Three Years
Oil and You

English as a Second Language

Let’s Talk about Future Trends, Predictions and Possibilities of Oil

Compiled by David DuByne

Oil is a subject filled with big words that even native English speakers don't understand, so I have designed this ESL class into easy to read, simplified English, for anyone on this planet to study from. Anyone who's English is good enough to say "I drive a car", "I bought vegetables at the market", "I am cooking dinner" "I go to the store" will understand the main point. Natural gas and oil are now a finite, quantifiable (measurable), limited commodity (product). The following pages will explain that some oil wells in the world are past the half way point in production and each day from now on will give less oil, so many oil fields and wells are declining that new oil being found in our planet is not enough to replace what is being used daily. I leave the politics out of the subject, presenting only documented facts to allow anyone to see the future. The switch to bio-diesel and ethanol has begun. The first part of this compilation explains why the change is taking place, the last part explains what crops will be used and the way forward for these new industries. If you are interested in the subject of oil, want to see some possible investment opportunities or want to be in the right place at the right time. I present to you a crystal ball, so please look into the near future. Future Trends in Oil. Predictions, Possibilities and You.

This is a compendium, a compilation, a collection of articles, theories and ideas about our worlds oil supply and how the world population (number of people) is effected by the price of crude oil. Throughout the text I use parenthesis ( ) next to difficult words with an easier to understand definition for English learners. We use oil in every part of our societies, for delivery of goods, to run our factories, and allow business itself to expand (become larger). Without oil and the products made from it, business can not go on, expand or even remain at the same level (stay the same) for longer that three of four days planet wide.

From the Industrial Revolution up to now we have built a system entirely dependent (100% reliant) on one substance (thing) to power our planet, oil. Sadly no secondary system is in place. World population has grown from 750 million (750,000,000) to 6.5 billion (6,500,000,000) with its use. We use it in machines that plow, plant and harvest vast (very large and wide) fields and at over 100 kmh/ 60 mph deliver food to stores where people that live far away from stores drive to do their shopping. Mining machines dig and separate (break into different parts) metals from the earth that will become finished products. Global (worldwide) shipping now allows us to have strawberries in the middle of winter from a different continent separated by oceans. Containers on ships, boxes in planes and freezers on wheels all use the same substance (material) to get products to waiting customers, oil. Commerce (business) is at light speed, and we all have grown up expecting that the economies of this world will expand forever. Expand forever because oil is cheap and abundant (a lot of something). It has been expected that there will be jobs in 30 years, so banks give loans to buy homes expecting the ever growing economies will provide jobs so the loan can be paid back. But what if this once infinite, inexhaustible (can never finish) cheap resource is suddenly finite, has a limit and is no longer cheap? What if the supply pumped from the ground is not enough supply everyone on earth that needs it at once? This issue (topic) is not about "running out" of oil, it never will be, the issue is about not having enough oil to keep our economies running and forever expanding with 6.5 billion people on earth, and growing. Remember 96 % of transportation uses a crude oil product.

 Global problems require global solutions. Each and every person has ideas and solutions to solve problems, now the internet allows all of us to link together. Feel free to pass along and spread this information about bio-fuels and oil depletion to the world, find out what other people think.

After reading this ESL class about oil, natural gas, bio-diesel and ethanol, if you have any questions, comments or suggestions I would like to hear them. The author David DuByne can be contacted at

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Sincerely,

David DuByne

Feburary 13, 2007

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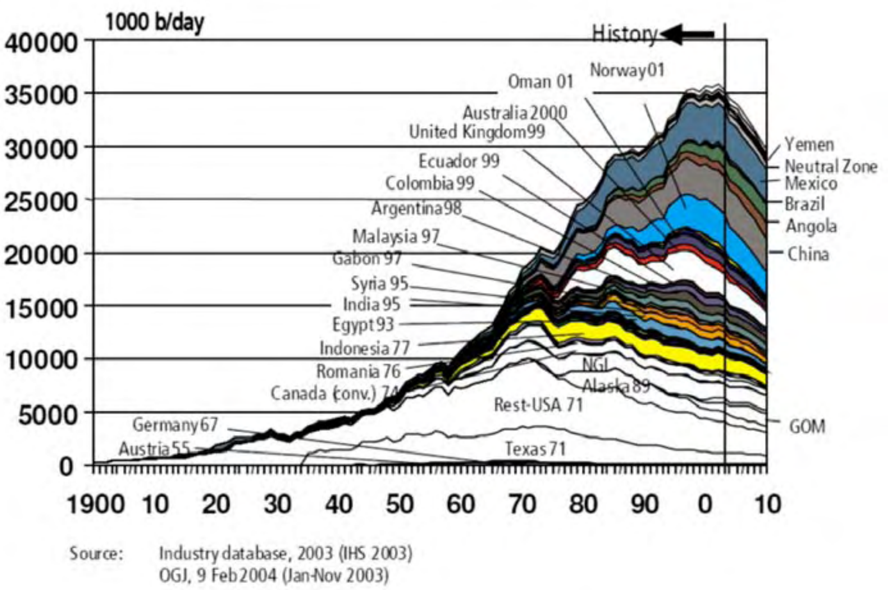
Front Cover Photo
http://www.southlandnz.com/sites/southlandnz.com/images/crops/AW%2006%20Newsletter/oil%20pump.jpg

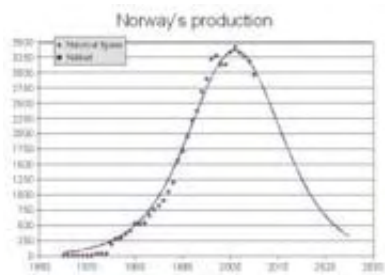
Hubbert Peak Theory



The Hubbert curve, devised by Dr. King Hubbert, is a model of future oil availability (the amount of oil that will be available in the future)**. The issue is not about "running out of oil" it never will be, it's about not having enough oil to keep our economies running and expanding.**

The Hubbert peak theory, also known as "peak oil", is about the long-term rate of extraction (take out of the ground) and depletion (using up at a known rate) in conventional petroleum (oil from the ground that you pump) and other fossil fuels. It is named after American geophysicist Marion King Hubbert, who created a model of known oil reserves (a known place where oil is located) on the planet, and proposed (gave the theory), in a paper he presented to the American Petroleum Institute in 1956, that oil production would peak (reach its highest level) in the continental United States between 1965 and 1970, and worldwide in 2000.

Hubbert, created a model of oil extraction which predicted (told in the future of an event) that the cumulative (total) amount of oil extracted (taken out) over time would follow a bell-shaped pattern now known as the Hubbert curve. The theory implies (says) that the predicted (know in advance) rate (amount) of oil extraction will reach a maximum (highest) level, and then deplete (decrease as more is used).



Above is a graph of Norway's production bell curve. The peak of world oilfield discoveries (find new oil) occurred in 1962. In 2004, 30 billion (30,000,000,000) barrels of oil were consumed (used) worldwide, while only eight billion (8,000,000,000) barrels of new oil reserves were found. In August 2005, the International Energy Agency (IEA) reported annual global (worldwide) demand (want of a product) at 84.9 million barrels per day (mbd) or 31 billion barrels annually (every year).

Chevron has launched the *Will You Join Us* ad campaign, wanting to inform (tell) the public about the possibility of petroleum (oil product) depletion and encourage discussion (exchange ideas). "Fossil fuels (oil and natural gas) currently (now) supply most of the world's energy, and are expected to (predicted to) continue to do so for the future. While supplies are currently abundant (very large amount), they won't last forever. Oil production is in decline in 34 of the 48 largest oil producing countries. More info at: http://en.wikipedia.org/wiki/Peak_oil

Oil Reserves by Country in Depletion

As the amount of oil left is an estimate (best guess), not a known amount, there are many differing (different) estimates for the amount of oil remaining (left) in different regions (parts) of the world. The following table lists the highest (most) and lowest (least) estimates for regions (areas), and countries, with significant (very large if compared to other countries) oil reserves in giga-barrels (billions) as listed here. The large range (highest and lowest amounts) of some country's estimates, Canada in particular, is because of potential (possible) future development (production) of non-conventional oil from tar sands, oil shale, etc. (See pages 45-56 about Tar Sands and Oil Shale)

This chart lists when oil production peaked. Peaking can occur for many reasons, related or unrelated to technical extraction difficulties, (too deep in the earth, too deep in the oceans, too cold in the Arctic) Few discoveries of more accessible oil elsewhere (easier to get at and produce), or changes in regulations (laws). **Being included on this list does not necessarily (only) mean oil extraction cannot exceed the previous (be larger than before) peak production in that country. Tar Sands production in Venezuela and Canada as examples.**

Countries that have already passed their production peak

	Regular Oil (light sweet, heavy sour, deepwater, polar (Arctic)		
State	**Oil Discovery peak**	**Oil Production peak**	**Oil Depletion midpoint**
USA	1930	1971	2003
Mexico	1977	2002	1999
Argentina	1960	1998	1994
Colombia	1992	1999	1999
Chile	1960	1982	1979
Ecuador	1969	2004	2007
Peru	1861	1983	1988
Trinidad and Tobago	1969	1978	1983
Albania	1928	1983	1986
Austria	1947	1955	1970
Croatia	1950	1988	1987
Denmark	1971	2002	2004
France	1958	1988	1987
Germany	1952	1966	1977

Hungary	1964	1987	1987
Italy	1981	1997	2005
Netherlands	1980	1987	1991
Norway	1979	2003	2003
Romania	1857	1976	1970
Ukraine	1962	1970	1984
United Kingdom	1974	1999	1998
Cameroon	1977	1986	1994
Congo	1984	2001	2000
Egypt	1965	1995	2007
Gabon	1985	1996	1997
Libya	1961	1970	2011
Sudan	1980	2005	2009
Tunisia	1971	1981	1998
Bahrain	1932	1970	1977
Oman	1962	2001	2003
Qatar	1940	2004	1998
Syria	1966	1995	1998
Saudi Arabia	1946	2006	2010
Yemen	1978	1999	2003
Turkey	1969	1991	1992
Uzbekistan	1992	1998	2008
Brunei	1929	1978	1989
China	1953	2005	2003
India	1974	2004	2003
Indonesia	1955	1977	1992
Malaysia	1973	2004	2002
Pakistan	1983	1992	2001
Thailand	1981	2005	2008
Papua New Guinea	1987	1993	2007
Australia	1967	2000	2001
Turkmenistan	?????	1973	?????

