interest rates to control inflation, and it is the high interest rates that cause most of the economic damage. As peaking is approached, devising appropriate offsetting fiscal, monetary, and energy policies will become more difficult. Economically, the decade following peaking may resemble the 1970s, only worse, with dramatic increases in inflation, long-term recession, high unemployment, and declining living standards.[50]

"Sectoral Job Creation and Destruction Response to Oil Price Changes," *Journal of Monetary Economics,* Vol. 48, 2001, pp. 465-512.

[48]"Demand destruction" has often been identified as a solution, since oil price increases resulting from a disruption will reduce demand and this will moderate further price increases. However, demand is reduced because the economy is devastated and large numbers of jobs are lost. Demand destruction – a polite word for economic and job losses – is the problem, not the solution. See the discussion in Roger Bezdek and Robert Wendling, "The Case Against Gas Dependence," *Public Utilities Fortnightly*, Vol. 142, No. 4, April 2004, pp. 43-47.

[49]Joint Economic Committee of the U.S. Congress, "10 Facts About Oil Prices," March 2003; Mark Hooker, "Oil and the Macroeconomy Revisited," Federal Reserve Board, August 1999.

[50]Nevertheless, during disruptions, public actions may be required to address societal risks. This creates a dilemma: In the event of a severe shortfall of long duration, government intervention of some sort may be required, and allocation plans to moderate the effects of this shortfall will likely be advocated. However, given the experience of the 1970s, many of the policies enacted in a crisis atmosphere will be, at best, sub-optimal. For example, in 1980, the Federal government developed a Congressionally-mandated stand-by U.S. gasoline rationing plan which could, in some form, be implemented; see *Standby Gasoline Rationing Plan*, U.S. Department of Energy, Washington, D.C., June 1980.

V. LEARNING FROM THE NATURAL GAS EXPERIENCE

A. Introduction

A dramatic example of the risks of over-reliance on geological resource projections is the experience with North American natural gas. Natural gas supplies roughly 20 percent of U.S. energy demand. It has been plentiful at real prices of roughly $2/Mcf for almost two decades. Over the past 10 years, natural gas has become the fuel of choice for new electric power generation plants and, at present, virtually all new electric power generation plants use natural gas.

Part of the attractiveness of natural gas was resource estimates for the U.S. and Canada that promised growing supply at reasonable prices for the foreseeable future. That optimism turns out to have been misplaced, and the U.S. is now experiencing supply constraints and high natural gas prices. Supply difficulties are almost certain for at least the remainder of the decade. The North American natural gas situation provides some useful lessons relevant to the peaking of conventional world oil production.

B. The Optimism

As recently as 2001, a number of credible groups were optimistic about the ready availability of natural gas in North America. For example:

- In 1999 the National Petroleum Council stated "U.S. production is projected to increase from 19 trillion cubic feet (Tcf) in 1998 to 25 Tcf in 2010 and could approach 27 Tcf in 2015…. Imports from Canada are projected to increase from 3 Tcf in 1998 to almost 4 Tcf in 2010." [51]

- In 2001 Cambridge Energy Research Associates (CERA) stated "The rebound in North American gas supply has begun and is expected to be maintained at least through 2005. In total, we expect a combination of US lower-48 activity, growth in Canadian supply, and growth in LNG imports to add 8.95 Bcf per day of production by 2005." [52]

- The U.S. Energy Department's Energy Information Administration (EIA) in 1999 projected that U.S. natural gas production would grow continuously from a level of 19.4 Tcf in 1998 to 27.1 Tcf in 2020.[53]

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[51]National Petroleum Council. Meeting the Challenges of the Nation's Growing Natural Gas Demand. December 1999.
[52]Esser, R. et al. Natural Gas Productive Capacity Outlook in North America - How Fast Can It Grow? Cambridge Energy Research Associates, Inc. 2001.
[53]U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 2000*. December 1999.

C. Today's Perspectives

The current natural gas supply outlook has changed dramatically. Among those that believe the situation has changed for the worse are the following:

- CERA now finds that "The North American natural gas market is set for the longest period of sustained high prices in its history, even adjusting for inflation. Disappointing drilling results … have caused CERA to revise the outlook for North American supply downward … The downward revisions represent additional disappointing supply news, painting a more constrained picture for continental supply. Gas production in the United States (excluding Alaska) now appears to be in permanent decline, and modest gains in Canadian supply will not overcome the US downturn."[54]

- Raymond James & Associates finds that "Natural gas production continues to drop despite a 20 percent increase in U.S. drilling activity since April 2003."[55] "U.S. natural gas production is heading firmly downwards…"[56]

- "Lehman now expects full-year U.S. production to decline by 4% following a 6% decline in 2003. …. Domestic production is forecast to fall to 41.0 billion cubic feet a day by 2008 from 46.8 in 2003 and 52.1 in 1998. After a sharp 12% fall in 2003, Canadian imports are seen dropping..."[57]

- The NPC now contends that "Current higher gas prices are the result of a fundamental shift in the supply and demand balance. North America is moving to a period in its history in which it will no longer be self-reliant in meeting its growing natural gas needs; production from traditional U.S. and Canadian basins has plateaued."[58]

Canada has been a reliable U.S. source of natural gas imports for decades. However, the Canadian situation has recently changed for the worse. For example: "Natural gas production in Alberta, the largest exporter to the huge U.S. market, slipped 2 percent last year despite record drilling and may have peaked in 2001, the Canadian province's energy regulator said on Thursday … Production peaked at 5.1 trillion cubic feet in 2001. … (EUB) forecast flat production in 2004 and an annual decline of 2.5 percent through at least 2013."[59]

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[54]CERA Advisory Services. *The Worst is Yet to Come: Diverging Fundamentals Challenge the North American Gas Market*. Cambridge Energy Research Associates, Inc. Spring 2004.
[55]Industry Trends (quoting Raymond James & Associates). *OGJ*. June 7, 2004.
[56]Adkins, J.M. et al. "Energy Industry Brief". Raymond James & Associates. May 17, 2004.
[57]"Lehman Says US 1Q Gas Production Fell By 5.3%". Dow Jones. May 12, 2004.
[58]National Petroleum Council. *Balancing Natural Gas Policy – Fueling the Demands of a Growing Economy: Volume I – Summary of Findings and Recommendations*. September 25, 2003.
[59]Reuters. "Alberta Gas Output Falling Despite Record Drilling". June 6, 2004.

D. U.S. Natural Gas Price History

EIA data show that U.S. natural gas prices were relatively stable in constant dollars from 1987 through1998.[60] However, beginning in 2000, prices began to escalate -- they were roughly 50 percent higher in 2000 compared to 1998.[61] Skipping over the recession years of 2001 and 2002, prices in late 2003 and early 2004 further increased roughly 25 percent over 2000.[62]

While it is often inappropriate to extrapolate gas or oil prices into the future based on short term experience, a number of organizations are now projecting increased U.S. natural gas prices for a number of years. For example, CERA now expects natural gas prices to rise steadily through 2007.[63]

E. LNG –Delayed Salvation

With North American natural gas production suddenly changed, hopes of meeting future demand have turned to imports of liquefied natural gas (LNG).[64] The U.S. has four operating LNG terminals, and a number of proposals for new terminals have been advanced. Indeed, the Secretary of Energy and the Chairman of the Federal Reserve Board recently called for a massive buildup in LNG imports to meet growing U.S. natural gas demand.

But the construction of new terminals demands state and local approvals. Because of NIMBYism and fear of terrorism at LNG facilities, a number of the proposed terminals have been rejected. There are also objections from Mexico, which has been proposed as a host for LNG terminals to support west coast natural gas demands.[65] In the Boston area there is an ongoing debate as to whether the nation's largest LNG terminal in Everett, Massachusetts, ought to be shut down, because of terrorist concerns.[66] Decommissioning of that terminal would exacerbate an already tight national natural gas supply situation. Public fears about LNG safety were heightened by an explosion at an LNG liquefaction plant in Algeria that killed 27 people in January 2004. Alternatively, some are considering locating LNG terminals offshore with gas pipelined underwater to land; related costs will be higher, but safety would be enhanced.

[60] Natural Gas Markets and EIA's Information Program March 2000.
[61] U.S. Department of Energy, Energy Information Administration, *Natural Gas Annual 2002*.
[62] U.S. Department of Energy, Energy Information Administration, "Natural Gas Navigator." Last Updated 5/6/04.
[63] CERA Advisory Services. "The Worst is Yet to Come: Diverging Fundamentals Challenge the North American Gas Market". Cambridge Energy Research Associates, Inc. Spring 2004.
[64] The Alaska natural gas pipeline is at least 10 years from operation, maybe longer.
[65] Flalka, J.J. & Gold, R. "Fears of Terrorism Crush Plans For Liquefied-Gas Terminals." *The Wall Street Journal*. May 14, 2004.
[66] Bender, B. "DistriGas Contests Hazard Study Findings." *Boston Globe*. June 2, 2004.

F. The U.S. Current Natural Gas Situation

U.S. natural gas demand is increasing; North American natural gas production is declining or poised for decline as indicated in references 53, 54, and 55. The planned U.S. expansion of LNG imports is experiencing delays. U.S. natural gas supply shows every sign of deteriorating significantly before mitigation provides an adequate supply of low cost natural gas. Because of the time required to make major changes in the U.S. natural gas infrastructure and marketplace, forecasts of a decade of high prices and shortages are credible.

G. Lessons Learned

A full discussion of the complex dimensions of the current U.S. natural gas situation is beyond the scope of this study; such an effort would require careful consideration of geology, reserves estimation, natural gas exploration and production, government land restrictions, storage, weather, futures markets, etc. Nevertheless, we believe that the foregoing provides a basis for the following observations:

- Like oil reserves estimation, natural gas reserves estimation is subject to enormous uncertainty. North American natural gas reserves estimates now appear to have been excessively optimistic and North American natural gas production is now almost certainly in decline.

- High prices do not a priori lead to greater production. <u>Geology is ultimately the limiting factor, and geological realities are clearest after the fact.</u>

- Even when urgent, nation-scale energy problems arise, business-as-usual mitigation activities can be dramatically delayed or stopped by state and local opposition and other factors.

If experts were so wrong on their assessment of North American natural gas, are we really comfortable risking that the optimists are correct on world conventional oil production, which involves similar geological and technological issues?

If higher prices did not bring forth vast new supplies of North American natural gas, are we really comfortable that higher oil prices will bring forth huge new oil reserves and production, when similar geology and technologies are involved?

VI. MITIGATION OPTIONS AND ISSUES

A. Conservation

Practical mitigation of the problems associated with world oil peaking must include fuel efficiency technologies that could impact on a large scale. Technologies that may offer significant fuel efficiency improvements fall into two categories: retrofits, which could improve the efficiency of existing equipment, and displacement technologies, which could replace existing, less efficient oil-consuming equipment. A comprehensive discussion of this subject is beyond the scope of this study, so we focus on what we believe to be the highest impact, existing technologies. Clearly, other technologies might contribute on a lesser scale.

From our prior discussion of current liquid fuel usage (Chapter III), it is clear that automobiles and light trucks (light duty vehicles or LDVs) represent the largest targets for consumption reduction. This should not be surprising: Auto and LDV fuel use is large, and fuel efficiency has not been a consumer priority for decades, largely due to the historically low cost of gasoline. An established but relatively little-used engine technology for LDVs in the U.S. is the diesel engine, which is up to 30 percent more efficient than comparable gasoline engines. Future U.S. use of diesels in LDVs has been problematic due to increasingly more stringent U.S. air emission requirements. European regulations are not as restrictive, so Europe has a high population of diesel LDVs – between 55 and 70 percent in some countries. [67]

A new technology in early commercial deployment is the hybrid system, based on either gasoline or diesel engines and batteries. In all-around driving tests, gasoline hybrids have been found to be 40 percent more efficient in small cars and 80 percent more efficient in family sedans.[68]

For retrofit application, neither diesel nor hybrid engines appear to have significant potential, so their use will likely be limited to new vehicles. Under business-as-usual market conditions, hybrids might reach roughly 10 percent on-the-road U.S. market share by 2015.[69] That penetration rate is based on the fact that the technology has met many of the performance demands of a significant number of today's consumers and that gasoline hybrids use readily available fuel.

Government-mandated vehicle fuel efficiency requirements are virtually certain to be an element in the mitigation of world oil peaking. One result would almost certainly be the more rapid deployment of diesel and / or hybrid engines. Market

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[67]Harvan, R. "Diesel Use Surging". *World Refining*. June 2004.
[68] Consumer Reports. August 2004. Page 49.
[69]National Research Council*. The Hydrogen Economy: Opportunities, Costs, Barriers, and R & D Needs*. National Academy Press. 2004.

penetration of these technologies cannot happen rapidly, because of the time and effort required for manufacturers to retool their factories for large-scale production and because of the slow turnover of existing stock. In addition, a shift from gasoline to diesel fuel would require a major refitting of refineries, which would take time.

Nation-scale retrofit of existing LDVs to provide improved fuel economy has not received much attention. One retrofit technology that might prove attractive for the existing LDV fleet is "displacement on demand" in which a number of cylinders in an engine are disabled when energy demand is low. The technology is now available on new cars, and fuel economy savings of roughly 20 percent have been claimed.[70] The feasibility and cost of such retrofits are not known, so we consider this option to be speculative.

It is difficult to project what the fuel economy benefits of hybrid or diesel LDVs might be on a national scale, because consumer preferences will likely change once the public understands the potential impacts of the peaking of world oil production. For example, the current emphasis on large vehicles and SUVs might well give way to preferences for smaller, much more fuel-efficient vehicles.

The fuel efficiency benefits that hybrids might provide for heavy-duty trucks and buses are likely smaller than for LDVs for a number of reasons, including the fact that there has long been a commercial demand for higher efficiency technologies in order to minimize fuel costs for these fleets.

Hybrids can also impact the medium duty truck fleet, which is now heavily populated with diesel engines. For example, road testing of diesel hybrids in FedEx trucks recently began, with fuel economy benefits of 33 percent claimed.[71] On the other hand, there appears to be limits to the fuel economy benefits of hybrid engines in large vehicles; for example, the fuel savings in hybrid buses might only be in the 10 percent range.[72]

On the distant horizon, innovations in aircraft design may result in large fuel economy improvements. For example, a 25 to 50 percent fuel efficiency improvement may be possible with a new, blended wing aircraft.[73] Such benefits would require the purchase of entirely new equipment, requiring a decade or more for significant market penetration. Innovations for major liquid fuel savings for trains and ships may exist but are not widely publicized.

B. Improved Oil Recovery

Management of an oil reservoir over its multi-decade life is influenced by a range

[70]Kerwin, K. "Chrysler Puts Some Muscle on the Street". *Business Week*. June 7, 2004.
[71]Press release. Eaton Corp., March 30, 2004.
[72]Press release. National Renewable Energy Technology Laboratory, February 8, 2002.
[73]Homes, S. "A Silver Lining for Boeing". *Business Week*. May 24, 2004.

of factors, including 1) actual and expected future oil prices; 2) production history, geology, and status of the reservoir; 3) cost and character of production-enhancing technologies; 4) timing of enhancements; 5) the financial condition of the operator; 6) political and environmental circumstances, 7) an operator's other investment opportunities, etc.

Improved Oil Recovery (IOR) is used to varying degrees on all oil reservoirs. IOR encompasses a variety of methods to increase oil production and to expand the volume of recoverable oil from reservoirs. Options include in-fill drilling, hydraulic fracturing, horizontal drilling, advanced reservoir characterization, enhanced oil recovery (EOR), and a myriad of other methods that can increase the flow and recovery of liquid hydrocarbons. IOR can also include many seemingly mundane efficiencies introduced in daily operations.[74]

IOR technologies are adapted on a case-by-case basis. It is not possible to estimate what IOR techniques or processes might be applied to a specific reservoir without having detailed knowledge of that reservoir. Such knowledge is rarely in the public domain for the large conventional oil reservoirs in the world; if it were, then a more accurate estimate of the timing of world oil peaking would be possible.

A particularly notable opportunity to increase production from existing oil reservoirs is the use of enhanced oil recovery technology (EOR), also known as tertiary recovery. EOR is usually initiated after primary and secondary recovery have provided most of what they can provide. Primary production is the process by which oil naturally flows to the surface because oil is under pressure underground. Secondary recovery involves the injection of water into a reservoir to force additional oil to the surface.

EOR has been practiced since the 1950s in various conventional oil reservoirs, particularly in the United States. The process that likely has the largest worldwide potential is miscible flooding wherein carbon dioxide (CO_2), nitrogen or light hydrocarbons are injected into oil reservoirs where they act as solvents to move residual oil. Of the three options, CO_2 flooding has proven to be the most frequently useful. Indeed, naturally occurring, geologically sourced CO_2 has been produced in Colorado and shipped via pipeline to west Texas and New Mexico for decades for EOR. CO_2 flooding can increase oil recovery by 7-15 percent of original oil in place (OOIP).[75] Because EOR is relatively expensive, it has not been widely deployed in the past. However, in a world dealing with peak conventional oil production and higher oil prices, it has significant potential.

[74] Williams, B. "Progress in IOR technology, economics deemed critical to staving off world's oil production peak". *OGJ*. August 4, 2003.

[75] Williams, B. "Progress in IOR technology, economics deemed critical to staving off world's oil production peak". *OGJ*. August 4, 2003; National Research Council. *Fuels to Drive Our Future*. National Academy Press. 1990.; "EOR Continues to Unlock Oil Resources". *OGJ*. April 12, 2004.

Because of various cost considerations, enhanced oil recovery processes are typically not applied to a conventional oil reservoir until after oil production has peaked. Therefore, EOR is not likely to increase reservoir peak production. However, EOR can increase total recoverable conventional oil, and production from the reservoirs to which it is applied does not decline as rapidly as would otherwise be the case. This concept is notionally shown in Figure IV-1.

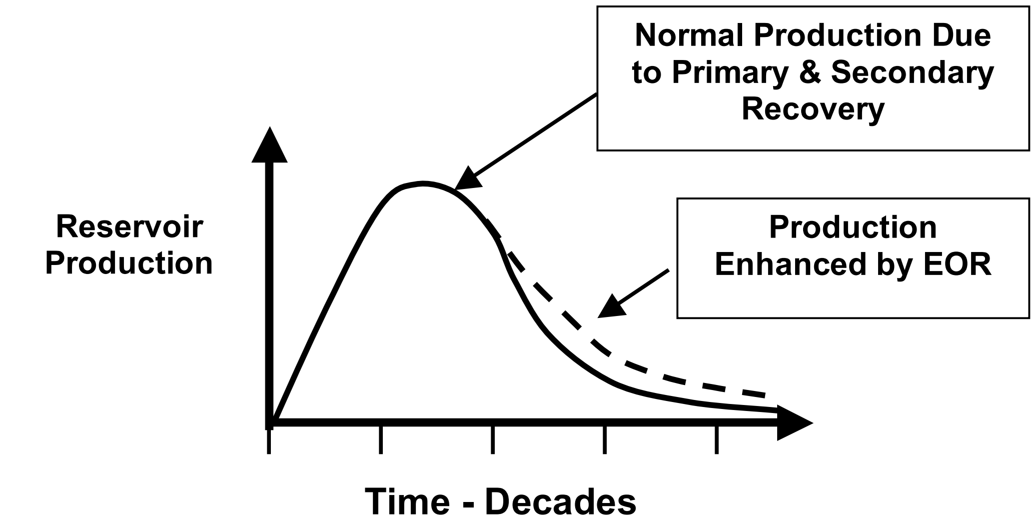

Figure VI-1. The Timing of EOR Applications

C. Heavy Oil and Oil Sands

This category of unconventional oil includes a variety of viscous oils that are called heavy oil, bitumen, oil sands, and tar sands. These oils have potential to play a much larger role in satisfying the world's needs for liquid fuels in the future.

The largest deposits of these oils exist in Canada and Venezuela, with smaller resources in Russia, Europe and the U.S. While the size of the Canadian and Venezuela resources are enormous, 3-4 trillion barrels in total, the amount of oil estimated to be economically recoverable is of the order of 600 billion barrels.[76] This relatively low fraction is in large part due to the extremely difficult task of extracting these oils.[77]

[76]Economists will argue that this amount will increase with higher world oil prices, which is almost certainly correct. However, without careful analysis, estimation of the increased reserves would be strictly speculation.

[77]These numbers are subject to revision upwards or downwards depending on future geological findings, advancing technology, or higher oil prices. Williams, B. "Heavy Hydrocarbons Playing Key Role in Peak Oil Debate, Future Supply". *OGJ*. July 28, 2003.

Canadian oil sands production results in a range of products, only a part of which can be refined into finished fuels that can substitute for petroleum-based fuels. These high quality oil-sands-derived products are called synthetic crude oil (SCO). Other products from oil sands processing are Dilbit, a blend of diluent and bitumen, Synbit, a blend of synthetic crude oil and bitumen, and Syndilbit, a blend of Synbit and diluent. Current Canadian production is approximately 1 million bpd of which 600,000 bpd is synthetic crude oil and 400,000 bpd is lower grade bitumen.[78]

The reasons why the production of unconventional oils has not been more extensive is as follows: 1) Production costs for unconventional oils are typically much higher than for conventional oil; 2) Significant quantities of energy are required to recover and transport unconventional oils; and 3) Unconventional oils are of lower quality and, therefore, are more expensive to refine into clean transportation fuels than conventional oils.

Canadian oil sands have been in commercial production for decades. During that time, production costs have been reduced considerably, but costs are still substantially higher than conventional oil production. Canadian oil sands production currently uses large amounts of natural gas for heating and processing. Canada recently recognized that it no longer has the large natural gas resources once thought, so oil sands producers are considering building coal or nuclear plants as substitute energy sources to replace natural gas.[79] The overall efficiency of Canadian oil sands production is not publicly available but has been estimated to be less than 70 percent for total product, only a part of which is a high-quality substitute transport fuel.[80]

In addition to needing a substitute for natural gas for processing oil sands, there are a number of other major challenges facing the expansion of Canadian oil sands production, including water[81] and diluent availability, financial capital, and environmental issues, such as SO_X and NO_X emissions, waste water cleanup, and brine, coke, and sulfur disposition. In addition, because Canada is a signatory to the Kyoto Protocol and because oil sands production results in significant CO_2 emissions per barrel, there may be related constraints yet to be fully evaluated.

The current Canadian vision is to produce a total of about 5 MM bpd of products from oil sands by 2030. This is to include about 3 MM bpd of synthetic crude oil from which refined fuels can be produced, with the remainder being poorer quality bitumen that could be used for energy, power, and/or hydrogen and

[78] Gray, D. *"Oil Sands Conference Report".* Mitretek. May 24, 2004.
[79] "*Oil Sands Technology Roadmap*". Alberta Chamber of Resources. January 2004.
[80] Gray, D. *"Oil Sands Conference Report".* Mitretek. May 24, 2004.
[81] Underground steam recovery requires about 3 bbls of water per barrel of recovered bitumen. Mining operations need 4-6 bbls of water per bbl of bitumen. Ref.: Gray, D. *Oil Sands Conference Report.* Mitretek. May 24, 2004.

petrochemicals production. 5 MM bpd would represent a five-fold increase from current levels of production.[82] Another estimate of future production states that if all proposed oil sands projects proceed on schedule, industry could produce 3.5 MM bpd by 2017, representing 2 MM bpd of synthetic crude and 1.5 MM bpd of unprocessed lower-grade bitumen.[83] It should be noted that not everyone supports this expansion. For example, the executive director of the Sierra Club of Canada, calls tar sands "… the world's dirtiest source of oil."[84]

Venezuela's extra-heavy crude oil and bitumen deposits are situated in the Orinoco Belt, located in Central Venezuela. There are currently a number of joint ventures between the Venezuelan oil company, PdVSA, and foreign partners to develop and produce this oil. In 2003, production was about 500,000 bpd of synthetic crude oil. That is expected to increase to 600,000 bpd by 2005.[85] While the weather in tropical Venezuela is more conducive to oil production operations than the bitter winters of Alberta, Canada, the political climate in Venezuela has been particularly unsettled in recent years, which could impact future production.

In closing, it is also worth noting that the bitumen yield from oil sands surface mining operations is about 0.6 barrels per ton of mined material, excluding overburden removal. This is similar to the yield from a good quality oil shale, but is less than Fisher-Tropsch liquid yields from coal, which is about 2.6 barrels per ton of coal. [86]

D. Gas-To-Liquids (GTL)

Very large reservoirs of natural gas exist around the world, many in locations isolated from gas-consuming markets. Significant quantities of this "stranded gas" have been liquefied and transported to various markets in refrigerated, pressurized ships in the form of liquefied natural gas (LNG). Japan, followed by Korea, Spain and the U.S. were the largest importers of LNG in 2003. LNG accounted for an important fraction of all traded gas volumes in 2003, and that fraction is projected to continue to grow considerably in the future.[87]

Another method of bringing stranded natural gas to world markets is to disassociate the methane molecules, add steam, and convert the resultant mixture to high quality liquid fuels via the Fisher-Tropsch (F-T) process. As with coal liquefaction, F-T based GTL results in clean, finished fuels, ready for use in existing end-use equipment with only modest finishing and blending. This Gas-

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[82]"*Oil Sands Technology Roadmap".* Alberta Chamber of Resources. January 2004.
[83]Stott, J. "*CERI: Alberta Oil Sands Industry Outlook 'Very Robust.'*" *OGJ*. March 22, 2004.
[84]Jaremko, G. *"Green forces rally to divert oil sands' use of Arctic gas. Gas use by 2015 could surpass Mackenzie capacity".* The Edmonton Journal. April 15, 2004.
[85]U.S. Department of Energy, Energy Information Administration, "*Country Analysis Briefs – Venezuela,*" June 2004.
[86]Gray, D. "Oil Sands Conference Report". Mitretek. May 24, 2004.
[87]Sen, C.T. "*World's LNG Industry Surges, Pushed By Confluence of Factors".* June 14, 2004.

To-Liquids process has undergone significant development over the past decade. Shell now operates a 14,500 bpd GTL plant in Malaysia. A number of large, new commercial plants recently announced include three large units in Qatar -- a 140,000 bpd Shell facility, a 160,000 bpd ConocoPhillips facility, and a 120,000 bpd Marathon Oil plant. Projects under development and consideration total roughly 1.7 MM bpd, but not all will come to fruition. Under business-as-usual conditions, 1.0 MM bpd may be produced by 2015, in line with a recent estimate of 600,000 bpd of GTL diesel fuel by 2015 -- the remaining 400,000 bpd being gasoline and other products.[88]

E. Liquid Fuels from U.S. Domestic Resources

The U.S. has three types of natural resource from which substitute liquid fuels can be manufactured: coal, oil shale, and biomass. All have been shown capable of producing high quality liquid fuels that can supplement or substitute for the fuels now produced from petroleum.

To derive liquid fuels from coal, the leading process involves gasification of the coal, removal of impurities from the resultant gas, and then synthesis of liquid fuels using the Fisher-Tropsch process. Modern gasification technologies have been dramatically improved over the years, with the result that over 150 gasifiers are in commercial operation around the world, a number operating on coal. Gas cleanup technologies are well developed and utilized in refineries worldwide. F-T synthesis is also well developed and commercially practiced. A number of coal liquefaction plants were built and operated during World War II, and the Sasol Company in South Africa subsequently built a number of larger, more modern facilities.[89] The U.S. has huge coal reserves that are now being utilized for the production of electricity; those resources could also provide feedstock for large-scale liquid fuel production.[90] Lastly, coal liquids from gasification/F-T synthesis are of such high quality that they do not need to be refined. When co-producing electricity, coal liquefaction is a developed technology, currently believed capable of providing clean substitute fuels at $30-35 per barrel.[91]

The U.S. is endowed with a vast resource of oil shale, located primarily in the western part of the Lower 48 states with lesser quantities in the mid Atlantic region. Processes for mining shale and retorting it at high temperatures were developed intensively in the late 1970s and early 1980s. However, when oil prices decreased in the mid 1980s, all large-scale oil shale R&D was terminated.[92]

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[88]Higgins,T. *"Gas-To-Liquids: An Emerging Driver for Diesel Markets?"* World Refining. April 2004.
[89]*Kruger, P du P. "*Startup Experience at Sasol's Two and Three". Sasol. 1983.
[90]National Research Council. *Fuels to Drive Our Future*. National Academies Press. 1990.
[91]Gray, D. et al. "*Coproduction of Ultra Clean Transportation Fuels, Hydrogen, and Electric Power from Coal"*. Mitretek Systems Technical Report MTR 2001-43, July 2001.
[92]Johnson, H. et al. *"Strategic Significance of America's Oil Shale Resource"*. DOE. March 2004.

The oil shale processing technologies that were pursued in the past required large volumes of water, which is now increasingly scarce in the western states. Also, air emissions regulations have become much stricter in the ensuing years, presenting additional challenges for shale mining and processing. Finally, it should be noted that the oil produced from shale retorting requires refining before it can be used as transportation fuels.

In recent years, Shell has been developing a new shale oil recovery process that uses insitu heating and avoids mining and massive materials handling. Little is known about the process and its economics, so its potential cannot now be evaluated.[93] (See Appendix VI for notes on shale oil).

Biomass can be grown, collected and converted to substitute liquid fuels by a number of processes. Currently, biomass-to-ethanol is produced on a large scale to provide a gasoline additive. The market for ethanol derived from biomass is influenced by federal requirements and facilitated by generous federal and state tax subsidies. Research holds promise of more economical ethanol production from cellulosic ("woody") biomass, but related processes are far from economic. Reducing the cost of growing, harvesting, and converting biomass crops will be necessary.[94] In other parts of the world, biomass-to-liquid fuels might be more attractive, depending on a myriad of factors, including local labor costs. Related projections for large-scale production would be strictly speculative. In summary, there are no developed biomass-to-fuels technologies that are now near cost competitive. (See Appendix VI for notes on biomass).

F. Fuel Switching to Electricity

Electricity is only used to a limited extent in the transportation sector. Diesel fuels (mid-distillates) power most rail trains in the U.S.; only a modest fraction are electric powered. Other electric transportation is limited to special situations, such as forklifts, in-factory transporters, etc.

In the 1990s electric automobiles were introduced to the market, spurred by a California clean vehicle requirement. The effort was a failure because existing batteries did not provide the vehicle range and performance that customers demanded. In the future, electricity storage may improve enough to win consumer acceptance of electric automobiles. In addition, extremely high gasoline prices may cause some consumers to find electric automobiles more acceptable, especially for around-town use. Such a shift in public preferences is unpredictable, so electric vehicles cannot now be projected as a significant offset to future gasoline use.

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[93] O'Conner, T. "*Mahogany Research Project: Technology to Secure Our Future*". Presentation at the DOE Shale Peer Review. February 19-20, 2004.
[94] Smith, S.J. et al. "*Near-Term US Biomass Potential*." PNWD-3285. Battelle Memorial Institute. January 2004.

A larger number of train routes could be outfitted for electric trains, but such a transition would likely be slow, because of the need to build additional electric power plants, transmission lines, and electric train cars. Since existing diesel locomotives use electric drive, their retrofit might be feasible. However, since diesel fuel use in trains is only roughly 0.3 MM bpd,[95] electrification of trains would not have a major impact on U.S liquid fuel consumption.

There are no known near-commercial means for electrifying heavy trucks or aircraft, so related conversions are not now foreseeable.

G. Other Fuel Switching

It is conceivable that consumers who now use mid-distillates and LPG (Liquefied Petroleum Gas) for heating could switch to natural gas or electricity, thereby freeing up liquid fuels for transportation. Analysis of this path is beyond the scope of this study, but it should be noted that these uses represent only a few percent of U.S. liquid fuel consumption. Such switching on a large scale would require the construction of compensating natural gas and/or electric power facilities and infrastructure, which would not happen quickly. In addition, freed-up liquids would likely require further refining to meet market and environmental requirements. Related refining would require refinery construction, which would also be time consuming.

H. Hydrogen

Hydrogen has potential as a long-term alternative to petroleum-based liquid fuels in some transportation applications. Like electricity, hydrogen is an energy carrier; hydrogen production requires an energy source for its production. Energy sources for hydrogen production include natural gas, coal, nuclear power, and renewables. Hydrogen can be used in internal combustion engines, similar to those in current use, or via chemical reactions in fuel cells.

The Department of Energy is currently conducting a high profile program aimed at developing a “hydrogen economy.”[96] DOE’s primary emphasis is on hydrogen for light duty vehicle application (automobiles and light duty trucks). Recently, the National Research Council (NRC) completed a study that included an evaluation of the technical, economic and societal challenges associated with the development of a hydrogen economy.[97] That study is the basis for the following highlights.

[95] American Association of Railroads. Railroad Facts. 2002.
[96] "*DOE Hydrogen Posture Plan*". www.eere.energy.gov/hydrogenandfuelcells. March 10, 2004.
[97] National Research Council. *The Hydrogen Economy: Opportunities, Costs, Barriers and R & D Needs*. National Academies Press. 2004.

A lynchpin of the current DOE hydrogen program is fuel cells. In order for fuel cells to compete with existing petroleum-based internal combustion engines, particularly for light duty vehicles, the NRC concluded that fuel cells must improve by 1) a factor of 10-20 in cost, 2) a factor of five in lifetime, and 3) roughly a factor of two in efficiency. The NRC did not believe that such improvements could be achieved by technology development alone; instead, new concepts (breakthroughs) will be required. In other words, today's technologies do not appear practically viable.[98]

Because of the need for unpredictable inventions in fuel cells, as well as viable means for on-board hydrogen storage, the introduction of commercial hydrogen vehicles cannot be predicted.

I. Factors That Can Cause Delay

It is extremely difficult, expensive, and time consuming to construct any type of major energy-related facility in the U.S. today. Even assuming the expenditure of substantial time and money, it is not certain that many proposed facilities will ever be constructed. The construction of transmission lines, interim and permanent nuclear waste disposal facilities, electric generation plants, waste incinerators, oil refineries, LNG terminals, waste recycling facilities, petrochemical plants, etc. is increasingly problematic.

What used to be termed the "not-in-my-back-yard" (NIMBY) principle has evolved into the "build-absolutely-nothing-anywhere-near-anything" (BANANA) principle, which is increasingly being applied to facilities of any type, including low-income housing, cellular phone towers, prisons, sports stadiums, water treatment facilities, airports, hazardous waste facilities, and even new fire houses.[99] Construction of even a single, relatively innocuous, urgently needed facility can easily take more than a decade. For example, in 1999, King County,

[98] Ibid.

[99] There has been extensive discussion of these problems in the literature; see, for example, Management Information Services, Inc., *Summary of the Implications of the Environmental Justice Movement for EPRI and its Members*; prepared for the Electric Power Research Institute, 1997; K.A Kilmer, G. Anandalingam, and J. Huber, "The Efficiency of Political Mechanisms for Siting Nuisance Facilities: Are Opponents More Likely to Participate Than Supporters?" *Journal of Real Estate Finance and Economics*, vol. 22, 2001; Sheila Foster, "Justice from the Ground Up: Distributive Inequalities, Grassroots Resistance, and the Transformative Politics of the Environmental Justice Movement," *California Law Review*, vol. 86, no. 4 (1998), pp. 775-841; D. Minehard and Z. Neeman, "Effective Siting of Waste Treatment Facilities," *Journal of Environmental Economics and Management*, vol. 43, 2002, pp. 303-324; Joanne Linnerooth-Bayer, "Fair Strategies for Siting Hazardous Waste Facilities," International Institute for Applied Systems Analysis, Laxenburg, Austria, May 1999; Don Markley, "Its not NIMBY Anymore, its BANANA," *Broadcast Engineering*, March 1, 2002; S. Tierney and P. Hibbard, "Siting Power Plants in the New Electric Industry Structure: Lessons From California," *The Electric Journal*, 2000, pp. 35-49; Dan Sandoval, "The NIMBY Challenge," *Recycling Today*, April 14, 2003; Philip Sittleburg, "NIMBY Mindset Looks for Zoning Loopholes," *Fire Chief*, February 1, 2002.

Washington, initiated the siting process for the Brightwater wastewater treatment plant, which it hopes to have operation in 2010.[100]

The routine processes required for siting energy facilities can be daunting, expensive, and time consuming, and if a facility is at all controversial, which is almost invariably the case, opponents can often extend the permitting process until sponsors terminate their plans. For example, approval for new, small, distributed energy systems requires a minimum of 18 separate steps, requiring approval from four federal agencies, 11 state government agencies, and 14 local government agencies.[101] Opponents of energy facilities routinely exercise their right to raise objections and offer alternatives. Intervenors in permitting processes may delay decisions and in some cases force outright cancellations, although cases do exist in which facilities have been sited quickly.

The implications for U.S. homeland-based mitigation of world oil peaking are troubling. To replace dwindling supplies of conventional oil, large numbers of expensive and environmentally intrusive substitute fuel production facilities will be required. Under current conditions, it could easily require more than a decade to construct a large coal liquefaction plant in the U.S. The prospects for constructing 25-50, with the first ones coming into operation within a three year time window are essentially nil. Absent change, the U.S. may end up on the path of least resistance, allowing only a few substitute fuels plants to be built on U.S. soil; in the process the U.S. would be adding substitute fuel imports to its increasing dependence on imports of conventional oil.

For the U.S. to attain a lower level of dependence on liquid fuel imports after the advent of world oil peaking, a major paradigm shift will be required in the current approach to the construction of capital-intensive energy facilities. Federal and state governments will have to adopt legislation allowing the acceleration of the development of substitute fuels projects from current decade time-scales. During World War II, facilities of all types were constructed on a scale and schedules that would have previously been inconceivable. In the face of the 1973 energy crisis, the Alaska oil pipeline was approved and constructed in record time.[102]

While world oil peaking poses many dangers for the U.S., it also offers substantial opportunities. The U.S. could emerge as the world's largest producer of substitute liquid fuels, if it were to undertake a massive program to construct substitute fuel production facilities on a timely basis. The nation is ideally positioned to do so because it has the world's largest coal reserves, and it could

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[100] *Siting the Brightwater Treatment Facilities: Site Selection and Screening Activities*, King County, March 2001.

[101] U.S. Department of Energy, *Environmental Siting Guide*, Office of Energy Efficiency and Renewable Energy, 2004.

[102] On the other hand, even in the midst of the energy crisis, the Alaska oil pipeline was approved by only one vote in the U.S. Senate and, currently, EIA anticipates that an Alaska gas pipeline will not be completed prior to 2020 – see U.S. Energy Information Administration, *2004 Annual Energy Outlook*, February, 2004.

muster the required capital, technology, and labor to implement such a program. However, unless a process is developed to expedite plant construction, this opportunity could easily slip away. Other nations, such as China, India, Japan, Korea, and others also have the capabilities needed to construct and operate such plants. Under current conditions, other countries are able to bring such large energy projects on-line much more rapidly than the U.S. Such countries could conceivably even import U.S. coal, convert it to liquid fuels products, and then export finished product back to the U.S. and elsewhere.

The U.S. has well-developed coal mining, transportation, and shipping systems that move coal to the highest bidders, be they domestic or international. As recently as 1981, 14 percent of U.S. coal production was exported.[103] While that number has declined in recent years, the U.S. could easily expand its current coal exports many fold to provide feedstock for coal liquefaction plants in other nations. Not only would the U.S. be dependent on foreign sources for conventional oil, which will continue to dwindle in volume after peaking, but it could also become dependant on foreign sources for substitute fuels derived from U.S. coal.

[103]U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, 2004.

VII. A WORLD PROBLEM

Oil is essential to all countries. In 2002 daily consumption ranged from almost 20 million barrels in the U.S. to 20 barrels in the tiny South Pacific island of Niue, population 2,400.[104]

Oil is produced in 123 countries. The top 20 producing countries provide over 83 percent of total world oil. Production by the largest producers is shown in Table VII-1.[105] The table also lists the top 20 oil-consuming countries and their respective consumption. In total, the top 20 countries consume over 75 percent of the average daily production. Beyond these larger consumers, oil is also utilized in all the world's 194 remaining countries.