Above data from the annual British Petroleum Energy Report.

Countries where production can be increased

	Regular Oil (light, heavy, deepwater, polar)		
State	**Oil Discovery peak**	**Oil Production peak (projection)**	**Oil Depletion midpoint**
Venezuela	?????	?????	?????
Brazil	1996	2012	2012
Algeria	1956	2006	2010
Angola	1998	2019	2011
Chad	1977	2008	2014
Nigeria	2001	2009	?????
Iran	1961	1974	2009
Iraq	1948	2015	2021
Kuwait	1938	1971	2018
United Arab Emirates	1964	2011	2026
Azerbaijan	1871	2015	2014
Kazakhstan	2000	2020	2036
Russia	1960	?????	?????
Vietnam	1975	2009	?????
Venezuela	?????	?????	?????
Bolivia	1966	2010	2016

Above data from the annual British Petroleum Energy Report. (See OPEC nations list pg.13)

As oil wells are drilled (oil wells suck oil out of the ground by pumping) and more efficient facilities (better pumps and machinery) are installed (put in place), oil production increases. At some point, a peak output (maximum output) is reached that can not be exceeded (pump more than), even with improved technology or additional (more) drilling. After the peak, oil production slowly but increasingly (more and more) tapers off (drops off). After the peak, but before an oil field is empty, another significant (major) point is reached when it takes more energy to recover, (get out of the ground) transport, and process a barrel of oil (turn into a product) than the amount of energy contained within that barrel. At that point, it is no longer worthwhile (useful) to extract (pump) petroleum for energy - it becomes a resource sink. The EROEI is 1to 1 (1:1) or less. (See next page for EROEI)

Energy Return on Energy Invested (EROEI) (EROI)

This is not about investment dollars, but how much "energy" you must invest (use) to get the oil out of the ground and transported (move from one place to another). In order to acquire (get) energy it takes energy, in order to transport (move) a form of energy it takes energy, in order to store (keep) energy it takes energy, and in order to use energy it takes energy. When oil production first began in the mid-nineteenth century (1850's), the largest oil fields recovered (got back) fifty barrels (50) of oil for every (1) barrel used in the extraction (50:1), transportation and refining (process oil into a usable product). This ratio is often referred to as the Energy Return on Energy Invested (EROI or EROEI). This ratio (comparing A to B) becomes increasingly (more and more) inefficient over time. Currently (now), between one and five barrels (1-5) of oil are recovered for each (1) barrel used in the recovery process.(5:1)-(1:1) The reason for this efficiency decrease is that oil becomes harder to extract (get out) as an oil field is depleted (emptied).

It's all about NET ENERGY, Net energy is how much energy is left after the energy needed to find, concentrate (put together) and deliver its energy services are subtracted. Most alternatives (substitutes) to conventional liquid fuels have very low or unknown EROEIs. The EROEI for Ethanol from corn grown in the U.S. is about 1.4:1, well below that for conventional motor gasoline. The Alberta oil sands evidence suggests an EROEI of 3:1. Certainly oil sands will have a lower EROEI than conventional crude oil due to more resources being used in the production process. Shale oils the same. Sugarcane grown in Brazil apparently has a higher EROEI, perhaps as high as 8:1.

Oil depletion scenarios (possibilities): A global decline in oil production will have serious social and economic implications (effects) without preparation. Global economic growth (economy of the planet increasing) relies on (depends on) cheap energy, and oil contributes to the worldwide energy supply, particularly (especially) for transportation. A decline in energy supply would likely slow, if not reverse, growth. Our world is a Growth Based Economic Model, continuing to grow for ever. More info at http://www.eroei.com/content/view/23/36/

Conversions			
1 thousand cu ft	natural gas	0.175	barrels oil
1 ton	coal	3.883	barrels oil
1 thousand kWh	electric power	1.834	barrels oil
1 tonne	oil	7	barrels oil

Conversion graph source: http://www.theoildrum.com/node/2187#more

** (Note: David DuByne) Our present economic system is built on the concept (thought) of perpetual, limitless (continuing with no limit) growth. Now it appears there is a limit, so there will be a limit on economic growth as well. The present mind frame (way to think about something) of how the monetary (money) system works will have to be re-thought (think of a new way to do something). This will include, stocks, bonds, credit, real estate and currency (physical money).**

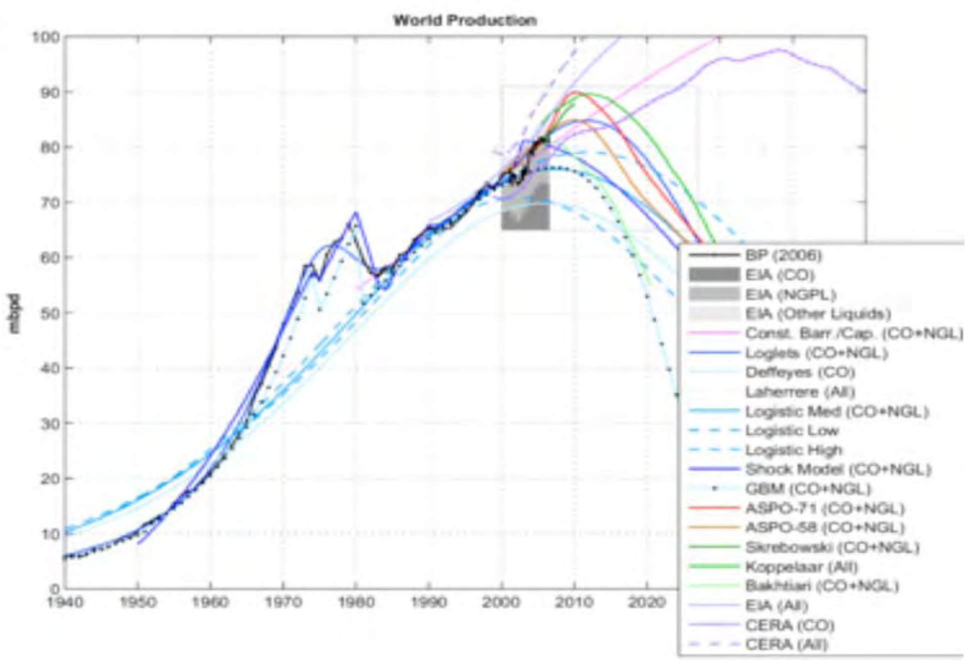
Initially a peak in oil production would manifest itself (show itself) as rapidly escalating (quickly increasing) prices and worldwide oil and commodities shortages (lack of some product). This shortage would differ (be different from) from shortages of the past because the fundamental (base) cause is geological, not political. While past shortages stemmed (came from) from a temporary insufficiency of supply (lack of supply), this will be permanent.

Crossing Hubbert's Peak means that the production of oil will continue to decline. Demand must be reduced to meet supply. World population is based on (depends on) available oil supply, so is the economy, our transportation systems and globalization itself.

It is unlikely that the actual peak in global oil production will be the direct catalyst (cause) of global economic decline. Instead, severe economic problems will be begin with the realization (understanding) of the financial ($) and investment world (stock/bond market/futures market) that "peak oil" (and natural gas) is a real phenomenon (event) and is either imminent (100% sure the event will happen) or has already occurred (happened).

However, the impacts (effects) of peaking oil and increased global competition over scarce (very little left) remaining oil supplies, have led many analysts to predict dire consequences (bad things to happen) for conventional oil-dependent economies (societies that use a lot of fuel for factories or manufacturing and transportation). When common practices cannot be maintained (goods and services on a daily use basis) and too many people suddenly begin hoarding scant supplies (keep for themselves what little is left), the desired (wanted) resource dries up. These effects quickly compound (add to) whatever triggered the crisis (started the problem)." This scenario (set of events) is referred to by Lundberg as Petrocollapse.

PEAK PREDICTION



Maximum Oil Production Before Decline.
Graph in full color at http://en.wikipedia.org/wiki/Peak_oil

The organization, Association for the Study of Peak Oil & Gas (ASPO) predicts that oil production will peak around 2010, but others such as Collin Campbell author of “The Coming Oil Crisis” and Professor Kenneth Deffeyes, author of "Hubbert's Peak" and "Beyond Oil" asserts (says) that the peak was passed on Dec 16, 2005 and both authors have said that global production has already peaked and from the year 2007 onward we will start to see the real effects caused by depletion start around the planet.

Has it happened already?

A number of theorists (a person with their own theory about a subject) believe some peak in world oil production has already occurred. Collin Campbell of (ASPO) has calculated that the global (worldwide) production of conventional oil peaked in the spring of 2004 albeit at a rate of 23-GB/yr (billion barrels), not Hubbert's 13-GB/yr. Another peak oil proponent (a person who agrees on the same subject) Kenneth S. Deffeyes predicted in his book *Beyond Oil - The View From Hubbert's Peak* that global oil production would hit a peak on Thanksgiving Day 2005 Deffeyes has since revised his claim (changed his first idea), and now says that world oil production peaked on December 16 2005. After Hurricane Katrina, Saudi Arabia claimed that it simply could not increase production to make up for the loss of Gulf of Mexico oil rigs (floating platforms that pump oil that is under the sea). Furthermore (additionally), in April, 2006, a Saudi Aramco (oil company in Saudi Arabia) spokesman (person who tells news about a company) admitted that its mature (old) fields are now declining (decreasing) at a rate of 8% per year, and its composite (overall) decline rate of producing fields is about 2%, with this information it is possible that Saudi Arabia has probably peaked.
More info at: http://www.peakoil.net

What is crude oil?

www.chevron.com
Crude oil - petroleum directly out of the ground - is a remarkably (amazingly) varied substance, both in its use and composition (what it is made out of). It can be a straw-colored liquid or tar-black solid. Red, green and brown hues (colors) are not uncommon. In addition, not all crude oils behave in the Hollywood manner (do the same thing) shooting into the air (gusher), some flow about as well as cold peanut butter.

Several historical factors (events at that time in history) changed that. The kerosene lamp, invented in 1854, ultimately created the first large-scale demand for petroleum. Kerosene first was made from coal, but by the late 1880s most was derived (made from) from crude oil (black oil from the ground). Petroleum was used mostly for its yield (total given amount) of kerosene until the turn of the century (100 year period). Gasoline was burned off, and bitumen and asphalt (the heavier parts of crude oil) were discarded (thrown away). But gradually becoming more important were the incandescent light (electric light bulb) and the internal combustion engine (motor engine). The incandescent light relied (depended) on oil-fired generating plants, the internal combustion engine on gasoline.

Geologists generally agree that crude oil was formed (made) over millions of years from the remains of tiny aquatic (water) plants and animals that lived in ancient seas. But petroleum owes its existence (is around because) largely (mostly) to one-celled marine (seawater) organisms. As these organisms died, they sank to the sea bed (sea floor). Usually buried with sand, mud and gravel, they formed a layer that eventually turned to sedimentary rock (sandstone and shale for example). The process (steps to make something happen) repeated itself, one layer covering another. Then, over millions of years (1,000,000), the seas withdrew (went away). In lakes and inland seas, a similar (almost the same) process took place with deposits formed of non-marine (fresh water or dry land) vegetation (plants). Bacteria broke down the trapped preserved plants and tiny organisms, molecule by molecule, into substances (matter) rich in hydrogen (H) and carbon (C) (hydrocarbons). Increased pressure (pushing force) and heat from the weight of the rock layers above caused the organic remnants (leftover plants and tiny organisms), ever so slowly (extremely slowly) to transform (change into), into crude oil and natural gas. The oldest oil-bearing rocks (oil inside the rock) date back more than 600 million years, the youngest about 1 million. However, most oil fields have been found in rocks between 10 million and 270 million years old.

Sub-surface (below the ground) temperature, which increases with depth (the deeper it is the hotter it is), is a critical factor (one of the most important parts) in the creation of oil. Petroleum hydrocarbons (crude oil and natural gas) rarely (hardly ever) are formed at temperatures less than 150 degrees Fahrenheit and generally (usually) are destroyed at temperatures greater than (above) 500 degrees. Most hydrocarbons are found at "moderate" (medium) temperatures ranging from 225 to 350 degrees.

Some crudes (crude oils) from Louisiana and Nigeria are similar because both were formed in similar (same type of) marine environments. In parts of the Far East, crude oil generally (usually) is waxy, black or brown, and low in sulfur. It is similar to crudes found in central Africa because both were formed from non-marine sources. In the Middle East, crude oil is black but less waxy and higher in sulfur. Crude oil from Western Australia can be a light, honey-colored liquid, while that from the North Sea typically is a waxy, greenish-black liquid.

Sweet and Sour Crude

Not all the black gooey stuff that comes out of the ground is the same. Crude oil produced by different fields differs in viscosity (how thick or thin an oil is) and sulfur content (percentage of natural element Sulfur in the oil). The more viscous (thicker and slow flowing) crudes are called "heavier," and those with higher sulfur content are called "sour" as opposed to low-sulfur called "sweet" and thin easy flowing called “light” crude. The heavier and more sour the crude, the more difficult and expensive it is to turn into usable refined products (finished oil product). The price of oil you usually hear quoted is the price of a “light”, “sweet” grade like West Texas Intermediate, Saudi and Middle Eastern types and Brent Sea.

One factor (cause) contributing (adding to) to the dramatic increase (remarkable increase) in the price is a decrease (decline) in the supply of light, sweet crude. The higher quality crude supplies of course get used up first (because it produces a lot of gasoline per barrel), so the world is now increasingly reliant (depending more and more on) on a lower quality product. Over the last five years, the average API gravity of non-OPEC oil production has decreased (crude being pumped is increasingly "heavy") and the sulfur content has increased (crude is increasingly "sour").

Crude oil is classified as **Light, Medium/Intermediate or Heavy**, according to its measured API gravity. API measures the specific gravity of liquids less dense (lighter) than water. Does oil pour like honey, thick or does it pour like water, thin?
Light crude oil is defined as having an **API gravity higher than 31.1 °API**
Medium/Intermediate oil is defined as having an **API gravity between 22.3 °and 31.1 °API**
Heavy crude oil is defined as having an **API gravity below 22.3 °API.**
Oil which will not flow at normal temperatures or without dilution (thinning out with other substance) is named bitumen and the API gravity is generally less than 10 °API. Bitumen derived from (coming from) the oil sands deposits in the Alberta, Canada area has an API gravity of around 8 °API. It is 'upgraded' (made thinner with heat and other chemicals) to an API gravity of 31 °API to 33 °API and the upgraded oil is known as synthetic oil (syncrude).

OPEC's 2005 August Oil Market Report calculates (estimates) that global production of light, sweet crude actually declined between 2000-2004, and peak oil has already passed, at least as far as light, sweet crude is concerned.

The third critical (most important) ingredient is refining capacity (what type of oil and the amount of oil that can be made into other products). British Petroleum (BP) reported that global refinery capacity increased by 1.8 million barrels a day between 2001 and 2004, while global crude production was up 5.3 mbd. Additionally, not enough of this capacity (size and amount) is able to process the increasingly (more and more) heavy and sour crude supplies.
Energy Information Administration (EIA)   August 21, 2005 Report

Classification of different types of crude oils

The oil industry classifies "crude" by the location of its origin (e.g., "West Texas Intermediate, WT I" or "Brent") and often by its relative weight (API gravity or viscosity) ("light", "intermediate" or "heavy"); refiners may also refer to it as (call it) "sweet", which means it contains little sulfur, or as "sour", which means it contains substantial amounts (large amount by percentage) of sulfur and requires more refining to make products from it.

The World Reference Barrels are:
Brent Blend, comprising (made up of) 15 oils from fields in the Brent and Ninian systems in the East Shetland Basin of the North Sea. The oil is landed (taken to) at Sullom Voe terminal (port) in the Shetlands. Oil production from Europe, Africa and Middle Eastern oil flowing (going in the direction of) West tends to be priced off the price of this oil, which forms a benchmark (standard measure). “Brent Crude”

- West Texas Intermediate (WT I) for North American oil.
- Dubai, used as benchmark for Middle East oil flowing to the Asia-Pacific region.
- Tapis (from Malaysia, used as a reference for light Far East oil)
- Minas (from Indonesia, used as a reference for heavy Far East oil)

In June 15, 2005 the OPEC basket was changed to reflect the characteristics (uniqueness) of the oil produced by OPEC members. The new OPEC Reference Basket (ORB) is made up of the following:

- Saharan Blend (Algeria)
- Minas (Indonesia)
- Iran Heavy (Islamic Republic of Iran)
- Basra Light (Iraq)
- Kuwait Export (Kuwait)
- Es Sider (Libya)
- Bonny Light (Nigeria)
- Qatar Marine (Qatar)
- Arab Light (Saudi Arabia)
- Murban (UAE) United Arab Emirates
- BCF 17 (Venezuela)

The price of a barrel of oil is highly dependent (depends on) on both its grade which is determined by factors (points) such as its specific gravity or API and its sulfur content, and location (where it comes from). More info at: http//www.opec.org/home/basket.asp

OPEC Reveal Global Light Sweet Crude Peaked

August 2005 by Chris Vernon

This information on has come to us from the Organization of Petroleum Exporting Countries (OPEC) itself. OPEC publishes (prints) a monthly global (worldwide) market review and the August 2005 issue has data (information) on non-OPEC and OPEC oil extraction (pumped out of the ground) by weight and sulfur content from 2000 to 2004. August 2005 OPEC Monthly Oil Market Report, Page 4.

The key point (most important piece of information) is that non-OPEC light sweet crude went from 41% of 66 mb/d to 34% of 70 mb/d from 2000 to 2004, a drop of 3.25mb/d. OPEC added 1 mb/d of light sweet crude over the same period resulting in a global reduction (shrinking amount) of light sweet crude of over 2mb/d showing that global light sweet crude has peaked (reached maximum production level and then started to decrease) and is now in decline. **Although the total volume (amount) of 'oil' extracted in 2004 compared with 2000 has increased, the proportions (percentage amount) of different grades (types) of oil have shifted (changed).**

Light sweet crude is the most attractive (most wanted) because it is easier to refine (turn into gasoline or other oil products made from oil), global refining capacity (total amount the world combined can turn crude oil into gasoline or other oil based products) is tailored to (custom built for) light sweet crude of which there is now a shortage. This shift (changed from one to the other) in grades (light to sour) has resulted in (caused) a shortage of refining capacity (not enough space) for the available (have right now) medium/heavy sour oil. As oil becomes scarce (less and less available) it is clear that the best stuff will be pumped first, the best stuff is the light sweet crude.

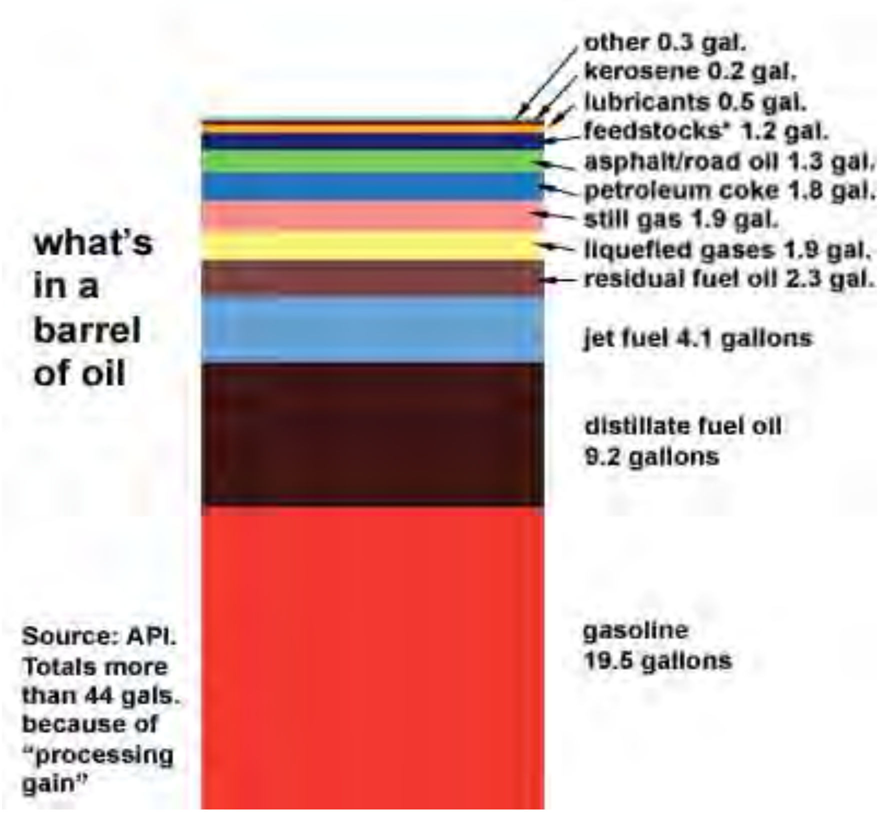


Illustration: What is inside each barrel of oil.