Table VII.1.Top World Oil Producing and Consuming Countries - 2002

Producers				**Consumers**			
Rank	**Country**	**MM bpd**	**Percent**	**Rank**	**Country**	**MM bpd**	**Percent**
1	United States	9.0	11.7	1	United States	19.8	25.3
2	Saudi Arabia	8.7	11.3	2	Japan	5.3	6.8
3	Russia	7.7	10.0	3	China	5.2	6.6
4	Mexico	3.6	4.7	4	Germany	2.7	3.5
5	Iran	3.5	4.6	5	Russia	2.6	3.3
6	China	3.5	4.6	6	India	2.2	2.8
7	Norway	3.3	4.3	7	Korea, South	2.2	2.8
8	Canada	2.9	3.8	8	Brazil	2.2	2.8
9	Venezuela	2.9	3.8	9	Canada	2.1	2.7
10	United Kingdom	2.6	3.3	10	France	2.0	2.5
11	United Arab Emirates	2.4	3.1	11	Mexico	2.0	2.5
12	Nigeria	2.1	2.8	12	Italy	1.8	2.4
13	Iraq	2.0	2.7	13	United Kingdom	1.7	2.2
14	Kuwait	2.0	2.6	14	Saudi Arabia	1.5	1.9
15	Brazil	1.8	2.3	15	Spain	1.5	1.9
16	Algeria	1.6	2.0	16	Iran	1.3	1.7
17	Libya	1.4	1.8	17	Indonesia	1.1	1.4
18	Indonesia	1.4	1.8	18	Taiwan	0.9	1.2
19	Kazakhstan	0.9	1.2	19	Netherlands	0.9	1.1
20	Oman	0.9	1.2	20	Australia	0.9	1.1
	103 other countries	***12.6***	***16.3***		***194 other countries***	***18.4***	***23.5***

[104]U.S. Department of Energy, Energy Information Administration. "Table 1.2 World Petroleum Consumption, 1980-2002" database and "Table G.2 World Production of Crude Oil, NGPL, Other Liquids, and Refinery Processing Gain 1980-2002" database, 2004.
[105] Ibid

VIII. THREE MITIGATION SCENARIOS

A. Introduction

Issues related to the peaking of world oil production are extremely complex, involve literally trillions of dollars and are very time-dependent. To explore these matters, we selected three mitigation scenarios for analysis:

- Scenario I assumes that action is not initiated until peaking occurs.
- Scenario II assumes that action is initiated 10 years before peaking.
- Scenario III assumes action is initiated 20 years before peaking.

Our approach is simplified in order to provide transparency and promote understanding. Our estimates are approximate, but the mitigation envelope that results is believed to be indicative of the realities of such an enormous undertaking.

B. Mitigation Options

Our focus is on large-scale, physical mitigation, as opposed to policy actions, e.g. tax credits, rationing, automobile speed restrictions, etc. We define physical mitigation as 1) implementation of technologies that can substantially reduce the consumption of liquid fuels (improved fuel efficiency) while still delivering comparable service and 2) the construction and operation of facilities that yield large quantities of liquid fuels.

C. Mitigation Phase-In

The pace that governments and industry chose to mitigate the negative impacts of the peaking of world oil production is to be determined.. As a limiting case, we choose overnight go-ahead decision-making for all actions, i.e., crash programs. Our rationale is that in a sudden disaster situation, crash programs are most likely to be quickly implemented. Overnight go-ahead decision-making is most probable in our Scenario I, which assumes no action prior to the onset of peaking. By assuming overnight implementation in all three of our scenarios, we avoid the arduous and potentially arbitrary challenge of developing a more likely, real world decision-making sequence. This is obviously an optimistic assumption because government and corporate decision-making is never instantaneous.

D. The Use of Wedges

The model chosen to illustrate the possible effects of likely mitigation actions involves the use of "delayed wedges" to approximate the scale and pace of each action. The use of wedges was effectively utilized in a recent paper by Pacala and Socolow.[106]

Our wedges are composed of two parts. The first is the preparation time needed prior to tangible market penetration. In the case of efficient transportation, this time is required to redesign vehicles and retool factories to produce more efficient vehicles. In the case of the production of substitute fuels, the delay is associated with planning and construction of relevant facilities.

After the preparation phase, our wedges then approximate the penetration of mitigation effects into the marketplace. This might be the growing sales of more fuel-efficient vehicles or the growing production of substitute fuels. Our wedge pattern is shown in Figure VIII-1, where the horizontal axis is time and the vertical axis is market impact, measured in barrels per day of savings or production. The figure is bounded on the right side for illustrative purposes only. We assume our wedges continue to expand for a few decades, which simplifies illustration but is increasingly less realistic over time because markets will adjust and impact rates will change.

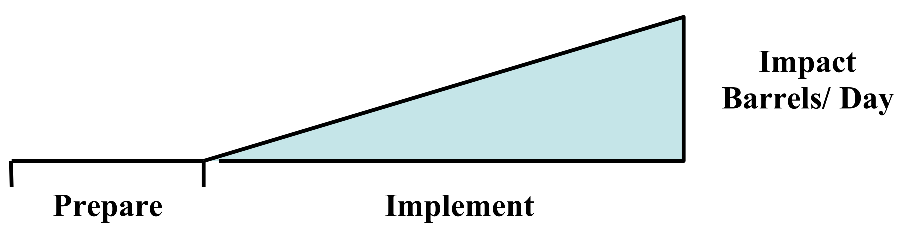

Figure VIII-1. Delayed wedge approximation for various mitigation options

How our delayed wedges approximate reality is illustrated in Figure VIII-2, which shows possible fuel savings associated with implementation of significant new Corporate Average Fuel Efficiency (CAFE) standards.[107]

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[106] Pacala, S., Socolow, R. "*Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies*." Science. August 13, 2004.

[107] These potential savings are documented in National Research Council, National Academy of Sciences, *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards,* Washington, D.C.: National Academy Press, 2002; Management Information Services, Inc., and 20/20 Vision, *Fuel Standards and Jobs: Economic, Employment, Energy, and Environmental Impacts of Increased CAFE Standards Through 2020,* report prepared for the Energy Foundation, San Francisco, California, July 2002; David L. Greene and John DeCicco, *Engineering-Economic Analysis of Automotive Fuel Economy Potential in the United States,* paper presented at the IEA International Workshop on Technologies to Reduce Greenhouse Gas Emissions, Washington, D.C., May 1999; David Friedman, et al, *Drilling in Detroit: Tapping Automaker Ingenuity to Build Safe and Efficient Automobiles*, Union of Concerned Scientists, UCS Publications, Cambridge, MA, June 2001; Roland Hwang, Bryanna Millis, and Theo Spencer, *Clean Getaway: Toward Safe and Efficient Vehicles*, Natural Resources Defense Council: New York, July 2001; Brent D. Yacobucci, Marc Ross, *Technical Options for Improving the Fuel Economy of U.S. Cars and Light*

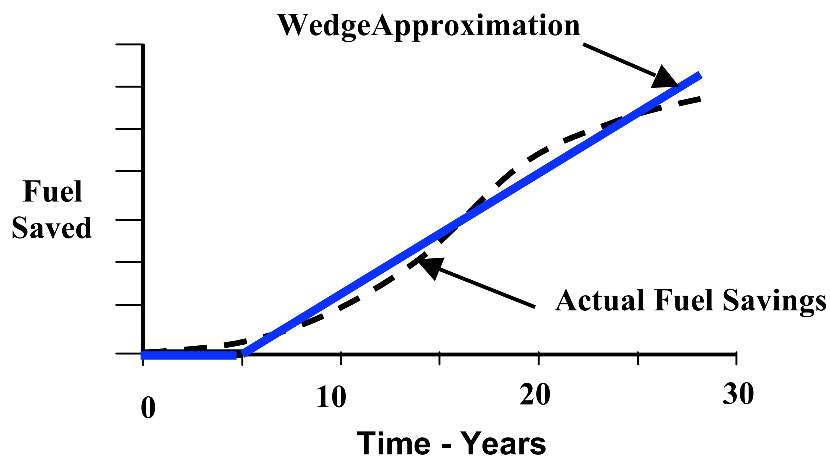

Figure VII-2. The delayed wedge approximation in the case of major changes in transportation fuel consumption

Our aim is to approximate reality in a simple manner. Greater detail is beyond the scope of this study and would require in-depth analysis.

E. Criteria for Wedge Selection

Our criteria for selecting candidates for our energy saving and substitute oil production wedges were as follows:

1. The option must produce liquid fuels that can, as produced or as refined, substitute for liquid fuels currently in widespread use, e.g. gasoline, jet fuel, diesel, etc. The end products will thus be compatible with existing distribution systems and end-use equipment.

2. The option must be capable of liquid fuels savings or production on a massive scale – ultimately millions to tens of millions of barrels per day worldwide.

3. The option must include technology that is commercial or near commercial, which at a minimum requires that the process has been demonstrated at commercial scale. For production technologies, this means that at least one plant has operated at greater than 10,000 bpd for at least two years, and product prices from the process are less than

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Trucks by 2010-2015, American Council for an Energy Efficient Economy, July 2001; Robert L Bamberger, *Automobile and Light Truck Fuel Economy: Is CAFE Up to Standards?* Washington, D.C.: Congressional Research Service, September 29, 2001; Energy and Environmental Analysis, Inc. *Technology and Cost of Future Fuel Economy Improvements for Light-Duty Vehicles*, prepared for the National Research Council, 2001.

$50/barrel in 2004 dollars. For fuels efficiency technologies, the technology must have at least entered the commercial market by 2004.

4. Substitute fuel production technologies must be inherently energy efficient, which we assume to mean that greater than 50 percent of process energy input is contained in the clean liquid fuels product.[108]

5. The option must be environmentally clean by 2004 standards.

6. While domestic resources are of greatest interest to the U.S., the oil market is international, so substitute fuel feedstocks not abundantly available in the U.S. must also be considered, e.g. heavy oil/tar sands and gas-to-liquids.

7. Energy sources or energy efficiency technologies that produce or save electricity are not of interest in this context because commercial processes to convert electricity to clean hydrocarbon fuels do not currently exist.

F. Wedges Selected & Rejected

The combination of technologies, processes, and feedstocks that meet these criteria are as follows:

1. Fuel efficient transportation,
2. Heavy oil/Oil sands,
3. Coal liquefaction,
4. Enhanced oil recovery,
5. Gas-to-liquids.

In the end-use category, a dramatic increase in the efficiency of petroleum-based fuel equipment is one attractive option. As previously described, the imposition of CAFE requirements for automobile in 1975 was one of the most effective of the government mandates initiated in response to the 1973-74 oil embargo. In recent years, fuel economy for automobiles has not been a high national priority in the U.S. Nevertheless, a new hybrid engine technology has been phasing into the automobile and truck markets. In a period of national oil emergency, hybrid technology could be massively implemented for new vehicle applications. Hybrid technologies offer fuel economy improvements of 40 percent or more for automobiles and light-medium trucks – no other engine technologies offer such large, near-term fuel economy benefits.[109]

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[108] The choice of a minimum is subjective. A minimum of 50 percent seems reasonable, but a higher rate is clearly more desirable.

[109] While diesel engines offer significant improvements in fuel economy over gasoline engines, their benefits are notably less than hybrids. For simplicity, we neglect the broader use of diesels in this study, which is not meant to imply that they might indeed make an important contribution in the LDV markets.

The fuels production options that we chose are heavy oil/tar sands, coal liquefaction, improved oil recovery, and gas-to-liquids. Our rationale was as follows:

1. Enhanced Oil Recovery is applicable worldwide.

2. Heavy oil / Oil sands is currently commercial in Canada and Venezuela.

3. Coal liquefaction is a well-developed, near-commercial technology.

4. Gas-To-Liquids is commercially applicable where natural gas is remote from markets.

We excluded a number of options for various reasons. While the U.S. has a huge resource of shale oil that could be processed into substitute liquid fuels, the technology to accomplish that task is not now ready for deployment. Because various shale oil processing prototypes were developed in years past and because shale oil processing is likely to be economically attractive, a concerted effort to develop shale oil technology could well lead to shale oil becoming a contributor in Scenarios II or III. However, that would require the initiation of a major R & D program in the near future.

Biomass options capable of producing liquid fuels were also excluded. Ethanol from biomass is currently utilized in the transportation market, not because it is commercially competitive, but because it is mandated and highly subsidized. Biodiesel fuel is a subject of considerable current interest but it too is not yet commercially viable. Again, a major R & D effort might change the biomass outlook, if initiated in the near future.[110]

Over 45% of world oil consumption is for non-transportation uses. Fuel switching away from non-transportation uses of liquid fuels is likely to occur, mimicking shifts that have already taken place in the U.S. The time frame for such shifts is uncertain. For significant world scale impact, alternate large energy facilities would have to be constructed to provide the substitute energy, and that facility construction would require the kind of decade-scale time periods required for oil peaking mitigation.

Nuclear power, wind and photovoltaics produce electric power, which is not a near-term substitute fuel in transportation equipment that requires liquid fuels. In

[110] In their recently published hydrogen study, the National Research Council has shown that hydrogen from biomass is roughly three times as expensive as coal-based hydrogen. This relationship holds roughly for liquids production, another basis for not considering biomass fuels as acceptable under our criteria. See National Research Council, National Academy of Sciences, *The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs,* Washington, D.C.: National Academy Press, 2004

the many-decade future after oil peaking, it is conceivable that a massive shift from liquid fuels to electricity might occur in some applications. However, consideration of such changes would be speculative at this time.

It is possible that technology innovations resulting from aggressive future research may well change the outlook for various technologies in the future. Our focus on the currently viable is in no way intended to prejudice other future options We have chosen not to add a wedge for undefined technologies that might result from accelerated research, because such a wedge would be purely speculative. No matter what the new technology(s), implementation delay times and contribution growth rates will inherently be of the same order of magnitude of the technologies that we have considered, because of the inherent scale of all physical mitigation.

G. Modeling World Oil Supply / Demand

It is not possible to predict with certainty when world conventional oil peaking will occur or how rapidly production will decline after the peak. To develop our scenarios, we utilize the U.S. Lower 48 production pattern as a surrogate for the world. This assumption is justified on the basis that Lower 48 oil production represents what really happened in a large, complex oil province over the course of decades of modern oil production development.

Our starting point is the triangular pattern of production increase followed by production decline shown in Figure II-2. Our horizontal axis is centered on the year of peaking (the date is not specified) and spans plus and minus two decades. For this study, our vertical axis is pegged at a peak world oil production of 100 MM bpd, which is 18 MM bpd above the current 82 MM bpd world production. If peaking were to occur soon, 100 MM bpd might be high by 20 percent. If peaking were to occur at 125 MM bpd at some future date, the 100 MM bpd assumption would be low by 20 percent. Since the estimates in our wedges are rough under any conditions, a 100 MM bpd peak represents a credible assumption for this kind of analysis. The selection of 100 MM bpd is not intended as a prediction of magnitude or timing; its use is for illustration purposes only.

Next is the important issue of the slopes of the production profile showing the rate of growth of production/demand before peaking and the subsequent decline in production. The World Energy Council stated: “Oil demand is projected to increase at about 1.9 percent per year rising from about 75.7 million b/d in 2000 (actual) to 113-115 million b/d in 2020 – an increase of about 37.5-39.5 million b/d.”[111] Recent trends indicate a 3+ percent world oil demand growth, driven in part by rapidly increasing oil consumption in China and India. However, a 3+ percent growth rate on a continuing basis seems excessive. On this basis, we

[111] *"Hydrocarbon Resources: Future Supply and Demand."* World Energy Council - 18 th Congress, Buenos Aires, October 2001.

assume a two percent demand growth before peaking, and we assume an intrinsic two percent long-run hypothetical, healthy economy demand after peaking. This extrapolation of demand after peaking provides a reference that facilitates calculation of supply shortfalls. The assumption has the benefit of simplicity, but it ignores the real-world feedback of oil price escalation on demand, which is sure to happen but the calculation thereof will be complicated and was beyond the scope of this study.

Estimating a decline rate after world oil production peaking is a difficult issue. While human activity dominates the demand for oil, the "rocks" (geology) will dominate the decline of world conventional oil production after peaking. Referring to U.S. Lower 48 production history, the decline after the 1970 peaking was roughly 1.7 percent per year, which we have chosen to round off to two percent per year as our estimated world conventional oil decline rate.[112] It should be noted that other analysts have projected decline rates of 3-8%, which would make the mitigation problem much more difficult.[113]

H. Our Wedges

In Appendix IV we develop the sizes of the wedges that we believe appropriate for our trends analysis. The categories, delays and 10-year estimated impacts are shown in Figure VIII-3. Once again, bear in mind that these are rough approximations aimed at illustrating the inherently large scale of mitigation.

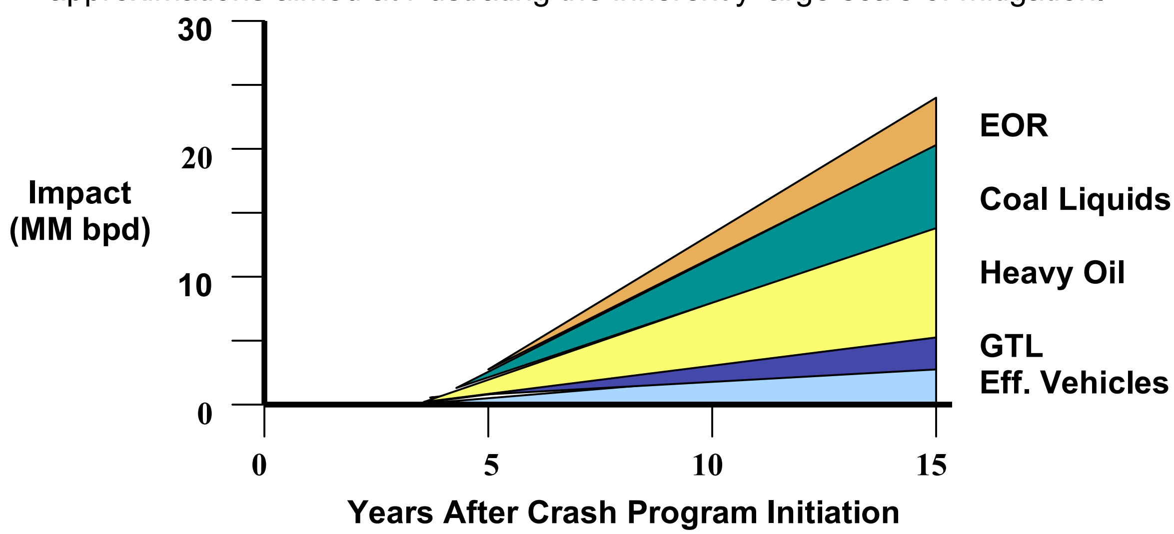

Figure VIII-3. Assumed wedges

[112] Compounding starts at 67.3 MM bpd at –20 years, rises to 100 MM bpd at year 0, and drops to 66.8 MM bpd at +20 years.

[113] See for instance Al-Husseini, S.I. , Retired Exec. V.P., Saudi Aramco. A Producer's Perspective on the Oil Industry. Oil and Money Conference. London. October 26, 2004; Hakes, J. Long Term World Oil Supply. EIA. April 18, 2000; and ExxonMobil. A Report on Energy Trends, Greenhouse Emissions and Alternate Energy. February 2004.

I. The Three Scenarios

As noted, our three scenarios are benchmarked to the unknown date of peaking:

- **Scenario I**: Mitigation begins at the time of peaking;
- **Scenario II:** Mitigation starts 10 years before peaking;
- **Scenario III:** Mitigation starts 20 years before peaking.

Our mitigation choices then map onto our assumed world oil peaking pattern as shown in Figures VIII-4, 5 and 6.

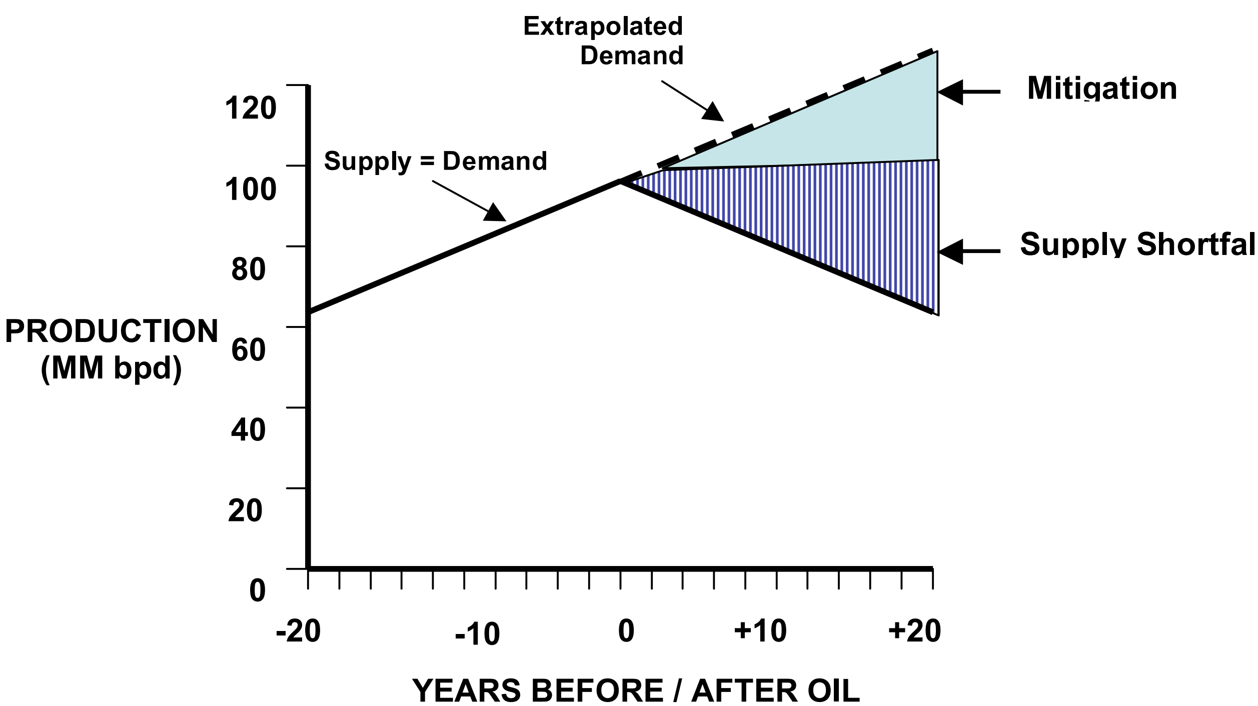

Figure VIII-4. Mitigation crash programs started at the time of world oil peaking: A significant supply shortfall occurs over the forecast period.

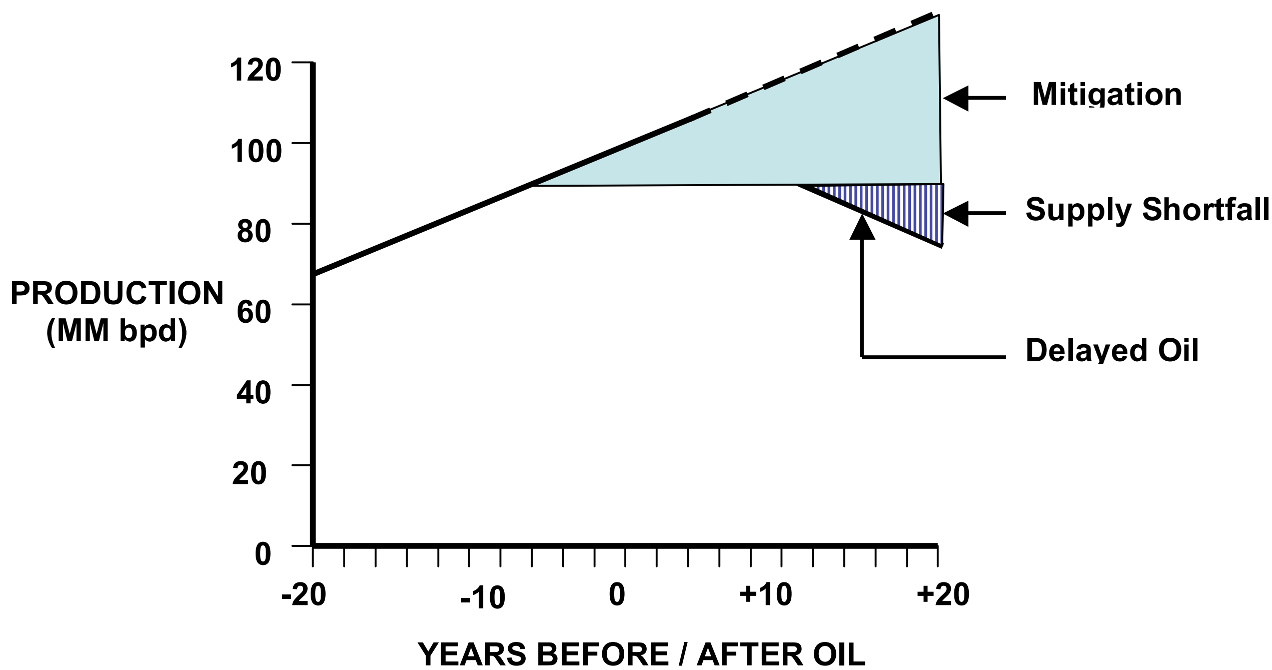

Figure VIII-5. Mitigation crash programs started 10 years before world oil peaking: A moderate supply shortfall occurs after roughly 10 years.

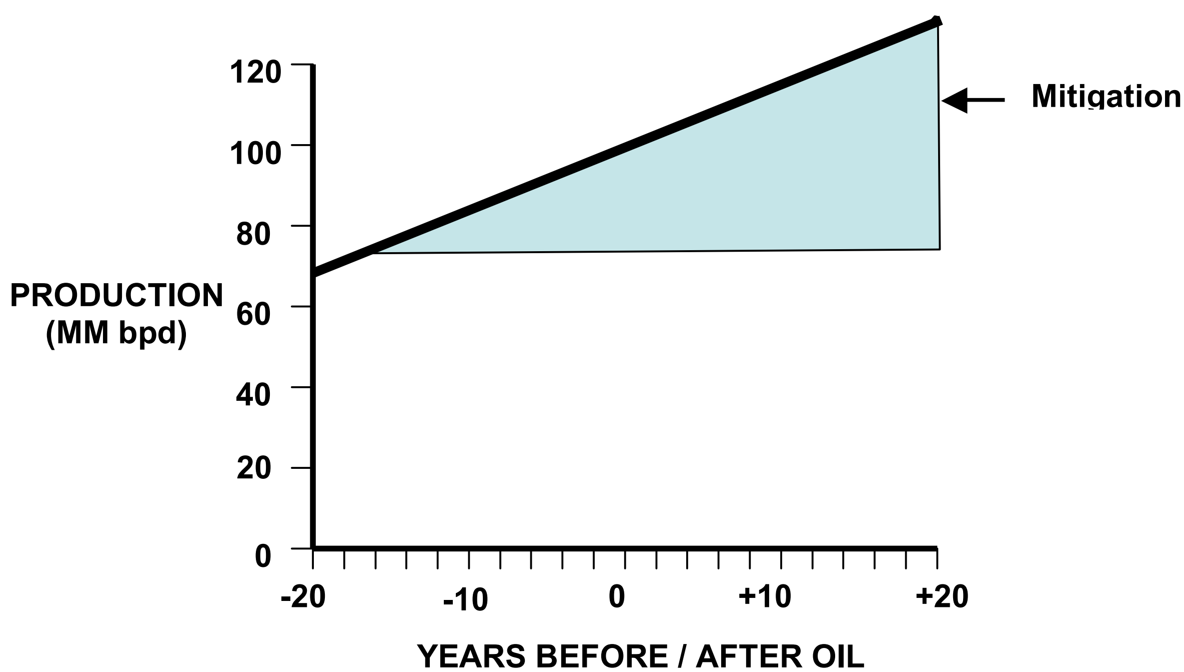

Figure VIII-6. Mitigation crash programs started 20 years before world oil peaking: No supply shortfall occurs during the forecast period.

J. Observations & Conclusions on Scenarios

This exercise was conducted bottom – up; we estimated reasonable potential contributions from each viable option, summed them, and then applied them to our assumed world oil peaking pattern.

While our option contribution estimates are clearly approximate, in total they probably represent a realistic portrayal of what might be achieved with an array of physical mitigation options. Together, implementation of all of the specified options would provide 15 – 20 MM bpd impact, ten years after simultaneous initiation. Roughly 90 percent would result from substitute liquid fuel production and roughly ten percent would come from transportation fuel efficiency improvements.

Our results are congruent with the fundamentals of the problem:

- Waiting until world oil production peaks before taking crash program action leaves the world with a significant liquid fuel deficit for more than two decades.

- Initiating a mitigation crash program 10 years before world oil peaking helps considerably but still leaves a liquid fuels shortfall roughly a decade after the time that oil would have peaked.

- Initiating a mitigation crash program 20 years before peaking appears to offer the possibility of avoiding a world liquid fuels shortfall for the forecast period.

The obvious conclusion from this analysis is that with adequate, timely mitigation, the costs of peaking can be minimized. If mitigation were to be too little, too late, world supply/demand balance will be achieved through massive demand destruction (shortages), which would translate to significant economic hardship, as discussed earlier.

K. Risk Management

It is possible that peaking may not occur for several decades, but it is also possible that peaking may occur in the near future. We are thus faced with a daunting risk management problem:

- On the one hand, mitigation initiated soon would be premature if peaking is still several decades away.

- On the other hand, if peaking is imminent, failure to initiate mitigation quickly will have significant economic and social costs to the U.S. and the world.

The two risks are asymmetric:

- Mitigation actions initiated prematurely will be costly and could result in a poor use of resources.

- Late initiation of mitigation may result in severe consequences.

The world has never confronted a problem like this, and the failure to act on a timely basis could have debilitating impacts on the world economy. Risk minimization requires the implementation of mitigation measures well prior to peaking. Since it is uncertain when peaking will occur, the challenge is indeed significant.

IX. MARKET SIGNALS AS PEAKING IS APPROACHED

As world oil peaking is approached and demand for conventional oil begins to exceed supply, oil prices will rise steeply. As discussed in Chapter IV, related price increases are almost certain to have negative impacts on the U.S. and world economies. Another likely signal is substantially increased oil price volatility.

Oil prices have traditionally been volatile. Causes include political events, weather, labor strikes, infrastructure problems, and fears of terrorism.[114] In an era where supply was adequate to meet demand and where there was excess production capacity in OPEC, those effects were relatively short-lived. However, as world oil peaking is approached, excess production capacity by definition will disappear, so that even minor supply disruptions will cause increased price volatility as traders, speculators, and other market participants react to supply/demand events. Simultaneously, oil storage inventories are likely to decrease, further eroding security of supply, aggravating price volatility, and further stimulating speculation.[115]

While it is recognized that high oil prices will have adverse effects, the effects of increased price volatility may not be sufficiently appreciated. Higher oil price volatility can lead to reduction in investment in other parts of the economy, leading in turn to a long-term reduction in supply of various goods, higher prices, and further reduced macroeconomic activity. Increasing volatility has the potential to increase both economic disruption and transaction costs for both consumers and producers, adding to inflation and reducing economic growth rates.[116]

The most relevant experience was during the 1970s and early 1980s, when oil prices increased roughly six-fold and oil price volatility was aggravated. Those reactions have often been dismissed as a "panic response," but that experience may nevertheless be a good indicator of the oil price volatility to be expected when demand exceeds supply after oil peaking.[117]

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[114]Over the past 20 years, oil prices have been extremely volatile. Between 1982 and 2002, the standard deviation in monthly oil prices was 29.5 percent of its mean. The only other major commodity whose price exhibited similar volatility was coffee – 27.8 percent of its mean. See Andre Plourde and G.C. Watkins, "Crude Oil Prices Between 1985 and 1994: How Volatile in Relation to Other Commodities?" *Resource and Energy Economics*, Vol. 20, 1998, pp. 245-262. In general, Plourde and Watkins found that oil prices fluctuated more or at least as much as the most volatile of commodity prices; see the discussion in Hillard Huntington, "Energy Disruptions, Interfirm Price Effects, and the Aggregate Economy," Stanford Energy Modeling Forum, September 2002.

[115]International Energy Agency, *"IEA Expresses Concern About High Oil Prices as it Celebrates its 30th Anniversary,"* Istanbul, April 2004; International Monetary Fund, *World Economic Outlook Report*, September 2003.

[116]Walter C. Labys, *Globalization, Oil Price Volatility, and the U.S. Economy*, 2001.

[117]Vincente Ramirez, "Oil Crises Delay – a World Oil Price Forecast," REXplore Zachasumsc, Switzerland, July 1999.

The factors that cause oil price escalation and volatility could be further exacerbated by terrorism. For example, in the summer of 2004, it was estimated that the threat of terrorism had added a premium of 25 - 33 percent to the price of a barrel of oil.[118] As world oil peaking is approached, it is not difficult to imagine that the terrorism premium could increase even more.

In conclusion, oil peaking will not only lead to higher oil prices but also to increased oil price volatility. In the process, oil could become the price setter in the broader energy market, in which case other energy prices could well become increasingly volatile and unpredictable.[119]

[118]John Schoen, *"Oil Prices Include a Growing Risk Premium,"* Business with MSNBC, Oil and Energy News, May 12, 2004.
[119]Jean-Marie Bourdaire, "*Energy Supply Conditions and Oil Price Regime,"* presented at the Association for the Study of Peak Oil, Paris, May 2003.

X. WILDCARDS

There are a number of factors that could conceivably impact the peaking of world oil production. Here is a list of possible upsides and downsides.

A. Upsides – Things That Might Ease the Problem of World Oil Peaking

- The pessimists are wrong again and peaking does not occur for many decades.
- Middle East oil reserves are much higher than publicly stated.
- A number of new super-giant oil fields are found and brought into production, well before oil peaking might otherwise have occurred.
- High world oil prices over a sustained period (a decade or more) induce a higher level of structural conservation and energy efficiency.
- The U.S. and other nations decide to institute significantly more stringent fuel efficiency standards well before world oil peaking.
- World economic and population growth slows and future demand is much less than anticipated.
- China and India decide to institute vehicle efficiency standards and other energy efficiency requirements, reducing the rate of growth of their oil requirements.
- Oil prices stay at a high enough level on a sustained basis so that industry begins construction of substitute fuels plants well before oil peaking.
- Huge new reserves of natural gas are discovered, a portion of which is converted to liquid fuels.
- Some kind of scientific breakthrough comes into commercial use, mitigating oil demand well before oil production peaks.

B. Downsides - Things That Might Exacerbate the Problem of World Oil Peaking

- World oil production peaking is occurring now or will happen soon.
- Middle East reserves are much less than stated.
- Terrorism stays at current levels or increases and concentrates on damaging oil production, transportation, refining and distribution.
- Political instability in major oil producing countries results in unexpected, sustained world-scale oil shortages.
- Market signals and terrorism delay the realization of peaking, delaying the initiation of mitigation.
- Large-scale, sustained Middle East political instability hinders oil production.
- Consumers demand even larger, less fuel-efficient cars and SUVs.
- Expansion of energy production is hindered by increasing environmental challenges, creating shortages beyond just liquid fuels.

XI. SUMMARY AND CONCLUDING REMARKS

Our analysis leads to the following conclusions and final thoughts.

1. World Oil Peaking is Going to Happen

World production of conventional oil will reach a maximum and decline thereafter. That maximum is called the peak. A number of competent forecasters project peaking within a decade; others contend it will occur later. Prediction of the peaking is extremely difficult because of geological complexities, measurement problems, pricing variations, demand elasticity, and political influences. Peaking will happen, but the timing is uncertain.

2. Oil Peaking Could Cost the U.S. Economy Dearly

Over the past century the development of the U.S. economy and lifestyle has been fundamentally shaped by the availability of abundant, low-cost oil. Oil scarcity and several-fold oil price increases due to world oil production peaking could have dramatic impacts. The decade after the onset of world oil peaking may resemble the period after the 1973-74 oil embargo, and the economic loss to the United States could be measured on a trillion-dollar scale. Aggressive, appropriately timed fuel efficiency and substitute fuel production could provide substantial mitigation.

3. Oil Peaking Presents a Unique Challenge

The world has never faced a problem like this. Without massive mitigation more than a decade before the fact, the problem will be pervasive and will not be temporary. Previous energy transitions (wood to coal and coal to oil) were gradual and evolutionary; oil peaking will be abrupt and revolutionary.

4. The Problem is Liquid Fuels

Under business-as-usual conditions, world oil demand will continue to grow, increasing approximately two percent per year for the next few decades. This growth will be driven primarily by the transportation sector. The economic and physical lifetimes of existing transportation equipment are measured on decade time-scales. Since turnover rates are low, rapid changeover in transportation end-use equipment is inherently impossible.

Oil peaking represents a liquid fuels problem, not an “energy crisis” in the sense that term has been used. Motor vehicles, aircraft, trains, and ships simply have no ready alternative to liquid fuels. Non-hydrocarbon-based energy sources, such as solar, wind, photovoltaics, nuclear power, geothermal, fusion, etc. produce electricity, not liquid fuels, so their widespread use in transportation is at best decades away. Accordingly, mitigation of declining world oil production must be narrowly focused.

5. Mitigation Efforts Will Require Substantial Time

Mitigation will require an intense effort over decades. This inescapable conclusion is based on the time required to replace vast numbers of liquid fuel consuming vehicles and the time required to build a substantial number of substitute fuel production facilities. Our scenarios analysis shows:

• Waiting until world oil production peaks before taking crash program action would leave the world with a significant liquid fuel deficit for more than two decades.

• Initiating a mitigation crash program 10 years before world oil peaking helps considerably but still leaves a liquid fuels shortfall roughly a decade after the time that oil would have peaked.

• Initiating a mitigation crash program 20 years before peaking appears to offer the possibility of avoiding a world liquid fuels shortfall for the forecast period.

The obvious conclusion from this analysis is that with adequate, timely mitigation, the economic costs to the world can be minimized. If mitigation were to be too little, too late, world supply/demand balance will be achieved through massive demand destruction (shortages), which would translate to significant economic hardship.

There will be no quick fixes. Even crash programs will require more than a decade to yield substantial relief.

6. Both Supply and Demand Will Require Attention

Sustained high oil prices will stimulate some level of forced demand reduction. Stricter end-use efficiency requirements can further reduce embedded demand, but substantial, world-scale change will require a decade or more. Production of large amounts of substitute liquid fuels can and must be provided. A number of commercial or near-commercial substitute fuel production technologies are currently available, so the production of large amounts of substitute liquid fuels is technically and economically feasible, albeit time-consuming and expensive.

7. It Is a Matter of Risk Management

The peaking of world conventional oil production presents a classic risk management problem:

- Mitigation efforts initiated earlier than required may turn out to be premature, if peaking is long delayed.
- On the other hand, if peaking is imminent, failure to initiate timely mitigation could be extremely damaging.

Prudent risk management requires the planning and implementation of mitigation well before peaking. Early mitigation will almost certainly be less expensive and less damaging to the world's economies than delayed mitigation.

8. Government Intervention Will be Required

Intervention by governments will be required, because the economic and social implications of oil peaking would otherwise be chaotic. The experiences of the 1970s and 1980s offer important lessons and guidance as to government actions that might be more or less desirable. But the process will not be easy. Expediency may require major changes to existing administrative and regulatory procedures such as lengthy environmental reviews and lengthy public involvement.

9. Economic Upheaval is Not Inevitable

Without mitigation, the peaking of world oil production will almost certainly cause major economic upheaval. However, given enough lead-time, the problems are soluble with existing technologies. New technologies are certain to help but on a longer time scale. Appropriately executed risk management could dramatically minimize the damages that might otherwise occur.

10. More Information is Needed

The most effective action to combat the peaking of world oil production requires better understanding of a number of issues. Is it possible to have relatively clear signals as to when peaking might occur? It would be desirable to have potential mitigation actions better defined with respect to cost, potential capacity, timing, etc. Various risks and possible benefits of possible mitigation actions need to be examined. (See Appendix V for a list of possible follow-on studies).

The purpose of this analysis was to identify the critical issues surrounding the occurrence and mitigation of world oil production peaking. We simplified many of the complexities in an effort to provide a transparent analysis. Nevertheless, our study is neither simple nor brief. We recognize that when oil prices escalate dramatically, there will be demand and economic impacts that will alter our simplified analysis. Consideration of those feedbacks will be a daunting task but one that should be undertaken.

Our study required that we make a number of assumptions and estimates. We well recognize that in-depth analyses may yield different numbers. Nevertheless, this analysis clearly demonstrates that the key to mitigation of world oil production peaking will be the construction a large number of substitute fuel production facilities, coupled to significant increases in transportation fuel efficiency. The time required to mitigate world oil production peaking is measured on a decade time-scale, and related production facility size is large and capital intensive. How and when governments decide to address these challenges is yet to be determined.

Our focus on existing commercial and near-commercial mitigation technologies illustrates that a number of technologies are currently ready for immediate and extensive implementation. Our analysis was not meant to be limiting. We believe that future research will provide additional mitigation options, some possibly superior to those we considered. Indeed, it would be appropriate to greatly accelerate public and private oil peaking mitigation research. However, the reader must recognize that doing the research required to bring new technologies to commercial readiness takes time under the best of circumstances. Thereafter, more than a decade of intense implementation will be required for world scale impact, because of the inherently large scale of world oil consumption.