Source: American Petroleum Institute (www.api.org). Figures (numbers) are based on 1995 average yields (output) for U.S. refineries. One barrel contains 42 gallons of crude oil. The total volume of products made is 44.2 GALLONS - 2.2 gallons greater than the original 42 gallons of crude oil. This is called "processing gain," where other chemicals are added to the refining process to create the products.

(ESL LESSON 1) Oil in Our Every Day Life

A.) The one thing that we collectively use every day regardless of wealth, nationality, or belief system is oil? What is made from oil that we use everyday in our lives? What transport systems (way to deliver something by road, sea or air) need oil to keep functioning (working)? What is delivered by modern transportation systems? Leave this as an open discussion topic, let everyone speak their mind and give their ideas.

B.) Brainstorm and cover the whiteboard with a spider web of words that link to other words. For example, if plastic comes up because it is made from oil just look around the room to see what is made of plastic, especially the things the students have with them in their bags. Plastic-bottles-pens-food packaging-straws etc… Even the candy wrapper counts! Link it all together. The list of items (things) made from oil is endless, from lipstick to buttons on shirts to hospital supplies and everything in between.

Expand further by explaining the furniture in the room was brought there by a vehicle car/truck. The glass in the windows was produced in a factory, and the metal for the window frame was mined using an oil driven machine to dig the earth, and that earth delivered to a factory to be separated and the metal removed. That pure metal is then transported by vehicle to another factory where it is made into a window frame. You will be lucky to find one item that didn't use oil in some step from manufacture to delivery. Although I did have a student that picked a mango from a tree in his yard and then walked to class.

C.) Focus on the industries that use fuel that could be **negatively affected** if prices go higher.

1. Cruise ship industry (Tourism)
2. Airline industry (Tourism)
3. Farming industry (Planting and Harvesting, Pesticides) but could be offset by demand for crops to make into Ethanol or Bio-fuels,
4. Mining Industry (more expensive to get the metal out of the ground),
5. Tire manufacturers (Synthetic and natural rubber prices both rise)
6. Container ship companies (moving a container from A to B country will be more expensive).

Switch discussion to industries that will **benefit** from higher fuel prices.

1. Natural rubber producers (rubber sap from a tree), will benefit as companies switch from synthetic rubbers. SBR- NBR- EPDM (see lesson 7 Rubber for definitions)
(As the price of oil goes higher these synthetic rubbers can be replaced with natural rubber latex as the "filler" for tires, window sealing and conveyer belts etc.)
2. Oil companies as gasoline prices rise so do profits.
3. Recyclers of plastic, metal and paper (but that cost will have to be compared to costs of shipping by container which will increase).
4. Shipping companies in the beginning while people and businesses still ship goods by container and air, but that will eventually fade away as fuel prices get too high.
5. Farmers especially as corn and other crops are used for bio-fuel and ethanol. (But food prices will increase as corn is wanted by both people to eat and factories to make Ethanol)

This list will be quite a bit shorter than the industries that will suffer as a result (outcome) of higher fuel prices.

http://resources.schoolscience.co.uk/Exxonmobil/infobank/4/2index.htm?useful.html

Glossary of Oil & Gas Terms

The following are abbreviations and definitions of terms (words) commonly used in the oil and gas industry.

“Bbl” means a barrel of 42 U.S. gallons of oil. One barrel equals 159 liters or 35 imperial gallons.

“Bcf” means billion cubic feet of natural gas. (1,000,000,000,000)

“Bcfe” means billion cubic feet equivalent, [Convert using the ratio of six Mcf (6,000) of natural gas to one Bbl of crude oil, condensate or natural gas liquids.]

“BOE” means barrels of oil equivalent. (equals the same amount of energy).

“Completion” means the installation (put in place) of permanent equipment for the production of oil or gas.

“Condensate” is composed of light hydrocarbons in the liquid state at normal temperature and pressure. Condensates are produced from liquid hydrocarbons which are separated when natural gas is treated. Condensate may be similar in appearance to light crude oil.

“Development Well” means a well drilled within the proved area (100% known area of oil) of an oil or gas reservoir (pool of oil or gas underground) to the depth known to be productive.

“Exploratory Well” means a well drilled to find and produce oil or gas in an unproved area, to find a new reservoir in a field previously (before) found to be productive (producing) of oil or gas in another reservoir, or to extend (reach out to) a known reservoir.

“Horizontal drilling” (sideways drilling) means a drilling technique that allows the operator to contact (hit) and intersect (touch and come into) a larger portion (section) of the producing area than conventional vertical drilling techniques (up and down) and can result in both increased production rates and greater ultimate recoveries of hydrocarbons (oil and gas).

“MBbls” means thousand barrels of oil. (One M= thousands 1,000’s)

“Mcf” means thousand cubic feet of natural gas.

“Mcfe” means 1,000 cubic feet equivalent, using the ratio of six Mcf (6,000 cubic feet) of natural gas to one bbl of crude oil, condensate or natural gas liquids.

“MMBbls” means million barrels of oil. (Two MM’s= millions 1,000,000’s)

“MMBOE” means million barrels of oil equivalent (equals the same amount of energy as 1,000,000 barrels).

“MMcf” means million cubic feet of natural gas.

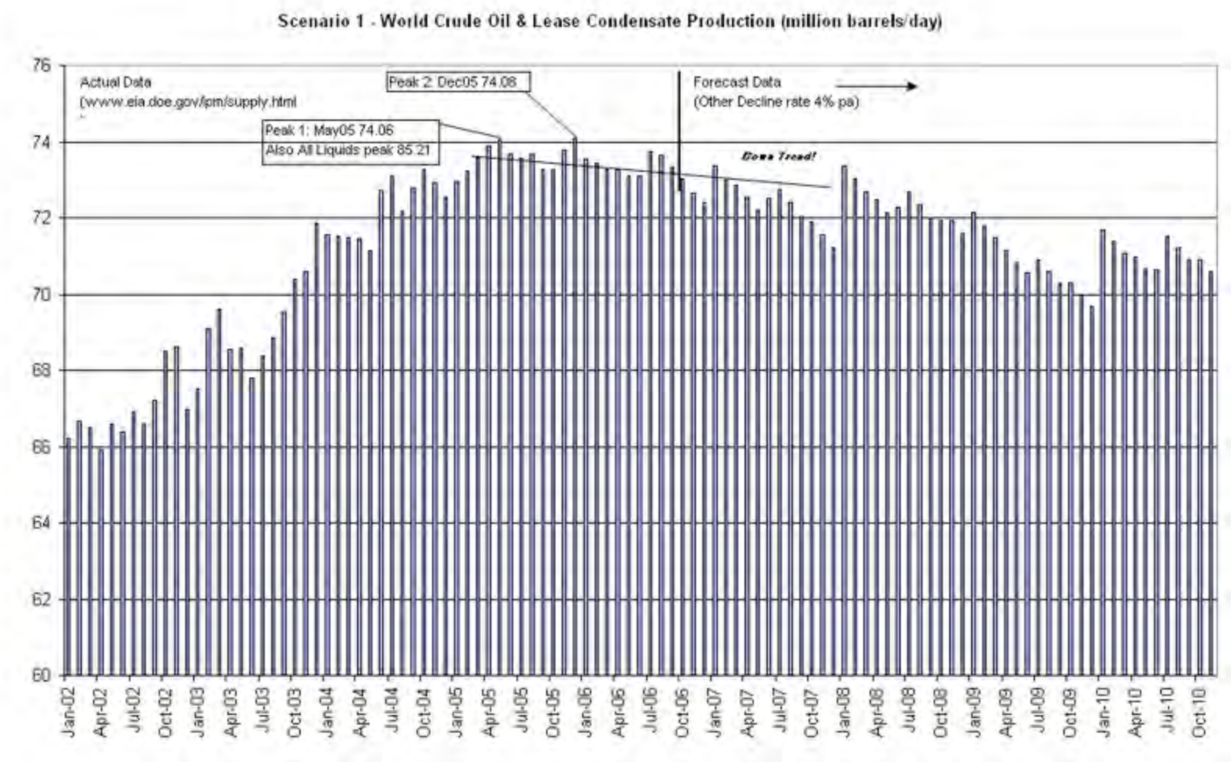
“MMcfe” means million cubic feet of gas equivalent, using the ratio of six Mcf (6,000 cubic feet) of natural gas to 1 bbl of crude oil, condensate or natural gas liquids.

“Reserves” means proved reserves.

“Workover” means operations on a producing well to restore (put back in place) or increase production using water/nitrogen/carbon dioxide injection or horizontal drilling.

This Graph Below: Using a database of future oil fields to come online (start producing oil) combined with current production from known fields (each project produces more than) >50,000 bpd .The annual (yearly) decline rates vary from 4% for new fields, 6% for mature field workovers, 7% for mature fields to 18-33% (for specific field decline rates e.g. Cantarell in Mexico). The model has 95 new mega projects/workovers and 120 existing fields. EIA (Energy Information Agency) actual data for crude oil and lease condensate (C&C) production are used (Jan 02-Dec06). These data show a first peak of 74.06 mbpd on May 05 as the beginning of the down trend (pattern). The production on Nov 10 is forecast to be 70.6 mbpd. ** Lower now with new numbers showing Cantarell crashing at 25% not 14%**

World Crude Oil Production Forecast using Current Fields and Future Megaprojects
Posted by Khebab on December 28, 2006 - 12:18pm This graph is by Ace, compiled from Chris Skrebowski's mega project forecasts. **www.theoildrum.com**



**(Note: David DuByne) This graph is a three year window from 2007 to 2010 showing the amount of new oil coming on line compared to the amount of oil production lost from depleting oil fields around the world. My prediction based on this graph for 2007 is oil prices from March- May will increase to the $61-67 range, then slack (back) off as new production comes on line (more oil is added) in June and July. From late Aug-Dec again is an upward price increase, with highest prices at the end of the year from Oct-Dec $80-86 per barrel. Huge price decrease in the beginning of 2008 as new production floods the market (large amount comes onto the market all at once). Reading this graph, remember when the graph goes down (e.g. Oct 07) the oil price goes up, and when the graph goes up (e.g. Jan 08) the price comes down.

Based on this scenario, (See mega-projects list pg. 18-21)

- The increased forecast (future) production from Nigeria, Qatar, Angola, Brazil, Canada, Kazakhstan and Azerbaijan is not enough to offset (balance) the forecast declines from Saudi Arabia, Russia, North Sea, Mexico, Indonesia, Iraq, China, India, Malaysia and the USA.

- Given lag times (delays) of at least five years for new mega-projects to start production, world C&C (crude oil and condensate) production has begun a slow irreversible decline. which started on May 2005.

More Oil Fields will be Found www.naturalhub.com

If more fields continue to be found, then we will not yet have reached the peak of global production. The world has been thoroughly (through and through) explored for oil. Yes, more fields will be found. The question is, how much more oil will be added to the global reserve? The best answer appears to be "about 4% of the total volumes (amount) of global reserves have not yet been found".

To stop the decline in global oil production for the next five years past the peak, 5 very large oilfields ***producing a minimum of I million barrels a day each*** need to be found. As the global decline rate continues, yet more very large oilfields need to be found. The idea that there is a constant number of very large oilfields just waiting to be found to replace year on year declines of millions of barrels of oil a day is simply fantasy (not believable). New fields brought into production after peak oil are by definition small, and cannot make up for the huge amount of reserves already used up over the years. More regular oil will be found, including small overlooked (passed by) pockets in existing fields, but the quantity (amount) is trivial relative to (very small compared to) the rate of global decline and rate of global consumption (usage).

Some Producing Oil Fields by size
Currently there are 116 oil fields that produce more than 100,000 barrels of oil per day. These 116 fields produce almost half the world's oil.

Mega oilfields
Middle East - Saudi Arabia - **Ghawar mega field** - 5,800,000 barrels a day (includes Ain Dar, Shedgum, and Uthmaniyah reserves, producing -3.5 million barrels a day) -recoverable reserves are *supposedly* 115 billion barrels of oil reserves (US billion, 1,000,000,000) 70 billion already produced as at 2000 (range of estimates 95-125 billion barrels) discovered 1948 - commenced (started producing) 1951 - peaked 1981 (at 5,694,000 barrels a day). - Aramco State Oil Company
South Ghawar - Hawiyah and Haradh - commenced production 1996 Ghawar total after 1996 - 5,772,000 barrels a day (2005 IEA report, includes Hawiyah, and Haradh III as part of Ghawar and may also include an unstated (not published) amount of condensate and natural gas liquids. After 1996 peak - with the new Haradh III field included, but without liquids, have experts estimating 'Ghawar revamped' (reworked) will peak in 2010
Notes - this field, or the most productive part of it, is flagged for *the possibility* of catastrophic (disastrous) decline within several years due to the aggressive (forceful) extraction methods. The area of highest production has been in North Ghawar, producing at the rate of around 4.5 million barrels a day, but containing only 20% of total (albeit massive) reserves. The rest of this huge field produces naturally at only about 300,000 barrels a day, according to Matt Simmons.
“Haradh, for example, currently needs 500,000 barrels of water a day of injected (pumped) into it to maintain (keep up) a flow rate of 300,000 barrels of oil a day. To sustain (continue) the same production rate as present, the less free-flowing (thicker oil) middle and southern part of Ghawar will have to double the number of drilling rigs in place by the end of 2006, and by 10 years from now, will need 2,000 drilling rigs in place, a number close to the current total of rigs in the world.”

South America - Mexico - offshore - **Cantarell** complex (includes Ajkal, Nohoch, Chac, Kutz and Sihil)- around 1,900,000 barrels a day (2 million barrels a day in 2005,1.7 million bpd expected by end of 2006) - first field discovered 1976 - production commenced 1979 - peaked, pressurized, re-peaked - production now declining at an unusually fast about 12%-14% a year. Notes - this field is flagged for *the possibility* of catastrophic decline within 3 years due to the aggressive extraction methods, including water and nitrogen injection.

Middle East - Saudi Arabia - offshore - **Safaniya** - 1,728,000 barrels a day (IEA 2005 report on 2004 production) - 28 API heavy oil - peaked 1981 (1,544,000 barrels a day, but see IEA *supposed* 2004 production)
South America - Venezuela - coastal - **Bolivar** - contains 14-36 Gigabarrels (billion barrels) ultimately recoverable reserves of oil.

Middle East - Kuwait - **Burgan** - 1,700,000 barrels a day - proven reserves 15 billion barrels - peaked (current production about 14% less than peak)
East Eurasia - China - **Da Qing** - 1,000,000 barrels a day - peaked 2003.
Central Eurasia - Russia - **Samotlor mega field -** Smatlor **South** reserves 44.6 billion barrels oil equivalent in place, up to 47% may be recoverable, and 35% has been recovered to date -TNKBP
Central Eurasia - Russia - **Samotlor megafield** - Smatlor **North** reserves 8.1 billion barrels oil equivalent in place, up to 25% may be recoverable, and 18% has been recovered to date - peaked, production declining at about 9% per year - TNKBP

Very Large oilfields
Middle East - **Shaybah** - 492,000 barrels a day - (IEA report 2005 on 2004 production) - 42° gravity Arab Extra Light sweet crude - discovered 1968
Middle East - Saudi Arabia - Abqaiq - 434,000 barrels a day (IEA 2005 report) -peaked 1973 (1,094,061 barrels a day)
Middle East - Saudi Arabia - offshore - **Zuluf** - 407,000 barrels a day (IEA 2005 report) - peaked 1981 (658,000)
Middle East - **Haradh-III** - 300,000 barrels a day (IEA 2005 report) - commenced 2006
East Eurasia - Russia **-Sakhalin basin area 1** - Chayvo field - commenced 2005 -250,000 barrels a day (anticipated year end 2006) - reserves 2.3 billion barrels oil
Middle East - Saudi Arabia - offshore - **Marjan** - 223,000 barrels a day (IEA 2005 report) -peaked 1979 (108,000)
Africa - Angola - Deepwater offshore - **Plutonio** - 220,000 to 240,000 barrels a day - peak expected 2007 - BP, Sonangol (Angola State), Sinopec (China State)
Middle East - Saudi Arabia - **Berri** - 213,000 barrels a day (IEA 2005 report) - 43 API very light oil - peaked 1976 (807,557 barrels a day)

Large fields
Middle East - **Abu Sa'fah** -189,000 barrels a day (IEA report 2005 on 2004 production)
Africa - Angola - Deepwater offshore - **Girassol cluster** (Jasmin, Lirio, Rosa fields) -180,000 barrels a day in 2002 - reserves 1 billion barrels - 32° API oil - Total, Fina, Elf, Sonangol
South America - Brazil - Deepwater offshore - **Roncador 3** - 145,000 barrels a day - PetroBras
South America - Brazil - Deepwater offshore - **Marlim Sul** - 100,000 barrels a day
Middle East - Iran - **Azadegan** - onshore - 100,000 barrels a day
Middle East - **Qatif-** 100,000 barrels a day - (IEA report 2005 on 2004 production)
Middle East - Oman - **Yibal** -onshore - 80,000 barrels a day (2003) -peaked 1997 (225,000 barrels a day) – Shell

Medium fields and smaller
West Eurasia - North Sea - **Brent** - offshore - 30,000 barrels a day - commenced 1976 - peaked early 1980's (500,000 barrels a day) -
Central Eurasia - Russia - **Kharyaga** - 30,000 barrels a day - reserves of 0.71 Giga barrels
East Eurasia - Russia **-Sakhalin basin area 2** - 70,000 barrels a day from the Molikpaq offshore platform - commenced production 1999 - low sulphur Vityaz crude - Gazprom/Mitsubishi/ Mitsui/ Shell/Sakhalin Energy
Middle East - **Harmaliyah** - 28,000 barrels a day - (IEA report 2005 on 2004 production)
Middle East - **Hawtah** - 26,000 barrels a day - (IEA report 2005 on 2004 production)

Middle East - Saudi Arabia - **Khurais** - 150,000 barrels a day in the 80's, currently mothballed (Slang for stopped production) - reserves "multiple billion barrels" - commenced 1964, mothballed 1980's due to poor flow requiring high investment to 'rework' and extensively pressurize.

Expected Oil fields by year 2006-2010
2006 - Central Eurasia - Russia - Pechora Sea polar continental shelf- **Prirazlomnoyo** -offshore - 155,000 barrels a day expected - peak expected 610,000 barrels in 2010 -proven reserves about 0.61 Giga barrels -Rosneft/Gazprom
2006 - South America - Brazil - Deepwater offshore - **Marlim Leste** - 180,000 barrels a day

2007 - Africa - Angola - Deepwater offshore - **Lobito/Tomboco** - 32° API oil - will commence early 2007 - Chevron Texaco
2007 - Middle East - Saudi Arabia - **Khursaniyah** (but includes Abu Hadriya, Harmaliyah, and Fadhili) - 500,000 barrels a day (Saudi Petroleum Ministry). These old oilfields will require huge investment to re-work and pressurize to achieve these levels, or sustain them for long.
2007 - Malaysia - Deepwater offshore - **Kikeh** - 120,000 barrels a day - Malaysia and Brunei dispute ownership

2008 - East Eurasia - Russia **-Sakhalin basin area 2** - 70,000 barrels a day additional production via deployment of the Mitsubishi/Shell/Sakhalin Energy Piltun-Astokhskoye-B platform - recoverable reserves estimated at 1 billion barrels.
2008 - East Eurasia - Russia - Eastern Siberia **-Vandorskoye** - 220,000 barrels a day -recoverable reserves 0.9 Gigabarrels - RosNeft.
2008 - South America - Brazil - Deepwater offshore - **Marlim Sul stage 4** completion -180,000 barrels a day additional production
2008 - Indonesia - **Cepu** - 180,000 barrels a day - reserves estimated 500 million barrels
2008 - Middle East - **Shaybah** - 300,000 barrels a day of additional production.

2009 - Central Eurasia - Russia - **West Salym, Upper Salym** and **Vadelyp** fields -120,000 barrels per day expected Salym Petroleum Development NV (50:50 ShelkSibir Energy) - note Upper Salym has already commenced, Vadelyp is expected in 2006
2009 - Central Eurasia - Russia - **West Siberia Uvatskoye project** - 60 million tonnes of oil reserves recoverable - 200,000 barrels a day - TNKBP (for tonnes multiply by 7 to get barrels)

2010 - South America - Brazil - Deepwater offshore - **Rone a dor 3** (phase 3) - 260,000 barrels a day *additional* production
2010 - Russia - Siberia - **Vankorskoye** - ? 200,000 barrels a day - little reliable information.
2010 - Middle East - Saudi Arabia - **Khurais** and **Munifa** -1.2 million barrels a day -**high sulfur and high vanadium** oil awaiting completion of a specialized refinery in Saudi Arabia to be built. Khurais will need high water pressurization.