ACKNOWLEDGEMENTS

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APPENDICES

I. MOST MEANINGFUL EIA OIL PEAKING CASE

II. MORE HISTORICAL OIL CRISIS CONSIDERTIONS

III. LIKELY FUTURE OIL DEMAND

IV. RATIONALES FOR THE WEDGES

A. Vehicle Efficiency Wedge
B. Coal Liquids
C. Heavy oils / Oil Sands
D. Improved Oil Recovery
E. Gas-To-Liquids
F. Sum of the Wedges

V. NOTES ON SHALE OIL AND BIOMASS

VI. TOPICS FOR FUTURE STUDY

APPENDIX I. MOST MEANINGFUL EIA OIL PEAKING CASE

In the year 2000, EIA developed 12 scenarios for world oil production peaking using three U.S. Geological Survey (USGS) estimates of the world conventional oil resource base (Low, Expected, and High) and four annual world oil demand growth rates (0, 1, 2, and 3 percent per year).[120] We believe the most likely of the EIA scenarios is the one based on the USGS expected ultimate world recoverable oil of 3,003 billion barrels coupled with a 2% annual world oil demand escalation.

Figure A-I shows the two EIA scenarios based on these assumptions. The difference between the two profiles is attributable to two assumed production decay rates following peak production. Both curves assume a 2 percent per year growth from the year 2000 until the peak. One scenario assumes a 2 percent decline after the world oil production peak, while the other assumes a steeper drop after the world oil production peak. Because the areas under both curves must equal the projected 3,003 billion barrels of recoverable conventional oil from the year 2000 forward, the rapid decay curve will inherently yield the later occurring, higher world oil production peak.

The EIA scenario that peaks in 2016 looks like the relatively symmetric U.S. Lower 48 production profile in Figure II-2. The EIA scenario that peaks in 2037 not only differs dramatically from the U.S. experience, it differs from typical individual oil reservoir experience, which often displays a relatively symmetric production profile, not the sharp drop illustrated in the alternate EIA case. On this basis, we believe that the EIA 2016 peaking case appears much more credible than the 2037 peaking case. The associated 21-year difference between the two predicted production peaks clearly would have profound implications for the time available for mitigation.

It is worth noting that the USGS mean estimate for the remaining recoverable world oil resource is much higher than estimates made by other investigators, according to K.S. Deffeyes, retired Shell geologist and emeritus Princeton geology professor.[121] Deffeyes also opined "… in 2000 the USGS again released implausibly large estimates of world oil." A lower total reserves estimate would of course mean a world oil production peak earlier than 2016.

[120] DOE EIA. "Long Term World Oil Supply." April 18, 2000.
[121] Deffeyes, K.S. *Hubbert's Peak-The Impending World Oil Shortage*. Princeton University Press. 2003. p. 134.

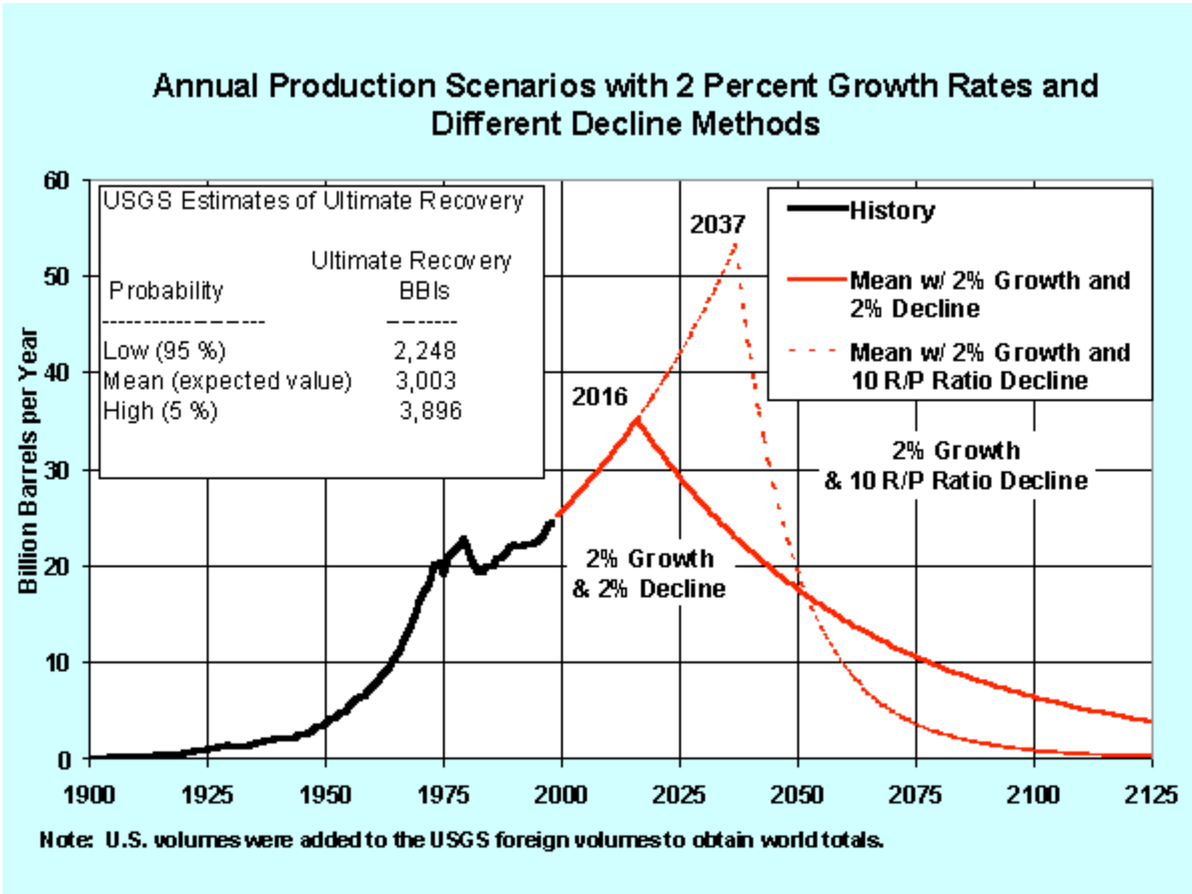

Figure A-1. Two EIA oil production scenarios based on expected ultimate world-recoverable oil of 3,003 billion barrels and a 2 percent annual world oil demand escalation

APPENDIX II. MORE HISTORICAL OIL CRISIS CONSIDERTIONS

Economists have debated whether the economic problems of the 1970s were due to the oil supply disruptions or to inappropriate fiscal, monetary, and energy policies implemented to deal with them. The consensus is that the disruptions would have caused economic problems irrespective of fiscal, monetary, and energy policies, but that price and allocation controls exacerbated the impacts in the U.S. during the 1970s.[122] There is general consensus on the following:

- Appropriate actions taken included CAFE, the 55 mph speed limit, reorganization of the Federal energy bureaucracy, greatly increased energy R&D, establishment of the Strategic Petroleum Reserve (SPR), energy efficiency standards and building codes, establishment of IEA and EIA, and burden sharing agreements among nations.
- Inadvisable actions included price and allocation controls, excessive regulations, de-facto gasoline rationing, "excess profits" taxes, policies targeting "greedy energy companies," prohibitions on energy use, and subsidy programs.
- Some actions that seemed to be inappropriate may have been desirable if the problem had not been short-lived. For example, synthetic fuel initiatives may have looked prescient had oil prices not collapsed in the mid 1980s.[123]

Estimated costs to the U.S. of oil supply disruptions range from $25 billion to $75 billion per year, and the cumulative costs since 1973-74 total about $4 trillion.[124] Nevertheless, except for several serious disruptions (and then only temporarily), oil prices have risen little in real terms over the past century, as shown in Figure A-2.

Cost of living adjustment clauses imbedded in many contracts, labor agreements, and government programs (e.g., Social Security) are less visible but important inflation drivers. Price increases generated by oil supply disruptions automatically trigger successive inflationary adjustments throughout the

[122]This consensus emerged by the 1990s; see, for example, K. Lee, S. Ni, and R. Ratti, "Oil Shocks and the Macroeconomy: The Role of Price Variability," *Energy Journal*, Vol. 16, no. 4, 1995.

[123]Once again, this experience may preclude such an option in the future, even though it may be called for. For example, by the 1990s, CBO had concluded that the threat posed by oil disruptions had declined; see U.S. Congressional Budget Office, op. cit.

[124]Estimates range from $2 trillion to more than $7 trillion (2004 dollars) -- exclusive of military or political costs. See U.S. General Accounting Office, *Energy Security: Evaluating U.S. Vulnerability To Oil Supply Disruptions and Options for Mitigating Their Effects*, GAO/RCED-97-6, 1997; David Greene and Nataliya Tishchishyna, *Cost of Oil Dependence: A 2000 Update*, Oak Ridge National Laboratory, May 2000; National Defense Council Foundation, *The Hidden Cost of Imported Oil*, October 2003.

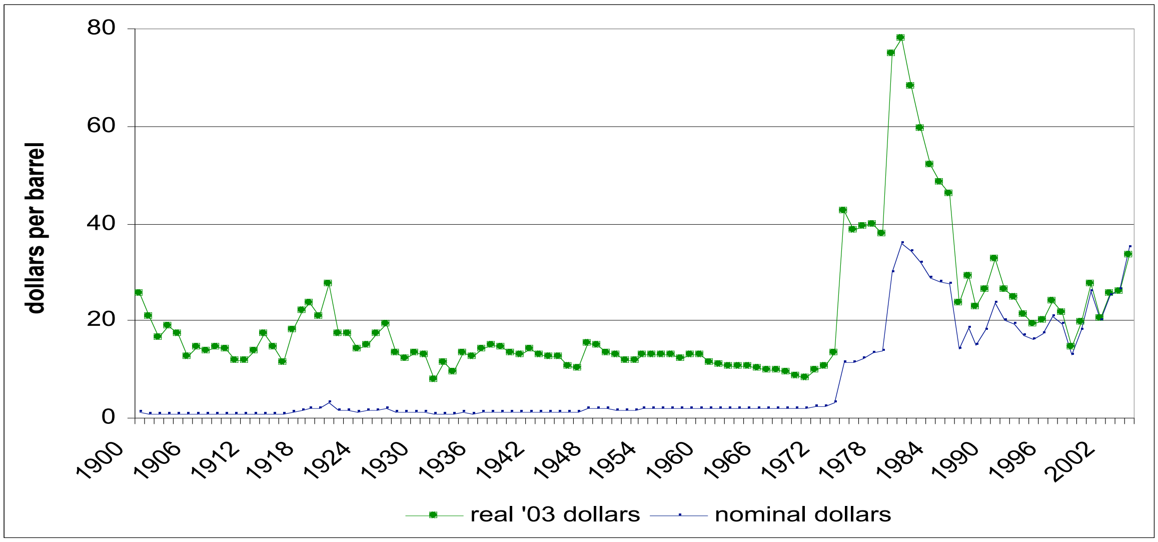

Figure A-2. Oil Prices in Current and Constant Dollars: 1900 - 2004

economy, and these complicate monetary policies designed to counter the inflationary effects of the disruption.[125]

The U.S. is currently less oil-dependent (in terms of oil / GDP ratios) than during the 1970s. However, as shown in Figure A-3, the U.S. is now importing twice as much oil (in percentage terms) as 30 years ago and its transportation sector consumes a larger portion of total oil consumption.[126] Further, by 2000 most of the energy saving trends resulting from the 1970s disruptions (increased energy efficiency and conservation, increased vehicle mpg, etc.) had been captured.

The primary effect of the 1973-74 disruption was oil price increases. As shown in Figure A-2, the real price of oil peaked in 1981 and has never again reached similar levels.

At present, oil would have to be nearly $80 per barrel and gasoline would have exceed $3 per gallon to equal real 1981 prices. Even then, however, energy would still be less significant factor in the U.S. economy because average U.S. per capita incomes have doubled since 1981 and energy is a much smaller component of expenditures[127].

[125] See the discussion in Roger Bezdek and John Taylor, "Allocating Petroleum Products During Oil Supply Disruptions," *Science*, June 19, 1981, Vol. 212, pp. 1357-1363.
[126] DOE, EIA *Monthly Energy Review* and Management Information Services, Inc., 2004
[127]In 1981, consumers spent nearly six percent of their incomes on gasoline, but in 2003 they spent only three percent of their incomes on gasoline; in 1985, gasoline and oil represented 20 percent of the cost of owning and operating a vehicle, but by 2002 represented only 10 percent of the cost.

Nevertheless, over the past 20 years, oil prices have been extremely volatile – more volatile than virtually any other commodity.[128]

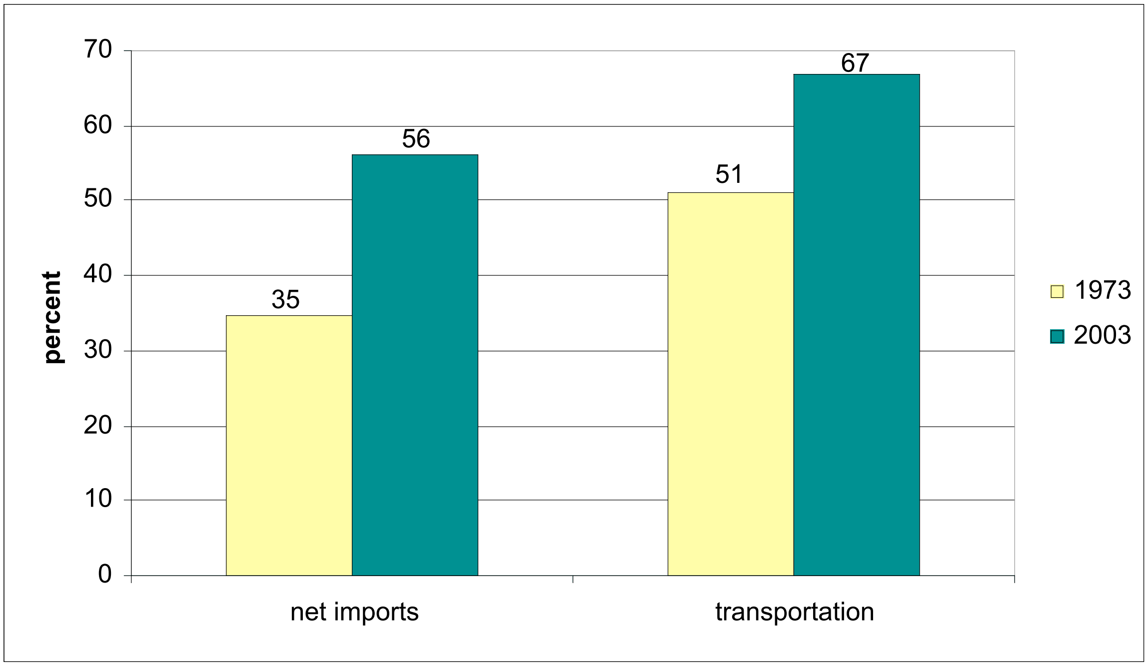

Figure A-3. U.S. Oil Imports and Transportation Shares of Oil Consumption, 1973 and 2003

[128]Between 1982 and 2002, the standard deviation in monthly oil prices was 29.5 percent of its mean, and the only other major commodity whose price exhibited similar volatility was coffee – 27.8 percent of its mean. See Andre Plourde and G.C. Watkins, "Crude Oil Prices Between 1985 and 1994: How Volatile in Relation to Other Commodities?" *Resource and Energy Economics*, Vol. 20, 1998, pp. 245-262. In general, Plourde and Watkins found that oil prices fluctuated more or at least much as the most volatile of commodity prices; see the discussion in Hillard Huntington, "Energy Disruptions, Interfirm Price Effects, and the Aggregate Economy," Stanford Energy Modeling Forum, September 2002.

APPENDIX III. LIKELY FUTURE OIL DEMAND

Petroleum consumption has been inexorably linked to population growth, industrial development, and economic growth for the past century. This relationship is expected to continue worldwide for the foreseeable future. While the U.S. consumes more oil than any other country – about 20 MM bpd, it represents only 26 percent of world production, compared to the 46 percent of world oil production the U.S. consumed in 1960. As shown in Figure A-4, Western Europe currently consumes the second largest amount (18 percent) followed by Japan (7 percent), China (6 percent), and the FSU (5 percent), with over 150 other countries accounting for the remaining 38 percent of production.[129]

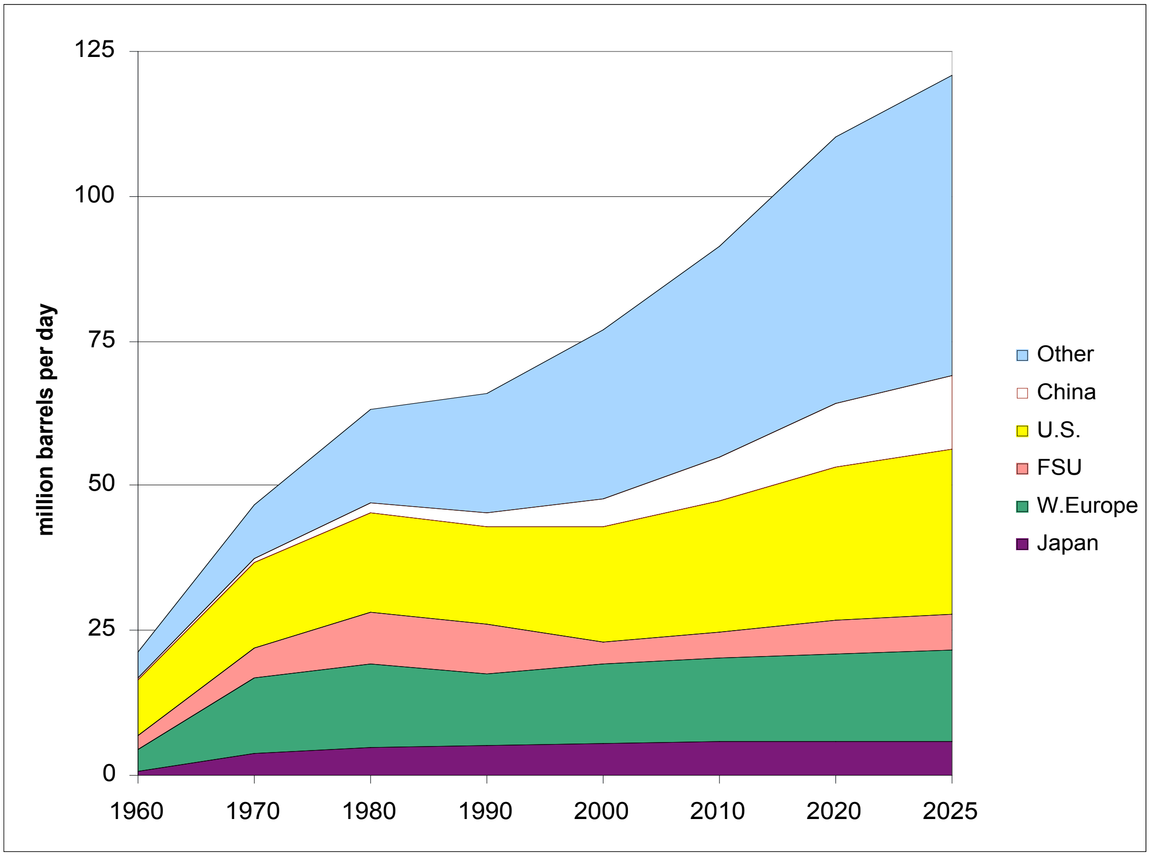

Figure A-4. World Petroleum Consumption, 1960-2025

Energy forecasting is difficult due to the numerous complex factors that influence energy supply and demand.[130] Here we utilize the U.S. Energy Department's Energy Information Administration forecasts of future world oil requirements.

[129] DOE EIA, *International Energy Outlook, 2004*.
[130] See the discussion in Roger H. Bezdek and Robert M. Wendling, *"A Half-Century of Long-Range Energy Forecasts; Errors Made, Lessons Learned, and Implications for Forecasting,"*

Table A-1 presents summary statistics for the EIA 2001-2025 forecast including 24-year country or country group projections for petroleum consumption, gross domestic product (GDP), and population.

Table A-1.
Reference Case Projections, 2001-2025
(Average annual % change)[131]

	Petroleum Consumption	GDP (Con. $)	Population
U.S.	1.5	3.0	0.8
W.Europe	0.5	2.0	0.1
China	4.0	6.1	0.5
FSU	2.1	4.2	-0.2
Japan	0.3	1.7	-0.1
Other	2.0	4.0	1.3
World	**1.9**	**3.0**	**1.0**

Oil consumption in China is expected to increase 4 percent a year, and by 2025 China is projected to be the second largest oil consuming country in the world, accounting for 11 percent of total world consumption. The second fastest growing market is projected to be the FSU countries, where petroleum consumption is forecast to increase an average of over 2 percent per year.

The remaining large consumers, including the U.S., Western Europe, and Japan are forecast to experience consumption growth over the 24-year period at or below the world average. The U.S. is forecast to increase oil consumption at a rate of 1.5 percent per year, and by 2025 the U.S. share of world oil consumption is forecast to decline to 23 percent (29.7 MM bpd), while Western Europe's share decreases to 13 percent (14.4 MM bpd). The many countries grouped as "Other" above, including India, Mexico, and Brazil, are expected to experience oil consumption growth rates 10 to 30 percent higher than the world average. By 2025, this group is forecast to account for 43 percent of world oil consumption.

In sum, in the EIA reference case, world oil consumption of 80 MM bpd in 2003 is projected to increase to 121 MM bpd in 2025, with the most rapid increases occurring in nations other than the U.S., Japan, or those in Western Europe. Average annual world oil demand growth is projected as 1.9 percent over the period.

[131] Source: U.S. Department of Energy, Energy Information Administration, 2004.

APPENDIX IV. RATIONALES FOR THE WEDGES

A. Vehicle Fuel Efficiency

The original U.S. Corporate Average Fuel Efficiency (CAFE) timetable, enacted in 1975, mandated a 53 percent increase in vehicle fuel efficiency, from 18 mpg to 27.5 mpg, over the seven years between 1978 and 1985. Average on-road vehicle fuel efficiency began to improve markedly in the early 1980s and continued to improve substantially every year through 1995. It showed little change between 1995 and 1999, and then began to decline gradually due to the shift to greater purchases of light trucks and SUVs. Between 1982 and 1995, average on-road vehicle fuel efficiency increased from about 14 mpg to 20 mpg. In other words, the first major U.S. oil disruption occurred in the fall of 1973; CAFE was not enacted until two years later; the increased mpg requirements did not begin until 1978, and were phased in through 1985; and significant increases in average on-road vehicle fuel efficiency did not occur until the mid- to late 1980s.[132]

From the time world oil peaking occurs or is recognized, it may thus take as long as 15 years until strengthened vehicle fuel efficiency standards significantly increase average on-road fleet fuel efficiency. However, care must be exercised in making extrapolations. Most "realistic" enhanced vehicle fuel efficiency standards might not actually decrease future total gasoline consumed in the U.S. due to the anticipated continued increase in numbers of drivers and vehicles. Thus, a new CAFE mandate might decrease the rate at which future gasoline consumption increases, but not necessarily reduce total consumption.[133] Only aggressive vehicle fuel efficiency standards legislation that "pushes the envelope" of fuel efficiency technologies over the next two decades (as determined, for example, in the study by the National Research Council of the National Academy of Sciences[134]) is likely to actually reduce total U.S. gasoline consumption.

Savings in the U.S. Assuming a crisis atmosphere, we hypothesize an aggressive vehicle fuel efficiency scenario, based on the NRC CAFE report and other studies that estimate the fuel efficiency gains possible from incremental technologies available or likely to be available within the next decade.[135] We

[132]Management Information Services, Inc., and 20/20 Vision, *Fuel Standards and Jobs: Economic, Employment, Energy, and Environmental Impacts of Increased CAFE Standards Through 2020,* report prepared for the Energy Foundation, San Francisco, California, July 2002.
[133]Ibid.
[134]National Research Council, National Academy of Sciences, *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards,* Washington, D.C.: National Academy Press, 2002.
[135]Ibid. Management Information Services, Inc., and 20/20 Vision, op. cit.; David L. Greene and John DeCicco, *Engineering-Economic Analysis of Automotive Fuel Economy Potential in the United States,* paper presented at the IEA International Workshop on Technologies to Reduce Greenhouse Gas Emissions, Washington, D.C., May 1999; David Friedman, et al, *Drilling in*

assume that legislation is enacted on the action date in each scenario. We further assume that vehicle fuel efficiency standards are increased 30 percent three years later -- for cars from 27.5 mpg to 35.75 mpg and for light trucks from 20.7 mpg to 26.9 -- and then increased to 50 percent above the base eight years later -- for cars from 27.5 mpg to 41.25 mpg and for light trucks from 20.7 mpg to 31 mpg; finally, we assume full implementation is assumed 12 years after the legislation is enacted. These assumptions "push the envelope" on the fuel efficiency gains possible from current or impending technologies.[136]

On the basis of our assumptions, the U.S. would save 500 thousand barrels per day of liquid fuels 10 ten years after legislation is enacted; 1.5 million barrels per day of liquid fuels at year 15; and 3 million barrels per day of liquid fuels at year 20.

Worldwide Savings. The U.S. currently has about 25 percent of total world vehicle registrations, but consumes nearly 40 percent of the liquid fuels used in transportation worldwide.[137] Since we could not find credible forecasts of the potential impacts of increased worldwide vehicle fuel efficiency standards, we assumed that the impact in the rest of the world of enhanced vehicle fuel efficiency standards will be about equal to that in the U.S. In total, the worldwide impact of increased vehicle fuel efficiency standards would thus yield a savings of 1 million barrels per day of liquid fuels 10 years after legislation is enacted; 3 million barrels per day 15 years after legislation is enacted; and 6 million barrels per day 20 years after legislation is enacted.

Increased vehicle fuel efficiency standards are a powerful way to reduce liquid fuels consumption. However, they required long lead-times to enact, implement, and become effective in the past. On the other hand, their importance and contributions continue to grow over time as older vehicles are retired. Our world

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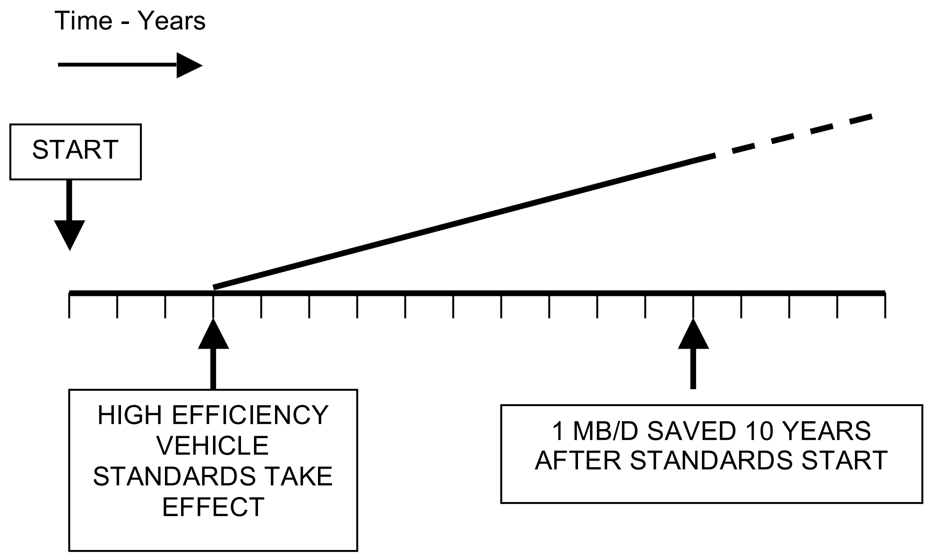
Detroit: Tapping Automaker Ingenuity to Build Safe and Efficient Automobiles, Union of Concerned Scientists, UCS Publications, Cambridge, MA, June 2001; Roland Hwang, Bryanna Millis, and Theo Spencer, *Clean Getaway: Toward Safe and Efficient Vehicles*, Natural Resources Defense Council: New York, July 2001; Brent D. Yacobucci, *Sport Utility Vehicles, Mini-Vans and Light Trucks: An Overview of Fuel Economy and Emissions Standards*, Congressional Research Service, U.S. Congress: Washington, D.C., (RS20298), January 16, 2001; Robert L Bamberger, *Automobile and Light Truck Fuel Economy: Is CAFE Up to Standards?* Washington, D.C.: Congressional Research Service, September 29, 2001; Energy and Environmental Analysis, Inc. *Technology and Cost of Future Fuel Economy Improvements for Light-Duty Vehicles*, prepared for the National Research Council, 2001.

[136]See Management Information Services, Inc., and 20/20 Vision, op. cit.; Roger H. Bezdek and Robert M. Wendling, "The Economic and Employment Effects of Increasing CAFE Standards." *Energy Policy*, 2004.

[137]U.S. Energy Information Administration, *World Petroleum Consumption by Fue*l database, 2003, and Oak Ridge National Laboratory, *Transportation Energy Data Book*, 2003. Japan has 10% of total vehicle registrations, Germany 9 percent, France 5 percent, and UK 5 percent, totaling (including the U.S.) 54 percent%. However, the U.S. has a higher miles per vehicle rate than any other developed country – it is less densely populated, has relatively inexpensive gasoline, and U.S. drivers do a large amount of discretionary driving.

vehicle fuel efficiency wedge is assumed to be as follows:



We note that a detailed study of these issues and opportunities would be of great value.

B. Coal Liquids

High quality liquid fuels can be made from coal via direct liquefaction or via gasification followed by Fisher-Tropsch synthesis. A number of coal liquefaction plants were built and operated during World War II, and the Sasol Company in South Africa subsequently built a number of larger, more modern gasification-based facilities.[138]

While the first two Sasol coal liquids production plants were built under normal business conditions, the Sasol Three facility was designed and constructed on a crash basis in response to the Iranian revolution of 1978-79. The project was completed in just over three years after the decision to proceed. Sasol Three was essentially a duplicate of Sasol Two on the same site using a large cadre of experienced personnel. Sasol Three was brought "up to speed almost immediately."[139]

The Sasol Three example represents the lower bound on what might be accomplished in a twenty-first century crash program to build coal liquefaction plants. This is because the South African government made a quick decision to replicate an existing plant on an existing, coal mine-mouth site without the delays

[138] Kruger, P du P. *"Startup Experience at Sasol's Two and Three."* Sasol. 1983.
[139] Collings, J. *"Mind Over Matter – The Sasol Story: A Half-Century of Technological Innovation,"* Sasol. 2002.

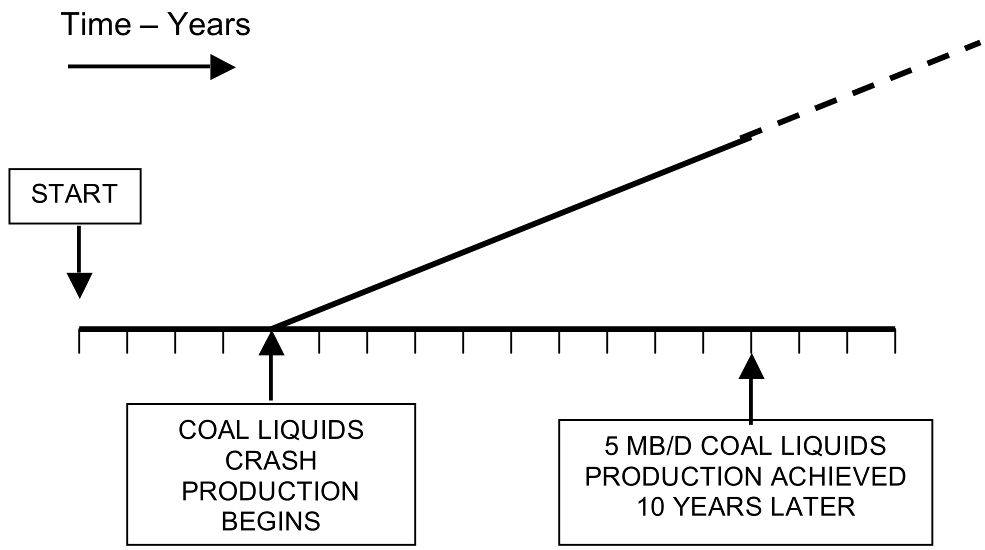
associated with site selection, environmental reviews, public comment periods, etc. In addition, engineering and construction personnel were readily available, and there were a number of manufacturers capable of providing the required heavy process vessels, pumps, and other auxiliary equipment. While we have not done a survey of worldwide capabilities to perform similar tasks today, it is our belief that such capabilities are now in much shorter supply – a situation that will worsen dramatically with the advent of a worldwide crash program to build alternate fuels plants. We have therefore attempted to strike a balance between what we believe could be a somewhat slow startup of a worldwide coal liquefaction industry and a later speed up as experience is gained and new plants are built as essentially duplicates of previous plants.

Our coal liquefaction wedge thus assumes that the first coal liquefaction plants in a worldwide crash program would begin operation four years after a decision to proceed. We assume plant sizes of 100,000 bpd of finished, refined product, and we assume that five such plants could be brought into operation each year. We cannot predict where in the world these coal liquefaction plants might be built. Candidate countries with large coal reserves include the U.S. and the Former Soviet Union with the largest, followed in descending order by China, India and Australia.[140] We note that a consortium of Chinese companies has recently signed a letter of intent with Sasol for feasibility studies on the construction of two new coal-to-liquids plans in China.[141]

If U.S. siting and environmental reviews of new energy facilities were to continue to be as time consuming as they are today, few coal liquefaction plants would likely be built in the U.S. On the other hand, China has been quick to approve major new facilities, so coal liquefaction plants in that country might well be built expeditiously and economically. Because there is presently a large international trade in coal, it is not inconceivable that coal-poor counties might become the sites of many coal liquefaction plants using imported coal, possibly even from the U.S.

Our coal liquefaction wedge then appears be as follows:

[140] DOE EIA. *International Energy Outlook*. 2004.
[141] "Sasol Taps Into China's Demand for Oil." *Financial Times*. July 8, 2004.



C. Heavy Oils / Oil Sands

As noted, significant heavy oil production currently exists in Canada and Venezuela. While their total resource is estimated to be 3-4 trillion barrels, recoverable oil reserves are estimated to be roughly 600 billion barrels.[142] Such reserves could support a massive expansion in production of these unconventional oils.

In the case of Canadian oil sands, a number of factors would challenge a crash program expansion, such as the need for massive supplies of auxiliary energy, huge land and water requirements, environmental management, and the harsh climate in the region. In the case of Venezuela, large amounts of supplemental energy, inherently low well productivity and other factors will likely pose significant challenges.

We know of no comprehensive analysis of how fast the Canadian and Venezuelan heavy oil production might be accelerated in a world suddenly short of conventional oil. Recent statements by the World Energy Council (WEC) guided our wedge estimates:[143]

- "Unconventional oil is unlikely to fill the gap (associated with conventional oil peaking). Although the resource base is large and technological progress has been able to bring costs down to competitive levels, the dynamics do not suggest a rapid increase in supply but, rather, a long, slow growth over several decades."

[142] Williams, B. *"Heavy Hydrocarbons Playing Key Role in Peak Oil Debate, Future Supply."* OGJ. July 28, 2003; DOE EIA. Early Release *AEO 2004*. December 16, 2003.
[143] "*Drivers of the Energy Scene*." World Energy Council. December 2003.

- "(Extrapolating expectations of TOTAL Oil Company in the Orinoco, Venezuela) overall reserves today would be only ~60 Gb over 30 years, allowing at best 6 MM bpd of production in 2030 if the entire area were put into production."

- "Current estimates put the additional production of Canada (heavy oil) … at less than 2 MM bpd in 2015-2025."

In line with the WEC, we assume the following for our Venezuelan Heavy Oils wedge:

1. Accelerated production might begin three years after a decision to proceed with a crash program. This delay is based on the fact that the country already has significant production underway. Starting from scratch would require much more time.

2. Under business-as-usual conditions assumed by the WEC, Venezuela would have production of 6 MM bpd in 2030 -- 5.5 MM bpd beyond production of 0.5 MM bpd in 2003. If we assume this level of production is achieved 10 years after initiation of a crash program, rather than the roughly 25 years estimated by WEC, then roughly 5.5 MM bpd of incremental production might be achieved 13 years from a decision to accelerate.

3. In contrast to the WEC, we assume that Venezuelan production is not capped at 6 MM bpd but continues to expand for the period covered by our approximations. Note: We ignore the currently extremely unstable political environment in Venezuela and assume that scale-up timing is not hindered by local politics.

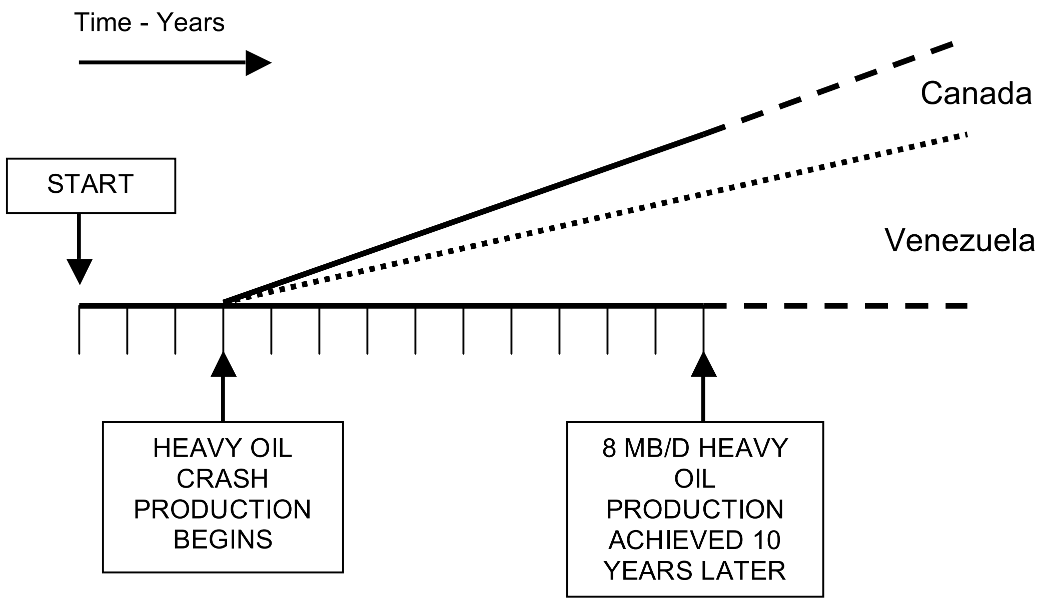
Our assumptions for Canadian oil sands are as follows:

1. Again, accelerated production might begin three years after a decision to proceed with a crash program, based in large part on the fact that the country already has significant production underway.

2. Current plans are for production of 3 MM bpd of synthetic crude oil from which refined fuels can be produced by 2030. This is above current production of 0.6 MM bpd. If we assume this level of production is achieved 10 years after initiation of a crash program, rather than the roughly 25 years targeted by the Canadians, then roughly 2.5 MM bpd of incremental production might be achieved 13 years from a decision to accelerate.

3. aWe know of no upper limit on Canadian oil sands production, so for purposes of this order-of-magnitude illustration, we do not assume one.

Our heavy oil wedge therefore is approximated as follows:



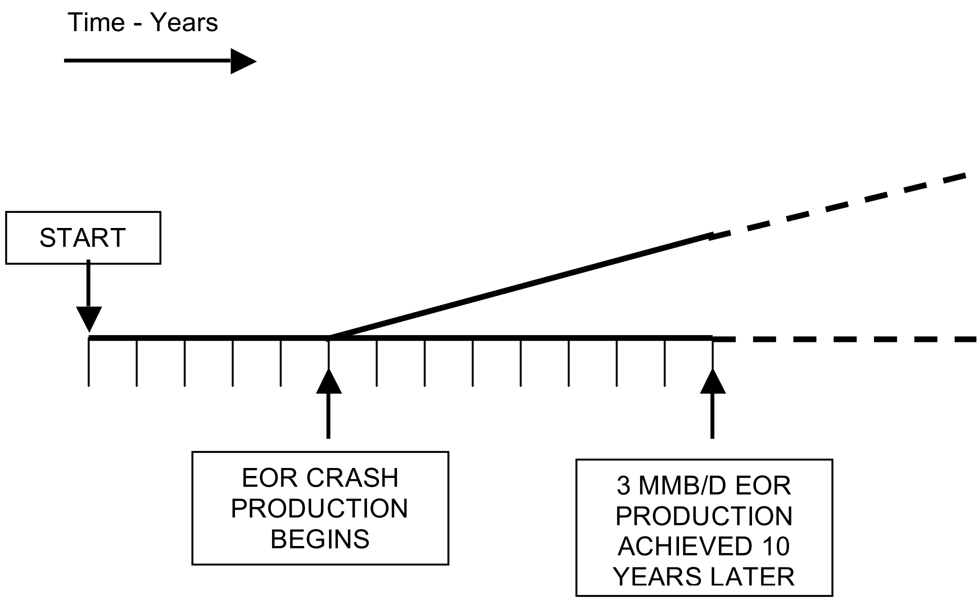
D. Enhanced Oil Recovery

Because it is impossible to evaluate the worldwide impact of Improved Oil Recovery (IOR) techniques, we can only provide a rough estimate of what might be achieved. We focus on a major subset of IOR technologies – Enhanced Oil Recovery (EOR). While EOR can add significantly to reserves, it is normally not applied to a conventional oil reservoir until after production has peaked. As discussed earlier, the most widely applicable EOR process involves the injection of CO_2 into conventional oil reservoirs to dissolve and move residual oil. Because EOR processes require extensive planning, large capital expenditures, procurement of very large volumes of CO_2, and major equipment for large reservoirs, our simplified assumptions parallel those for our heavy oil and coal liquids wedges.