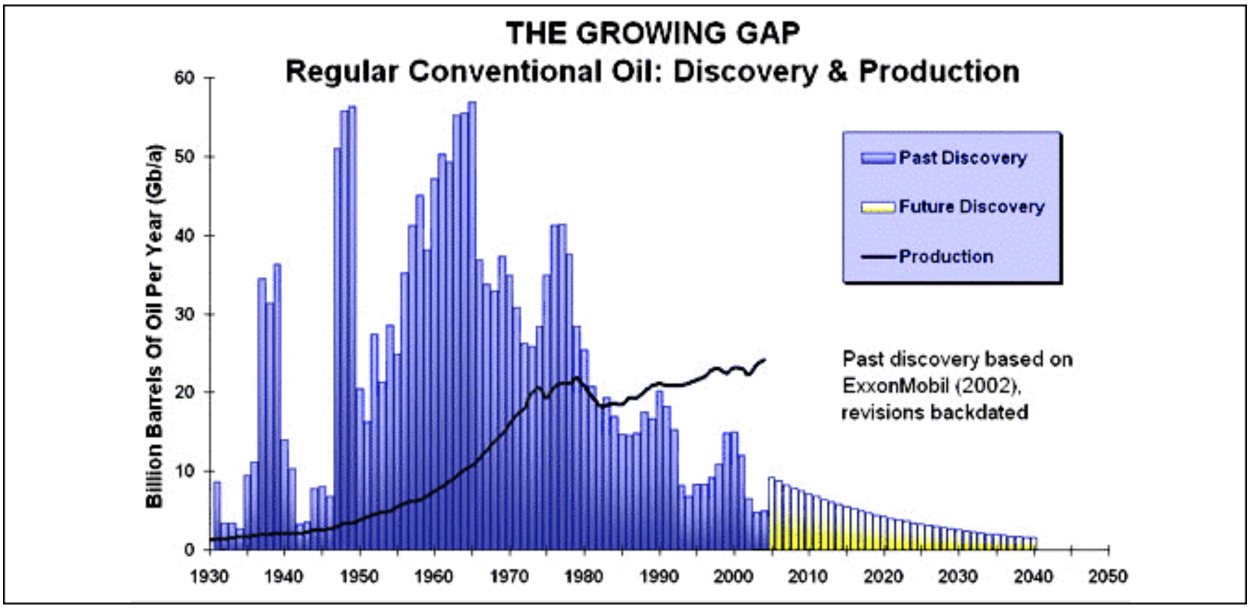
Future from 2010 – East Siberia - Pacific Ocean (VSTO) oil pipeline
Russia - **Verkhnechonskoye** - the 'largest' oil and gas field found in East Siberia. Isolated, awaiting the Russian Governments implementation (construction) of the Eastern Siberia -Pacific Coast pipeline system. The cost maybe $10 billion dollars. The costs of drilling in the harsh Siberian conditions are an enormous barrier (very large problem) to development. Russia - **Yurubcheno-Takhomskaya** area of Evenk has 780 million tonnes of oil reserves (for tonnes multiply by 7 to get barrels). It is uncertain how much is recoverable. Isolated (very remote), awaiting the Russian Governments implementation of the Eastern Siberia -Pacific Coast pipeline system. The cost may be $10 billion dollars. The costs of drilling in the harsh Siberian conditions are an enormous barrier to development. Most of this new oil output is heading to Japan or China.

Russia - the **Talakan** oil field in Sakha-Yakutia has 124 million tonnes of oil reserves. (Yukos/Slavneft) (for tonnes multiply by 7 to get barrels). It is uncertain how much is recoverable. Isolated, awaiting the Russian Governments implementation of the Eastern Siberia -Pacific Coast pipeline system. The cost may be $10 billion dollars. Russia - North Caucasus –

Mexico - the **Chicontepec** field currently (2006) produces trivial (small) amounts of oil - 20,000 barrels of oil a day. This vast field (3,800 sq km in the states of Veracruz and Puebla) holds 40% of Mexico's oil, and is ear-marked (chosen) for intensive development. Mexico's Permex oil company wants to be producing 1 million barrels a day by 2014. **To achieve this huge jump in production, Mexico will need at least US$38 billion, and will need to drill 20,000 wells.** Reserves are said to be 18 billion barrels of crude.

Oil field list provided by:
http://www.naturalhub.com/slweb/fading_of_the_oil_economy_oilfield_depletion_discovery_reserves.htm
http://www.saudiaramco.com State owned Saudi Arabia
http://www.moo.gov.kw Kuwait Ministry of Oil
http://www.fipc.ru Russian State Oil

(Note: DD) Doing the mathematics on decline rates the difference from 2005-2010 this includes the gains from the above projects 2006 + 790,000 / 2007 + 620,000 / 2008 + 950,000 / 2009 + 320,000 / 2010 1,660,000 bpd. The spikes in the graph by Ace (pg.17) show the same bumps when production starts up from new projects, but the new production is quickly erased by decline in other countries. Even with all of this new oil coming on line, by 2010 more declines than gain from new production.



Graph source: http://philhart.com/images/peak%20oil/growing_gap.gif

The amount of new discovery for new oil fields has been shrinking year by year, but we are using more oil year by year. The above graph clearly shows the downward trend. Even Exxon Mobile doesn't seem too optimistic about finding very much more oil around the planet either.

World Oil Consumption 2006 – 86.4 million barrels a day

Best estimates also have been made for true recoverable reserves in various (different) oil fields, and what the extraction rate has been and now is. Errors (mistakes) in estimates for small oilfields are unimportant. Errors for mega-oilfields are crucially (critically) important.

The figures below are estimated production profiles for conventional (pump it from the ground), i.e. 'cheap' oil (unconventional [tar sands/oil shale] excluded) The ASPO model seems most balanced, numbers below.

2005

Middle East Gulf	20 million barrels day	(ASPO end 2005 estimate).
Russia	9.2 million barrels day	(ASPO end 2005 estimate).
USA (lower 48)	3.6 million barrels day	(ASPO end 2005 estimate).
China	3.15 million barrels day	(ASPO 2004 projection).
Mexico	3.04 million barrels day	(ASPO 2004 projection).
Norway	2.62 million barrels day	(ASPO 2004 projection).
Nigeria	2.34 million barrels day	(ASPO 2004 projection).

These 7 major oil producers deliver about 43 million barrels of 'cheap' crude oil a day. Around half the oil that the world burns up every day comes from these 7 high volume producers alone.

2010

Middle East Gulf	19 million barrels day	(ASPO 2004 projection).
Russia	8.4 million barrels day	(ASPO end 2005 projection).
USA (lower 48)	2.8 million barrels day	(ASPO end 2005 projection).
China	2.57 million barrels day	(ASPO 2004 projection).
Mexico	2.37 million barrels day	(ASPO 2004 projection).
Nigeria	2.14 million barrels day	(ASPO 2004 projection).
Norway	1.82 million barrels day	(ASPO 2004 projection).

These 7 major oil producers deliver around 39 million barrels of 'cheap' crude oil a day.

(Note: DD) This set of numbers from ASPO is similar with a decline of 4 million barrels by 2010. The above project list from http://www.naturalhub.com of new projects to come on line through 2010 adds up to 4,340,000 barrels. This is under the best case with no delays, no higher metals prices that will cancel or delay projects and building the specialized refineries to process ultra-high sulfur on time, and most importantly, they meet their production target (pump the amount they said they would)

OPEC Warns High Commodity Prices May Kill Oil Projects

Posted on Friday, April 14, 2006, from Dow Jones Newswires
http://etf.seekingalpha.com/article/9061

Soaring (rising quickly and going high) commodity and raw material prices are increasing the cost of oil and gas projects (venture) by up to three times, Organization of Petroleum Exporting Countries (OPEC) ministers said Friday. Although current high oil prices may be helping to drive (push) much-needed crude investment, the rising cost of construction projects could curtail (slow down or stop) new energy production development, they warn. Qatari Oil Minister Abdullah Ai Attiyah said: "Our costs have tripled from two years ago, due to high commodity prices. And it’s not just that, it is also contractors (builders/construction companies) who have tripled their prices."

Alongside high oil prices, the cost of raw materials and commodities has also risen rapidly (quickly) in recent months. The price of copper - a key material in the development of energy projects - has so far this year risen by 30% compared with a year ago. Friday, three-month copper on the London Metal Exchange hit an all-time record high price of $5,830 a metric ton.

AI Attiyah, told delegates that he has spoken to senior executives (managers of companies) at international contracting firms (construction companies) to warn them of the damage which may be caused by rising development costs. "I have told the CEO's that projects have to be viable (usable) on both sides otherwise it will kill the projects." AI Attiyah's comments were also echoed (said the same thing), by United Arab Emirates Oil Minister Mohammed AI Hamli. Hamli said as a result of soaring commodity costs, it is difficult to forecast how much it will cost the U.A.E. to raise its crude production to 3.5 million barrels a day from 2.5 million b/d by 2010.

A shortage (lack) of commodities also means that machinery such as cranes are in short supply (limited supply), will enables (allows) construction firms to charge extortionate costs (higher than normal prices) for projects, said an executive from a Gulf-based oil producing country. Officials of the Organization of Petroleum Exporting Countries have acknowledged (understood) there isn't much they can do right now to boost supply (increase supply). Led by the Saudis, OPEC is pumping close to flat out (pumping as fast as they can). "OPEC looks in pretty bad shape now," Mr. Halff says. **"At some point in time we're going to reach a limit, and we will see a real impact (effect) of increased oil prices on our economic activity."**

Other analysts have talked of the possibility of crude rising to $100 a barrel or more, but most aren't predicting such high levels for this year unless there is a major loss of supply due to a cataclysmic (disastrous) event. One scenario: Amid Tehran's standoff with the West over Iran's nuclear-energy program, there might be a cutoff of Iranian oil exports (4 million barrels per day) or a closure of the Straits of Hormuz, a choke point for oil shipments from the all-important Persian Gulf. At that point the minimum price per barrel would be $160-200.

Carbon black shortages slow down mining

www.energybulletin.net April 27, 2006 archives

Mining companies are complaining about a shortfall in the supply (not enough supply) of the giant tires that go on large dump trucks and other heavy equipment (very large machines). These out size tires stand as tall as 12 feet / 4 meters tall and can spread 4 feet / 1.3 meters wide. They are used everywhere from the Canadian tar sands to open-air coal mines (strip-mines) in the United States and China, but lately (recently) they have become almost as precious (valuable) as gold and silver. Prices have quadrupled (4X) for some of them in the last year to more than $40,000 a tire.

Tire companies complain they are also squeezed (effected negatively) by rising prices for raw materials, with natural rubber prices rising nearly six fold (6X), to about $2 a pound since 2002. High crude oil and natural gas prices are also adding a burden (problem) to tire companies, which use petroleum in large amounts to produce the carbon black needed for tire carcasses (outside of the tire) and threads (ropes in the tire).

(ESL LESSON 2) History of Mining

A.) What is mined today? Everything from Gemstones: Diamonds, Rubies, Emeralds, Sapphires, Uranium, Coal, Industrial metals: Tin, Magnesium, Cobalt, Zinc, Copper, Nickel, Aluminum, Iron Ore, Lithium and the precious metals Gold, Silver, Platinum and Palladium. What other things can be mined? Brainstorm with your students, first about the metals that are mined and secondly really focus on what is made from each metal. If Aluminum is mentioned, start with cans and see where it leads, Lead/Lithium-batteries, Steel-cars, Copper-pipes etc…

B.) Mining goes back to the appearance of the first flint tools around 2.5 million years ago when a person dug up what they could carry on their backs. Today it has evolved (turned into) into massive (very large) mines above and below ground with 160,000 kg Dump Trucks.

Trace the evolution of mining from one man to mining corporations of today's mega mines. Try a time line first, 50,000 B.C- Present, have students fill in of what was mined long ago and what is mined now for profit. What was valuable in the past when the earth was plentiful? Fast forward and compare the idea of "valuable". In the 1880's aluminum was extremely valuable, palladium and platinum were unheard of, now it's the opposite. Etc…

C.) Mining requires large inputs of energy from digging, separating, transporting twice, and crushing. Below is Iron Ore (dirt from the ground with metal mixed in) to refined Pellets (Taconite), then these pellets go to a factory to be manufactured into something we use everyday.

1. **Blasting**
Taconite is a very hard rock. Using explosives, the taconite is blasted into small pieces.
2. **Transportation**
Taconite pieces are scooped up by electric shovels. Each shovel can hold up to 85 tons of rock! The shovels place the taconite into giant dump trucks. These trucks are as big as a house and hold up to 240 tons of taconite. The trucks take the taconite directly to the processing plant, if it is nearby, or to train cars if it is far away.
3. **Crushing**
In the processing plant, the taconite is crushed into very small pieces by rock crushing machines. The crushers keep crushing the rock until it is the size of a marble. The rock is mixed with water and ground in rotating mills until it is as fine as powder.
4. **Separation**
The iron ore is separated from the taconite using magnetism (magnets). The remaining rock is waste material and is dumped into tailings basins (holding areas). The taconite powder with the iron in it is called concentrate.
5. **Pellets**
The concentrate (the wet taconite powder) is rolled with clay inside large rotating cylinders. The cylinders cause the powder to roll into marble-sized balls. (This is like rolling wet, sticky snow into balls to make a snowman). The balls are then dried and heated until they are white hot. The balls become hard as they cool. The finished product is taconite pellets.
6. **Steel**
The taconite pellets are loaded into ore ships. These ships sail on the Great Lakes to Gary, Indiana, Cleveland, Ohio and other steel-making towns. The taconite pellets are brought to the steel mills to be melted down into steel. China and India also has a large steel industries.
Steps 1-6 courtesy of http://www.dnr.state.mn.us/education/geology/digging/taconite.html

Now for your students have them trace each and every step from the ground to a store shelf, car dealership or bicycleshop, how many times energy is used along the way. I will leave out the addition of a consumer using a gasoline driven auto to get to the store to buy the product. Each of the industrial metals has a similar production chain.

Middle East map source**:** http://www.lib.utexas.edu/maps/middle_east_and_asia/middleeast_ref01.jpg

SAUDI ARABIA

Trouble in the World's Largest Oil Field-Ghawar

Monday, 16 August 2004

By G.R. Morton From: http://home.entouch.net/dmd/ghawar.htm

There are four oil fields in the world which produce over one million barrels per day. **Ghawar in Saudi Arabia**, which produces 4.5 million barrels per day, **Cantarell in Mexico**, which produces nearly 2 million barrels per day, **Burgan in Kuwait** which produces 1 million barrels per day and **Da Qing in China** which produces 1 million barrels per day. Ghawar is, therefore, extremely (very) important to the world's economy and well being. Today the world produces 82.5 million barrels per day (2004) which means that Ghawar produces 5.5 percent of the world's daily production. Should it decline, there would be major problems. Its production was restricted (limited) during the 1980s but by 1996 with the addition of two other areas to the south of Ghawar brought on production, Hawiyah and Haradh, the production went back up above 5 million per day. In 2001 it was producing around 4.5 million barrels per day. There have been 3400 wells drilled into this reservoir (the pool of oil underground).

Others have noted how the percentage (%) of water brought up with the oil has been growing (increasing) on Ghawar. There are published reports that Ghawar has from 30-55% water cut. This means that about half the fluids brought up the well are water. Today the decline rate is 8%. “At Ghawar, they have to inject water (put in by pressure) into the field to force the oil out. By contrast, Shayba's oil contained only trace (very small amounts) amounts of water. At Ghawar, the engineer said, the 'water cut' was 30%."

Most new oilfields produce almost pure oil (almost 100%) or oil mixed with natural gas--with little water. Over time, however, as the oil is drawn (taken) out, operators (company pumping the oil out of the ground) must replace it with water to keep the oil flowing until eventually (finally) what flows is almost pure water and the field is no longer worth operating (it turns into an energy sink, remember EROEI)

Saudi Aramco is injecting (putting into) a staggering 7 million barrels of sea water per day back into Ghawar, the world's largest oilfield, in order to prop up pressure (continue same pressure). It accounts for 30% of Saudi oil reserves and up to 70% of daily output. It seems a growing number of analysts are falling into line (saying the same thing) with the Simmons & Company International view that Saudi Arabia may be running out of steam and may not be able to perform the role of global swing producer (country that can produce extra in case oil cannot be produced from another place) for many more years, despite being credited (documented) with oil reserves in the order of 260 billion barrels. The Centre for Global Energy Studies hinted at the beginning of the year that the kingdom appeared to be heading for difficulties. Now one of its analysts has said that having reserves does not equate (equal) to production capacity. Citing the Haradh field, he said "**it required 500,000 barrels per day of water injection to get out 300,000 bpd of oil.** Moreover the problem is even more serious in the Khurais field." With 100 billion bbl of crude oil produced so far, Saudi Arabia should not be far from the midway point of its proved reserves of 260 billion bbl—that means just 10 years at the going rate of roughly 3 billion bbl/year. Bearing in mind the [spurious revision] (higher new numbers) of 1990 that boosted proved Saudi reserves to 257 billion bbl from 170 billion bbl, the midway point could happen even sooner than that." "Doubts grow about Saudi as Global Swing Producer," Aberdeen Press & Journal Energy, April 5, 2004, p.15

"Furthermore, the 35 billion bbl produced during 1990-2002 has not been accounted for (subtracted from the total yet), as Saudi "proved reserves" were still being reported at 260 billion bbl by the close of 2001." [Original Saudi reserves at 170 Billion barrels, they pumped 100 Billion so we have left 35 billion. Do the math using original estimate, not revised estimate of 257.] A. M. Samsam Bakhtiari, "Middle East Oil Production to Peak within next decade." Oil and Gas Journal, July 7, 2003, p. 24

Saudi Aramco boosts drilling efforts to offset declining fields

by Glen Carey Platts,   Tuesday, April, 11, 2006
http://deconsumption.typepad.com/deconsumption/2006/04/aramco_producti.html

Saudi Aramco's mature crude oil fields are expected to decline at a gross average of 8% per year without additional maintenance and drilling, a Saudi Aramco spokesman said Tuesday. "The drilling of additional development wells in the producing fields is Saudi Aramco's standard practice to offset (counterbalance) normal declines of older wells" Two drilling support structures (oil well machinery) in Zuluf field to be installed in December 2006 and one new wellhead production platform in the Central Safaniya oil field to support start-up in May 2007, Saudi Aramco said. Three additional (extra) wellhead platforms will be installed (put in place) in the Central Safaniya and Zuluf fields by December 2007.

More information can be seen about Saudi Arabia and all other regions of the world in the **February 2007 ASPO newsletter.** http://www.peakoil.ie/newsletter/en/htm/Newsletter74.htm

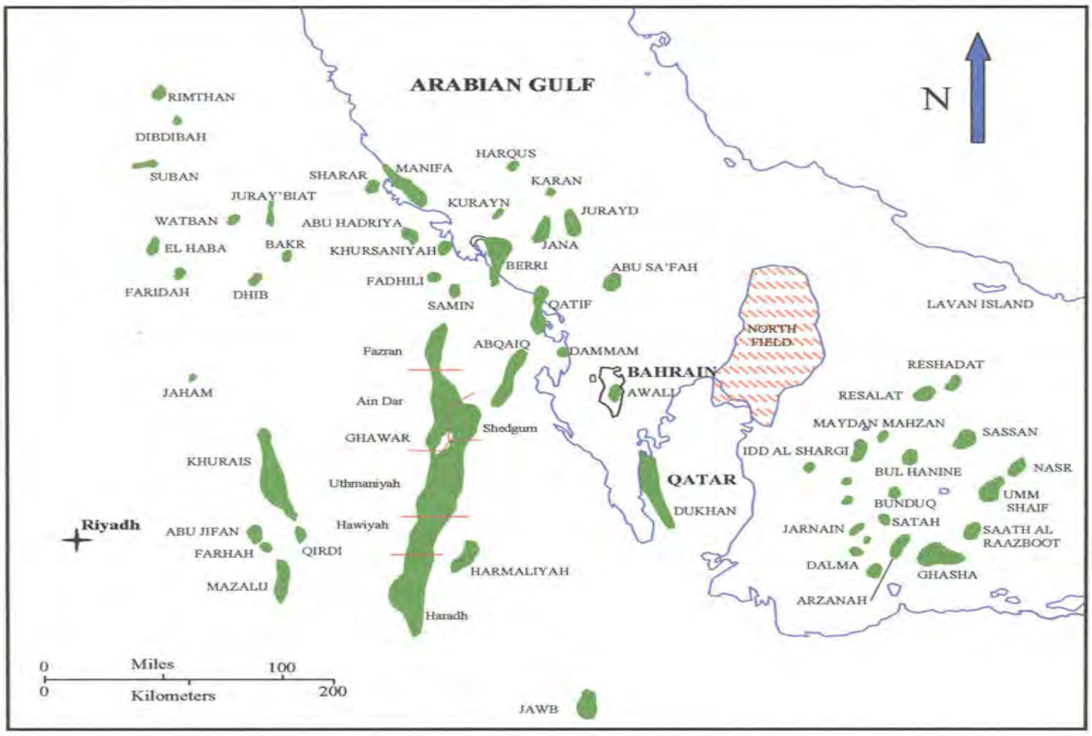
How is Saudi Arabia getting on, or more evidence of a deteriorating situation?