We assume that the massive application of EOR worldwide will not begin to show production enhancement until 5 years after the peaking of world oil production, paced primarily by the difficulties of procuring CO_2. We further assume that world oil production enhancement due to such a crash effort worldwide will increase world oil production by roughly 3 percent after 10 years.[144] We translate

[144]Even under a crash program, 5 percent production increase in 10 years does not seem achievable, but roughly half that level might be possible. Our reasoning is strongly influenced by the need for relatively pure CO_2, which is difficult to obtain in most places around the world. This

the 3 percent to 3 MM bpd, based on our assumed world oil peaking level of roughly 100 MM bpd. Our EOR wedge thus appears as follows:



E. Gas-To-Liquids

Estimating how fast world Gas-To-Liquids (GTL) production might grow as a result of the peaking of world oil production is an extremely complex undertaking because of the need to consider the total world energy system, its likely growth by country, future energy economics, other resources that compete with natural gas, etc. In a crash program, GTL plants might be built in a number of counties that have large reserves of stranded gas.. Once operational, GTL product could be moved to markets around the world by conventional oil product tankers.

Our estimates for a crash program of world GTL production are tempered by the conflicting world demand for Liquefied Natural Gas (LNG), whose export volumes are currently growing at a rapid pace. The tradeoffs involved in estimating the future LNG / GTL balance are complex, and a world crash program in GTL could yield higher or lower volumes than our estimates. Note also that seven countries currently account for almost 80 percent of the world gas export market, and it is not inconceivable that the recently formed Gas Exporting Countries Forum (GECF) might well evolve into a future OPEC-like cartel.[145]

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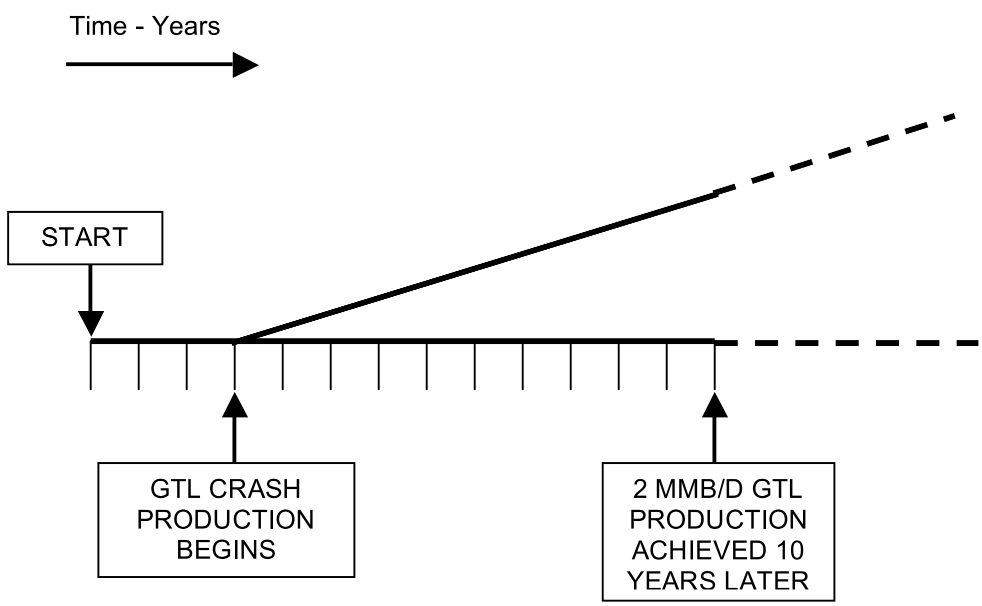
is especially true in the Middle East, where large sources of relatively pure CO_2 are somewhat rare at this time.

[145] McCaughey, J. "Is Gas OPEC in the Cards?" *Electricity Daily*. June 29, 2004.

Again, we assume a startup delay of three years before crash program GTL plants might come into operation. Using a base case, business-as-usual production forecast of 1.0 MM bpd in 2015 from the current level of essentially zero, we assume that a crash program might yield the 1.0 MM bpd in 5 years. The resultant wedge might then be as follows:



F. Sum of the Wedges

A summary of the estimates from the foregoing is presented in Table A-2.

Table A-2.
Summary of Consumption and Production Wedge Estimates

CATEGORY	DELAY UNTIL FIRST IMPACT (Years)	IMPACT 10 YEARS LATER (MM bpd)
Vehicle Efficiency	3	3
Gas-To-Liquids	3	2
Heavy Oils / Oil Sands	3	8
Coal Liquids	4	5
Enhanced Oil Recovery	5	3

Ordering the various contributions by their starting dates, the total mitigation wedge is as shown in Figure A-5.

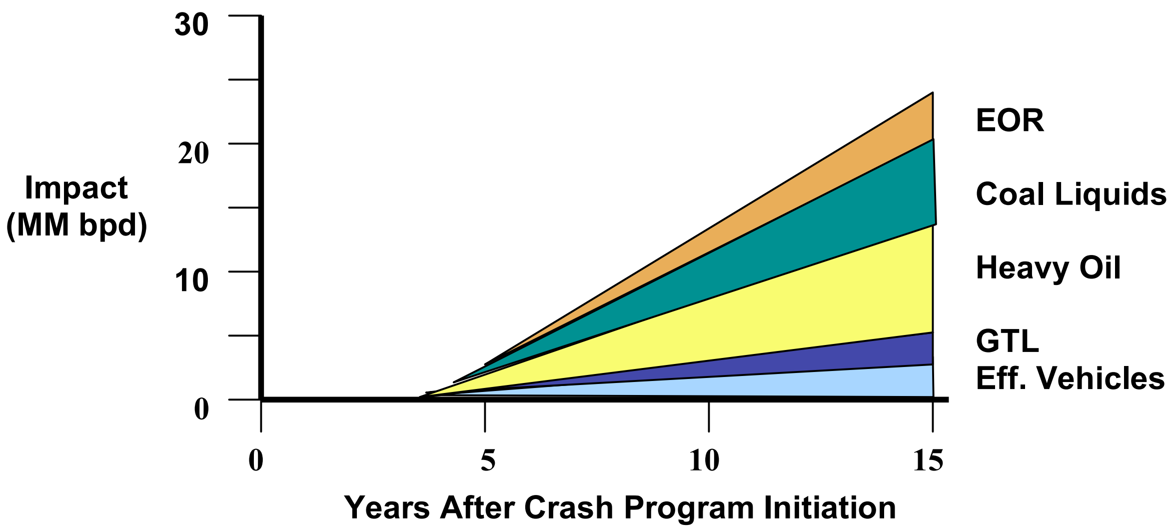


Figure A-5. The total of the wedge estimates

APPENDIX V. NOTES ON SHALE OIL AND BIOMASS

A. Oil Shale by Gilbert McGurl, NETL

Worldwide resources of oil shale comprise an estimated 2.6 trillion barrels, of which two trillion are located within the United States. The richest deposits, 1.5 trillion bbl with high concentrations of kerogen, lie in Colorado, Utah, and Wyoming. An additional 16 billion barrels of rich but physically different oil shale is found in Kentucky, Indiana, and Ohio. A recent estimate is that, from the Green River deposits, 130 billion barrels of oil may be produced. Technology development on oil shale 'retorting' reached a high point in the late 1970s, with the major oil companies leading the way. The oil price collapse of the 1980s, the dissolution of the synfuels program, and the termination of the Unocal project in 1991 led to the demise of oil shale production in the United States.

A recent study performed by the DOE Office of Naval Petroleum and Oil Shale Reserves advocates a research and development program with a production goal of two million barrels per day by 2020.[146] Production would be initiated by 2011. Traditional technologies for mining and preparation of oil shale ores and for aboveground upgrading have been 'proven' at less-than-commercial scale. Newer Canadian technologies have been tested at demonstration projects in Australia. However, that project, the Stuart upgrading project, is currently suspended pending project re-design. Nonetheless, the same technology has been licensed by operators in Estonia. Technologies for in-situ recovery are newer and less developed. In 2000, Shell revived an oil shale project called "Mahogany" in Colorado.[147] Shell aims to test its process until 2010. If successful, the in-situ method would leave heavier hydrocarbons in the shale while producing lighter hydrocarbons and using much less water than traditional methods.

Most Estonian processing of oil shale has been for boiler fuel for electricity production. Small liquids facilities have been operating at "full capacity" given recent market oil prices. There are no solid figures for cost in large-scale plants since none have been built. The aborted Australian project estimated $8.50/bbl in operating costs once a commercial plant had been built. The Estonians estimate a break-even point at $21 Brent price (app $23 WTI) and low capacity factor. At higher capacity factors, plants may operate profitably even with prices in the mid-teens.

Besides water use and production, environmental concerns include fine particulates and carbon dioxide emissions. Since the last US oil shale project

[146] US DOE ONPOSR. *Strategic Significance of America's Oil Shale*, Vols I and II. March 2004.

[147] Rocky Mountain News, October 18, 2004, *"Shale's New Hope: Shell Tests Technology to Cook Oil out of Rocks Underground,"* p. 1B.

ceased operation before the implementation of the 1990 Clean Air Act amendments, new emission-control equipment would need to be tested on US shales.

B. Biofuels by Peter Balash, NETL

Bioethanol is produced as a transportation fuel largely in only two countries. In 2003 the US produced about 2.8 billion gallons and Brazil produced 3.5 billion gallons. All of this ethanol is produced by conversion of starch to sugar and fermentation to ethanol. In the US ethanol represents about 1.4% of the BTU content (2.0% by volume) of gasoline used in transportation. Current costs for ethanol production in the US are said to be $0.90 per gallon,[148] which is equivalent to a gasoline price of $1.35 per gallon. Because of recent increases in energy costs current costs will be somewhat higher. Grain ethanol provides only a modest net energy gain because of the energy required to produce it. USDA calculated a net energy gain of 34% for a modern corn to ethanol plant,[149] but there is considerable controversy over the real efficiency of the process. Most of the energy used to produce ethanol comes from natural gas and electricity. The production of ethanol uses only about 5% of the corn crop in the US. Significant expansion is possible but at some point there might be an impact on food prices.

Cellulosic ethanol is currently being produced only in two rather small pilot plants but is capable of producing about 40% conversion of cellulosic biomass to ethanol while providing all the energy needed for the process and exporting a modest amount of energy as electricity. It is anticipated that successful research may reduce the cost of cellulosic ethanol to about $1.10 per gallon by 2010. If this occurs the potential ethanol to mitigate peaking is high. Using only waste biomass and grass grown on land currently in the conservation reserve could produce 50 billion gallons of ethanol which would be equivalent to 35 billion gallons of gasoline or 17% of current US consumption. This could be achieved without any impact on current food production and at prices only $ 0.35 per gallon higher than refinery prices for gasoline. Since ethanol has an RON of 130 and a MON of 96 it raises the octane of the gasoline to which it is added and has a premium value as a result.

[148] NREL 2002.
[149] USDA 2002.

APPENDIX VI: AREAS FOR FURTHER STUDY

1. **Economic Benefits to the U.S. Associated With an Aggressive Mitigation Initiative**

Important economic and jobs benefits could result from a concerted U.S. effort to develop substitute fuels plants based on U.S. coal and shale resources and scale up of EOR. The impacts might include hundreds of billions of dollars of investment, hundreds of thousands of jobs, a rejuvenation of various domestic industries, and increased tax revenues for the Federal, state, and local governments. The identification and analysis of such benefits require analysis.

In the short run, the U.S would be hard-pressed to find adequate physical and human resources to plan, develop, construct, and operate the required facilities. Given that oil peaking is a world problem, it is virtually certain that at the same time the U.S. embarked on an aggressive mitigation program, other major initiatives would likely be undertaken elsewhere in the world. All would require similar types of capital, technology, and human resources, generating additional constraints and inflationary pressures on the U.S. program. Assessment of the impacts of these constraints on the feasibility, costs, and timing of a major U.S. mitigation program merits investigation.

2. **Oil Peaking Risk Analysis: Cost of Premature Mitigation versus Waiting**

The date of world oil production peaking is unknowable, but it may occur in the not too distant future. Large-scale mitigation is needed more than a decade before the onset of peaking if economic hardship is to be avoided. If major efforts were initiated early and peaking was to occur decades later, there might be an unproductive use of resources. On the other hand, mitigation initiated at the time of peaking will not spare the world from a decade or more of devastating economic impacts. A careful analysis of the benefits / costs of early versus late mitigation could provide valuable insights.

3. **U.S. Natural Gas Production as a Paradigm for Viewing World Oil Peaking**

The history of U.S. natural gas production is cited as an example of the perils of over-optimistic resource forecasts. A detailed analysis of the North American natural gas history, status, and outlook might provide lessons useful in addressing world oil production peaking.

4. Potential for Non-transportation Oil Fuel-Switching

World non-transportation liquid fuel usage is amenable to fuel switching, thereby freeing up liquids for transportation. If switching were to occur on a large-scale, it would likely take place gradually because other energy substitutes would have to be scaled up to meet the new demands associated with a major shift, e.g., electric power plants built, refineries expanded to produce a different product slate, etc. A detailed study would provide an understanding of how difficult, expensive, time-consuming and productive worldwide non-transportation fuel switching might be.

5. World Coal-To- Liquids Potential

Sasol has operational coal-to-liquids (CTL) production plants and is under contract to study the construction of similar facilities in China. An analysis of worldwide large-scale CTL potential could yield a useful estimate of complexity, timing and potential.

6. World Heavy Oil / Oil Sands Potential

Canada, Venezuela, and, to a lesser degree, other countries have potential to massively scale up their unconventional oil production. A better understanding of how quickly scale-up might be implemented, the related barriers, and ultimate potential would help in the understanding the potential contribution of these resources.

7. World EOR Potential

An analysis of worldwide large-scale EOR potential could provide an estimate of complexity, timing and potential.

8. World GTL Potential

An analysis of worldwide large-scale GTL potential could yield a useful estimate of complexity, timing and potential. In particular, the likely conflicts between GTL and LNG production could provide a quantitative estimate of likely future use of world stranded gas.

9. World Transportation Fuel Efficiency Improvement Potential

It is important that we have the best possible understanding of the U.S. and worldwide potential for the upgrading of transportation fuel efficiency, including possible timing, cost, and savings as a function of time. Excellent data is available on U.S. transportation fleets, but fleets elsewhere in the world are less well described. A careful study is needed.

10. Impacts of Oil Prices and Technology on U.S. Lower 48 Oil Production

Analysis of U.S. Lower 48 oil production since the 1970 peak strongly suggests that oil prices and advancing technology had little impact on the production decline. However, a number of institutional factors also impacted Lower 48 oil production, e.g., allowables (Texas Railroad Commission), price and allocation controls (1970s), free market pricing (since 1981), foreign opportunities for multi-national oil companies, etc. An in-depth understanding of these various influences might provide useful guidance for the future.

11. Technological Options for Coal Liquefaction

Current world coal liquefaction R & D is focused on gasification of coal followed by the Fischer-Tropsch synthesis. Other coal-to-liquids processes have been proposed, some of which were tested at relatively large scale. It may be worthwhile to revisit the various options in light of today's technology and environmental requirements to determine if any of them might also have competitive potential.

12. Performance of Oil Provinces Outside of the U.S.

There is a strong rationale for using U.S Lower 48 oil production as a surrogate pattern for future world oil production peaking and decline. Other large oil province histories could also yield valuable insights and alternate patterns. Related analysis might provide an improved basis for modeling future world oil production.

13. How the U.S. Could Again Become the World's Largest Oil Producer.

After the peaking of world conventional oil production, there will be a major world transition from the current world liquid fuel infrastructure. Over time, major conservation and energy switching initiatives will almost certainly be implemented, but the need for liquid fuels will not disappear for at least the remainder of this century because there are no known alternatives for a number of transportation applications. An analysis of the major factors required for the U.S. to return to a position of oil supremacy and oil independence would be enlightening.

14. Market Signals in Advance of Peaking

Increases in oil prices and oil price volatility have been identified as two precursors of world oil peaking, but both are likely short-term signals. The identification and character of longer-term signals, if they exist, could be of significant value.

15. Risk of Repeating the Synthetic Fuels Experience of 1970s and 1980s

One risk of embarking on aggressive oil peaking mitigation is that OPEC might undermine such efforts by dramatically increasing conventional oil production. This could only happen if excess capacity were to exist, which could happen if world oil peaking was many decades away. Were such a dramatic increase in OPEC production to occur, governments would be under pressure to terminate support for their mitigation programs. Related scenarios might worthy of study.

16. Effects of Oil Price Spikes in Causing U.S. Recessions

Oil price spike have been followed by U.S. recessions, but they are not the only cause of recessions. A detailed study of the role of oil prices and other factors in causing recessions might be worth further study.

From:	Mark Robinowitz
To:	Columbia River Crossing;
CC:	
Subject:	Columbia River Crossing DEIS comment: attachment - March 1998 Scientific American "The End of Cheap Oil"
Date:	Tuesday, July 01, 2008 2:56:01 AM
Attachments:	ScientificAmerican1998.pdf

The End of Cheap Oil

Global production of conventional oil will begin to decline sooner than most people think, probably within 10 years

Please note that the layout of this document is slightly different than the original.

by Colin J. Campbell and Jean H. Laherrère

In 1973 and 1979 a pair of sudden price increases rudely awakened the industrial world to its dependence on cheap crude oil. Prices first tripled in response to an Arab embargo and then nearly doubled again when Iran dethroned its Shah, sending the major economies sputtering into recession. Many analysts warned that these crises proved that the world would soon run out of oil. Yet they were wrong.

Their dire predictions were emotional and political reactions; even at the time, oil experts knew that they had no scientific basis. Just a few years earlier oil explorers had discovered enormous new oil provinces on the north slope of Alaska and below the North Sea off the coast of Europe. By 1973 the world had consumed, according to many experts' best estimates, only about one eighth of its endowment of readily accessible crude oil (so-called conventional oil). The five Middle Eastern members of the Organization of Petroleum Exporting Countries (OPEC) were able to hike prices not because oil was growing scarce but because they had managed to corner 36 percent of the market. Later, when demand sagged, and the flow of fresh Alaskan and North Sea oil weakened OPEC's economic stranglehold, prices collapsed.

The next oil crunch will not be so temporary. Our analysis of the discovery and production of oil fields around the world suggests that within the next decade, the supply of conventional oil will be unable to keep up with demand. This conclusion contradicts the picture one gets from oil industry reports, which boasted of 1,020 billion barrels of oil (Gbo) in "Proved" reserves at the start of 1998. Dividing that figure by the current production rate of about 23.6 Gbo a year might suggest that crude oil could remain plentiful and cheap for 43 more years—probably longer, because official charts show reserves growing.

Unfortunately, this appraisal makes three critical errors. First, it relies on distorted estimates of reserves. A second mistake is to pretend that production will remain constant. Third and most important, conventional wisdom erroneously assumes that the last bucket of oil can be pumped from the ground just as quickly as the barrels of oil gushing from wells today. In fact, the rate at which any well—or any country—can produce oil always rises to a maximum and then, when about half the oil is gone, begins falling gradually back to zero.

From an economic perspective, when the world runs completely out of oil is thus not directly relevant: what matters is when production begins to taper off. Beyond that point, prices will rise unless demand declines commensurately.

HISTORY OF OIL PRODUCTION, from the first commercial American well in Titusville, Pa. (*left*), to derricks bristling above the Los Angeles basin (*below*), began with steady growth in the U.S. (*red line*). But domestic production began to decline after 1970, and restrictions in the flow of Middle Eastern oil in 1973 and 1979 led to inflation and shortages (*near* and *center tight*). More recently, the Persian Gulf War, with its burning oil fields (*far right*), reminded the industrial world of its dependence on Middle Eastern oil production (*gray line*).

Using several different techniques to estimate the current reserves of conventional oil and the amount still left to be discovered, we conclude that the decline will begin before 2010.

Digging for the True Numbers

We have spent most of our careers exploring for oil, studying reserve figures and estimating the amount of oil left to discover, first while employed at major oil companies and later as independent consultants. Over the years, we have come to appreciate that the relevant statistics are far more complicated than they first appear.

Consider, for example, three vital numbers needed to project future oil production. The first is the tally of how much oil has been extracted to date, a figure known as cumulative production. The second is an estimate of reserves, the amount that companies can pump out of known oil fields before having to abandon them. Finally, one must have an educated guess at the quantity of conventional oil that remains to be discovered and exploited. Together they add up to ultimate recovery, the total number of barrels that will have been extracted when production ceases many decades from now.

The obvious way to gather these numbers is to look them up in any of several publications. That approach works well enough for cumulative production statistics because companies meter the oil as it flows from their wells. The record of production is not perfect (for example, the two billion barrels of Kuwaiti oil wastefully burned by Iraq in 1991 is usually not included in official statistics), but errors are relatively easy to spot and rectify. Most experts agree that the industry had removed just over 800 Gbo from the earth at the end of 1997.

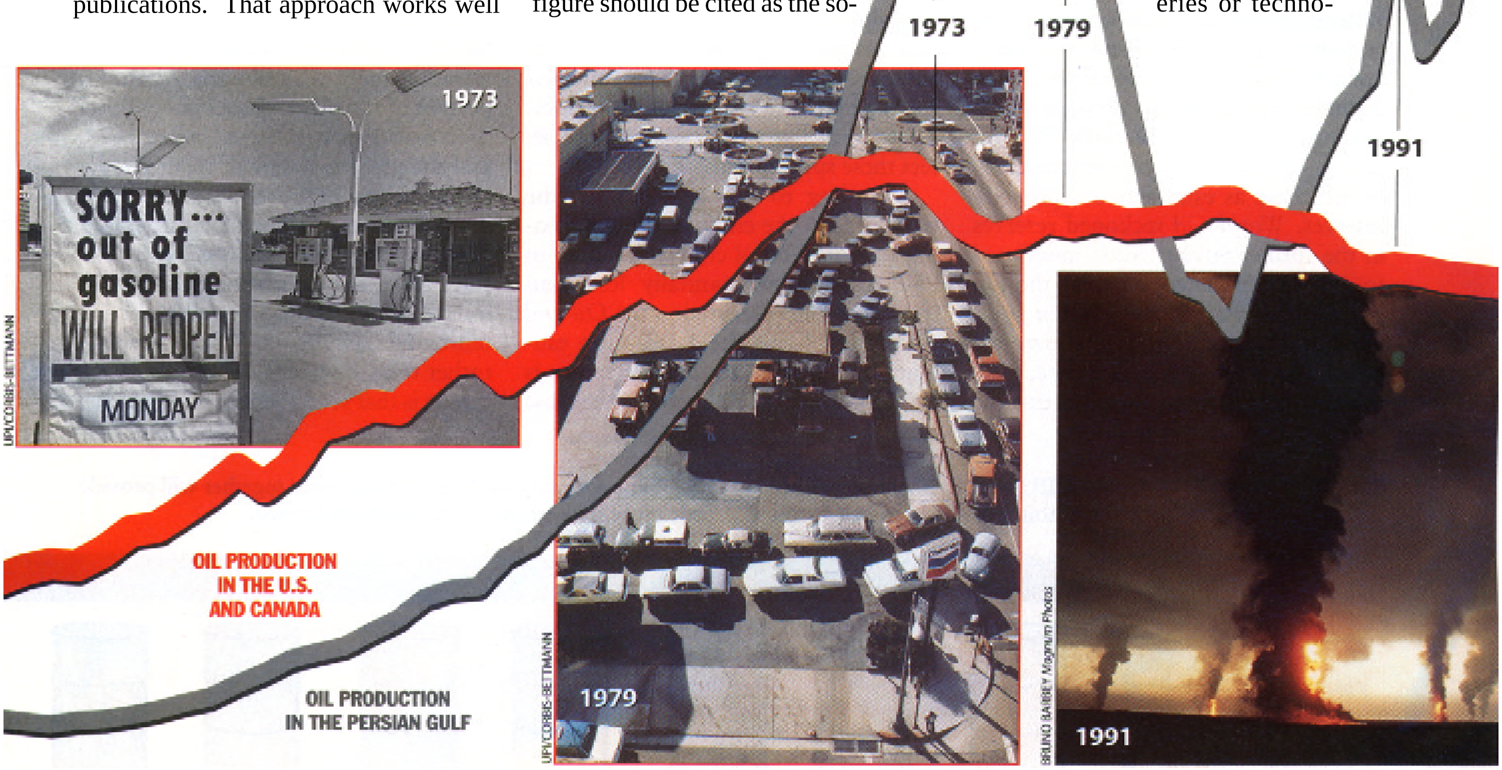
Getting good estimates of reserves is much harder, however. Almost all the publicly available statistics are taken from surveys conducted by the *Oil and Gas Journal* and *World Oil*. Each year these two trade journals query oil firms and governments around the world. They then publish whatever production and reserve numbers they receive but are not able to verify them.

The results, which are often accepted uncritically, contain systematic errors. For one, many of the reported figures are unrealistic. Estimating reserves is an inexact science to begin with, so petroleum engineers assign a probability to their assessments. For example, if, as geologists estimate, there is a 90 percent chance that the Oseberg field in Norway contains 700 million barrels of recoverable oil but only a 10 percent chance that it will yield 2,500 million more barrels, then the lower figure should be cited as the so-called P90 estimate (P90 for "probability 90 percent") and the higher as the P10 reserves.

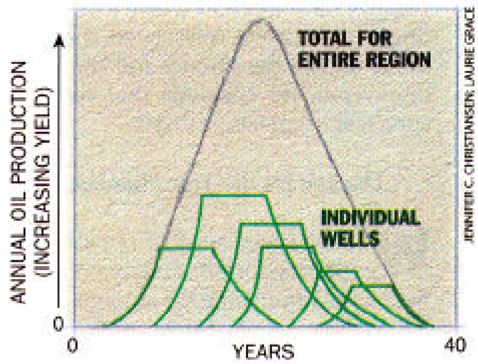
In practice, companies and countries are often deliberately vague about the likelihood of the reserves they report, preferring instead to publicize whichever figure, within a P10 to P90 range, best suits them. Exaggerated estimates can, for instance, raise the price of an oil company's stock.

The members of OPEC have faced an even greater temptation to inflate their reports because the higher their reserves, the more oil they are allowed to export. National companies, which have exclusive oil rights in the main OPEC countries, need not (and do not) release detailed statistics on each field that could be used to verify the country's total reserves. There is thus good reason to suspect that when, during the late 1980s, six of the 11 OPEC nations increased their reserve figures by colossal amounts, ranging from 42 to 197 percent, they did so only to boost their export quotas.

Previous OPEC estimates, inherited from private companies before governments took them over, had probably been conservative, P90 numbers. So some upward revision was warranted. But no major new discoveries or techno-



FLOW OF OIL starts to fall from any large region when about half the crude is gone. Adding the output of fields of various sizes and ages (*green curves at right*) usually yields a bell-shaped production curve for the region as a whole. M. King Hubbert (*left*), a geologist with Shell Oil, exploited this fact in 1956 to predict correctly that oil from the lower 48 American states would peak around 1969.



logical breakthroughs justified the addition of a staggering 287 Gbo. That increase is more than all the oil ever discovered in the U.S.—plus 40 percent. Non-OPEC countries, of course, are not above fudging their numbers either: 59 nations stated in 1997 that their reserves were unchanged from 1996. Because reserves naturally drop as old fields are drained and jump when new fields are discovered, perfectly stable numbers year after year are implausible.

Unproved Reserves

Another source of systematic error in the commonly accepted statistics is that the definition of reserves varies widely from region to region. In the U.S., the Securities and Exchange Commission allows companies to call reserves "proved" only if the oil lies near a producing well and there is "reasonable certainty" that it can be recovered profitably at current oil prices, using existing technology. So a proved reserve estimate in the U.S. is roughly equal to a P90 estimate.

Regulators in most other countries do not enforce particular oil-reserve definitions. For many years, the former Soviet countries have routinely released wildly optimistic figures—essentially P10 reserves. Yet analysts have often misinterpreted these as estimates of "proved" reserves. *World Oil* reckoned reserves in the former Soviet Union amounted to 190 Gbo in 1996, whereas the *Oil and Gas Journal* put the number at 57 Gbo. This large discrepancy shows just how elastic these numbers can be.

Using only P90 estimates is not the answer, because adding what is 90 percent likely for each field, as is done in the U.S., does not in fact yield what is 90 percent likely for a country or the entire planet. On the contrary, summing many P90 reserve estimates always understates the amount of proved oil in a region. The only correct way to total up reserve numbers is to add the mean, or average, estimates of oil in each field. In practice, the median estimate, often called "proved and probable," or P50 reserves, is more widely used and is good enough. The P50 value is the number of barrels of oil that are as likely as not to come out of a well during its lifetime, assuming prices remain within a limited range. Errors in P50 estimates tend to cancel one another out.

We were able to work around many of the problems plaguing estimates of conventional reserves by using a large body of statistics maintained by Petroconsultants in Geneva. This information, assembled over 40 years from myriad sources, covers some 18,000 oil fields worldwide. It, too, contains some dubious reports, but we did our best to correct these sporadic errors.

According to our calculations, the world had at the end of 1996 approximately 850 Gbo of conventional oil in P50 reserves—substantially less than the 1,019 Gbo reported in the *Oil and Gas Journal* and the 1,160 Gbo estimated by *World Oil*. The difference is actually greater than it appears because our value represents the amount most likely to come out of known oil fields, whereas the larger number is supposedly a cautious estimate of proved reserves.

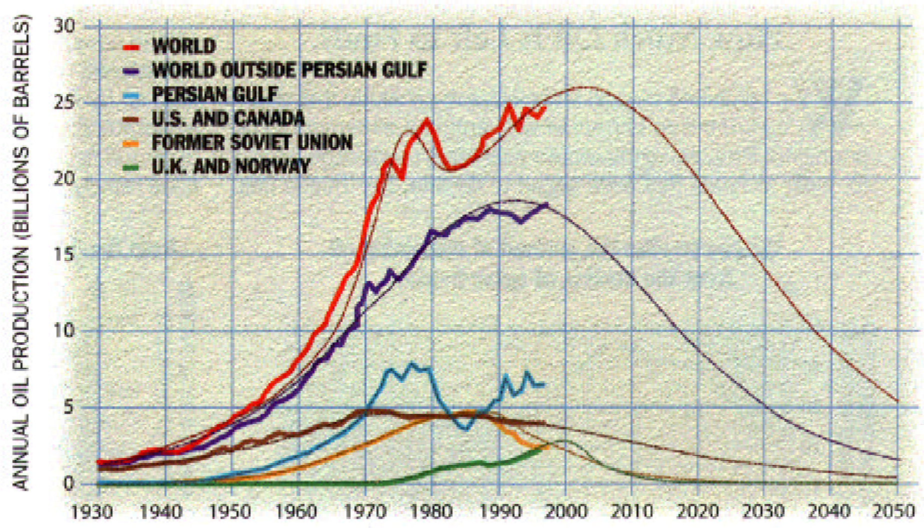
For the purposes of calculating when oil production will crest, even more critical than the size of the world's reserves is the size of ultimate recovery—all the cheap oil there is to be had. In order to estimate that, we need to know whether, and how fast, reserves are moving up or down. It is here that the official statistics become dangerously misleading.

Diminishing Returns

According to most accounts, world oil reserves have marched steadily upward over the past 20 years. Extending that apparent trend into the future, one could easily conclude, as the U.S. Energy Information Administration has, that oil production will continue to rise unhindered for decades to come, increasing almost two thirds by 2020.

Such growth is an illusion. About 80 percent of the oil produced today flows from fields that were found before 1973, and the great majority of them are declining. In the 1990s oil companies have discovered an average of seven Gbo a year; last year they drained more than three times as much. Yet official figures indicated that proved reserves did not fall by 16 Gbo, as one would expect rather they expanded by 11 Gbo. One reason is that several dozen governments opted not to report declines in their reserves, perhaps to enhance their political cachet and their ability to obtain loans. A more important cause of the expansion lies in revisions: oil companies replaced earlier estimates of the reserves left in many fields with higher numbers. For most purposes, such amendments are harmless, but they seriously distort forecasts extrapolated from published reports.

To judge accurately how much oil explorers will uncover in the future, one has to backdate every revision to the year in which the field was first discovered—not



GLOBAL PRODUCTION OF OIL both conventional and unconventional (*red*), recovered after falling in 1973 and 11979. But a more permanent decline is less than 10 years away, according to the authors' model, based in part on multiple Hubbert curves (*lighter lines*). U.S. and Canadian oil (*brown*) topped out in 1972; production in the former Soviet Union (*yellow*) has fallen 45 percent since 1987. A crest in the oil produced outside the Persian Gulf region (*purple*) now appears imminent.

to the year in which a company or country corrected an earlier estimate. Doing so reveals that global discovery peaked in the early 1960s and has been falling steadily ever since. By extending the trend to zero, we can make a good guess at how much oil the industry will ultimately find.

We have used other methods to estimate the ultimate recovery of conventional oil for each country [*see box on next two pages*], and we calculate that the oil industry will be able to recover only about another 1,000 billion barrels of conventional oil. This number, though great, is little more than the 800 billion barrels that have already been extracted.

It is important to realize that spending more money on oil exploration will not change this situation. After the price of crude hit all-time highs in the early 1980s, explorers developed new technology for finding and recovering oil, and they scoured the world for new fields. They found few: the discovery rate continued its decline uninterrupted. There is only so much crude oil in the world, and the industry has found about 90 percent of it.

Predicting the Inevitable

Predicting when oil production will stop rising is relatively straightforward once one has a good estimate of how much oil there is left to produce. We simply apply a refinement of a technique first published in 1956 by M. King Hubbert. Hubbert observed that in any large region, unrestrained extraction of a finite resource rises along a bellshaped curve that peaks when about half the resource is gone. To demonstrate his theory, Hubbert fitted a bell curve to production statistics and projected that crude oil production in the lower 48 U.S. states would rise for 13 more years, then crest in 1969, give or take a year. He was right: production peaked in 1970 and has continued to follow Hubbert curves with only minor deviations. The flow of oil from several other regions, such as the former Soviet Union and the collection of all oil producers outside the Middle East, also follows Hubbert curves quite faithfully.

The global picture is more complicated, because the Middle East members of OPEC deliberately reined back their oil exports in the 1970s, while other nations continued producing at full capacity. Our analysis reveals that a number of the largest producers, including Norway and the U.K., will reach their peaks around the turn of the millennium unless they sharply curtail production. By 2002 or so the world will rely on Middle East nations, particularly five near the Persian Gulf (Iran, Iraq, Kuwait, Saudi Arabia and the United Arab Emirates), to fill in the gap between dwindling supply and growing demand. But once approximately 900 Gbo have been consumed, production must soon begin to fall. Barring a global recession, it seems most likely that world production of conventional oil will peak during the first decade of the 21st century.

Perhaps surprisingly, that prediction does not shift much even if our estimates are a few hundred billion barrels high or low. Craig Bond Hatfield of the University of Toledo, for example, has conducted his own analysis based on a 1991 estimate by the U.S. Geological Survey of 1,550 Gbo remaining—55 percent higher than our figure. Yet he similarly concludes that the world will hit maximum oil production within the next 15 years. John D. Edwards of the University of Colorado published last August one of the most optimistic recent estimates of oil remaining: 2,036 Gbo. (Edwards concedes that the industry has only a 5 percent chance of attaining that very high goal.) Even so, his calculations suggest that conventional oil will top out in 2020.

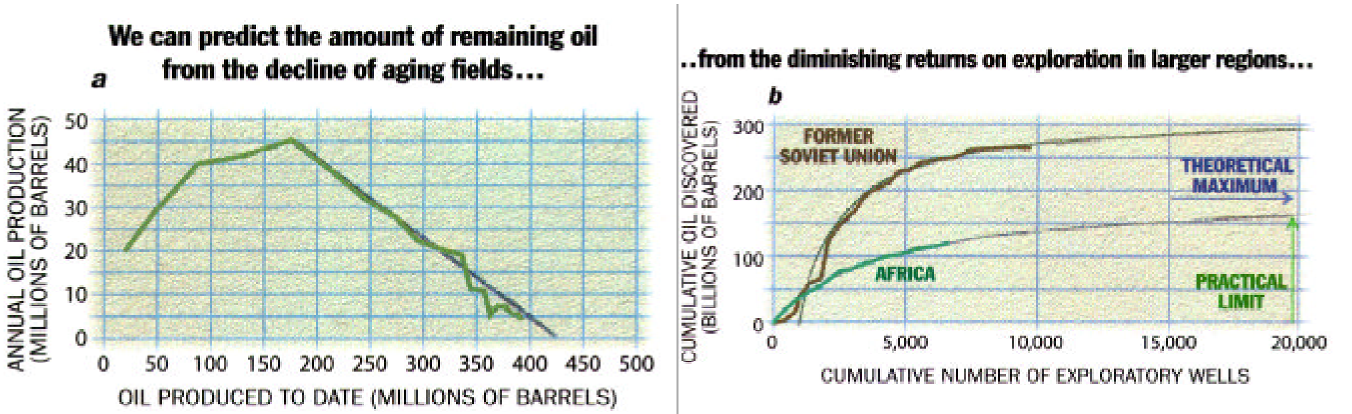
Smoothing the Peak

Factors other than major economic changes could speed or delay the point at which oil production begins to decline. Three in particular have often led economists and academic geologists to dismiss concerns about future oil production with naive optimism.

First, some argue, huge deposits of oil may lie undetected in far-off corners of the globe. In fact, that is very unlikely. Exploration has pushed the frontiers back so far that only extremely deep water and polar regions remain to be fully tested, and even their prospects are now reasonably well understood. Theoretical advances in geochemistry and geophysics have made it possible to map productive and prospective fields with impressive accuracy. As a result, large tracts can be condemned as barren. Much of the deepwater realm, for

How Much Oil Is Left to Find?

We combined several techniques to conclude that about 1,000 billion barrels of conventional oil remain to be produced. First, we extrapolated published production figures for older oil fields that have begun to decline. The Thistle field off the coast of Britain, for example, will yield about 420 million barrels (*a*). Second, we plotted the amount of oil discovered so far in some regions against the cumulative number of exploratory wells drilled there. Because larger fields tend to be found first-they are simply too large to miss-the curve rises rapidly and then flattens, eventually reaching a theoretical maximum:



example, has been shown to be absolutely nonprospective for geologic reasons.

What about the much touted Caspian Sea deposits? Our models project that oil production from that region will grow until around 2010. We agree with analysts at the USGS World Oil Assessment program and elsewhere who rank the total resources there as roughly equivalent to those of the North Sea that is, perhaps 50 Gbo but certainly not several hundreds of billions as sometimes reported in the media.

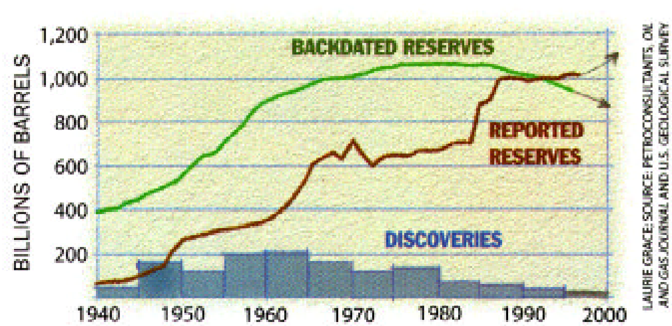
A second common rejoinder is that new technologies have steadily increased the fraction of oil that can be recovered from fields in a basin—the so-called recovery factor. In the 1960s oil companies assumed as a rule of thumb that only 30 percent of the oil in a field was typically recoverable; now they bank on an average of 40 or 50 percent. That progress will continue and will extend global reserves for many years to come, the argument runs.

Of course, advanced technologies will buy a bit more time before production starts to fall [see "Oil Production in the 21st Century," by Roger N. Anderson, on page 86]. But most of the apparent improvement in recovery factors is an artifact of reporting. As oil fields grow old, their owners often deploy newer technology to slow their decline. The falloff also allows engineers to gauge the size of the field more accurately and to correct previous underestimation—in particular P90 estimates that by definition were 90 percent likely to be exceeded.

Another reason not to pin too much hope on better recovery is that oil companies routinely count on technological progress when they compute their reserve estimates. In truth, advanced technologies can offer little help in draining the largest basins of oil, those onshore in the Middle East where the oil needs no assistance to gush from the ground.

Last, economists like to point out that the world contains enormous caches of unconventional oil that can substitute for crude oil as soon as the price rises high enough to make them profitable. There is no question that the resources are ample: the Orinoco oil belt in Venezuela has been assessed to contain a staggering 1.2 trillion barrels of the sludge known as heavy oil. Tar sands and shale deposits in Canada and the former Soviet Union may contain the equivalent of more than 300 billion barrels of oil [see "Mining for Oil," by Richard L. George, on page 84]. Theoretically, these unconventional oil reserves could quench the world's thirst for liquid fuels as conventional oil passes its prime. But the industry will be hard-pressed for the time and money needed to ramp up production of unconventional oil quickly enough

Such substitutes for crude oil might also exact a high environmental price. Tar sands typically emerge from strip mines. Extracting oil from these sands and shales creates air pollution. The Orinoco sludge contains heavy metals and sulfur that must be removed. So governments may restrict these industries from growing as fast as they could. In view of these potential obstacles, our skeptical estimate is that only 700 Gbo will be produced from unconventional reserves over the next 60 years.

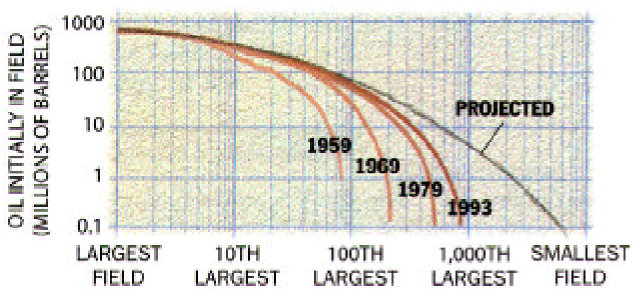


GROWTH IN OIL RESERVES since 1980 is an illusion caused by belated corrections to oil-field estimates. Backdating the revisions to the year in which the fields were discovered reveals that reserves have been failing because of a steady decline in newfound oil (*blue*).

for Africa, 192 Gbo. But the time and cost of exploration impose a more practical limit of perhaps 165 Gbo (*b*). Third, we analyzed the distribution of oil-field sizes in the Gulf of Mexico and other provinces. Ranked according to size and then graphed on a logarithmic scale, the fields tend to fall along a parabola that grows predictably over time (*c*). (Interestingly, galaxies, urban populations and other natural agglomerations also seem to fall along such parabolas.) Finally, we checked our estimates by matching our projections for oil production in large areas, such as the world outside the Persian Gulf region, to the rise and fall of oil discovery in those places decades earlier (*d*).
-C.J.C. and J.H.L

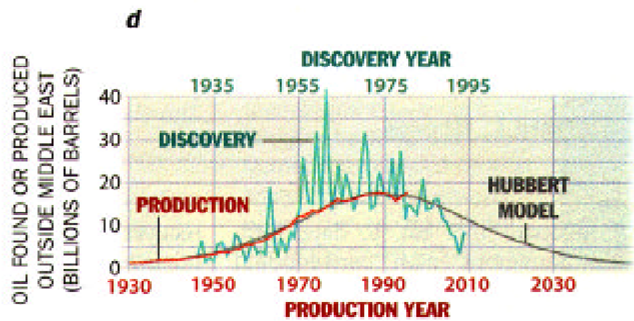
...by extrapolating the size of new fields into the future...

c



...and by matching production to earlier discovery trends.

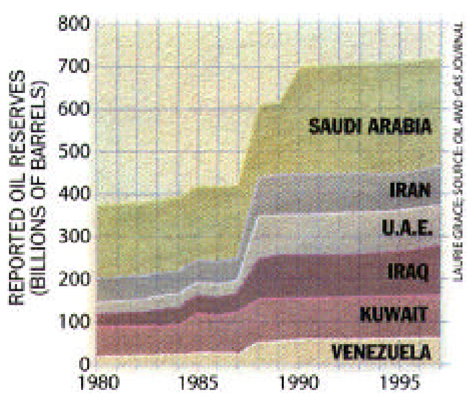
d



On the Down Side

Meanwhile global demand for oil is currently rising at more than 2 percent a year. Since 1985, energy use is up about 30 percent in Latin America, 40 percent in Africa and 50 percent in Asia. The Energy Information Administration forecasts that worldwide demand for oil will increase 60 percent (to about 40 Gbo a year) by 2020.

The switch from growth to decline in oil production will thus almost certainly create economic and political tension. Unless alternatives to crude oil quickly prove themselves, the market share of the OPEC states in the Middle East will rise rapidly. Within two years, these nations' share of the global oil business will pass 30 percent, nearing the level reached during the oil-price shocks of the 1970s. By 2010 their share will quite probably hit 50 percent.



SUSPICIOUS JUMP in reserves reported by six OPEC members added 300 billion barrels of oil to official reserve tallies yet followed no major discovery of new fields.

The world could thus see radical increases in oil prices. That alone might be sufficient to curb demand, flattening production for perhaps 10 years. (Demand fell more than 10 percent after the 1979 shock and took 17 years to recover.) But by 2010 or so, many Middle Eastern nations will themselves be past the midpoint. World production will then have to fall.

With sufficient preparation, however, the transition to the post-oil economy need not be traumatic. If advanced methods of producing liquid fuels from natural gas can be made profitable and scaled up quickly, gas could become the next source of transportation fuel [see "Liquid Fuels from Natural Gas," by Safaa A. Fouda, on page 92]. Safer nuclear power, cheaper renewable energy, and oil conservation programs could all help postpone the inevitable decline of conventional oil.

Countries should begin planning and investing now. In November a panel of energy experts appointed by President Bill Clinton strongly urged the administration to increase funding for energy research by $1 billion over the next five years. That is a small step in the right direction, one that must be followed by giant leaps from the private sector.

The world is not running out of oil—at least not yet. What our society does face, and soon, is the end of the abundant and cheap oil on which all industrial nations depend.

The Authors

COLIN J. CAMPBELL and JEAN H. LAHERRÈRE have each worked in the oil industry for more than 40 years. After completing his Ph.D. in geology at the University of Oxford, Campbell worked for Texaco as an exploration geologist and then at Amoco as chief geologist for Ecuador. His decade-long study of global oil-production trends has led to two books and numerous papers. Laherrère's early work on seismic refraction surveys contributed to the discovery of Africa's largest oil field. At Total, a French oil company, he supervised exploration techniques worldwide. Both Campbell and Laherrère are currently associated with Petroconsultants in Geneva.

Further Reading

UPDATED HUBBERT CURVES ANALYZE WORLD OIL SUPPLY. L. F Ivanhoe in *World Oil*, Vol. 217, No. 11, pages 91-94; November 1996.

THE COMING OIL CRISIS. Colin J. Campbell. Multi-Science Publishing and Petroconsultants, Brentwood, England, 1997.

OIL BACK ON THE GLOBAL AGENDA. Craig Bond Hatfield in Nature, Vol. 387, page 121; May 8,1997.

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includes: Joint Transportation Commission Hearings on Columbia River Crossing

Joint Senate Columbia Rivering Crossing oversight Committee hearings.

The Majority of the CRC TASK Force members did not & do not know these hearings took place.

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June - City Council public hearing and action on CRC Locally Preferred Alternative

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July – JPACT vote and recommendation to Metro Council on CRC LPA (must occur after City Council action on LPA)

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Columbia River CROSSING

Complete Calendar of meetings from CRC website up to June 19, 2008

(A)

Home » Calendar

Calendar of Events

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Meetings & Events

Click headings to sort

Group	Description	Meeting Date	Location
Community Meetings	Portland Pedestrian Advisory Committee	4/15/2008 7:00-8:00 PM	Portland City Hall
Community Meetings	Bicycle Transportation Alliance Forum	4/16/2008 6:00-8:00 PM	Bicycle Transportation Alliance
Task Force	Cancelled Meeting	4/17/2008 4:00-8:00 PM	WSDOT, SW Region Headquarters
Community and Environmental Justice Group	Meeting	4/17/2008 6:00-8:30 PM	Kenton Fire House
Community Meetings	Rose Village Neighborhood Association	4/22/2008 7:00 PM	Memorial Lutheran Church
Community Meetings	Shumway Neighborhood Association	5/1/2008 7:00 PM	Vancouver School of Arts and Academics
Community Meetings	Society of American Military Engineers, Portland Chapter	5/7/2008 11:30-1:00 PM	Kells Irish Restaurant & Pub
Community Meetings	Vancouver Bicycle Club	5/14/2008 7:00-8:30 PM	Bortolami's Pizzeria
Community and			

Environmental Justice Group	Meeting	5/15/2008 6:00-8:30 PM	Kenton Fire House
Community and Environmental Justice Group	Meeting	6/19/2008 6:00-8:30 PM	Kenton Fire House

1 2

700 Washington Street, Suite 300 | Vancouver, WA | 98660

Columbia River CROSSING

Home » Calendar

Calendar of Events

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Meetings & Events

Click headings to sort

Group	Description	Meeting Date	Location
Community Meetings	Bridgeton Neighborhood Association	3/19/2008 7:00-9:00 PM	Columbia High School
Freight Working Group	Meeting	3/20/2008 10:00-12:00 PM	Columbia River Crossing project office
Community and Environmental Justice Group	Meeting	3/20/2008 6:00-8:30 PM	Kenton Fire House
Urban Design Advisory Group	Cancelled Meeting	3/21/2008 7:30-9:30 AM	Red Lion at the Quay
Community Meetings	Highland Home Owners Association	3/24/2008 7:00-8:00 PM	Pleasant Valley Middle School
Community Meetings	Woodland Chamber of Commerce	3/25/2008 12:00-1:00 PM	Oak Tree Restaurant
Fairs and Festivals	Energy Trust Better Living Home, Garden & Lifestyle Show	3/28/2008 12:00-5:00 PM	Portland Expo Center
Community Meetings	West Minnehaha Neighborhood Association	4/7/2008 7:00-8:00 PM	West Minnehaha Community Center
Community	Association for the Advancement of	4/10/2008 5:30-7:30 PM	University Place Hotel &

Meetings	Cost Engineering		Conference Center
Community Meetings	Senior Connections Expo	4/13/2008 11:00-4:00 PM	Hilton Vancouver Washington hotel

1 2

Oregon Department of Transportation | Washington State Department of Transportation

700 Washington Street, Suite 300 | Vancouver, WA | 98660

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Brad asked about the projected goal for completion of the Draft Environmental Impact Statement (DEIS). Rob responded that the DEIS is expected to be completed by 2007.

Rex stated that there is an interest in developing new "bridges" across the Columbia River and the current project is an opportunity to form a bi-state compact, which can help alleviate dissimilar statutes by allowing the states to agree on comprehensive laws which would apply both equally.

Wally asked whether the information the Task Force receives could be shared with the public. Katy responded in the affirmative and in fact it is expected the members will share this information with the groups they represent. The Task Force meetings fall under public meeting law.

Katy discussed the next steps in the process. The Task Force will meet again in May 2005, when the project team will present:

- project purpose and need
- beginning of the scoping process
- project contractor
- key issues that will be addressed in the process

Henry stated that the purpose of the meeting was to provide background on the project and initiate the Task Force process. He encouraged members to ask questions of one another following the meeting and become better acquainted.

Public Comments:

No members of the public indicated that they wished to address the Task Force.

The meeting ended at 6:00 p.m.

↑ No public present no notices that the meeting had started.

Wally asked if information could be shared with the public because the public + some CRC Task Force members where not invited to the first meeting.

COLUMBIA RIVER CROSSING

Oregon Department of Transportation | Washington State Department of Transportation

Meeting Summary
Columbia River Crossing Task Force
February 3, 2005
Scheduled: 4–6:30 p.m.

Members Present:

Sam Adams, City of Portland
Rich Brown, Portland Business Alliance
Rex Burkholder, Metro
Bob Byrd, Identity Clark County
Lora Caine, Friends of Clark County
Serena Cruz, Multnomah County
Hal Dengerink, Washington State University Vancouver (Task Force Co-chair)
Elliot Eki, Oregon/Idaho AAA
Dave Frei, Arnada Neighborhood Association
Jill Fuglister, Coalition for a Livable Future
Lynne Griffith, C-TRAN
Brad Halverson, Overlook Neighborhood Association
Henry Hewitt, Stoel Rives (Task Force Co-chair)
Eric Holmes, City of Battle Ground
Monica Isbell, Portland Business Alliance
Dean Lookingbill, Regional Transportation Council
Ed Lynch, Vancouver National Historic Reserve Trust
Dick Malin, Central Park Neighborhood Association
Mark McCloud, Greater Vancouver Chamber of Commerce
Wally Mehrens, Columbia Pacific Building Trades
Bob Russel, Oregon Trucking Association
Art Schaff, Washington State Trucking Association
Jonathan Schleuter, Westside Economic Alliance
Karen Schmidt, Washington Freight Mobility Strategic Investment Board
Steve Stuart, Clark County
Walter Valenta, Bridgeton Neighborhood Association
Scot Walstra, Vancouver Chamber of Commerce
Tom Zelenka, Oregon Freight Advisory Committee

Members' Substitutions Present:

Bob Applegate for Bill Wyatt, Port of Portland
Addison Jacobs for Larry Paulson, Port of Vancouver, USA
Neil McFarlane for Fred Hansen, TriMet

Project Team Members Present:

Katy Brooks, The JD White Company, Inc. (JDW)
Kyle Brown, JDW
Rob DeGraff, Co-Project Director
Doug Ficco, Co-Project Director
Matthew Garrett, Project Team
Don Wagner, Project Team
Kris Strickler, Project Team

Absent Members:

Dr. Wayne Branch, Clark College
Fred Hansen, TriMet
Larry Paulson, Port of Vancouver, USA

Bart Phillips, Columbia River Economic Development Council
Royce Pollard, City of Vancouver,
Janet Ray, Washington AAA
Dave Shields, City of Gresham
Jeri Sundval, Environmental Justice Action Group

Introduction:

Henry Hewitt, Task Force Co-chair, began the meeting by thanking those in attendance. Some of the Task Force members have participated in other phases of the study and he appreciates their commitment to the effort. Previous efforts concluded that baseline transportation conditions on the I-5 bridge were not an option, however, there is no single solution that will satisfy everyone. Henry added that the project will likely require 3 years of study and he looks forward to working with other Task Force members. Henry also emphasized that this group's success will be measured by the degree to which we are able to develop consensus around a project that solves the problem. Thus, members should keep in mind that no one can get everything they want in an effort like this; that we need to look for solutions that appropriately balance varied interests for the benefit of the community.

Hal Dengerink, Task Force Co-chair, welcomed members. He noted that, while he does not have an extensive background in transportation, he understands the core issues and solutions that are needed. The community will benefit from the work of the Task Force and Hal thanked them for their commitment. The meeting was then turned over to Katy Brooks, The JD White Company, Inc. (JDW), who discussed meeting logistics and asked Task Force members to briefly introduce themselves.

Sam Adams, City of Portland, introduced himself and stated he is a City Commissioner and was pleased to be participating.

Eric Holmes, City of Battle Ground, introduced himself and stated that he is Battle Ground's City Manager.

Karen Schmidt, Washington Freight Mobility Strategic Investment Board, introduced herself and noted that she is the Board's Director.

Neil McFarlane, TriMet, stated that he was attending for Fred Hansen, who was on vacation.

Walter Valenta, Bridgeton Neighborhood Association, stated that he lives on a floating home on north Portland harbor. He is interested in transportation issues and is committed to making the project beneficial to his community.

Dick Malin, Central Park Neighborhood Association, stated that he lives in the Central Park Neighborhood in Vancouver, which will be affected by the project.

Ed Lynch, Vancouver National Historic Reserve Trust, stated that he is representing the Trust, which owns land on the north side of the river.

Bob Byrd, Identity Clark County, stated that he is representing an organization which focuses on civic issues in Vancouver.

Dave Frei, Arnada Neighborhood Association, introduced himself.

Monica Isbell, Portland Business Alliance, stated that she is head of a supply chain consulting company. Her perspective on the project will be from a freight mobility standpoint.

Rex Burkholder, Metro, stated that he represents the agency's elected council and is chair of the Joint Policy Advisory Committee on Transportation (JPACT) and serves on the Bi-State Transportation Committee.

Bob Applegate, Port of Portland, stated that he was attending for Bill Wyatt, who was away lobbying for the channel deepening project.

Rich Brown, Portland Business Alliance, noted that Bank of America (his employer) has clients and employees on both sides of the river and is interested in the outcome of the project.

Bob Russel, Oregon Trucking Association, stated that the project has impacts on the trucking industry and other modes of freight. He is most interested in multi-modal approaches to freight mobility.

Tom Zelenka, Oregon Freight Advisory Committee, introduced himself and stated that his organization operates on both sides of the river.

Wally Mehrens, Columbia Pacific Building Trades, introduced himself and stated that he is the organization's Executive Secretary.

Dean Lookingbill, Regional Transportation Council (RTC), stated that he is the Director of the organization and is representing the Board of Directors on the Task Force.

Scot Walstra, Vancouver Chamber of Commerce, stated that he is director of business development for NW Natural Gas and is also a member of the Vancouver Chamber of Commerce's Board of Directors. He added that NW Natural Gas has operations on both sides of the river and is interested in the project's outcome.

Art Schaff, Washington State Trucking Association, stated that he is the organization's Oregon District Manager, and that the organization has an interest in the outcome of the project.

Brad Halverson, Overlook Neighborhood Association, stated that he lives near Swan Island and works at Kaiser Permanente. He also chaired the Interstate MAX Advisory Committee and was a South/North Advisory Committee member.

Addison Jacobs, Port of Vancouver, USA, stated that she was attending for Larry Paulson while he was away representing the Port in New Zealand.

Elliot Eki, Oregon/Idaho AAA, introduced himself and stated that his region's membership totals approximately 620,000 and is interested in traffic mobility.

Jonathan Schleuter, Westside Economic Alliance, stated that his organization represents businesses in the western region of Portland.

Lynne Griffith, C-TRAN, stated that she is the organization's Executive Director and has served on the I-5 Trade Corridor Committee. She currently serves on the Bi-State Coordinating Committee and is an RTC board member.

Steve Stuart, Clark County, stated that he is a County Commissioner and represents its Bi-State transportation boards.

Lora Caine, Friends of Clark County, stated that her organization is concerned with smart growth in Clark County and she has represented the organization on the I-5 Trade Corridor Committee.

Jill Fuglister, Coalition for a Livable Future, stated that her organization is part of 60 non-profits that focus on regional planning and livability issues.

Serena Cruz, Multnomah County, stated that she is a County Commissioner for north Portland. Her interests in the project include her constituents as well as economic and business interests in the region. She served on the I-5 Trade Corridor Task Force and is a Bi-State Transportation Commission member.

Task Force Protocols:

Katy discussed Task Force protocols. She directed the attention of the Task Force members to the meeting principles which consist of:

- Be as succinct as possible.
- Be considerate of each other's input and refrain from interrupting.
- During discussions, strive to communicate your values, concerns and ideas, rather than taking a position.
- Represent your constituency.
- Respect differing opinions.

Katy presented the Task Force charter, which is as follows:

> *The Task Force's role will be to provide input into the Columbia River Crossing Project (CRCP). Within the context created by the Strategic Plan, the Task Force will:*
>
> - *Respond to and advise the joint project team on technical data and its policy implications leading to a Notice of Intent*
> - *Provide advice to the Joint Commission Subcommittee throughout the Environmental Impact Statement (EIS) until the issuance of the Record of Decision.*
> - *Represent and report back to their representative organizations*

Katy added that the Task Force will be considering project technical information and policy issues during the National Environmental Policy Act (NEPA) process, which will likely last between 3 and 4 years. The Federal Highway Administration (FHWA) has asked that the EIS process move quickly and the state DOTs have heeded that advice. She noted that the Task Force Co-chairs have agreed that having alternates attend for members is acceptable, but that they should refrain from voting. Lora asked whether alternates could bring votes to the Task Force. Henry responded that, at the outset, it would be preferable that Task Force alternates not vote. Tom stated that he is uncomfortable with the possibility of policies changing during the course of the Task Force. Henry responded that, while the I-5 Trade Corridor Task Force policy was that alternates could not vote, one alternate was attending 90% of the meetings which necessitated a policy change. Hal added that alternates should represent the constituency for which they are speaking and, if an organizations sends an alternate, they should consistently send the same person (i.e. remain with one alternate throughout the process).

Rex noted that the meeting time was inconvenient due to conflicts with Metro's council meetings, and future meetings should be arranged with scheduling conflicts considered. Katy responded that the project team will be cognizant of scheduling and endeavor to minimize conflicts. She added that the Task Force will meet approximately once per quarter. Ed asked whether meetings could be scheduled for the next 2 years. Katy stated that the project team would consult members' schedules and attempt to schedule future meetings for the next 2 years. The project team will e-mail the Task Force with proposed dates. Task Force members indicated they agreed with the proposed solution.

Katy stated that the project team will provide ample notice of upcoming meetings and distribute materials via e-mail. The project team will also provide print copies of all materials at the meetings. Serena, Monica, and Sam all requested that print copies of meeting materials be sent to them prior to Task Force meetings, rather than receiving them via e-mail.

Katy noted that Task Force subcommittees will not be appointed. She added that some discussion may occur over e-mail rather than convening the entire Task Force.

Katy stated that members should indicate whether they wish to speak by standing their name placards on end. In addition, votes will be counted with members indicating, with their fingers, their level of agreement on a scale of one to five, with one being in total disagreement, and five indicating total agreement. Jill asked how the votes will be tallied. Katy stated that it will be a majority decision.

Doug Ficco, Co-Project Director, discussed a NEPA decision-making process diagram, which can be found in Appendix B—Presentation Materials. Henry noted that while the Task Force technically has no power, and no authority, it does have the ability to significantly influence the process and it outcome.

Project Briefing:

Jay Lyman, David Evans and Associates, presented an historical overview of the efforts leading up to the current project. Slides from his presentation can be found in Appendix B—Presentation Materials.

Following Jay's presentation, Rob DeGraff, Co-Project Director, presented an overview of the NEPA and how it pertains to the current project. Slides from his presentation can be found in Appendix B—Presentation Materials.

Rex asked how other studies conducted in the interim will fit into the current process. Rob responded that the agencies have undertaken additional work leading up to the scoping process which will help inform our decisions about what concepts advance into the EIS. Rob added that agencies have also been studying the regulatory framework which consists of Oregon, Washington, and federal statutes, which often are not complementary. The project team may need to speak with state and federal legislators to discuss areas where the statutes are not aligned. In addition, they will be exploring financing options so that the economic viability of the alternatives can be considered by the Task Force. Rob added that the project team will be working with local, state, and federal decision makers throughout the EIS process to properly coordinate funding options. Wally asked whether another group was working on the financing options and forming recommendations. Rob responded that the project team is working on the financing options and will bring information to the Task Force in order to receive members' input.

Wally asked whether the project could be funded through public-private partnerships. Rob stated that the project is a bi-state endeavor. Oregon has a law that allows ODOT to form public-private partnerships (i.e. Red Line MAX). Washington, however, has different guidelines, which complicates those types of funding opportunities for the current project. Washington and Oregon have agreed to refrain from forming public-private partnerships for the Columbia Crossing Project until a statutory framework has been developed.

Jonathan inquired regarding the shelf life of an EIS. Neil responded that an EIS has an approximate 3-year shelf life.

Hal noted that the scoping process should be thorough in considering the various alternatives in order to prevent the possibility of challenges later in the process. This also contributes to the length of an EIS. Rob responded that Hal's comments were accurate.

Walter asked whether funding has been earmarked for the project. Rob responded that the project team is working federal reauthorization for the project which would help pay for the EIS. Future reauthorization could also help fund further phases of the project. Walter asked whether the politicians realize the importance of the project. Rob stated that the project is not being ignored and that its importance is realized. Henry added that the project is very attractive at a national level, which may allow it to receive preferential funding.

Brad asked about the projected goal for completion of the Draft Environmental Impact Statement (DEIS). Rob responded that the DEIS is expected to be completed by 2007.

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Public Comments:

No members of the public indicated that they wished to address the Task Force.

The meeting ended at 6:00 p.m.

Appendix A—Sign In Forms

Appendix B—Presentation Materials

I requested the sign-in Sheets for all Public meetings. The would be from Feb. 3, 2005 until March 2007

This is all I recieved, There are Several meeting that took place yet no Sign in Sheets where provided.

The Sign in Sheets That where provided only have a few names. I Signed in at each meeting + Checked the box for Speaking. Yet the Sign in Sheets only show my name a couple of time. TRC Staff will not let you Speak unless you Sign in -

Columbia River CROSSING

GOV (CRC, Task Too)
~~News~~
Business
missing Task Force

Task Force Meeting May 17, 2006

PDFed + entered 7/17/06

Please Sign In

Name	Address	City	State	Zip Code	Phone	E-mail	Public Comment
Art Krenzel	10508 NE 285th St	B.G	WA	98604	360-666-1883		☐ I wish to address the Task Force during the public comment period.
Transportation Commiss → ED BARNES	4009 NE 50 Ave	Van	WA	98661	695-2180		☐ I wish to address the Task Force during the public comment period.
H. Luna Jiménez	P.O. Box 12371	PDX	OR	97212	503-281-5570		☐ I wish to address the Task Force during the public comment period.
Chuck Williams	103 N.E. 83rd St, APT B Vanc, WA, 98665	Vanc	WA	98665	360-694-6227		☐ I wish to address the Task Force during the public comment period.
							☐ I wish to address the Task Force during the public comment period.
							☐ I wish to address the Task Force during the public comment period.
							☐ I wish to address the Task Force during the public comment period.

03520

Columbia River CROSSING

Task Force Meeting
May 17, 2006

Please Sign In

Name	Address	City	State	Zip Code	Phone	E-mail	Public Comment
Gregg Snyder	227 N Highland	~~Vancouver~~ Portland	OR	97217		snyderworld@aol.com	☐ I wish to address the Task Force during the public comment period.
Ed Pickering	C-TRAN						☐ I wish to address the Task Force during the public comment period.
Sheila Babb	Sen. Patty Murray	Seattle	WA			sheila_babb@murray.senate.gov	☐ I wish to address the Task Force during the public comment period.
Travis [illegible]		✓ [illegible]					☒ I wish to address the Task Force during the public comment period.
Richard Brandman	Metro						☐ I wish to address the Task Force during the public comment period.
Fred Hansen	TriMet						☐ I wish to address the Task Force during the public comment period.
Alan Lehto	TriMet						☐ I wish to address the Task Force during the public comment period.

?

Citz

03520

Columbia River CROSSING

Task Force Meeting
May 17, 2006

Please Sign In

Name	Address	City	State	Zip Code	Phone	E-mail	Public Comment
Jason Gately	3629 NW 31st C	Camas	WA	98607	360-521-1167	jbgately@comcast.net	☐ I wish to address the Task Force during the public comment period.
Marc Gross	12318 N Center Av. ~~Por~~	Portland	OR	97217	503 283-5801		☐ I wish to address the Task Force during the public comment period.
Thayer Rorabaugh	P.O. Box 1995	Vancouver	WA	98668	360.696.8290		☐ I wish to address the Task Force during the public comment period.
Sharon Wylie	2000 Kauffman Ave	Van	Wa	98660	360 921576	slwylie2@aol.com	☐ I wish to address the Task Force during the public comment period.
John Hoefs	39106 SE 37th St	~~Van~~ Washougal	WA	98671	360 906-2358		☐ I wish to address the Task Force during the public comment period.
Mindi Linquist	1323 officers Row #	Va		98661	360 696 7797	mindi.linquist@mail.house.gov	☐ I wish to address the Task Force during the public comment period.
Adrienne DeDona	109 SW 1st Street Suite 221 Battle Ground WA			98604	360-342-5004	adrienne.dedona@ci.battle-ground.wa.us	☐ I wish to address the Task Force during the public comment period.

Ward

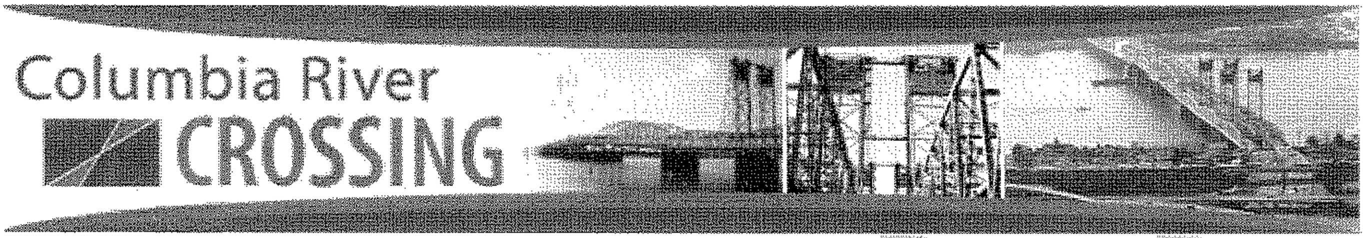
03520

15 miss no Alt
8 alts
1 ?

Task Force Member Sign-In Sheet May 17, 2006

Please mark your presence next to your name. If you are here as an alternate, please sign in next to your Task Force member's name.

Name		Present?	Alternate Sign-In
Adams	Sam	✓	Tom Miller
Becker	Charles		
Branch	Wayne	✓	
Brown	Rich	✓	
Burkholder	Rex		Richard Brandman
Byrd	Bob	✓	
Caine	Lora	✓	
Cruz	Serena	✓	
Dengerink	Hal	✓	
Eki	Elliott		
Frei	Dave	✓	
Fuglister	Jill	✓	
Grossnickle	Jerry		
Halverson	Brad	✓	
Hansen	Fred		
Hewitt	Henry	✓	
Hinsley	Brett		
Holmes	Eric	✓	Adrienne DeDona
Isbell	Monica		
Lookingbill	Dean		[illegible]
Lynch	Ed	✓	Ed Lynch
Malin	Dick	✓	[illegible]
McCloud	Mark		
Morris	Betty Sue		
Ostrowski	John	✓	[illegible]
Paulson	Larry	✓	Katy Brooks
Petersen	Steve		
Phillips	Bart	✓	
Pollard	Royce	✓	
Ray	Janet		?
X Russel	Bob		
Schlueter	Jonathan	✓	[illegible]
Schmidt	Karen		
Stuart	Steve	✓	
Sundvall-Williams	Jeri		
Valenta	Walter		
Walstra	Scot		
Wyatt	Bill		
Zelenka	Tom	✓	



EVENT CALENDAR CONTACT US

PROJECT HOME

PROJECT DETAILS

I-5 COMMUNITY

PROJECT MATERIALS

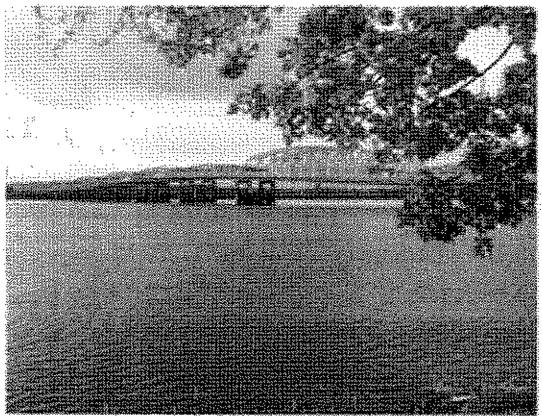
TRAFFIC CAMERAS

GET INVOLVED

Who's Involved?

The Columbia River Crossing project involves relationships and coordination among a variety of state and local agencies in both Washington and Oregon, in partnership with the federal government. Listed below are the groups involved and a short description of their role in the project.

In addition to these groups, the project will rely on the involvement of individuals, organizations, and businesses to provide input to the decision making process.



Project Development Team

Working Groups

Task Force

Project Sponsors Council

Federal Highway and Transit Administrations

Interstate Collaborative Environmental Process (InterCEP)

Project Development Team

The Project Development Team is responsible for the day-to-day management, development, and delivery of the Columbia River Crossing Project. It includes staff from sponsoring agencies (primarily WSDOT and ODOT) and is supported by contracted staff.

This WAS on web site in '05.

Working Groups

Working Groups are being formed to address specific project issues as they arise. Groups are expected to include specialists from agency and consultant staff as well as other organizations. The project anticipates working groups to address public involvement, freight issues, economic development, travel forecasting, engineering, specific environmental disciplines, and financing. Other working groups may also be formed as needed. Continue reading about Working Groups.

Task Force

The 39-member Task Force is comprised of leaders from a broad cross section of the Washington and Oregon communities interested in the project, including public agencies, businesses, civic organizations, neighborhoods, freight, commuter, and

environmental groups. The Task Force will provide recommendations regarding the project to the Project Sponsors Council. Continue reading about the Columbia River Crossing Task Force.

Project Sponsors Council

The Project Sponsors Council will receive recommendations from the Task Force, public input, and advice from the Project Development Team and concur on whether to move forward based on those recommendations. It includes executive staff or elected officials from:

- WSDOT
- ODOT
- RTC
- Metro
- C-TRAN
- TriMet
- City of Vancouver
- City of Portland
- FTA and FHWA (ex-officio)

Federal Highway Administration and Federal Transit Administration

The Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) are co-lead agencies for the National Environmental Policy Act (NEPA) process that governs proposed actions requiring federal funding, federal permits, or federal approvals. FHWA and FTA will sign the Environmental Impact Statement and the Record of Decision, affirming the selection of project alternatives, and allowing it to move forward into design and construction.

Interstate Collaborative Environmental Process (InterCEP)

The Interstate Collaborative Environmental Process (InterCEP) was established to coordinate and streamline the regulatory reviews and permitting functions of the participating agencies. Members include representatives from key national and state agencies responsible for protecting the region's air, water, wildlife and cultural resources. This committee must formally concur on project decisions affecting their areas of concern at major project milestones. In addition, the committee provides advice and consultation regarding the NEPA process to the Project Development Team at formal concurrence points. They will use a "streamlining" approach patterned after Washington's Signatory Agency Committee processes and Oregon's Collaborative Environmental and Transportation Agreement on Streamlining.

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Accomplishments To Date

A substantial amount of groundwork for the Columbia River Crossing project was completed over the last 7 years. The list below highlights key milestones and work products.

February 2006: The Columbia River Crossing (CRC) Task Force recommends evaluation criteria that will be used to compare alternatives on how well they achieve community values.

December 2005: The Project Sponsors Council concurs with the Task Force's recommendation on the Problem Definition.

November 2005: The CRC Task Force creates a final version of the Problem Definition and, after a series of public open houses and other public involvement events, recommends it to the Project Sponsors Council. Read more about these activities on the Survey Results and Open House pages.

October 2005: The CRC Task Force adopts the Vision and Values Statement.

February 2005: The CRC Task Force convenes its first meeting.

September 2004: The Washington State Department of Transportation (WSDOT) and the Oregon Department of Transportation (ODOT) sign a "Memorandum of Understanding" to jointly pursue the Columbia River Crossing project. They form the Joint Commission Subcommittee to provide oversight of the project.

February 2004: WSDOT and ODOT begin work to further develop recommended project concepts from the I-5 Transportation and Trade Partnership and consider financing options and issues.

April 2003: Regional Economic Effects on the I-5 Corridor Columbia River Crossing Transportation Choke Points Report (4.5MB PDF) is published by the I-5 Transportation and Trade Partnership.

February 2003: The Bi-State I-5 Rail Capacity Study (1.1MB PDF) is completed.

January 2003: ODOT begins work on the environmental assessment for widening I-5 from Delta Park to Lombard Street.

November 2002: WSDOT completes an I-5 widening project from Burnt Bridge Creek in Vancouver to NE 78th Street in Hazel Dell.

June 2002: The I-5 Transportation and Trade Partnership Task Force adopts the Final Strategic Plan Recommendations (5.8MB PDF) for I-5 corridor improvements.

March 2000: A 100-member Community Forum is formed to provide guidance on development of a strategic corridor plan. The forum is composed of citizens representing neighborhood, business, environmental, and other interests in the corridor.

January 2000: I-5 Transportation and Trade Partnership Task Force releases the Portland/Vancouver I-5 Trade Corridor Freight Feasibility and Needs Assessment Study Final Report (4.8MB PDF).

December 1999: WSDOT and ODOT begin the bi-state transportation and trade corridor study. Governors Gary Locke and John Kitzhaber appoint a 28-member Bi-State Task Force of community, business, and elected representatives to help WSDOT and ODOT develop an I-5 regional strategic plan.

Columbia River CROSSING

Memorandum

March 15, 2006

TO: Task Force

FROM: Hal Dengerink and Henry Hewitt

SUBJECT: Evaluation Framework

COPY: Doug Ficco, Rob DeGraff

Task Force members:

At our February 1 meeting, we reviewed, edited, and adopted the Evaluation Framework. Subsequent to our meeting, the CRC Project Sponsors Council met to review progress to date, including the Evaluation Framework. The council, which is comprised of elected officials and senior staff representing the eight sponsor agencies (WSDOT, ODOT, TriMet, C-TRAN, Metro, RTC, Vancouver, Portland), made three changes to the criteria at the recommendation of senior project staff. The changes addressed two areas of concern: 1) the criteria dealing with cultural resources was inconsistent with federal law, which does not allow for the enhancement of cultural resources, and 2) repeating criteria in two separate locations created the risk of a legal challenge about unfairly weighting some criteria over others.

Following the Project Sponsors Council meeting, the project's Interstate Collaborative Environmental Process (InterCEP) group also met to consider the Evaluation Framework. The InterCEP members include representatives from key national and state agencies responsible for protecting the region's air, water, wildlife and cultural resources. This committee must formally concur on project decisions affecting their areas of concern at major project milestones. In addition, the committee provides advice and consultation regarding the NEPA process. At their meeting they recommended minor text changes to four of the criteria, solely for the purposes of clarification.

The PSC-adopted changes and InterCEP recommendations are summarized in the table on the following pages. For your reference, the complete screening criteria list, as amended by the PSC and InterCEP, is attached, as is a letter from the Washington State Department of Archaeology and Historic Preservation, which describe the agency concerns about the cultural resource criteria.

We have reviewed the changes with project staff, and believe that they improve the criteria, and that they do not substantively change the way that the criteria will be used. Moreover, the changes will be helpful in working collaboratively with the large number of regulatory and sponsor agencies affected by this project, as well as in avoiding potential future challenges to our process. Our plan is to move forward with the revised criteria without further action by the Task Force, unless members raise significant concerns.

Open meeting Laws

Please notice

Guest / Citizen being present at Transportation meeting are in the formal minutes as and Industry Standard.

CRC has not put citizen in attendance in their meeting not for Task Force meetings, Design meeting, Freight meetings, Modelings, transit or Communication meetings -

They Do have citizen present at Environmental Justice (EJ) meetings. When I pointed out Citizen not in minutes of meetings TO (EJ) Said yes they are .... Then we found only in EJ meeting.

Industry Standards

During the Transportation and Trade Partnership meetings in 2001 Kate Deanne ODOT's project manager explained to me why it was important for citizen to sign in on sign-in sheets at meetings. Kate had noticed I was attending but not signing in at the T&T partnership meetings. Kate pointed out that it was standard at government meetings to use sign in sheets as part of the meeting minutes to show citizen participations.

Sign-in sheets provide information;

1. It shows individual citizen involvement
2. A citizen wishing to comment on a series of meetings has a record of participant.
3. It list how many citizens are involved in the process
4. It shows how many business affiliates are involved in the process.
5. It show's how well out reach is working.
6. It gives officials unable to attend meetings an idea of who all was there at the meetings.

Kate convinced me of the importance I sign in. I also encourage others to sign in.

Columbia River Crossing meeting notes for May 2005 has a list of task force members present, member substitutes present, absent members, project team members as part of the formal meeting notes. Citizens are not listed, ever.

1. I thought staff forgot, so after the May meeting, I asked that citizen sign-in sheets become a matter of record in the minutes as other transportation meeting do.
   Nothing has happened
2. I asked again that citizen attending the meeting be added to the formal minutes after all we where being asked to sign in.
   Nothing has happened
3. I wrote up a list of this and other EJAG issue that where not being met and gave it to staff.
   A. Staff would not forward the list to the task force members.
   B. Staff would not put any questions or answers in writing, however
   C. They would discus the list over lunch with Charlie Tindal and I.
   Nothing has happened

It's a year later and nothing has happened with the list of EJAG issue. .

Why ?

What needs to happen?

CRC staff needs to pull out the sign-in sheets and amend the formal meeting notes showing what citizen have attended each meeting and their affiliations. These amended meeting notes need to be made available. It's an easy job for a good typist.

Attached:

JPACT, RTC, BI-State and CRC formal meeting attendance pages.... CRC is the only one unwilling to follow industry standards. Why?

 EJAG question Staff would not answer in writing

EJAG

The current Columbia River Crossing Mangers have been asked to address these issues and problems, to date all of these problems persist.

1. No name tags on task force members.

2. Name placement cards that state who representative, represents. Example: Sam Adam Portland City Commissioner, Bob Russell Oregon Trucking Assoc. Larry Paulson Port of Vancouver, etc.

3. The sign in sheet is confusing and every meeting people have not signed up for citizen comment period, because is unclear, hard to read in very tiny writing. They have been asked to have a large sign saying sign up here to speak, change the sign in sheet to large enough lettering to read, make a separate sign in sheet for speaking, they have refused and continue using the same sheet.

4. No name tags for the citizens who are participating.

5. Will not provide public information of the task force representative for constituents and citizens who may want to contact them in communication form. Example. Bob Russell, OTA russell@otrucking, 503.513.0005, 4005 SE Naef Road. Citizens and task force members have not been provided this vital normally public information. Not only has, it not been provided but also the task force managers have told us, we can try and catch the representatives before and after meetings as they hurry in and out. With no communication of any form allowed wants, the meeting has start.

6. When final votes are made a group Aye and Nay is used. Constituents have no way of knowing who voted for what. The final vote needs to be recorded, to show how each representative has voted. "Group" Aye, Nay does not follow meeting laws in either state. This voting practice has been pointed out, by task force members as inappropriate, and it continues.

7. No breaks during a 21/2 hour to keep citizens from talking to any representatives. Keeping them possibly from returning promptly to their seats.

8. No notes, hand out, information, or contacting task force representative in any form during meeting. In meeting protocol. EVEN BEFORE VOTE WITHOUT CITIZEN TESTIMONY BEFORE VOTES!!!!!! Also when the information is incorrect or faults.

9. The meeting notes do not show what citizen where present even through they are asked to sign in. Citizens have no way to prove they where present. For legal suits how do you show you have participated from the start? JPACT, RTC, and most regular government meeting show the citizen names in the meeting note. It is very disrespectful to the citizen who have taken the time, energy and money to participate.

10. Citizen testimony is not recorded in whole when they testify. A three-minute communication is turned into one or two sentences total. It does not communicate what the citizen participating has said.

11. Citizen testimony in writing NEVER is give to the task force representatives and does not show up on the web site. Representative asked, said that they have NEVER receive any write communication from citizen even though write citizen communication has been handed in at EVERY meeting. These write citizen comments handed in as part of record have not been put on the web site either.

12. The agenda showing citizen comment period is only available on the web site less than a week before the meeting. The task force managers have been asked to have the agenda for the next meeting the current meeting show when citizen will speak. Each meeting has had the citizen comment period at a different time.

13. Have a stated length of time for each citizen's comment so preparation can be made. How long a citizen speaks is important to have advance notice. The task force managers' citizen comment period is 15 minutes in total. It will be divided at each meeting, as the citizen comment period begins. However they will not allow any citizen over 3 minuets even it's only one person signed up to speak for the 15 minute period.

14. Million of taxes payers dollars have been spent in over 20 years of studying a new crossing over the Columbia River. These studies and the booklets formed out of these studies are not available at the meetings. Booklets that stating what has and hasn't been studied, results and to consult when questions are raised. Not available for the task force members, the citizen or task force manager to answer basic question.

15. Meeting times are not appropriate for citizen to attend. At 4-6:30 PM in the middle of the week. Daily shift ends at 5 PM plus travel makes it almost impossible for citizens to travel there before 6 PM. Those that work swing shift go to work at 3 PM. Example: A mall open house on a Saturday 11AM to 2 PM, why only 4 hours in the middle of the day and one off the least visited Malls in the area. The mall is open 8 AM to 7 PM. This one of many reasons why the open houses and meetings are so poorly attended.

16. There are several groups with elected official and others that are meeting about the Columbia River Crossing. This "groups" how many there are, when they met, how often they met, who attends, meeting notes, up dates, have not been disclosed at the official Columbia Crossing task force meetings. These groups believe they have veto over the Columbia Crossing task force without citizen input of knowledge. How many groups? Where, when, why are they meeting? Why all the Secrecy? Veto power? Without open meeting laws being met.

17. Maps of the complete study area have not been brought to meetings and are not on the web site. Maps of the study area have been missing. After several request to bring maps showing the complete study area. A map was brought to the last meeting. It did not show the neighborhoods, on either side of I-5 in Oregon, Washington or on Jantzen Beach. North Portland alone is 40 thousand plus other neighborhoods adjacent to the freeway. It showed I-5 from SR 500 to Portland Blvd. north and south and approximately 3 Blocks on the east and west side of I-5 excluding the majority of all the neighborhoods.

18. The task force paid staff, ODOT, WADOT, and outside paid consultants all wear the exact same uniform. It is impossible to distinguish between paid consultants state employees. Why are they all dressed a like? Who paid for all the fancy uniform shirts? If a uniform is required, why are they all a like? Why don't the two states dress a like and the paid consultants, dress differently? This is very confusing to the citizens, trying to figure out who's, who and what's in it for them.

19. On line survey for citizen was done so poorly, several hundred where thrown out. The task force managers forgot to set up the web site so people could not take more than one survey. Approximately 1400 surveys total came in. Approximately 200 where kept is valid. How was it determined that 1200 where bad? Who did the 200 get kept? What was the determining factor? Why weren't they all thrown out? Did the 200 hundred chosen say what they wanted and the other 1200 didn't. Where is all the original information? When can we see the 1400 and what they said? What is the difference in findings from what was thrown out.

20. Month after month, the task force members have asked for a line by line list of expenses. How much is being spent and on what? What did those uniforms cost and who okayed them? What is the money spent on? The rumors is they are spending between 1 and 3 million dollars a month? This is before the citizens have picked a project.

Approximately 1/3 of the task force members are missing from each meeting. The November meeting started with 7 of the 38 members present.

Oregon Department of Transportation Washington State Department of Transportation

missing citizens

Meeting Summary
Columbia River Crossing Task Force
February 3, 2005
Scheduled: 4–6:30 p.m.

Members Present:

Sam Adams, City of Portland
Rich Brown, Portland Business Alliance
Rex Burkholder, Metro
Bob Byrd, Identity Clark County
Lora Caine, Friends of Clark County
Serena Cruz, Multnomah County
Hal Dengerink, Washington State University Vancouver (Task Force Co-chair)
Elliot Eki, Oregon/Idaho AAA
Dave Frei, Arnada Neighborhood Association
Jill Fuglister, Coalition for a Livable Future
Lynne Griffith, C-TRAN
Brad Halverson, Overlook Neighborhood Association
Henry Hewitt, Stoel Rives (Task Force Co-chair)
Eric Holmes, City of Battle Ground
Monica Isbell, Portland Business Alliance
Dean Lookingbill, Regional Transportation Council
Ed Lynch, Vancouver National Historic Reserve Trust
Dick Malin, Central Park Neighborhood Association
Mark McCloud, Greater Vancouver Chamber of Commerce
Wally Mehrens, Columbia Pacific Building Trades
Bob Russel, Oregon Trucking Association
Art Schaff, Washington State Trucking Association
Jonathan Schleuter, Westside Economic Alliance
Karen Schmidt, Washington Freight Mobility Strategic Investment Board
Steve Stuart, Clark County
Walter Valenta, Bridgeton Neighborhood Association
Scot Walstra, Vancouver Chamber of Commerce
Tom Zelenka, Oregon Freight Advisory Committee

Members' Substitutions Present:

Bob Applegate for Bill Wyatt, Port of Portland
Addison Jacobs for Larry Paulson, Port of Vancouver, USA
Neil McFarlane for Fred Hansen, TriMet

Project Team Members Present:

Katy Brooks, The JD White Company, Inc. (JDW)
Kyle Brown, JDW
Rob DeGraff, Co-Project Director
Doug Ficco, Co-Project Director
Matthew Garrett, Project Team
Don Wagner, Project Team
Kris Strickler, Project Team

Absent Members:

Dr. Wayne Branch, Clark College
Fred Hansen, TriMet
Larry Paulson, Port of Vancouver, USA

↑

pg 2

Bart Phillips, Columbia River Economic Development Council
Royce Pollard, City of Vancouver,
Janet Ray, Washington AAA
Dave Shields, City of Gresham
Jeri Sundval, Environmental Justice Action Group

missing Citizen

Columbia River CROSSING

700 WASHINGTON STREET
VANCOUVER, WA 98660
360-737-2726 | 503-256-2726

Meeting Summary
Columbia River Crossing Task Force
November 30, 2005
4–8:00 p.m.
OAME, Main Conference Room
4134 North Vancouver, Portland, Oregon

Members Present:

Sam Adams, City of Portland
Charles Becker, City of Gresham
Dr. Wayne Branch, Clark College
Rich Brown, Bank of America
Rex Burkholder, Metro
Lora Caine, Friends of Clark County
Hal Dengerink, Washington State University Vancouver (Task Force Co-chair)
Elliot Eki, Oregon/Idaho AAA
Dave Frei, Arnada Neighborhood Association
Jill Fuglister, Coalition for a Livable Future
Lynne Griffith, C-TRAN
Jerry Grossnickle, Columbia River Tugboat Association
Brad Halverson, Overlook Neighborhood Association
Fred Hansen, TriMet
Henry Hewitt, Stoel Rives (Task Force Co-chair)
Brett Hinsley, Columbia Pacific Building Trades
Eric Holmes, City of Battle Ground
Dean Lookingbill, Regional Transportation Council
Ed Lynch, Vancouver National Historic Reserve Trust
Steve Petersen, Portland Business Alliance
Bart Phillips, Columbia River Economic Development Council
Bob Russel, Oregon Trucking Association
Art Schaff, Washington State Trucking Association
Jonathan Schlueter, Westside Economic Alliance
Walter Valenta, Bridgeton Neighborhood Association
Scot Walstra, Greater Vancouver Chamber of Commerce

Member Substitutes Present:

Todd Coleman for Larry Paulson, Port of Vancouver
Susie Lahsene for Bill Wyatt, Port of Portland
Alan Lehto (attended portion of meeting for Fred Hansen, TriMet)
Don Lemmons for Karen Schmidt, Washington Freight Mobility Strategic Investment Board
Tom Miller (attended portion of meeting for Sam Adams, City of Portland)
Lisa Prentice for Monica Isbell, Portland Business Alliance
Thayer Rorabaugh for Royce Pollard, City of Vancouver
Lawrence Russell for Jeri Sundvall, Environmental Justice Action Group

Missing Citizen

Columbia River CROSSING

Meeting Summary

Not BJAG Guideline

Meeting: Columbia River Crossing Task Force

Meeting Date: May 17, 2006, 4:00–6:30 p.m.

Location: WSDOT SW Region Headquarters, 11018 NE 51st Circle, Vancouver, WA

No late Bus Service. Inside Government Building

Members Present:

Tom Miller for Sam Adams, City of Portland
Dr. Wayne Branch, Clark College
Rich Brown, Bank of America
Richard Brandman for Rex Burkholder, Metro
Bob Byrd, Identity Clark County
Lora Caine, Friends of Clark County
Serena Cruz, Multnomah County
Hal Dengerink, Washington State University Vancouver (Task Force Co-chair)
Elliot Eki, Oregon/Idaho AAA
Dave Frei, Arnada Neighborhood Association
Jill Fuglister, Coalition for a Livable Future
Jerry Grossnickle, Columbia River Tugboat Association
Brad Halverson, Overlook Neighborhood Association
Fred Hansen, TriMet
Henry Hewitt, Stoel Rives (Task Force Co-chair)
Adrienne DeDona for Eric Holmes, City of Battle Ground
Dean Lookingbill, Regional Transportation Council
Ed Lynch, Vancouver National Historic Reserve Trust
Betty Sue Morris, C-TRAN
John Ostrowski, C-TRAN
Katy Brooks for Larry Paulson, Port of Vancouver, USA
Bart Phillips, Columbia River Economic Development Council
Royce Pollard, City of Vancouver
Bob Russel, Oregon Trucking Association
Jonathan Schlueter, Westside Economic Alliance
Steve Stuart, Clark County
Walter Valenta, Bridgeton Neighborhood Association
Tom Zelenka, Oregon Freight Advisory Committee

Absent Members:

Charles Becker, City of Gresham
Brett Hinsley, Columbia Pacific Building Trades
Monica Isbell, Portland Business Alliance
Dick Malin, Central Park Neighborhood Association
Mark McCloud, Greater Vancouver Chamber of Commerce
Steve Petersen, Portland Business Alliance
Janet Ray, Washington AAA
Karen Schmidt, Washington Freight Mobility Strategic Investment Board
Jeri Sundvall-Williams, Environmental Justice Action Group
Scot Walstra, Greater Vancouver Chamber of Commerce
Bill Wyatt, Port of Portland

Project Team Members Present:

Ron Anderson
Doug Ficco
Jeff Heilman
Jay Lyman
Linda Mullen
John Osborn
Peter Ovington
David Parisi
Anne Pressentin
Laura Reilly
Lynn Rust
Gregg Snyder
Rex Wong

Announcements

The purpose of the meeting was announced by Co-chair Hal Dengerink:

- to finish the discussion and selection of components to move forward for further study;
- to consider transit and replacement bridge ideas begun at April 26 meeting;
- to discuss how the Task Force wants project staff to combine these components into packages.

Peak Oil and Demand Modeling: Staff is working to arrange for a speaker on these topics and will schedule this for an upcoming meeting.

Regional Transportation Council resolution:

Reminder that Task Force alternates may not participate in voting.

Action: Motion passed:
Motion to support the Regional Transportation Council board's *Policy Statement on Guidance for the Transportation Corridors Visioning Process and Context for Addressing New Columbia River Crossings* (see meeting materials, attachment from RTC).

All approved except Jill Fuglister, who abstained.

Walter Valenta noted that there is also some interest in including Bi-State Coordination Committee as a forum for discussing this issue. Steve Stuart said it could be brought up at that meeting the next morning.

Other materials: A handout was given to Task Force members titled *Appendix A: Attachments to Public Comments, April 12-13, 2005 Open Houses* in response to Dave Frei's request for attachments referred to in the *Database of Public Comments Received through April Open Houses.*

Environmental Justice Update

- An environmental justice training has been scheduled for the June Task Force meeting. The trainer will be John Ridgeway of the Washington State Department of Ecology, who will lead this full discussion of the federal Environmental Justice rules and how they apply to the CRC project. Note: June meeting will be extended to four hours to accommodate this (4pm to 8pm).

JOINT POLICY ADVISORY COMMITTEE ON TRANSPORTATION
November 13, 2003

MEMBERS PRESENT	AFFILIATION
Rod Park	Metro Council
Matthew Garrett	Oregon Department of Transportation (ODOT - Region 1)
Craig Pridemore	Clark County
Fred Hansen	TriMet
Carl Hosticka	Metro Council
Bill Kennemer	Clackamas County
Don Wagner	Washington State Department of Transportation (WSDOT)
Larry Haverkamp	City of Gresham, representing Cities of Multnomah County
Maria Rojo de Steffey	Multnomah County
Karl Rohde	City of Lake Oswego, representing Cities of Clackamas County
Jim Francesconi	City of Portland
Rex Burkholder	Metro Council
Roy Rogers	Washington County

MEMBERS ABSENT	AFFILIATION
Stephanie Hallock	Oregon Department of Environmental Quality (DEQ)
Royce Pollard	City of Vancouver
Bill Wyatt	Port of Portland
Rob Drake	City of Beaverton, representing Cities of Washington County

ALTERNATES PRESENT	AFFILIATION
Andy Ginsburg	Oregon Department of Environmental Quality (DEQ)
Dean Lookingbill	SW Washington RTC
Susie Lahsene	Port of Portland

GUESTS PRESENT	AFFILIATION
Kathy Busse	Washington County
Karen Schilling	Multnomah County
Kevin Downing	Oregon Department of Environmental Quality (DEQ)
Rod Monroe	Metro Council
Jim Bernard	City of Milwaukie
John Gillam	City of Portland
John Rist	Clackamas County
Dave Nordberg	Oregon Department of Environmental Quality (DEQ)
Phil Selinger	TriMet
John Russell	Oregon Transportation Commission
Robin McArthur	Oregon Department of Transportation (ODOT - Region 1)

GUESTS PRESENT (cont)	AFFILIATION
Kathy Busse	Washington County
Olivia Clark	TriMet
Jef Dalin	City of Cornelius
Rick Finn	Port of Portland
Marianne Fitzgerald	DEQ
Ann Gardner	Schnitzer Steel
Kathryn Harrington	Citizen, Washington County
Mark Kemball	OHSU
Tom Markgraf	CRC
Sharon Nasset	ETA
Ron Papsdorf	City of Gresham
Karen Schilling	Multnomah County
Terry Whisler	City of Cornelius
John Wiebke	City of Hillsboro

STAFF

Richard Brandman, Jon Coney, Andy Cotugno, Kim Ellis, Tom Kloster, Jessica Martin, Kathryn Sofich, Randy Tucker

I. CALL TO ORDER, INTRODUCTIONS AND WELCOME OF NEW MEMBERS

Chair Rex Burkholder declared a quorum and called the meeting to order at 7:39 a.m.

II. CITIZEN COMMUNICATIONS

Ms. Sharon Nasset, 4772 N. Lombard, appeared before the committee and stated her appreciation for the Cost of Congestion report presented December 1st. She also spoke of the importance of how public transportation works versus how it looks, noting specifically that people working non-traditional hours do not have access to public transportation as well as those living in areas outside of the city have bus stops that have no shelters, benches or paved places to wait.

III. COMMENTS FROM THE CHAIR

Chair Burkholder announced that the January 19, 2006 JPACT meeting would start at 7:15a.m. in order to accommodate Ms. Gail Ackerman, who would be presenting an Oregon Transportation Plan update.

IV. CONSENT AGENDA

Minutes

ACTION TAKEN: Mayor Rob Drake moved for approval of the amended October 13th and November 10th meeting minutes. Councilor. Lynn Peterson seconded the motion and it passed.

Bi-State Coordination Committee
Meeting Report
September 23, 2004

1. Welcome and Approval of August 10, 2004, Meeting Report

The meeting of the Bi-State Coordination Committee was called to order by Chair Rex Burkholder, at 7:15 a.m. at Metro Regional Center, room 370A-B, 600 NE Grand Avenue, Portland. He announced at that at 8 a.m., Bi-State Coordination Committee members are invited to join members of JPACT in welcoming Federal Transit Administration (FTA) Administrator Jenna Dorn in the Metro Council Chamber.

Those attending the Bi-State meeting are listed below:

<u>Committee Members</u>
Rex Burkholder, Metro Councilor, Chair
Serena Cruz, Multnomah County Commissioner
Matthew Garrett, ODOT, Region 1 Manager
Lynne Griffith, C-TRAN Executive Director/CEO
Eric Holmes, City of Battle Ground Manager
Susie Lahsene, Port of Portland Alternate
Don Wagner, WSDOT, SW Regional Administrator
Rod Monroe, Metro Councilor Alternate
<u>Staff</u>
Andy Cotugno, Metro
Bob Hart, RTC
Mark Turpel, Metro
Jan Faraca, Metro
<u>Interested Guests</u>
Edward Barnes, WSDOT Commissioner
Jim Bernard, City of Milwaukie Mayor
Karen Ciocia, J.D. White Co., Inc.
John Cullerton, Metro
Rob DeGraff, ODOT
Mark Garrity, WSDOT
Jim Howell, AORTA
Greg Miller, Associated General Contractors
Sharon Nasset
Scott Patterson, C-TRAN
Lynn Peterson, City of Lake Oswego
Dale Robins, RTC
Thayer Rorabaugh, City of Vancouver
Karen Schilling, Multnomah County
Kristopher Strickler, WSDOT
Laurel Wentworth, City of Portland

Southwest Washington Regional Transportation Council
Board of Directors
August 3, 2004, Meeting Minutes

I. Call To Order and Roll Call of Members

The Southwest Washington Regional Transportation Council Board of Directors Meeting was called to order by Chair Royce Pollard on Tuesday, August 3, 2004, at 4:30 p.m. in the Clark County Public Service Center 6th Floor Training Room, Vancouver, Washington. Those in attendance follow.

Board Members:	
Brian Beecher	City of Washougal Council Member
Bill Ganley	City of Battle Ground Council Member
Matthew Garrett	ODOT Region One Manager
Lynne Griffith	C-TRAN Executive Director/CEO
Pat McDonnell	City of Vancouver Manager
Arch Miller	Port of Vancouver Commissioner
Royce Pollard	City of Vancouver Mayor
Craig Pridemore	Clark County Commissioner
Judie Stanton	Clark County Commissioner
Bob Talent	Skamania County Commissioner
Don Wagner	WSDOT SW Regional Administrator
Ed Orcutt	Representative 18th District
Joe Zarelli	Senator 18th District
Guests:	
Keith Ahola	Skillings-Connolly, Inc.
Ed Barnes	Washington Transportation Commissioner
Pete Capell	Clark County
Mike Clark	WSDOT
Justin Clary	City of Ridgefield
Paul Edgar	Citizen
Becky Eisiminger	Port of Vancouver
John Fratt	Port of Vancouver
Mark Garrity	WSDOT
Chuck Green	Parsons Brinckerhoff
Michael Kepcha	Citizen
Mary Legry	WSDOT
Ginger Metcalf	Identity Clark County
Erin Middlewood	*The Columbian*
Scott Patterson	C-TRAN
Ed Pickering	C-TRAN
Thayer Rorabaugh	City of Vancouver
Bill Stewart	*The Oregonian*
Sharon Wylie	Clark County
Staff:	
Lynda David	Senior Transportation Planner
Bob Hart	Transportation Section Supervisor
Mark Harrington	Transportation Analyst
Dean Lookingbill	Transportation Director

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METRO

Joint Policy Advisory Committee on Transportation

MINUTES

December 15, 2005
7:30 a.m. – 9:00 a.m.
Council Chambers

MEMBERS PRESENT	AFFILIATION
Rex Burkholder, Chair	Metro Council
Sam Adams	City of Portland
Brian Newman	Metro Council
Bill Kennemer	Clackamas County
Roy Rogers	Washington County
Rob Drake	City of Beaverton, representing Cities of Washington County
Lynn Peterson	City of Lake Oswego, representing Cities of Clackamas County
Dick Pedersen	Oregon Department of Environmental Quality (DEQ)
Fred Hansen	TriMet
Paul Thalhofer	City of Troutdale, representing Cities of Multnomah County
Don Wagner	Washington State Department of Transportation (WSDOT)
Bill Wyatt	Port of Portland

MEMBERS ABSENT	AFFILIATION
Matthew Garrett	Oregon Department of Transportation (ODOT - Region 1)
Rod Park, Vice Chair	Metro Council
Maria Rojo de Steffey	Multnomah County
Steve Stuart	Clark County
Royce Pollard	City of Vancouver

ALTERNATES PRESENT	AFFILIATION
Chuck Becker	City of Beaverton, representing Cities of Multnomah County
James Bernard	Cities of Clackamas County
Dean Lookingbill	Southwest Washington Regional Transportation Council
Jason Tell	Oregon Department of Transportation (ODOT - Region 1)

OTHER COUNCILORS PRESENT	
Robert Liberty	Metro Council

GUESTS PRESENT	AFFILIATION
Kenny Asher	City of Milwaukie
Meeky Blizzard	Office of Congressman Blumenauer

GUESTS PRESENT (Cont.) AFFILIATION

Brianne Echenhart	Portland State University
Dale Himes	Washington State Department of Transportation
Sharon Nassit	NPBA
Nancy Kraushaar	City of Oregon City
Alice Rouyer	City of Milwaukie
Ron Papsdorf	City of Gresham

STAFF

Dick Benner Richard Brandman Renee Castilla Kim Ellis Tom Kloster
Mark Turpel

I. CALL TO ORDER AND DECLARATION OF A QUORUM

Chair Rod Park called the meeting to order and declared a quorum at 7:17 a.m.

II. REVIEW OF MINUTES

ACTION TAKEN: Fred Hansen moved and Roy Rogers seconded the motion to approve the meeting minutes of October 9, 2003 as amended. The motion passed.

AMENDMENT: October 9, 2003, 2nd page, reference to Powell/Foster to include pavement and preservation.

III. CITIZEN COMMUNICATIONS TO JPACT ON NON-AGENDA ITEMS

Chris Smith, Transportation Chair for the NW District Association (neighborhood association for NW Portland) and current TPAC member stated that they have completed a twenty-year update to their neighborhood plan with the City of Portland. He expressed a concern regarding a late amendment to the plan that the neighborhood association feels has impacts on regional planning. He explained that as part of the plan, an area on the north side of Juan Street was rezoned to allow offices use. This has led to concerns regarding livability impacts in their neighborhood as well as regional concerns in terms of losing industrial lands to office use. He said that the rezoning was done at the request of ESCO to allow them to remain there and build headquarters office space. He stated that having headquarter space is not something that the neighborhood opposes, however they oppose the speculative office space development portion. Further, that high-density employment should occur in a 2040 regional center not in industrial areas. The impact of that would be serious transportation problems in that corridor as indicated by property owners own consultant's analysis. It would also differ transportation resources that should be going to centers to be applied to this challenge. To the extent that they are not able to mitigate that would also mean they would have freight movement problems as well. These issues were raised in a letter from Councilor Burkholder to Commissioner Francesconi however his understanding is that letter has yet to be answered. In fairness to Commissioner Francesconi, there is report of an SDC associated with this intended to provide mitigation however they have

Bi-State Coordination Committee
Meeting Report
November 3, 2005

1. Welcome and Approval of September 29, 2005, Meeting Report

The meeting of the Bi-State Coordination Committee was called to order by Chair Rex Burkholder at 7:30 a.m. at the Clark County Elections Building Conference Room 226, 1408 Franklin Street, Vancouver, Washington. Those in attendance follow:

Committee Members
Rex Burkholder, Metro Councilor
Roland Chlapowski, City of Portland Alternate
Serena Cruz, Multnomah County Commissioner
Doug Ficco, WSDOT SW Alternate
Matt Garrett, ODOT Region One Manager
Lynne Griffith, C-TRAN Executive Director/CEO
Eric Holmes, City of Battle Ground City Manager
Larry Paulson, Port of Vancouver Executive Director
Royce Pollard, City of Vancouver Mayor
Fred Hansen, TriMet General Manager
Steve Stuart, Clark County Commissioner
Staff
Andy Cotugno, Metro
Dean Lookingbill, RTC
Mark Turpel, Metro
Diane Workman, RTC
Interested Guests
Ed Barnes, Washington State Transportation Commissioner
Richard Brandman, Metro
Pam Brokaw, Representative Brian Baird's Office
Justin Clary, City of Ridgefield
Kate Deane, ODOT
Chris Deffebach, Metro
Walt Evans, Schwabe Williamson & Wyatt
David Forte, WSDOT
Stuart Gwin, City of Portland
Bob Hart, RTC
Addison Jacobs, Port of Vancouver
Jim Leahy, Bechtel
Alan Lehto, TriMet
Steve Matthews, WSDOT
Brian McMullen, WSDOT
Sharon Nasset, Economic Transportation Alliance
Joy Overstreet, Citizen, Vancouver
Thayer Rorabaugh, City of Vancouver
Jeanne Stewart, Vancouver City Council Member
Rex Wong, Columbia River Crossing
Bill Wright, Clark County

Southwest Washington Regional Transportation Council
Board of Directors
February 1, 2005, Meeting Minutes

I. Call To Order and Roll Call of Members

The Southwest Washington Regional Transportation Council Board of Directors Meeting was called to order by Chair Arch Miller on Tuesday, February 1, 2005, at 4:05 p.m. at the Clark County Public Service Center Sixth Floor Training Room, Vancouver, Washington. Attendance follows.

Board Members Present:
Brian Beecher, Washougal Council Member
Marc Boldt, Clark County Commissioner
Bill Ganley, Battle Ground Council Member
Matthew Garrett, ODOT Region One Manager
Lynne Griffith, C-TRAN Exec. Director/CEO
Pat McDonnell, Vancouver City Manager
Arch Miller, Port of Vancouver Commissioner
Betty Sue Morris, Clark County Commissioner
Paul Pearce, Skamania County Commissioner
Royce Pollard, Vancouver Mayor
Steve Stuart, Clark County Commissioner

Board Members Absent:
Rex Burkholder, Metro Councilor
Brian Prigel, Bingen Mayor
Don Wagner, WSDOT Regional Administrator
Jim Honeyford, Senator 15th District:
Bruce Chandler, Representative 15th District:
Dan Newhouse, Representative 15th District
Don Benton, Senator 17th District
Jim Dunn, Representative 17th District
Deb Wallace, Representative 17th District
Joe Zarelli, Senator 18th District
Ed Orcutt, Representative 18th District
Richard Curtis, Representative 18th District
Craig Pridemore, Senator 49th District
Bill Fromhold, Representative 49th District
Jim Moeller, Representative 49th District

Guests Present:
Sam Adams, City of Battle Ground
Ed Barnes, WA Transportation Commissioner
Peter Capell, Clark County
Justin Clary, City of Ridgefield
Paul Edgar, Citizen
Bart Gernhart, WSDOT
Brent Grening, Port of Ridgefield
John Hoefs, C-TRAN
Addison Jacobs, Port of Vancouver
Mike Mabrey, Clark County
Dick Malin, Citizen
Ginger Metcalf, Identity Clark County
Sharon Nasset, Citizen
Thayer Rorabaugh, City of Vancouver
Scott Sawyer, City of Washougal
Bill Stewart, *The Oregonian*
Mark Turpel, Metro
Terri Tweedell, Identity Clark County
Steve Vestal, WSDOT
Bob Voller, Citizen
Bill Wright, Clark County

Staff Present:
Lynda David, Senior Transportation Planner
Mark Harrington, Transportation Analyst
Bob Hart, Transportation Section Supervisor
Dean Lookingbill, Transportation Director
Dale Robins, Senior Transportation Planner
Diane Workman, Administrative/Staff Assistant

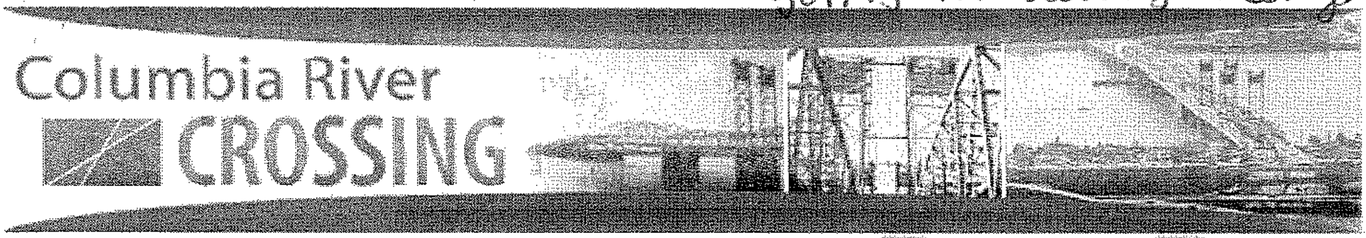
II. Approval of January 4, 2005, Meeting Minutes

ROYCE POLLARD MOVED FOR APPROVAL OF THE JANUARY 4, 2005, MEETING MINUTES. THE MOTION WAS SECONDED BY LYNNE GRIFFITH AND UNANIMOUSLY APPROVED.

III. Citizen Communications

There was no citizen comment.

No meeting report found for ongoing modeling meeting



EVENT CALENDAR CONTACT US

PROJECT HOME

PROJECT DETAILS

I-5 COMMUNITY

PROJECT MATERIALS

TRAFFIC CAMERAS

GET INVOLVED

Working Groups

Working Groups are being formed to address specific project issues as they arise. Groups are expected to include specialists from agency and consultant staff as well as other organizations. Working groups will likely address public involvement, freight issues, economic development, travel forecasting, engineering, specific environmental disciplines, and financing. It's also possible that other working groups may also be formed as needs arise.

Current Working Groups

Communications

This working group coordinates the public involvement for the project, meeting twice a month to achieve its goal of effectively exchanging information with the public. Visit the Event Calendar to learn more about getting involved with this project. You can also view the open house and survey results, the most recent communication activities.

Design

The Design Working Group is currently meeting once a month to discuss and resolve technical issues related to the design and development of the proposed alignments/project with an emphasis on highway design. As the project moves into alternative development, the group may meet bi-weekly. Group members are charged with:

1. Representing their agencies in decision making and also acting as the liaison for bringing issues to and from agencies.
2. Functioning as the primary contact for design-related information required for the project.

Environmental Justice

The bi-state Environmental Justice Working Group (EJWG) includes members from low-income, Limited English Proficiency, and minority communities who live and/or work in the region. The EJWG will serve in an advisory role to the project team to help ensure that the project complies with federal guidelines. Specifically, the group is charged with:

1. Working with the Project Development Team to review project materials planned for public distribution, to help ensure that appropriate communication strategies are employed in outreach to Environmental Justice communities.
2. Helping to identify issues of concern to Environmental Justice communities, to shape the evaluation of impacts and benefits specific to those communities.
3. Helping to assess the results of the evaluation of impacts and benefits with respect to Environmental Justice communities.

Freight

This working group currently meets every other month to achieve the following goals:

1. Provide insights, observations, and recommendations about the needs for truck access and mobility within the corridor.
2. Characterize trucks' horizontal and vertical clearances, acceleration/deceleration, and stopping performance needs that must be accommodated.
3. Provide meaningful comments on the effect of geometric, regulatory, and capacity changes on truck movements in the corridor.
4. Provide testimony and objective information about the effects of congestion on freight-related businesses and the businesses they, in turn, serve.

Modeling

The Modeling Working Group currently meets with the Transit Working Group twice a month. Their goal is to develop travel and patronage demand modeling parameters and evaluation criteria for the project.

Transit

This working group is currently meeting with the Modeling Working Group twice a month to address the transit needs of the project area. In doing this, this working group is:

1. Sharing information with appropriate agencies and elected officials.
2. Being thoughtful, open, and objective by using an analytical approach when evaluating the various alternatives and components that will help solve the Bridge Influence Area's problems.
3. Committed to attending meetings and providing technical input in a timely manner.
4. Working together, because the group recognizes that is the only way forward.

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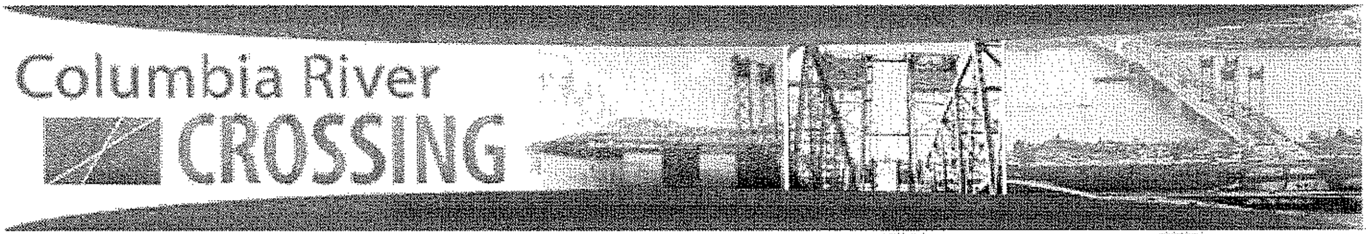

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Freight meets every other month ↑ a month currently —
When did it start, Location, time, minutes
who attends?

Columbia River CROSSING

Meeting Materials

This is all that is on web site
They where currenty meeting 04-25-06

Click headings to sort

Download	View	Title	Date	Size
		Freight Working Group - January 17, 2008 Agenda	01/17/2008	32 K
		Freight Working Group - November 17, 2007 Meeting Summary	01/17/2008	50 K
		Freight Working Group - November 17, 2007 Meeting Summary	10/17/2007	50 K
		Freight Working Group - July 18, 2007 Agenda	07/18/2007	32 K
		Freight Working Group - June 13, 2007 Meeting Summary	06/13/2007	61 K
		Freight Working Group - May 16, 2007 Meeting Summary	05/16/2007	50 K

minute must
↑ be on for at least
1 yr –
Should meeting minute
be ~~[illegible]~~ avaibiable the entire
project time?

Approximate Download Times (per megabyte)

56 Kbps (dial-up modem)= 2 Minutes, 30 Seconds

768 Kbps (broadband)= 11 Seconds

1.54 Mbps (T1)= 5.5 Seconds

Oregon Department of Transportation | Washington State Department of Transportation

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Columbia River
CROSSING

Meeting Minutes

Location ?   Actual deliberation
What was said

MEETING: CRC Freight Working Group Meeting

MEETING DATE: May 16, 2007

ATTENDEES:

Corky Collier	CCA	503-287-8686
Bob Hillier	Portland DOT	503-823-7567
Lee Johnson	Jet Delivery Systems	503-256-3621
John Leber	Swanson Bark/Wood Products	360-414-9663
Deena Platman	Portland Metro	503-797-1754
Tom Hildreth	CRC	360-816-2169
Tracy Ann Whalen	ESCO Corporation	503-778-6252
Dave Parisi	CRC	360-816-2165
Claudia Hirschey	CRC	425-227-5144
Ryan LeProwse	CRC	360-816-2174

Guest ?

Reviewed the Following Agenda:

- Update on Task Force decisions and major project activities since January FWG meeting
- Update on Draft Environmental Impact Statement Process
- Review of new and revised design concepts – freight components
- Project updates, schedule, discussion of next steps, action items, and next meeting

Project Update since January FWG Meeting

In late 2006 the project staff recommended one bridge option and two transit options move forward for further analysis, forming two project alternatives. The alternatives defined at the end of 2006 were:

- Alternative 1 – No Build
- Alternative 2 – Replacement Bridge with Bus Rapid Transit
- Alternative 3 – Replacement Bridge with Light Rail Transit

An additional bridge option was added in March 2007 as a result of the CRC Task Force recommendation. The existing bridge is retained and a "supplemental bridge" to the west of the existing bridge would be constructed. This new bridge option would also have BRT and LRT. The new alternatives are:

- Alternative 4 – Supplemental Bridge with Bus Rapid Transit
- Alternative 5 – Supplemental Bridge with Light Rail Transit

Preliminary design work for Alternatives 4 and 5 will be complete at the end of June. The supplemental bridge option would include a total of eight lanes, including through and auxiliary lanes. Southbound traffic would be on the supplemental bridge and northbound traffic would be split on to the supplemental bridge and the existing bridge. Design and traffic operations of the northbound traffic could be complicated. The bike/ped path would be cantilevered on the east side of the existing bridge. Publication of the Draft Environmental Impact Statement (DEIS) is still scheduled for late winter 2008. Detailed evaluation of project alternatives will begin in June and continue throughout the preparation of the DEIS.

Update on Design Concepts – Alternatives 2 and 3

Marine Drive Interchange. The current design concept developed at Marine Drive is a modified version of the single point urban interchange (SPUI). A flyover ramp takes the heavy volume from eastbound Marine View Drive to northbound I-5 over the interchange rather than through the signal at the ramp

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Columbia River CROSSING

Meeting Agenda

MEETING TITLE: Freight Working Group

DATE: Thursday, January 17, 2008

INVITEES: Distribution ?, Limited Target

LOCATION: 10:00 AM to 11:30 PM at the CRC Project Office, North Conference Room

AGENDA:

1. Update on Task Force presentation in November	45 minutes
2. Freight performance review	30 minutes
3. Next steps and other items	15 minutes

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Columbia River CROSSING

Meeting Agenda

MEETING TITLE: Freight Working Group

DATE: Wednesday, July 18, 2007

INVITEES: Distribution ? limited Target

LOCATION: 10:00 AM to 11:30 AM at the CRC Project Office, North Conference Room

AGENDA:

1. Update on project activities since June 13 FWG Meeting	10 minutes
2. Review design concepts	75 minutes
3. Next steps	5 minutes

Columbia River CROSSING

DRAFT

Meeting Minutes

MEETING: CRC Freight Working Group Meeting

Location?, Time, minutes with deliberation?

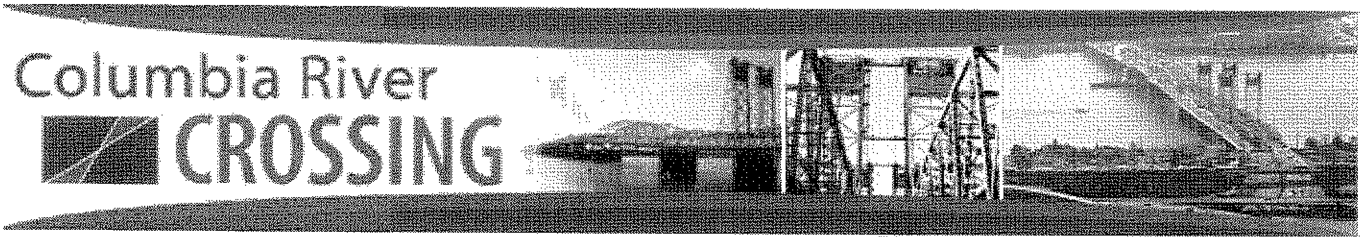
MEETING DATE: June 13, 2007

ATTENDEES:

Steve Bates	Redmond Heavy Hauling	503-793-2069
Katy Brooks	Port of Vancouver	360-693-3611
Corky Collier	CCA	503-287-8686
Bob Hillier	Portland DOT	503-823-7567
John Leber	Swanson Bark/Wood Products	360-414-9663
Anne Sylvester	Parametrix (Port of Vancouver)	503-233-2400
Tracy Ann Whalen	ESCO Corporation	503-778-6252
Dave Parisi	CRC	360-816-2165
Claudia Hirschey	CRC	425-227-5144
Ryan LeProwse	CRC	360-816-2174
Gavin Oien	CRC	360-816-2176

Reviewed the Following Agenda:

- Update on Project Activities since May 16 FWG Meeting
- Comparative Truck Volume Data
- Review of design concepts and alternatives



EVENT CALENDAR CONTACT US

PROJECT HOME

PROJECT DETAILS

I-5 COMMUNITY

PROJECT MATERIALS

TRAFFIC CAMERAS

GET INVOLVED

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Current Working Groups

Communications

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Design

currently meets.

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Freight

CRC
Website complete copy
04.25.06

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4. Working together, because the group recognizes that is the only way forward.

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Columbia River CROSSING

Urban Design Advisory Group
March 9, 2007
DRAFT Meeting Summary

Location ?

MEMBERS PRESENT	
Mayor Royce Pollard, Co-Chair	Dave Smith
Commissioner Sam Adams, Co-Chair	Dick Pokornowski
Rob Barrentine	Jane Hansen
Michelle Tworoger	Jeff Stuhr
Carrie Schilling	Marcia Ward
Members not in attendance: Ed Carpenter, Walter Valenta, Jeanne Caswell	

OTHER ATTENDEES Guest ?	
Greg Baldwin, Zimmer Gunsul Frasca	Dean Lookingbill, Regional Transportation Commission
Jesse Beason, Commissioner Adams Office	Mark Raggett, City of Portland – Planning
Roland Chlapowski, Commissioner Adams Office	Matt Ransom, City of Vancouver – Transportation
John Gillam, Portland Office of Transportation	Phil Wuest, City of Vancouver – Transportation

CRC STAFF: Public ? (04.25.06 States Design Working Group currently meeting once a month

Doug Ficco, Kris Strickler, Jay Lyman, Lynn Rust, Frank Green, Ron Anderson, Mark Hirota, Barbara Hart, Tom Hildreth, Paddy Tillett, Scott Danielson, Tom Cooper, Tom Markgraf, Carolyn Sharp

Welcome/Introductions and Kickoff:

Mayor Pollard agreed to chair the first UDAG meeting with the understanding that he and Co-chair Commissioner Adams would alternate this responsibility. The meeting began with introductions.

Doug Ficco, Project Director, reviewed the project timeline and current status of the project. He expects the work of the group to extend beyond the four meetings that are currently scheduled and past the completion of the DEIS. He described some of the design challenges and opportunities the project is addressing, including Marine Drive, Hayden Island, SR-14, National Historic Reserve and downtown Vancouver.

Dec 13, 06 where are minutes place Time

Tom Hildreth, CRC project team, reviewed the Charter and touched on the origins of the committee and the December 13th meeting of partner agency staff that helped to shape the purpose of the Urban Design Advisory Group. He reviewed the schedule of meetings through June 2007 and explained that meetings beyond that date are planned and will be scheduled soon.

meet monly - (?)

Columbia River CROSSING

Urban Design Advisory Group

June 15, 2007

Meeting Summary

Location ?

MEMBERS PRESENT	
Commissioner Sam Adams, Co-Chair	Carrie Schilling
Rob Barrentine	Dave Smith
Ed Carpenter	Jeff Stuhr
Jane Hansen	Marcia Ward
Mark Masciarotte	Walter Valenta
Members not in attendance: Mayor Royce Pollard, Co-Chair; Dick Pokornowski, Michelle Tworoger, Jeanne Caswell	
OTHER ATTENDEES	
Roland Chlapowski, Commissioner Adams' Office	Matt Ransom, City of Vancouver
David Cusack, Clark County	Peter Stark, Stark Design
Randy Gragg	Patrick Sweeney, Portland Office of Transportation
Mark Raggett, Portland Bureau of Planning	Phil Wuest, City of Vancouver

CRC STAFF: Public ?

Kris Strickler, Ron Anderson, Barbara Hart, Scott Danielson, Paddy Tillett, Lynn Rust, Carolyn Sharp, Derek Chisholm

Welcome and Introductions:

Co-chair Commissioner Sam Adams opened the meeting with introductions of the committee members and the audience. He gave his impressions of a flight tour from Pearson Field arranged by Mark Masciarotte. He noted a better appreciation for the growth and change in Vancouver and the noticeable constraints of the flight paths for Pearson Field.

May Meeting Summary:

Ron Anderson, CRC staff, reviewed the May meeting summary and the committee offered no changes. Ron summarized the items that the group requested from CRC staff during the May meeting, including more information on vertical clearances, a detailed description of the DEIS alternatives, zoning designations for the project area, and information about the next Task Force meeting. Each of these items is addressed in the Project Update.

Project Update:

Deliberation ?

Columbia River CROSSING

Urban Design Advisory Group
August 17, 2007
Meeting Summary

Location ?

MEMBERS PRESENT	
Mayor Royce Pollard, Co-Chair	Mark Masciarotte
Commissioner Sam Adams, Co-Chair	Dick Pokornowski
Rob Barrentine	Dave Smith
Ed Carpenter	Jeff Stuhr
Jane Hansen	Michelle Tworoger
Members not in attendance: Marcia Ward, Walter Valenta, Jeanne Caswell, Carrie Schilling	
OTHER ATTENDEES	
Roland Chlapowski, Commissioner Adams' Office	Matt Ransom, City of Vancouver
Alan Lehto, TriMet	Patrick Sweeney, Portland Office of Transportation
Mark Raggett, Portland Bureau of Planning	

CRC STAFF: Public ?
Doug Ficco, Ron Anderson, Barbara Hart, Scott Danielson, Paddy Tillett, Tom Cooper, Frank Green, Lynn Rust, Carolyn Sharp, Derek Chisholm

Welcome and Introductions: Deliberation ?

Co-chair Mayor Pollard opened the meeting.

CRC Project Updates:

Ron Anderson, CRC staff, provided an update on project progress made since the last UDAG meeting. Due to significant technical challenges of the upstream replacement bridge alternative, staff are not conducting further analysis of these river crossing alternatives. The challenges include unavoidable conflicts with Pearson Field, a significantly longer construction schedule compared to downstream alignments, and impacts to historic resources at Fort Vancouver. The upstream alignments will be included in the Draft Environmental Impact Statement with the results of analysis conducted to date. Staff is assembling the environmental technical evaluation for the other bridge and transit alternatives and continues to optimize alignments to minimize right of way impacts and maximize constructability. CRC staff have led an aggressive outreach effort at neighborhood associations and community events this summer and will hold Open Houses on October 17 and 20, 2007. A preliminary preferred alternative will be presented at the November Task Force meeting. The Federal Highway Administration does not expect the project to select a bridge type until further engineering can provide more information about cost and materials. The Task Force is scheduled to select a preferred alternative at their January meeting. Decisions from sponsoring agencies, the cities of Vancouver and Portland, Metro, TriMet, RTC and C-TRAN will follow late spring or early summer.

Columbia River CROSSING

Meeting Agenda

MEETING TITLE: Urban Design Advisory Group

DATE: Friday, October 19, 2007, 7:30 – 9:30 a.m.

LOCATION: Vancouver Hilton, 301 W. 6th Street
Discovery D & E Rooms

TIME	TOPIC	ACTION
7:30 a.m.	Welcome and Introductions August Meeting Summary	Approve
7:40 a.m.	Project Update	Discussion
8:00 a.m.	Presentation of Design Guidance – Concept, Process, and Potential Outcomes	Discussion
8:25 a.m.	Small Group Exercise and Discussion	Application of Design Guidelines to Project Areas
9:05 a.m.	Report Back on Small Group Discussion	Discussion
9:20 a.m.	Schedule – Future Meetings	Discussion
9:25 a.m.	Wrap Up and Close	

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Columbia River CROSSING

Complete Calendar of meetings from CRC website up to June 19, 2008

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Calendar of Events

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Meetings & Events

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Group	Description	Meeting Date	Location
Community Meetings	Portland Pedestrian Advisory Committee	4/15/2008 7:00-8:00 PM	Portland City Hall
Community Meetings	Bicycle Transportation Alliance Forum	4/16/2008 6:00-8:00 PM	Bicycle Transportation Alliance
Task Force	Cancelled Meeting	4/17/2008 4:00-8:00 PM	WSDOT, SW Region Headquarters
Community and Environmental Justice Group	Meeting	4/17/2008 6:00-8:30 PM	Kenton Fire House
Community Meetings	Rose Village Neighborhood Association	4/22/2008 7:00 PM	Memorial Lutheran Church
Community Meetings	Shumway Neighborhood Association	5/1/2008 7:00 PM	Vancouver School of Arts and Academics
Community Meetings	Society of American Military Engineers, Portland Chapter	5/7/2008 11:30-1:00 PM	Kells Irish Restaurant & Pub
Community Meetings	Vancouver Bicycle Club	5/14/2008 7:00-8:30 PM	Bortolami's Pizzeria
Community and			

Environmental Justice Group	Meeting	5/15/2008 6:00-8:30 PM	Kenton Fire House
Community and Environmental Justice Group	Meeting	6/19/2008 6:00-8:30 PM	Kenton Fire House

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Columbia River CROSSING

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Calendar of Events

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Meetings & Events

Click headings to sort

Group	Description	Meeting Date	Location
Community Meetings	Bridgeton Neighborhood Association	3/19/2008 7:00-9:00 PM	Columbia High School
Freight Working Group	Meeting	3/20/2008 10:00-12:00 PM	Columbia River Crossing project office
Community and Environmental Justice Group	Meeting	3/20/2008 6:00-8:30 PM	Kenton Fire House
Urban Design Advisory Group	Cancelled Meeting	3/21/2008 7:30-9:30 AM	Red Lion at the Quay
Community Meetings	Highland Home Owners Association	3/24/2008 7:00-8:00 PM	Pleasant Valley Middle School
Community Meetings	Woodland Chamber of Commerce	3/25/2008 12:00-1:00 PM	Oak Tree Restaurant
Fairs and Festivals	Energy Trust Better Living Home, Garden & Lifestyle Show	3/28/2008 12:00-5:00 PM	Portland Expo Center
Community Meetings	West Minnehaha Neighborhood Association	4/7/2008 7:00-8:00 PM	West Minnehaha Community Center
Community	Association for the Advancement of	4/10/2008 5:30-7:30 PM	University Place Hotel &

Meetings	Cost Engineering		Conference Center
Community Meetings	Senior Connections Expo	4/13/2008 11:00-4:00 PM	Hilton Vancouver Washington hotel

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Oregon Department of Transportation
Washington State Department of Transportation

700 Washington Street, Suite 300 | Vancouver, WA | 98660

CRC PROJECT Public Meetings and Key Dates
City of Portland - PDOT

March 11 (3:00 PM) - Planning Commission briefing on CRC project

March 17 (1:00 PM) - City Council work session on CRC project

March 25– Planning Commission briefing on Hayden Island Concept Plan (by BOP)

Late March - CRC releases DEIS, public comment period begins (60 days)

April – Sustainable Development Commission conducts meeting on CRC project (date and format not yet determined)

April 8 – Planning Commission public hearing on Hayden Island Concept Plan

April 22 – Metro Council briefing on CRC project by Metro staff

April 28 - CRC Community Meeting. Draft EIS public hearing and open house. 5:00-8:00 pm, Hilton Hotel, Vancouver. Public testimony.

April 30 - CRC Community Meeting. Draft EIS public hearing and open house. 5:00-8:00 pm, Red Lion Hotel, Jantzen Beach. Public testimony.

May 1 - Metro Council public hearing and directs Task Force representative vote on Draft Recommended LPA

May 13 - Planning Commission reviews CRC DEIS and Performance of Alternatives Report and PDOT staff report/recommendations, including public testimony

May 20 - Planning Commission prepares letter advising City Council action on DEIS and Performance of Alternatives Report, and, Planning Commission decision and recommendations to City Council on Hayden Island Concept Plan

May 22 - CRC Task Force meeting/vote on Draft Recommended LPA

June - Planning Commission briefing on Hayden Island Recommended Plan by BOP

June/July - Planning Commission public hearing on Hayden Island Recommended Plan by BOP

June/July - Planning Commission decision and recommendations to City Council on Hayden Island Recommended Plan

June - City Council public hearing and action on CRC Locally Preferred Alternative

July - City Council public hearing and action on Hayden Island Recommended Plan

July – JPACT vote and recommendation to Metro Council on CRC LPA (must occur after City Council action on LPA)

July - City Council public hearing and action on CRC Locally Preferred Alternative

From: Mark Robinowitz
To: Columbia River Crossing;
CC:
Subject: Columbia River Crossing DEIS comment: James Howard Kunstler
Date: Tuesday, July 01, 2008 1:50:22 PM
Attachments:

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http://www.kunstler.com/mags_diary24.html

June 30, 2008
Worse Than Grandma's Depression

This isn't so funny anymore. Intimations of a July banking collapse rumbled though the Internet this weekend while mainstream news orgs like *The New York Times* and CNN pulled their puds over swift boats and Amy Winehouse's performance technique. *Something is happening, and you don't know what it is, do you Mr. Jones*...? to quote the master.

What's happening is that American society is sliding into a greater depression than the one Grandma lived through. On the technical side, there has been unending controversy as to whether we're gripped by inflation or deflation. It's certainly deceptive. Food and gasoline prices are rising faster than the rivers of Iowa. But the prices of assets, like houses, stocks, jet-skis, GMC Yukons and *pre-owned* Hummel figurines are cratering as America turns into Yard Sale Nation.

We're a very different country than we were in 1932. In that earlier crisis of capital, few people had any money but our society still possessed fantastic resources. We had plenty of everything that our land could provide**:** a treasure trove of mineral ores and the equipment to refine it all, a wealth of oil and gas still in the ground, and all the rigs needed to get at it, manpower galore (and of a highly disciplined, regimented kind), with fine-tuned factories waiting for orders. We had a railroad system that was the envy of the world and millions of family farms (even despite the dust bowl) owned by people who retained age-old skills not yet degraded by agribusiness. We had fully-functional cities with operating waterfronts and ten thousand small towns with local economies, local newspapers, and local culture.

We had a crisis of capital in the 1930s for reasons that are still debated today. My own guess is a combination of a bad debt workout that sucked "money" into a black hole (since money is loaned into existence, but vanishes if the loans are not systematically paid back) plus a gross saturation of markets, meaning that every American who had wanted to buy a car or an electric toaster had done so and there was no one left to sell to. (The first round of *globalism* -- 1870 - 1914 -- had shut down after the fiasco of World War One.)

Our debt problems today are of a magnitude so extreme that astronomers would be hard pressed to calculate them. By any rational measure our society is comprehensively bankrupt. From the federal treasury down to the suburban cul-de-sacs so much loaned money is either not being paid back, or is at risk of never being paid back, that the suckage of presumed wealth has passed through an event horizon out of the known universe into some other realm of space-time, never to be seen again in this realm. This would seem to be the very essence of monetary deflation -- money defaulted out-of-existence.

This condition is partly disguised by both the loss of credibility of US currency and real-world scarcities of oil and food, but the upshot will be something at least twice as bad as the Great Depression of the 1930s**:** people with no money in a land with no resources (with manpower that has no discipline), hardly any family farms left, cities that are basket-cases of bottomless need, comatose small towns stripped of their assets and social capital, an aviation industry on the verge of death, and a railroad system that is the laughingstock of the world. Not to mention the mind-boggling liabilities of suburbia and the motoring infrastructure that services it.

The banks have been doing their death dance for an entire year now, pretending that their problems are those of mere "liquidity" (i.e. cash-on-hand) rather than insolvency (no cash either on hand or in the vault and nothing else to sell to raise cash except worthless "creative" securities that nobody would ever buy). But the destruction of money (resulting from loans not paid back) is now so intense that the game of pretend has reached its terminal point. The question for the moment is exactly who and what will be crushed as these institutions roll over and die.

Complicating matters is a global oil predicament that is really not hard to understand, but which the organs of news and opinion have obdurately failed to explicate for an anxious public. Call it Peak Oil. There are only a few elements of it you need to know. 1.) that demand has now permanently outstripped supply; 2.) that new discoveries are too meager to offset consumption; 3.) That under under the circumstances, the systems we rely on for daily life are crumbling. I've called this situation The Long Emergency.

Our chances of mitigating this, and of continuing our current way-of-life is about zero. I've tried to promote the idea that rather than waste remaining resources in the futile attempt to sustain the unsustainable (i.e. come up with "solutions" to keep suburbia running), that we should begin immediately making other arrangements for daily life -- mainly by downscaling and re-scaling everything from farming to commerce to the way we inhabit the landscape -- but my suggestions have proven unpopular even among the "environmental" elites, who are too busy being entranced by new-and-groovy ways to keep all the cars running.

So where we are at now is the equivalent of standing in the slop by the ocean shore under a gathering hundred-foot-high wave that is about to come crashing down on our heads. Since I sure don't know everything, I can't say how this will all play out in the months ahead, especially with the presidential election coming at the exact moment that voters will be turning on their furnaces for the cold and dark winter beyond. I would venture to say that so far our society as a whole has done a piss-poor job of comprehending the situation. But there is still the possibility, with four months of politicking left, that the nature of our predicament can be articulated in a way that few can fail to understand, the way Mr, Lincoln articulated the terms of the Civil War on the eve of its fateful outbreak.

June 23, 2008
Penetration

The telling moment last week was Robert Hirsch's appearance on the CNBC morning "Squawkbox" financial show in which he proposed the probability of $500-a-barrel oil within "a three-to-five-year time-frame." Squawkhead Becky Quick was clearly nonplussed by the stolid Mr. Hirsch, author of a (then)-startling 2005 US Dept of Energy report (since referred to as the Hirsch Report and buried by the Secretary of Energy) that warned of dire effects on the American way of life as the Peak Oil predicament gained traction.

Perhaps more reality-challenged was the uber-idiot Larry Kudlow on CNBC's night-time money show, who kept repeating the mantra "drill, drill drill" when presented with signs that something other than "oil speculators" was driving up the price and creating global scarcity. These idiots always return to the shibboleth that "there's plenty of oil out there." What they don't get is that even while the world is enjoying the all time peak of production (somewhere around 85-million barrels-a-day), that same world is demanding at least 86-million barrels -- so even though there's more oil than ever, there's not enough. And the gap is only bound to get bigger.

The difference between what's available and what's demanded is being felt by poor countries and poor people in richer countries. Third world nations lacking their own oil are simply dropping out of the bidding, and the lower classes in the US are having to choose between buying gasoline and velveeta. The floods in the corn belt will surely aggravate the problem here in the USA. Lunch breaks may soon be a thing of the past for WalMart Associates. Maybe they'll just play video games on their cell phones in the parking lot to allay their hunger.

Meanwhile the notion that *drilling drilling drilling* offshore the US and up in Alaska will solve this problem shows how incredibly misinformed the news media itself is. The probability is next to zero that anything found off California or Florida would even fractionally offset ongoing depletion in the handful of old, established super-giant fields that the world gets most of it oil from. By the way, I support the idea of drilling in Alaska's ANWAR reserve because I think it can be done in a sanitary way and, more importantly, it would get the idiot cornucopian right-wing assholes to finally shut up about it -- before they discover that it contains less than half a year's oil supply for the US at current rates of use.

Also on the "meanwhile" front, the OPEC meeting Sunday at Jeddah, Saudi Arabia, was simply a desperate dodge, a mummery, a kabuki theater of powerlessness. Once again, the Saudis are pretending that they can increase their production -- in essence, pretending that they actually have some power in the game. As Jeffrey Brown has pointed out on **THEOILDRUM.COM**, the Kingdom will still show a steady three-year decline over their 2005 production rates even if they're able to goose current output as much as they say they will in 2008.

All this reality content is beginning to penetrate the collective consciousness in the US, but the result is mostly panic or paralyzed disbelief rather than any set of intelligent responses. For example, I got a call from one of Katie Couric's producers at CBS news on Friday. Somehow, they had noticed that oil prices were becoming a problem in America. They called me for a comment. The scary part was they were clearly treating the issue as a "lifestyle" story. *Did I think more suburbanites would move downtown? And would that be a good thing...?* They have no fucking clue how broadly and deeply these dynamics will affect the life of this nation, or even our ability to remain a nation. Also, by the way, this demonstrates how the nightly network news has become the equivalent of the old "women's pages" of the daily newspapers.

The parallel universe of the financial world is showing the strain of all this oil anxiety -- since, after all, oil is the primary resource for running industrial economies. It has been some time since the banker boyz embarked on their fateful venture to alchemize a new mutant strain of investment instruments to replace the tired old stocks and bonds which represented the hope for production of surplus wealth from industrial activity -- now mooted by the oil story. The idea of the mutant investments was to produce wealth with no real wealth-producing activity. This old trick, formerly known as Ponzi finance or a "pyramid scheme," was naturally self-limiting, and in a way that would prove ultimately very destructive to society as a whole. In fact, it has fatally undermined the legitimacy of the entire financial system, and a state of comprehensive nausea has set in as we all witness the dissolving foundation of the US economy under a tsunami of debt that will never be repaid.

The markets seem to know this, the more vocal playerz are squawking more about it, some banks are issuing frightening "duck-and-cover" warnings, using horror movie phrases such as "...worse than the Great Depression of the 1930s..." and the general public is sinking into the quicksand of bankruptcy, repossession, and ruin. I haven't been to any lawn parties in the Hamptons this year, but I imagine that eczematous anxiety rashes are competing with suntans and Versace separates out there this year. Really, we're right back where we were last year about this time, only worse. Oil has doubled, food is outasight, the levees have broken, the people who run things are shitting their pants, and everybody is waiting for a whole lotta other shoes to drop.

June 16, 2008

Status Quo-oh

A catastrophe for Iowa farmers will not be *just* a catastrophe for Midwestern Americans. In the Iowa floods, we'll see more evidence of how the problems of weird weather (climate change) combine and ramify the problems associated with peak oil. In this particular case they lead to an inflection point sometime around the 2008 harvest season, which will also be our time of political harvest.

These are not your daddy's or granddaddy's floods. These are 500-year floods, events not seen before non-Indian people starting living out on that stretch of the North American prairie. The vast majority of home-owners in Eastern Iowa did not have flood insurance because the likelihood of being affected above the 500-year-line was so miniscule -- their insurance agents actually advised them against getting it. The personal ruin out there will be comprehensive and profound, a wet version of the 1930s Dust Bowl, with families facing total loss and perhaps migrating elsewhere in the nation because they have no home to go back to.

Iowa in 2008 will be an even slower-motion disaster than Hurricane Katrina in 2005. Beyond the troubles of 25,000 people who have lost all their material possessions is a world whose grain reserves stand at record lows. The crop losses in Iowa will aggravate what is already a pretty dire situation. So far, the US Public has experienced the world grain situation mainly in higher supermarket prices. Cheap corn is behind the magic of the American processed food industry -- all those pizza pockets and juicy-juice boxes that frantic Americans resort to because they have no time between two jobs and family-chauffeur duties to actually cook (note: reheating is not cooking).

Behind that magic is an agribusiness model of farming cranked up on the steroids of cheap oil and cheap natural-gas-based fertilizer. Both of these "inputs" have recently entered the realm of the non-cheap. Oil-and-gas-based farming had already reached a crisis stage before the flood of Iowa. Diesel fuel is a dollar-a-gallon higher than gasoline. Natural gas prices have doubled over the past year, sending fertilizer prices way up. American farmers are poorly positioned to reform their practices. All that cheap fossil fuel masks a tremendous decay of skill in husbandry. The farming of the decades ahead will be a lot more complicated than just buying x-amount of "inputs" (on credit) to be dumped on a sterile soil growth medium and spread around with giant diesel-powered machines.

Like a lot of other activities in American life these days, agribusiness is unreformable along its current lines. It will take a convulsion to change it, and in that convulsion it will be dragged kicking-and-screaming into a new reality. As that occurs, the US public will have to contend with more than just higher taco chip prices. We're heading into the Vale of Malthus -- Thomas Robert Malthus, the British economist-philosopher who introduced the notion that eventually world population would overtake world food production capacity. Malthus has been scorned and ridiculed in recent decades, as fossil fuel-cranked farming allowed the global population to go vertical. Techno-triumphalist observers who should have known better attributed this to the "green revolution" of bio-engineering. Malthus is back now, along with his outriders: famine, pestilence, and war.

We're headed, it seems, toward a fall "crunch time," and that crunching sound will not be of cheez doodles and taco chips consumed on the sofas of America. I think we're heading into a season of hoarding. As the presidential campaign moves into its final round, Americans may be hard-up for both food and gasoline. On the oil scene, the next event on the horizon is not just higher prices but shortages. Chances are, they will occur first in the Southeast states because oil exports from Mexico and Venezuela feeding the Gulf of Mexico refineries are down more than 30 percent over 2007.

Perhaps more ominous is the discontent on the trucking scene. Truckers are going broke in droves, unable to carry on their business while getting paid $2000 for loads that cost them $3000 to deliver. In Europe last week, enraged truckers paralyzed the food distribution networks of Spain and Portugal. The passivity of US truckers so far has been a striking feature of the general zombification of American life. They might continue to just crawl off one-by-one and die. But it's also possible that, at some point, they'll mount a Night-of-the-Living-Dead offensive and take their vengeance out on "the system" that has brought them to ruin. America has only about a three-day supply of food in any of its supermarkets.

The yet-more-ominous thing here is that shortages of food and oil are two fiascos that are pretty clearly predictable for the second half of the year. That's bad enough without figuring in the "unknowns" that could kick up American hardship a few more notches.The hurricane season just got underway -- obscured for the moment by the bigger weather story in Iowa. The fate of the banks is a train wreck still waiting to happen. As it occurs -- also heading into the high political and hurricane seasons -- we could find ourselves not only a nation wet, hungry, and out-of-gas, but also completely broke. I'm sorry that Tim Russert will not be here to talk us through it all.

April 28, 2008
Belief System

A friend asked me how come the public apparently grasps the reality of climate change but can’t seem to wrap its collective brain around the unfolding oil crisis.

I'm not convinced that the public does grasp climate change. It's perceived, perhaps, as a background story to daily life, which goes on regardless. Are you even sure Hollywood didn't invent it -- and maybe some boob at *Time Magazine* is selling it as though it were really happening?

Few have anything to gain by espousing denial of climate change. It's hard for most people to tell if they have been affected by it. It doesn't quite seem real. Those who actually make gestures in the face of it –- screwing in compact fluorescent lightbulbs, buying Prius cars -- end up appearing ridiculous, like an old granny telling you to fetch your raincoat and rubbers because a force five hurricane is organizing iself offshore, beyond the horizon.

The public appears aggressively clueless about the peak oil story. They do not accept any threats to the motoring regime. The news media is surely not helping sort things out. I saw a remarkable display of ignorance on CNN last week when the new resident idiot-maniac Glenn Beck hosted Teamster Union boss James Hoffa and they agreed that the oil companies were to blame for high fuel prices. To put it as plainly as possible, Beck doesn't know what the fuck he's talking about, and it's disgraceful that CNN gives free reign to this moron to misinform the public. It's perhaps equally amazing that Hoffa doesn't know we have entered a permanent global oil crisis based on demand having outrun supply. These two idiots think that if Exxon-Mobil built a new refinery down in Louisiana, everything would be fine, diesel fuel would go back down to 99 cents a gallon, and it would be Christmas every morning.

This has been a pretty remarkable month, actually, with all the problems of "The Long Emergency" accelerating impressively. Oil is now testing the $120 mark, the airline industry is imploding (largely over fuel costs), the housing scene has reached a degree of collapse unseen since the 1930s, food shortages have strayed out of the Third World and begun to affect Japan and the USA, bats are dying of a mysterious disease in the Northeast, and the Arctic sea ice is shrinking away to nothing.

We're in a strange collective psychic bubble. We'd like to forget about all these troubling rumors of hardship and bad weather and just get on with the daily task of making a living and paying for stuff and enjoying our customary entertainments. The comforting ceremonies of everyday life seem to continue. The freeways are still full of cars. Nancy Grace comes on TV dependably at 8 p.m. and is there deploring the latest pervert arrest. The baseball season has ramped up and the teams are criss-crossing the nation in their chartered airplanes. The stock market is actually going up -- what's wrong with that?

But there's an equally eerie vibe out there that things are seriously out-of-whack. We're on the edge of something. We're at the entrance of a dark passage where some of the ceremonies of daily life meet resistance. You go to the WalMart and five of your six credit cards are refused. Uh oh. It begins to dawn on you that you're spending a quarter of your take-home pay filling up the gas-tank every week. There's no dial tone when you pick up the telephone. How could all the supermarkets in town be out of rice? The local hospital just declared bankruptcy. The neighbors down the street auctioned off all their furniture in the driveway last week. Why does the cat pick up so many ticks these days?

Events are not through with us this year. They'll keep moving where they will whether we believe in them or not. I'm hardly even convinced that it matters who wins the presidential race this year. It could end up being the world's biggest booby prize.

February 11, 2008
Burning Down the House

Behind all the blather and bullshit about the Federal Reserve's rescue gambits and the machinations of the ratings agencies, and the wiles of foreign sovereign wealth, and the incomprehensible mysteries of markets, and the various weather forecasts of a gathering "recession" is the simple fact that the USA is a way poorer nation than we imagined ourselves to be six months ago. The American economy has been running on the fumes of "creatively engineered" finance (i.e. new-and-improved swindling) for years, and now these swindles are unraveling. In their aftermath, they leave empty wallets, drained bank accounts, plundered retirements funds, boiled away capital reserves, worthless stocks, bankrupt companies, vandalized housing tracts, ruined families, and Wall Street executives who are still pulling down multimillion-dollar pay packages despite running their companies into the ground.

We're burning down the house and kidding ourselves that there is a remedy for it. All the rate cuts and loans to big banks and bank-like corporate organisms, and "monoline" bond insurers, and mortgage mills amount to little more than a final desperate shell game to conceal the radioactive pea of aggregate loss. The losses are everywhere, and when you add up seven billion here and eleven billion there they probably amount to something like a trillion dollars in sheer capital evaporation -- not counting the abstract "positions" that the capital was leveraged onto by the playerz and boyz who mistook algorithms for productive activity.

The shell game may run a few more weeks but personally I believe the timbers are burning. The losses are no longer "contained" or concealable. A consensus has now formed that we're in for a "recession." The idea is that, yes, this seems to be the low arc of the business cycle. Fewer Hamptons villas will be redecorated in the interim. We'll gird our loins and get through the bad weather and when the sun shines again, we'll be ready with new algorithms for new sport-with-capital.

Uh-uh. Think again. **This is not so much financial bad weather as financial climate change. Something is happenin' Mr Jones, and you don't know what it is, do ya? There has been too much misbehavior and it can no longer be mitigated. We're not heading into a recession but a major depression, worse than the fabled trauma of the 1930s. That one occurred against the background of a society that had plenty of everything except money. Back then, we had plenty of mineral resources, lots of trained-and-regimented manpower, millions of productive family farms, factories that were practically new, and more than 90 percent left of the greatest petroleum reserve anywhere in the world. It took a world war**

to get all that stuff humming cooperatively again, and once it did, we devoted its productive capacity to building an empire of happy motoring leisure. (Tragic choice there.)

This new depression, which I call *The Long Emergency*, will play out against the background of a society that has pissed away its oil endowment, bulldozed its factories, arbitraged its productive labor, destroyed both family farms and the commercial infrastructure of main street, and trained its population to become overfed diabetic TV zombie "consumers" of other peoples' productivity, paid for by "money" they haven't earned.

There is a theory (see **NOURIEL ROUBINI'S BLOG**) that a reform process will now ensue in the financial realm, new regulation and oversight of the same old familiar activities. This too, I'm afraid, will prove to be wishful thinking. The financial system will not be reformed until it lies in smoking wreckage, and when that "re-form" happens the armature of the re-organizing society will barely resemble the one that the previous burnt-down-house was designed to dwell in. Among other things, it will not support capital enterprise at anything like the scale that we became accustomed to lately. Globalism will be over. The great nations of the world will be scrambling desperately for the world's remaining oil supplies. It will not be a friendly contest, and anyone who thinks that current trade relations and capital flows will continue despite that is liable to be disappointed. (Are you reading this Tom Friedman?)

Long before the mathematical projections of oil depletion play out, the oil markets themselves -- and all the complex operations that they comprise, such as drilling and exploration, and the movement of tankers around the planet -- will destabilize and seize up. We will no longer be any oil exporter's "favored customer." Many of the exporters will enjoy watching us suffer. Contrary to the political platitude-du-jour, the USA will never become "energy independent" in the way we currently imagine. Rather we'll become energy independent by being deprived of imported oil, and we'll be thrown back on our own dwindling supplies -- which means that we're not going to run our system of daily life the way it has been set up to run. When Americans can no longer run their cars on a whim, they will simply go apeshit and you can kiss normal politics goodbye.

The financial system that emerges from this cataclysm, and the economy it serves (which is supposed to be the master of its capital deployment "arm," not its servant) will likely be modest to a degree that will shock and embarrass everyone currently connected with what we have lately called finance. If it even trades in paper, that paper will have to stand for something based in reality, either a productive activity or a genuine asset. It may take decades for this society to even regain the confidence necessary to operate such an elementary system -- or it may not come back at all, at least as far as the horizon lies before us. That's how bad the mischief and the damage has been.

It's not hard to understand why the Bernankes, Paulsons, Lawrence Kudlows and other public representatives of capital keep pretending that everything is under control. On the other side of their pretenses lies disorder and hardship. One wonders, of course, what they really see in their private minds' eyes. Do they actually believe that the statistics issued by their serveling agencies amount to a plausible picture of reality? Are they so lost in their fantasies of "management" that they think they're controlling events?

My guess is that their credibility is spent. In the weeks ahead, nobody will know who or what to believe. We may even run out of questions to ask as we just all collectively stand there in a thrall of wonder and nausea, watching the nation's financial house burn down.

From: Mark Robinowitz
To: Columbia River Crossing;
CC:
Subject: toxic cement - for Columbia River Crossing DEIS comments
Date: Tuesday, July 01, 2008 4:34:04 PM
Attachments:

The Columbia River Crossing needs to disclose whether the concrete that would be used by this project will be using toxic wastes as a feedstock or not, and what the full impacts of the cement / concrete production would be.

www.metrotimes.com/editorial/story.asp?id=8372

10/19/2005
12 years ago this week in Metro Times: Monte Paulsen follows a group of Greenpeace "commandos" as they hang an anti-incinerator banner on the 250-foot-tall smokestack of the Lafarge cement plant in Alpena. The story covers loopholes in environmental law that allow 90 percent of the country's chemical waste to be burned in large cement plants rather than in specialized hazardous waste incinerators.

Published in Detroit Metro Times, 1993.
Behind enemy lines with the granola commandos
By Monte Paulsen
Staff Writer

[note: this article is no longer available from the Detroit Metro Times website and the personal website of the author is not on line anymore. Fair Use only.]

Thunder Bay was silent that morning -- except, of course, for the familiar rumbling of the giant Lafarge cement plant in Alpena -- and desolate, too, except for the white minivan parked near its northern shore. Inside the van, all that could be heard was the heavy breathing of the Greenpeace warriors who had come to raid the plant.

A walkie-talkie broke the silence at 04:30.

"Beth to Carlos. Come in. Over."

The van's driver responded. "Carlos here. Go ahead. Over."

"This place is really dead. Are you ready? Over."

The driver looked around at the men and women crouched in the van. They wore loose, dark clothes and held blackened rucksacks filled with everything from climbing gear and custom radios to Baldy Eagle and Woodsy the Owl costumes. They nodded.

"Yeah. We're ready," said the driver.

"Well, birds, I say we do it," crackled the radio.

The van rolled up the narrow gravel road with its lights off. The climbers rechecked their shoelaces and climbing harnesses. Then, barely visible in the moonlight, something appeared directly in front of them.

"Deer!" someone yelled. It was 10 feet in front of the van.

The driver hit the brakes. The deer leapt into the bushes. The people resumed breathing.

"It's OK. It's OK," said the man clutching a Smokey the Bear costume, as much to himself as anyone else. "It's a good omen."

The van crested the hill and sped toward the well-lit plant. Its wheels spun in the loose gravel as the van pulled a quick U-turn and slid to a stop alongside a chain-link fence.

The sliding door flew open with a "whoooosh."

Bitter cold air rushed in as the Greenpeace commandos scrambled out, leapt the fence and charged toward the giant, ever-rumbling ovens that release more than a half-million pounds of potentially toxic waste every year.

Alpena is a city that greets its visitors with a giant yellow smiley face painted on a water tower at the edge of town. How this friendly city became host to the largest hazardous waste incinerator in Michigan is a sad story of good intentions betrayed by congressional confusion and corporate self-interest.

The story begins with passage of the 1976 Federal Resource Conservation and Recovery Act --- better known as RCRA, which jargon-savvy bureaucrats pronounce "rickra."

Ever since the industrial revolution, hazardous wastes have been created in ever-increasing quantities. They range from exotic manufacturing chemicals to used motor oil. Until RCRA, most of these were simply buried. But the discovery that hazardous waste dumps like Love Canal were oozing into community drinking water prompted Congress to ban the burial of most raw chemical wastes.

At the same time Congress was drafting RCRA, the mainstream environmental movement was advocating that flammable wastes be "recycled" into energy. So Congress, concerned about the country's dependence on foreign oil, offered an incentive designed to promote the "recovery" of these wastes: Any industry that substituted chemical waste for fuel would be exempt from RCRA's other stringent requirements.

Though this little-known loophole would prove to be worth billions, the cement industry was initially cool to idea. "We tried to generate interest in kiln incineration during the mid-'70s," recalled Thomas Wittman, co-founder of Systech, a company that prepares hazardous waste for use as fuel. "But the cement industry wasn't very interested. Their fuel costs were still quite low."

Congress sweetened the deal in 1980 with an amendment proposed by Alabama Congressman Tom Bevill, the son of a coal miner. The Bevill amendment exempted coal ash and cement kiln dust from RCRA's strict disposal guidelines --- at least until the EPA decided whether or not this dust was hazardous. (Thirteen years later, the EPA has still not made that determination.)

The Bevill amendment gave cement kilns a significant competitive advantage over other waste-to-energy plants seeking to burn hazardous materials. For while commercial waste incinerators --- such as the hotly protested Waste Technologies Inc. plant in East Liverpool, Ohio --- were required to pay upwards of $1,000 a ton to dispose of their ash in sealed landfills, cement kilns could dump their waste on site for free.
In 1984, Congress once again amended RCRA, this time to require that any waste-burning cement kiln located in a city of 500,000 or more people meet the more stringent rules placed on commercial hazardous waste incinerators. The amendment was offered by Dallas-Fort Worth Rep. Martin Frost, who was then battling a cement maker in his district.
Through these seemingly unrelated acts --- and despite of a growing body of evidence that the emissions from waste-burning cement kilns would prove hazardous to human health and the environment --- Congress created a situation in which the most cost-effective way to dispose of the nation's five million tons a year of liquid hazardous waste was to burn it in small-town cement kilns such as Alpena's.
Today, about 24 of the nation's roughly 110 cement plants have "interim status" operating permits that allow them to burn hazardous waste.
Ninety percent of the liquid hazardous waste and two-thirds of the sludge and solid hazardous waste incinerated in this country is burned in cement kilns, according to an EPA source.
And through it all, the cement industry has managed to keep the facts about this multibillion-dollar loophole a secret from the vast majority of citizens, lawmakers and even environmentalists.

Xeroxed maps, spiral notebooks, a dozen photographs of the cement plant and a half-eaten pizza lay scattered across a table at the campground where the Greenpeace commandos bivouacked on the eve of their attack.
There were six of them altogether: a three-person climbing team, a ground support person, an action coordinator and a campaign coordinator. The climbers were Mabel Olivera, a phone canvasser in

Greenpeace's Chicago office; Bill Busse, head of the St. Paul office; and Karen Hudson, a Michigan native who directs Greenpeace's Ann Arbor office. Bob Lyon of the Chicago staff was to support them from the ground.

Coordinating the action was Beth, a member of Greenpeace's direct action team. The only member of the team who does these sorts of law-breaking actions full-time, Beth did not want her last name used. It was her job to plan the action, to ensure the safety of her climbers and to uphold Greenpeace's code of nonviolence.

Coordinating media coverage and driving the van was Charlie Cray, a midwest organizer with Greenpeace's U.S. toxics campaign.

The ragtag team had spent the past two days rehearsing their maneuver in Ann Arbor. Beth drilled them until they were able to exit the van, hop an 8-foot fence and enter the tube that runs up the stack in less than 45 seconds. While climbing a smokestack and hanging a banner is nowhere near as risky as some of Greenpeace's famous high-seas actions, the team was nonetheless prepared for the worst. During a similar Florida action, climbers were threatened with gunfire.

During the final late-night hours before their departure, the team reviewed everything from what to eat to how to deal with the backwash of a helicopter. At the next campsite over, a group of hunters were laughing loudly while drinking beer and cleaning their guns. Beth and her team spoke in whispers as they prepared to go into battle armed with nothing more dangerous than a granola bar.

By 2:30 a.m., the granola commandos were finally ready to deploy.

Cement is made pretty much the same way it was when the Huron Portland Cement Company built its first kiln on the eastern edge of Alpena in 1908.

Limestone is taken from the quarry --- an awesome hole that's now more than a mile across and almost 200 feet deep --- is crushed and mixed with shale. The blend is fed into a long, cylindrical kiln and heated to 2700 degrees Fahrenheit, at which point the rock melts into a new material that cement-makers call "clinker." The clinker is then ground with gypsum to make cement, which is mixed with water, sand and gravel to make concrete.

But the business of making cement has changed dramatically.

National Gypsum bought the sprawling plant in 1957, and ran it for almost 30 years. But during the early '80s, the cost of the fuel needed to fire Alpena's five aging kilns rose sharply at the same time the demand for cement dropped in troubled cities like Buffalo, Cleveland and Detroit. In 1986, National Gypsum closed the plant and laid off all 640 employees.

The Lafarge Corporation bought the plant and quarry in 1987. Lafarge, the U.S. subsidiary of a Paris-based multinational corporation with annual sales in excess of $5.5 billion, was primarily interested in National Gypsum's network of Great Lakes distribution terminals, but took the aging Alpena plant as part of a package deal.

Lafarge began cutting operating costs at Alpena immediately. It imported new managers and rehired only 180 of the local employees, busting the union in the process. And Lafarge claims it has already spent nearly $100 million dollars to modernize the aging plant. Among these improvements was the addition of a rail terminal to receive tank cars of hazardous waste.

Lafarge had purchased Systech Environmental Corporation --- the alternative fuels company started by Tom Wittman --- in 1986. With the acquisition of Ohio-based Systech, Lafarge became the only cement producer to be vertically integrated into the hazardous waste disposal business. Systech and Lafarge quickly upped the quantity of hazardous waste being burned at Alpena.

Two of Lafarge's five Alpena kilns burned 12.8 million gallons of flammable hazardous waste last year, according to Systech Site Manager Gil Peterson. Lafarge has applied for permits to burn hazardous waste in its other three kilns. If approved, the Alpena plant would become the largest hazardous waste-burning facility in North America.

Most of the hazardous waste burned at Lafarge is used auto paint and industrial solvents. During 1992, these were shipped to Alpena came from as far away as Alaska, according to Systech shipping manifests obtained from the Michigan Department of Natural Resources (MDNR). About 37 percent of Alpena's waste was imported from Canada.

Roughly 26 percent of the waste burned in Alpena was supplied by three Detroit-area waste blenders --- City Environmental, Michigan Recovery Systems and Nortru, Inc. These companies collect hazardous wastes from many smaller companies, mix them together in a big blender and pay Systech to take the resulting witches' brew.

City Environmental, for example, took hazardous waste from more than 900 sites in 1992, according to the MDNR records. These ranged from auto body shops and small manufacturers to Boblo Island. And though some providers may have been under the impression that City Environmental was "recycling" those wastes, in fact a full 80 percent of the 2,585 tons of liquid hazardous waste listed on City Environmental's manifest wound up in Systech's hands.

Over the course of a year, there's more hazardous waste shipped to Alpena each year than there was oil spilled in Alaska by the Exxon Valdez.

Though Bill Busse had studied the reconnaissance photos of the Lafarge stack, he didn't get his first good look at the 250-foot monster itself until just before he leapt out of the van.

"That thing is huge," he gasped.

Karen and Mabel made it to the base of the stack ahead of him, and started up the tube. Bill was right on their heels, but he was having problems with his harness. About a quarter of the way up, he stopped to adjust it. In order to retie his harness, he had to remove his pack. And while he was struggling to fix the harness in the dark, his pack slipped and fell 70 feet to the ground.

Bill had no choice but to climb back down after it. Karen and Mabel

continued climbing, looking like ants against the giant structure.
By the time he got to the bottom, Bill was already tired. He was still having problems with his harness. And he was scared that his presence there would attract attention to the two women above him.
Beth, who was lying in the bushes across the road, made a command decision. She sent Bob over the fence to take Bill's place. Within a minute, Bob and Bill had traded packs, Bob was on his way up the tube and Bill was scurrying back across the road to join Beth in the brush.
Karen, still working her way up the stack, saw a figure approach the tube and radioed Beth.
"We've got a person at the bottom. Over."
"It's OK Woodsy," said Beth. "Smokey's on his way up. Over."
Once Bob was halfway up, he and Mabel fastened a barricade across the tube in order to prevent anyone from following them. By 6 a.m. the barricade was in place and the climbers were safe. Within minutes, the first light of dawn began creeping across Lake Huron.
Beth's cheered them from the bushes: "Way to go, birds!"

The inside of a cement kiln is the closest thing to hell on earth. Fire rushes everywhere at once, gasping hungrily after every last breath of oxygen foolish enough to enter its frenzied domain. Limestone glows red hot. And in Lafarge's Alpena kilns, waste oil ignites on arrival and forms a swiftly flowing fountain of bright white fireworks within a 17-foot-wide tunnel of flame.
It's hard to imagine anything surviving this place. But the fact is: everything that goes into one end of a cement kiln comes out the other. Greenpeace and other environmental groups claim cement kiln emissions pose serious threats to human health and the environment. Lafarge and the cement industry insist kiln emissions are safe. There are four basic categories of kiln emissions:
Cement kiln dust, or CKD, is the closest thing to "ash" that comes out of the kiln. Heavy metals from the hazardous waste have been proven to accumulate in the CKD. And a 1992 EPA survey of 15 cement plants

found that CKD from kilns that burned hazardous waste contained highly carcinogenic dioxins that CKD from non-waste-burning kilns did not.

Lafarge produces about 1,200 tons of a CKD a day, and dumps it back into the quarry.

Fugitive emissions; are simply airborne CKD. Cement-making has always been a dusty business, and Alpena has always been a dusty town. The plant itself is covered with a thick layer of what looks like grey frost, but is actually 80 years of layer upon thin layer of hardened CKD. This layer, which covers buildings, cars, chain-link fences and even living plants, gives the facility an other-worldy appearance. If the dust is toxic, so is everything else.

Lafarge, which handles more than four million tons of finely ground powder every year, says it's inevitable that a little will blow away. Plant officials and townspeople agree that far less dust has blown through town since the installation of new CKD conveyor systems.

Stack emissions; usually blow east, across Lake Huron. The opaque yellow plume can be seen for miles.

In theory, the 2700 degree kiln is ideal for disposing of dangerous materials such as chlorinated hydrocarbons. Lafarge and other cement kiln operators claim that unearthly heat renders toxic materials safe before releasing them into the environment. Commercial hazardous waste incinerators, by comparison, rarely operate above 1800 degrees Farenheit.

But temperature is not the only factor.

"The high temperature does accelerate the destruction of organic compounds," says Washington-based environmental consultant Ed Kleppinger. "But in a cement kiln, the temperature is in the wrong place. It's at the front end of the kiln. You want it at the back, to finish off anything not already destroyed."

Finally, the cement itself carries a portion of the hazardous waste out of the kiln.

Little is known about the risks of toxic cement. The cement clinker

spends an average of six hours in direct contact with hazardous waste, but the cement itself is not tested by either the plant, the MDNR or the EPA. Why not? Because RCRA only requires testing of emissions designated as waste. The cement is a product.
The only known study of cement toxicity was recently completed by a cement industry trade group. That study, which ignored organic compounds such as dioxin, found that levels of toxic heavy metals such as chromium were twice as high in cement produced in waste-burning kilns. Chromium has been linked to lung cancer among cement masons.
"There are potential health consequences," says Dr. Kleppinger. "But for the most part we just don't know. My view is that until we know more, we should label all cement made in hazardous waste kilns." That idea was recently rejected by the cement industry.
The industry admits that cement from waste-burning kilns does contain higher levels of heavy metal, but, as with the all other kiln emissions, they insist that the resulting risk to human health is insignificant.
However, if at some point in the future the EPA should decide that risk is significant --- as it did after asbestos was widely used for decades --- the potential exposure is enormous. Most public water systems are built entirely of cement pipe; and cement is used heavily in the construction of hospitals, schools and other public facilities.
The cost of replacing the 70 to 80 million tons of cement poured in the United States each year would make the billions of dollars currently being spent to remove asbestos look like small change.

Shortly after sunrise, a closed-circuit television monitor mounted inside the plant's windowless control room provided Lafarge's first glimpse of the granola commandos atop its tallest stack.
Plant Manager Guy Nevoret, a career Lafarge man with a distinctive French accent, heard the news about 9 a.m. --- after a reporter from the Alpena News called. He was not surprised. "They'd been promising to do something like this for some time," he said.
An hour later, Nevoret and plant PR man Carl Just met with the

Greenpeace team coordinators. Nevoret said he was concerned about the climbers' safety, and requested they come down. Greenpeace declined the invitation.
"They wanted to make a show for themselves," said Nevoret. "They wanted to hang their banner and attract the media."
Nevoret did not want the media attention. So he decided not to press charges. Not everyone else in the gathering crowd was as hospitable. A few plant workers cursed the climbers, and among the chatter overheard on the local police radio was an offer --- made in jest --- to "shoot them down."
But beneath Nevoret's cool demeanor lay a quiet sadness.
He is proud of Lafarge's environmental record, and convinced that the plant's emissions pose no threat to human health. Industry studies have found that an individual would receive more exposure to carcinogens by once filling the gas tank of his car than he would from a lifetime spent living downwind from a hazardous waste incinerator.
Also, he has worked hard to make Lafarge a good neighbor to Alpena. Nevoret estimated the plant gives up to $120,000 a year to local charities, on top of employee donations through the United Way.
"Ninety-nine percent of the people in the community support this plant," he said.
"These fellows from Greenpeace simply do not understand the facts," said Nevoret. "I'm convinced --- absolutely convinced --- that they have no reason to take these actions."

In the federal regulatory void created by RCRA, the Michigan Department of Natural Resources was left to deal with Lafarge on its own. And when the EPA finally did become involved, it allowed the MDNR to lead enforcement efforts at Alpena.
The MDNR has cited Lafarge for a wide variety of violations of air, water and waste violations during the past several years. But recent changes within the MDNR appear to be weakening the department's enforcement efforts.

Since 1991, the MDNR has held that when Lafarge began burning hazardous waste as fuel, its CKD became a "special waste" and must be placed in a lined landfill. The limestone quarry to which Lafarge returns its CKD sits close to and 50 feet below of Lake Huron. The MDNR is concerned that heavy metals and toxic chemicals will leach out of the CKD and into the water table. CKD has contaminated ground water at two other cement plants, both of which are now Superfund sites.
Lafarge has thus far ignored the MDNR's requests that it do something else with the CKD. Throughout a long paper trail of notices, violations and related correspondence between Lafarge and MDNR, the company has variously maintained that it is exempt from state regulations, that the CKD is inert and therefore not subject to the regulations, that the company did not understand the regulations, or that penalties are inappropriate until the CKD is proven hazardous.
The rapidly growing CKD dump prompted the MDNR's Gaylord office to nominate the Lafarge site for placement on the state's "Act 307" list of contaminated sites, as required by the Michigan Environmental Response Act. Field staff from that office found large quantities of lead, sulfate, chloride, arsenic and organic compounds in Lafarge's CKD. In April, the Gaylord office gave the plant a preliminary score of 47 of a possible 48 points, placing it among the worst five of more than 3,000 contaminated sites in the state.
And in a letter dated July 1, MDNR waste division head Jim Sygo accused Lafarge of knowingly violating state law by continuing to dump the CKD "without a permit, license or other disposal authorization."
Sygo further noted that Lafarge was profiting from its willful violation of state law. "We calculated the cost of tipping fees for disposal of 1,200 tons a day of CKD at a licensed Act 641 Type II landfill in the northern Michigan area," wrote Sygo. "This cost alone exceeds the $10,000 per day" maximum penalty for breaking the state law.
That it would cost Lafarge less to pay the fines than to obey the law explains plenty about the company's foot-dragging approach to the

MDNR, and calls into question whether the state laws are anywhere near tough enough.

But Lafarge has yet to pay a single penny in fines. And a growing number of Alpena residents have called into question whether the MDNR is tough enough on Lafarge. They complain that Lafarge and the MDNR have spent years haggling over what to do with the kiln dust, and there is no deadline for these negotiations to be concluded.

Even more surprising was the Oct. 5 revelation that the Lafarge site had been removed from the Act 307 list by an order from Lansing. MDNR Regional Director Don Inman said that Lafarge was only dropped from the list until negotiations concerning the disposal of the CKD are completed.

But sources inside the MDNR --- who asked not to be identified for fear of retribution --- said this is but the latest of many moves by Governor Engler-appointed brass to circumvent state law and put the interests of private businesses ahead of the public health.

Toward noon, a steady stream of local residents and area newspeople began dropping by to see the spectacle. Among the first of these was John Pruden, the co-founder of the Huron Environmental Action League, better known as HEAL.

Pruden showed up dressed to kill --- literally. He was ready to go hunting when he heard about the action. He showed up wearing cheap boots, faded camouflage pants, a black T-shirt and striped suspenders. With a video camera in one hand and a giant bottle of Diet Pepsi in the other, the red-bearded Pruden looked like a discount-store Rambo.

"Look, I'm not one of these tree huggers," he said, by way of introduction.

Pruden is one of the many local residents who were shocked to learn in 1991 that the plant had been burning hazardous waste since the mid-'80s. In 1992, HEAL turned out almost 1,000 of the town's 12,000 residents to a public forum. Since then the 500-member group's activities have ranged from buying a billboard that warned tourists about the plant to convincing the local school district to stop taking kids on plant field trips.

Pruden, who lives on Devil's River, has been hunting and fishing in this area for most of his 47 years. He believes the wildlife is changing as a result of toxic pollution. He often finds large tumors in the fish he catches. He said that these changes, plus the plant's secrecy, turned him into an activist: "The injustice of it all just blew my mind."

Pruden did not initially support Greenpeace's decision to protest Lafarge. He and other HEAL members worried that the backlash against out-of-town agitators would harm the local work they were doing. Greenpeace launched the action against HEAL's wishes.

"I changed my mind after I heard about the 307 site," said Pruden. "It's like doublespeak. One day the place is hazardous, and the next, it isn't. Not because the place is any different. Just because some asshole in Lansing says so."

Pruden wondered aloud if it might be time for HEAL to change its tactics.

"We've worked within the system. And look what it got us," he said. "They own the system. They own the chamber of commerce. They own the City Council. They own the local media...

"Lafarge spends a lot of money. They make whores of everybody, and they have contempt for the people they've made whores of," said Pruden. "This is a scandal and a coverup. It's got to be illegal."

But in spite of his cynicism, Pruden, like Rambo, holds on to a stubborn faith. "Somehow, somewhere, someday, somebody is going to hear us."

The EPA's failure to regulate the cement kiln industry has been even more pronounced than the MDNR's. Said Kleppinger, "You have a regulatory agency that, rather than regulate an industry, has promoted it."

The EPA's support of cement kiln incineration goes back two decades. Throughout the '70s, EPA doled out grant money to companies that were studying the use of waste as fuel. Systech, for example, depended heavily on EPA support during its early years. And in 1981, the EPA spent $500,000 on a hazardous waste test burn at the San Juan Cement Company in Puerto Rico.

Emissions of heavy metals and other toxins were evident at that test, and at other cement kilns that began burning hazardous waste. But the EPA ignored these problems, claiming their hands were tied by RCRA loopholes that exempted cement kiln incinerators. In 1984 Congress specifically instructed the EPA to regulate cement kiln incineration.

But by this time, many within the EPA had latched on to cement kiln incineration as an easy fix to the bureaucratic nightmare in which they had become entangled. On one hand, Congress had prohibited the burial of hazardous waste; on the other, every community in which industry tried to build a commercial hazardous waste incinerator was fighting tooth and nail against it, and many were winning. Meanwhile, the waste kept piling up. From the myopic viewpoint of an EPA bureaucrat, cement kilns were the perfect solution --- precisely because their use of hazardous waste had thus far been kept a secret from the general public.

So the Reagan-era EPA joined the foot-dragging parade and took seven years to write the rules under which cement kiln incineration would be regulated. As a result, cement kiln operators were essentially unregulated (at the federal level) --- and therefore free to pollute all they wanted --- until 1991.

And when those long-overdue regulations were finally released, they were astonishingly lax. The combined coal and hazardous waste burned by Lafarge, for example, may legally include up to 4 percent chlorine. This "limit" would presently enable Lafarge to pass through its kilns more than 1.5 million gallons of a chemical known to form dioxins and dibenzofurans. And since the federal rules contain no emissions limits for these by-products, Lafarge can legally release whatever dioxin it created into the air above Lake Huron.

But as lax as these new regulations are, the cement kiln industry has still failed to meet them. More than half of the cement kilns inspected in 1992 by the EPA failed to properly analyze the waste they burned, and

62 percent failed to comply with rules for feeding waste into the kilns. "These violations are with the basic fundamental requirements. They are not with the fine details," stated the document, written by senior EPA staffers. "It appears that some owners and operators may not be taking these rules seriously."

But neither has the EPA, according to EPA hazardous waste specialist Hugh Kaufman. In a scathing May 7 memo to new EPA head Carol Browner, Kaufman described a closed-door meeting between top EPA officials and representatives of the cement kiln hazardous waste industry. Kaufman alleged that "the participants worked on developing a joint strategy to subvert the federal government's enforcement process and procedures regarding the hazardous waste law." Two Lafarge executives were among the 19 industry representatives at the meeting, which was held at EPA headquarters during the final days of the Bush administration.

"No other hazardous waste treatment, storage, or disposal industry receives this kind of indulgent hand-holding and obsequious collusion as does the cement kiln hazardous waste industry," concluded Kaufman's admonition to Browner, "nor should they."

Ten days after receiving Kaufman's latter, Browner announced an 18-month moratorium on new hazardous waste burning permits. Browner also promised a major overhaul of federal rules governing waste combustion and waste prevention, full health-risk assessments of incinerator operations, and new permits requirements on dioxin and metal emissions.

The Greenpeace banner billowed in the strong winds that blew off Lake Huron all afternoon. "Don't foul our nest," it read. "Ban chlorine. Ban the burn. Greenpeace."

The commandos had a quiet afternoon. Bill was snoring in the back seat of the van. But Charlie was busier than he had been all day. Once the climbers were safe and the banner was hung, the action was largely in his hands. Armed with a cellular phone and a notebook filled with phone numbers for everyone from Carol Browner to the local radio station, it was Charlie's job to tell the world what they had done --- and why.

But on this particular day, the world was more interested in the escalation of a war in Somalia and the retirement of a basketball player in Chicago than in the complex reasons that had brought the granola commandos to Alpena. The event received considerable local attention, brief mentions by the regional print and broadcast media, and only a 12-sentence story on the Associated Press wire.

The wire story quoted Charlie once: "It's time for an incinerator moratorium and a ban on the chlorinated compounds that produce dioxin when burned."

Across the street from where Charlie was chatting up one last reporter, the crews of a local ambulance, fire truck and police squad car waited --- just in case --- and argued about Michael Jordan. Since the climbers weren't in any danger and plant wasn't pressing charges, there wasn't much for them to do.

"We ain't gonna do nuthin," said one Alpena police officer. "If they stay up there, we ain't gonna do nuthin. If they come down, we ain't gonna do nuthin. We're just gonna sit here doin' nuthin instead of sittin' in town doin' nuthin."

The money that Lafarge and other waste burning cement makers receive for taking other companies hazardous waste has improved their bottom lines significantly, and has changed the ownership structure of the industry.

Lafarge officials would not say exactly how much they make by burning hazardous waste, though Nevoret estimated that, after expenses, the waste netted the company "about a million dollars a year."

That figure, however, is grossly misleading.

A federal railroad administration shipping manifest inspected by HEAL indicated that Lafarge was paid $168,000 for a single rail car of hazardous waste. At 34,000 gallons per car, that's $4.94 a gallon. This

estimate is roughly consistent with reports of market prices of $800 a ton for hazardous waste.
If Lafarge earned that much for each of the 12.8 million gallons of hazardous waste it claims to have burned last year, then Lafarge and Systech would have made in the ballpark of $63 million last year on waste fees alone.
That's a significant amount of revenue, especially considering that the same plant probably only made something in the order of $126 million for the 2.1 million tons of cement it made. Based on these rough estimates, Lafarge, together with its Systech subsidiary, is making one-third of its gross revenue from the hazardous waste business.
Whatever the exact numbers, the added revenue available to companies that add hazardous waste to their kilns has given companies such as Lafarge a huge competitive advantage over non-waste-burning cement makers. As a result, all of North America's largest cement makers are now in the business of burning hazardous waste -- and they are using the added profits to squeeze smaller cement makers out of the market.
Since 1985, when President Reagan removed anti-trust barriers, Lafarge and four other European cement makers have acquired control of 75 percent of the U.S. cement market.
"What is in store for the U.S. market can already be seen in Canada," where these European cement makers already control 90 percent of the market, and where "cement prices are among the highest in the world," warned Toronto Globe and Mail reporter Jock Ferguson, writing in The Nation. These companies are under investigation by the European Commission for violations of Common Market antitrust laws. Lafarge was found guilty of price-fixing in France, and hit with a $1.5 million fine.
And these monopoly-minded corporations are intent on keeping their U. S. loopholes as long as possible. They have formed a trade group --- the Cement Kiln Recycling Council --- which has been active in trying to weaken the impact of Carol Browner's promised reforms.
The council and the industry are busy working both ends of

Pennsylvania Avenue in their effort to convince Washington lawmakers that their use of hazardous waste is "recycling" and should remain protected.
Cement makers gave away more than $85,000 of soft money to the Democratic and Republican parties during the last presidential election --- divided about equally between the camps --- on top of more than $100,000 in donations by individual executives of hazardous waste-burning cement companies during the past five congressional election cycles.
The industry has taken good care of Reagan-Bush era EPA chiefs ousted by Clinton. Most notable among these is F. Henry Habicht II, Bush's No. 2 man at the EPA, who now pulls down a six-figure salary at Safety-Kleen. As the world's largest handler of automotive and industrial wastes, Chicago-based Safety-Kleen sends huge quantities of hazardous wastes to cement kiln incinerators.
And the industry remains well-positioned to bend a ear now that Clinton is in the White House. **Hillary Clinton is a former member of Lafarge's board of directors --- a work-free job for which she received about $31,000 a year**.
Concludes Dr. Kleppinger, whose consulting clients include commercial hazardous waste incinerators that are being driven out of business by cement kilns, "This is one of the biggest scams of all time."

By dinner time, a crowd of 60 locals had gathered along the road alongside the Alpena plant. The crowd was by no means a representative sample of Alpean residents. Most were members of HEAL.
But neither was the crowd a typical group of environmental activists. These were people who drive big American cars and buy their clothes at Kmart. Most were old enough to be the parents of the Greenpeace climbers. Yet this group stood around for hours, waiting to greet the climbers who were slowing working their way back down to earth.
And every face in the crowd had a story to tell.

"Some nights I lie awake and watch the plume drift across the sky," said a quiet, brown-haired woman.
"This plant is the number one killer we face in this town," said Russ Hoover, a retired mechanic who is running for City Council. Russ handed out buttons and brochures to anyone who would take one.
"I was poisoned here," said a former plant worker, as he yanked up his shirt to show the scars left behind by radiation treatments. He is convinced his cancer was caused by the kiln dust.
"Our doctors, they only treat the symptoms. They don't look for the cause," complained Flora Lahman, a graceful, white-haired woman who is also ill. "And that's what most of the people in this town are doing, too."
The Alpena police confirmed that it was the largest protest they'd seen in a year or so, though it was far from a problem. One young officer, given the thankless job of trying to keep traffic flowing on a stretch of two-lane road where everybody knows everybody else and nobody bothers pulling off the road before starting up a conversation, politely asked an elderly woman to step off the road. "For your own safety, ma'am," he pleaded.
"My safety?" she scowled, pointing up at the stack. "How can I be safe when I have to breathe the air?"
The descending climbers were escorted through the plant and released at a different gate than the one at which this crowd was waiting. Charlie picked them up in the little white van, and drove them around. The van rolled to a stop near the same spot they had leapt the fence that morning. The sliding door flew open with a "whooosh."
And the granola commandos scrambled out to a chorus of cheers and congratulations --- while behind them, the beast rumbled on.

From: Mark Robinowitz
To: Columbia River Crossing;
CC:
Subject: DEIS Comments - Business Week admits Peak Traffic is here, gas price increases are permanent, suburbia is winding down
Date: Tuesday, July 01, 2008 7:12:49 PM
Attachments: 0423_mz_bus.jpg
highway_vehicle_miles_traveled.gif

When my views about "peak traffic" are being echoed (finally) by mainstream media, a paradigm shift can't be too far away.

Fixing the crumbling roads of Oregon will take the remaining decades of the petroleum era. Do we want strong bridges or wider roads connected by cracked bridges? That is the choice of transportation agencies across the state.

http://www.businessweek.com/magazine/content/08_18/b4082000518114.htm

Gas May Finally Cost Too Much

Highway traffic is falling as pump prices climb. Are Americans rethinking their auto addiction?

by Christopher Palmeri

For 20 years now, county workers in Palm Beach County, Fla., have been counting cars with sensors at strategic points along its 4,000 miles of roads. Nearly every year traffic volume has climbed at least 2%. But in 2007 there was a slight decline in the number of vehicles on the roads. This year traffic is down 7.5% through March. "We're seeing a very significant change," says county engineer George Webb. "We're having a good time speculating why."

It's not just Palm Beach. Traffic levels are trending downward nationwide. Preliminary figures from the Federal Highway Administration show it falling 1.4% last year. Now, with nationwide gasoline prices having passed the inflation-adjusted record of $3.40 a gallon set back in 1981, the U.S. Energy Information Administration is predicting that gasoline consumption will actually fall 0.3% this year. That would be the first annual decline since 1991. Others believe the falloff in consumption is steeper than the government's numbers show. "Our canaries out there tell us they are seeing demand drop much more considerably than the fraction the EIA is talking about," says Tom Kloza, chief oil analyst at Oil Price Information Service, a Gaithersburg (Md.) market research firm.

Is oil-guzzling America changing its ways? Some think so, though it's worth noting the U.S. still consumes one-third of the world's annual gasoline output. "It appears we've finally hit the ceiling that's causing the U.S. population to rethink how and where they use their vehicles," says Paul Weissgarber, who heads the energy practice at consulting firm A.T. Kearney.

Just look at the latest auto sales figures. Sales fell 8% overall during the first quarter of 2008, and those of gas-hungry SUVs and pickup trucks dropped off a cliff, down 27% and 14%, respectively. High gas prices are forcing even SUV lovers to shift gears. Fed up with spending $100 five times a month to fill up his Chevy Suburban, Ron Gesquere, an auto parts executive from suburban Detroit, recently bid $10,000 on eBay (EBAY) for a used Mini Cooper S. "I could make the payments on the Mini with the savings in gas," he says.

For years analysts have been surprised that gasoline consumption continued to rise even as prices kept climbing. Now that consumption has finally slowed, it remains to be seen if Americans are driving less just because the economy is doing poorly or if they are altering their behavior in a lasting way. Certainly consumers seem to be at a psychological turning point. Fuel prices are rising faster than incomes and show no sign of slowing down. Being green is trendy, and the war in Iraq has fanned concerns about U.S. dependence on oil from abroad.

Consider, too, that ridership on public transport climbed to a 50-year high in 2007, reports the American Public Transportation Assn., as more companies start to pick up part of the tab for employee commuter costs. (Such corporate subsidies became tax-deductible recently.) And sales of more fuel-efficient cars are up. The shift has not been lost on Detroit's Big Three, which heavily depend on SUV and pickup sales for profits. "Fuel economy as a selling point is absolutely here to stay," says James Farley, group vice-president for marketing at Ford Motor (F). "Our future plans revolve around the idea that gasoline is going sideways and up from here, not down."

A BOOMER SLOWDOWN

Demographic factors may also be driving down gasoline consumption. When the postwar march to the suburbs was in full swing and the nation's highways expanded, gas consumption grew by an average of 4% a year. In more recent years that rate has moderated to 1.2%. A study released in April by the EIA posited that part of the decline could be attributed to falling population growth and baby boomers exiting their peak driving years.

That translates into fewer car sales on a per capita basis. Many analysts have been knocking down their estimates of growth in worldwide oil demand because of weaker consumption in the U.S.

Mind you, it's not yet certain that falling gas consumption is here to stay. Historically, consumption tends to dip during recessions, then rebounds with the economy. "There have really only been a few times Americans have cut back their gas consumption over a long period of time," says Geoff Sundstrom, a spokesperson for the American Automobile Assn. "Those occasions are where you've had high prices and a recession, such as 1974 and 1981. It looks like we're heading into another one of those." EIA researchers expect consumption growth will rise back up to 0.9% next year—though that's still below what the U.S. has averaged so far this decade.

So even if gas consumption does bounce back it's likely to do so at a slower pace. "Consumer habits are pretty sticky," says Adam Robinson, an energy analyst at Lehman Brothers (LEH). "We've seen a long period of high prices that has finally hit the consumer, and now they're going to shift their preferences."

Indeed, some commuters are finding public transport to their liking. Aly Cohen, a 27-year-old financial analyst at Costco Wholesale (COST), first tried taking the bus to work in January. Now, with her employer picking up most of the $63 tab for a monthly bus pass, she has stopped driving to work altogether and cut her gas consumption in half. "It's nice," she says. "I can take a nap or read." Such a shift in commuting habits, if copied on a large scale, may alter U.S. energy consumption in significant and surprising ways.

For more on rising gasoline prices and motorists' reactions, watch a video report atbusinessweek.com/go/tv/gas.

With David Kiley and David Welch in Detroit.

Palmeri is a senior correspondent in BusinessWeek's Los Angeles bureau.

http://www.businessweek.com/magazine/content/08_18/b4082056979063.htm?chan=rss_topStories_ssi_5

Good-Bye, Cheap Oil. So Long, Suburbia?

Author James Kunstler says the Automotive Age is almost history and deconstructs McMansion living

by Mara Der Hovanesian

The suburban landscape has been marred by foreclosures and half-built communities abandoned in the subprime aftermath. But James Howard Kunstler, author of a dozen books, including *The Geography of Nowhere: The Rise and Decline of America's Man-Made Landscape*, thinks there's a bigger threat to those far-flung neighborhoods: the scarcity of oil. As Kunstler sees it, oil wells are running dry and the era of cheap fuel is over. Given the supply constraints, he says the U.S. will have to rethink suburban sprawl, bringing an end to strip malls, big-box stores, and other trappings of the automotive era. Kunstler, 59, predicts a return to towns and cities centered around a retail hub—not unlike his hometown of Saratoga Springs, N.Y. But the shift to this new paradigm, he says, will be painful. (Kunstler could be off the mark; he predicted technological Armageddon after Y2K.) *BusinessWeek* writer Mara Der Hovanesian spoke with Kunstler about suburbia, which he calls "the greatest misallocation of resources the world has ever known."

Why has suburban life flourished?
The suburbs were largely products of industrialism. We had a huge supply of oil and cheap undeveloped land, and we decided to become a happy, motoring utopia. It had many practical benefits. The trouble is after a while it became a cartoon of country living.

Why is suburbia now threatened?
Cheap oil is what made suburbia possible. But we'll run into problems with spot shortages. As we get into trouble with these supplies, our economy will suffer. Major instabilities in the system will present themselves much

sooner than we are led to believe. And by that I mean the way we produce food, the way we conduct commerce, and the way we move around.

When will all that happen?

The rise and fall of oil production is asymmetrical. In other words, it'll be a steeper, rockier tumble down than the steady increase going up. My own sense of things is that we will be in very serious trouble inside of five years.

Won't it help to cut back on gas?

I get people who come up to the podium after a speaking engagement to tell me they've just gotten a Prius, expecting brownie points. It's not that we're driving the wrong cars. It's that we're driving cars of any size, incessantly.

What about biofuels?

We will use all of them, probably. But we will be greatly disappointed by what they can do for us. We certainly aren't going to run Wal-Mart (WMT), Disney World (DIS), and the highway system on any combination of solar, wind, nuclear, ethanol, biodiesel, or used french-fry oil.

Isn't it a bit radical to declare game over for Wal-Mart?

It is part and parcel of the suburban predicament. How long can they maintain their warehouse-on-wheels as the price of motor fuels goes up?

How will the U.S. have to adapt?

Virtually anything organized on a grand scale is liable to fall into trouble—government, finance, corporate enterprise, agribusiness, schools. Our gigantic metroplex cities will prove to be inconsistent with the energy diet of our future. I think our smaller cities and towns will be reactivated. We are going to be a far less affluent society.

Does your lifestyle reflect all this?

I live in a classic Main Street town. I've always had a garden. It certainly doesn't provide for all my needs, but for all of my salad and salsa fresca needs, in season. I'm not a survival nut. I'm not squirreling away wheat berries in plastic tubs in the basement. I don't have an arsenal of firearms. I lead a pretty normal American small-town life. Of course, I'm a self-employed author and don't have to commute to work.

LINKS

Down on the Minifarm

Small vegetable and herb farms are sprouting in suburbia, reported *The Wall Street Journal*on Apr. 22. A one-eighth acre plot costs $5,500 to start plus $2,000 more each year, but it can yield $10,000 to $20,000 in annual sales. Environmentalists applaud the practice, which cuts the carbon cost of bringing food to consumers. But some neighbors of minifarms are complaining about bad smells from manure, the article notes.

Der Hovanesian is Banking editor for BusinessWeek in New York .

http://www.businessweek.com/magazine/content/08_18/b4082000049320.htm

NEWS April 23, 2008, 2:32PM EST

Suddenly, It's Cool to Take the Bus

Sky-high gas prices have more commuters switching to employer-subsidized transportation—and loving it

Microsoft's employee shuttle: The airy, Wi-Fi-equipped coaches are wildly popular Rick Dahms

by Michelle Conlin

For years, in-house transportation gurus at companies across the country have been obsessing about how to cajole employees out of their cars. They've handed out mass-transit passes, ordered fleets of luxury coaches, reserved premium parking spots for van pools, and filled locker rooms with toiletries and towels for those who bike to work. They've educated workers about the evils of not only the SUV but the SOV (single-occupancy vehicle). And they've appealed to the corporate drudge's quest for happiness, brandishing research showing that those who travel to work alone in cars are the most miserable commuters of all.

Nothing, however, has done as much for their cause as today's record prices for petrol. Employees who once sneered at the "bus people" or "bike freaks" are clamoring to sign up for all manner of company-subsidized transportation programs. "Every time gas prices rise, I get more and more employees who are taking our car pools or van pools or shuttle buses," says Schering-Plough's (SGP) transportation chief Sheila Gist. This new golden age has Gist in overdrive, scheduling new routes for what has become Schering's own in-house transit system. In the past year alone, Gist says, ridership is up by as much as 40%. Companies are big on breaking the car addiction because doing so raises productivity, amps morale, and delivers much lusted-after green cred.

The surge in oil prices has accelerated the trend. So have new corporate tax deductions for employer-subsidized transportation. Consider what's happening at insurer Safeco (SAF). When the company moved to Seattle last year, it installed commuting concierges to help employees figure out how best to use the company's vouchers for mass transit, shuttles, car pools, and ferries. Free rentals from Zipcar await those who need to run errands during the day. Safeco also encourages its staff to skip the commute altogether by offering free phone and broadband service for their home offices, as well as a furniture stipend with which to decorate. Today, 90% of employees are out of their cars, up from 50% in 2006. The company is aiming for zero-car status. Says Safeco transportation analyst Brady Clark: "We're still working on that 10%."

A PERMANENT SHIFT?

Some companies can't meet the demand fast enough. After Microsoft (MSFT) rolled out a new shuttle-bus service last fall, employees immediately howled for more routes. The plush, Wi-Fi-equipped coaches have become so wildly popular—strategy chief Craig Mundie is a big fan—that when word leaked recently that Microsoft was adding to the service, a group of Microserfs hacked into the reservation system and filled up the new routes before they were even announced. Employee Bryan Keller used to commute alone in his 20-mpg Honda Pilot. "I've regained two hours of my day," he says. Using Microsoft's online "carbon calculator," Keller estimates he's saved $150 on gas and dropped 1,000 pounds of CO_2 from his carbon footprint since he began using the service in October.

The executive in charge of the program, Chris Owens, has watched employee interest in alternatives rise and fall with the price of gas before. But he believes this time is different. "I think people are making lifestyle changes now, permanent changes like getting out of their cars or switching vehicles or just not driving to work anymore," says Owens. "People are starting to believe this is a longer-term situation."

Conlin is the editor of the Working Life Dept. at *BusinessWeek* .

ruckrover•
Apr 26, 2008 4:23 AM GMT•
What is the IQ of a Hummer driver? Do Hummer drivers have social consciences? How much longer can we fail to tax the hell out of big gas-guzzlers to pay for the health costs of air pollution and future costs of global warming or a world where there is not enough oil for essential air transport and shipping, mining and agriculture?

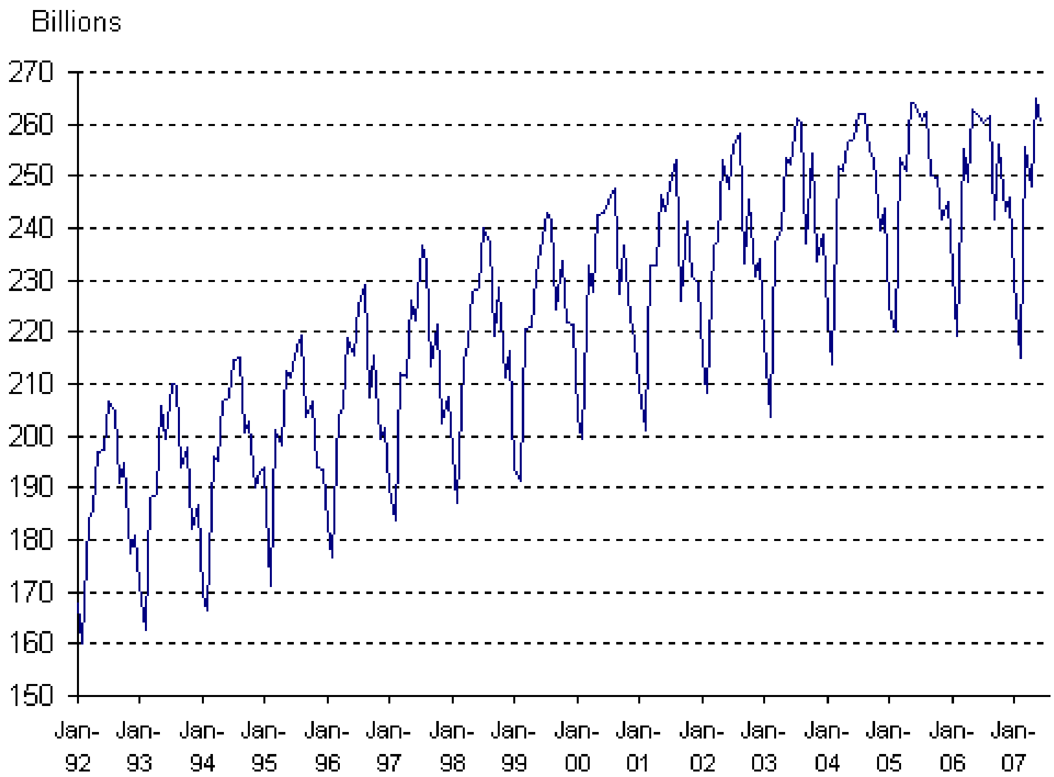
Squeezebox•
Apr 25, 2008 10:12 PM GMT•
The Federal Government is "on the bus" too! Federal employees have had subsidies for bus passes and vanpools for years. It's a nice way to give everyone a "raise" and clean the air too.

Olusegun Mikhail BAYODE•
Apr 25, 2008 9:05 AM GMT•
This is a case of "necessity is the mother of invention". Thanks for the rising pump price. On a serious note, with a well organised mass transit system, vehicular traffic will reduce and our roads will last longer. Road maintenance cost will reduce and more people are moved with less buses compared to cars & SUVs. In Nigeria, Lagos state has a Bus Rapid Transit(BRT) scheme operational presently. But the challenge has to do with consistency in government polices and sustainability. The issue of security will have to be looked into, timing of the arrivals and departures should also be predictable. This is very important especially where most organisations have zero tolerance policies for lateness.

US Department of Transportation
Bureau of Transportation Statistics

chart about "Peak Traffic"
(the BTS doesn't use that term)

Vehicle Miles Traveled	Highway miles (millions)	Percent change from same month previous year
Jun-06	261,657	-0.71
Jun-07	260,340	-0.50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