http://www.theoildrum.com January 3, 2007 archives

When the author wrote about some of the stories that are likely to be discussed over the next year, one of those that the author mentioned is the delay before we see further (more) increases in production from KSA. In the piece the author quoted from the Arab News about the latest projections of Aramco production increases over the next two years. While there has not been much change in the total projected (future) production over the last eighteen months, there have been some, as the Kingdom has moved toward a goal of 130 rigs operating there by May of this year.

Note that in a June 2005 post the the Center for Strategic and International Studies (CSIS) was quoted as suggesting the following for current and projected Saudi oil output by field.
Current plans to reach a 12.5 mbd goal call for the following production numbers (according to Cordesman and the CSIS)

Abqaiq - 400,000 bd
Ghawar - 5,500,000 bd
Berri - 400,000 bd
Safaniya - 1,500,000 bd
Abu Sa'fah - 300,000 bd
Zuluf - 800,000 bd
Marjan - 450,000 bd
Haradh - 170,000 bd
Shaybah - 500,000 bd
Munifa - 1,000,000 bd



Saudi Arabia Oil Field Map
Map source: http://www.gregcroft.com/reports.ivnu
Notice the size of Garwar how massive it is compared to the rest of the fields in the region.

This gives the 11 mbd that they claim to be able to currently produce - though it includes Munifa, of which we have commented negatively earlier. To bring this up to 12.5 mbd they plan an additional:

Haradh - 300,000 bd
Khursaniyah 500,000 bd
Shaybah - 500,000 bd
Khurais - 1,100,000 bd

When you include an anticipated (expected) 800,000 bd loss due to old fields declining, the sum (total) comes in just over the required number. Now of these Aramco has already brought Haradh on line (got it started), ahead of schedule last March. In contrast (the opposite) Munifa is now not going to be around until 2011 – so we need to scratch (erase) that 1 million barrels from current availability. Further if we look at the prediction in the Arab News we find that the list of fields where the production increases will come from with the addition of another field.

The Abu Hadriyah, Fadhili and Khursaniyah fields are being developed, with production of 500,000 bpd of Arabian Light crude oil, plus more than one billion standard cubic feet/day (scfd) of natural gas. This is forecast to come online in December 2008.

Located deep in the Rub Al-Khali, or Empty Quarter, the Shaybah field has been delivering 500,000 bpd of Arab Extra Light crude oil since its start-up in 1998. Plans call for increasing production capacity to one million bpd, with the first increment (small gain) of 250,000 bpd is forecast to come onstream (start up) by the end of 2008.

Two other major field development projects on track to meet the maximum production capacity target (goal) are the Khurais and Nuayyim fields. The Khurais project, which will also include production from the Abu Jifan and Mazalij fields, is projected to produce 1.2 million bpd of Arab Light crude oil in 2009. The Nuayyim project, a central Arabian field, is slated (projected) to add 100,000 bpd of Arabian Super Light crude oil by 2008.

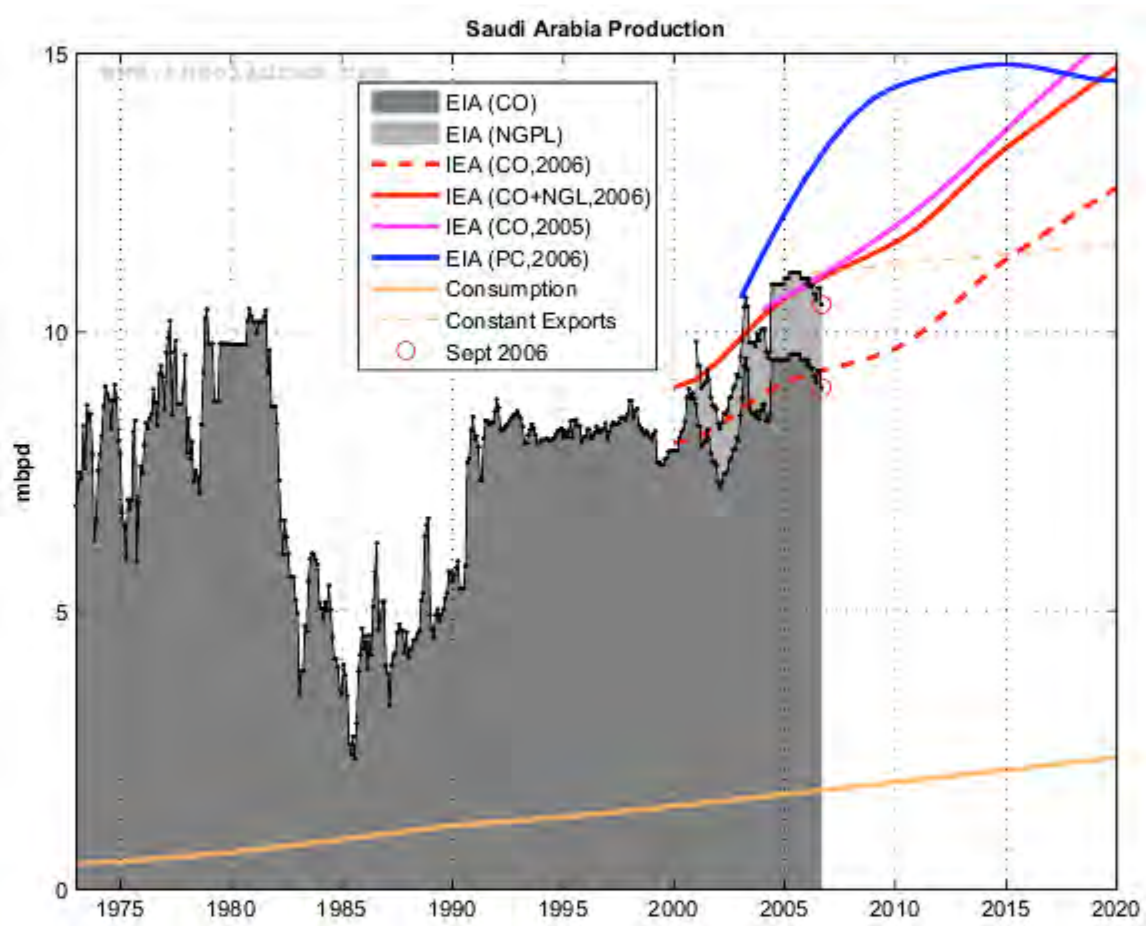
Reviewing these numbers, we are now seeing increments (gains) in production coming from multiple (many different) fields rather than just further development of a single one. After the first new increment for Shaybah comes on line, work for which is now underway (already started), but which may now be only 200,000 bd by April of 2008, with another 300,000 bd being added by 2010.

The next development, Khurais, is also going to be a three-field project. It will also include the Abu Jifan and Mazalij fields, and will need injection of an additional 4.5 mbd of heated sea-water water into those fields to achieve (reach) that production level. To achieve the target production Aramco has added another field, Nuayyim, which is anticipated (expected) to produce 100,000 bd by February 2009. This schedule has been accelerated (sped up) over earlier projections.

The EIA now shows that the Saudis have "voluntarily" cut their production by 800,000 bpd from their 2005 peak to October, 2006. Just another reminder that the Saudi stock market crash coincided (two events happen at the same time) with the start of "voluntary" production cuts. Odd that the Venezuelan stock market where they have long life unconventional oil (syncrude) reserves is booming (very active and expanding).

I think it worth noting (saying), that new capacity and existing KSA capacity is mainly "Arab Light" which is difficult to refine (despite the name "Light") With refining capacity at 98%, new KSA production -- if it occurs -- will not impact gasoline supply very much.

See EIA for the process of refining Arab Light
http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/oil_market_basics/refining_text.htm
or Encyclopedia of Earth
http://www.eoearth.org/article/Petroleum_refining



Saudi Arabia oil production (EIA monthly) summary to Sept 2006, and other different forecasts. Graph source: http://www.theoildrum.com

(ESL Lesson 3) Economic growth

A.) Start by asking what banks do. Examples: Take deposits, make loans for homes, cars, businesses etc… Focus on how they are able to make a loan. It is assumed with unlimited/limitless oil and gas there will be limitless growth in businesses around the world for all time. The bank gives a 30 year loan to Tom Jones because the bank assumes (thinks) there will still be jobs and a world economy throughout the 30 years allowing Tom Jones to pay back his home loan every month. Business starts up or car loans operate on the same system of beliefs, there will always be energy to make the world economy grow and the loan money will be paid back. Now it appears that there will have to be some limit on growth. What was before limitless and cheap now has a limit and is getting more expensive.

Gather your students' ideas on banking and how they see themselves in the next ten years using banks themselves for their future life plans. The regular family that needs a loan to buy a house, car or send their child to university? See if they also understand the need for business and corporate loans to keep the economy going. How will energy limitations or limited energy effect giant corporations that need loans to expand on the stock markets of the planet? Business X needs a new office building and then hires more employees? These loans create new businesses that expand, and then the economy expands.

B.) Have students brainstorm to link goods involved in the shopping mall, skyscraper or house building (construction) business. If there is no new construction started, what will be affected back down the supply chain of goods and service? First have them think about what is in a house, shopping mall or skyscraper, this list is truly endless. Link the services together to the building industry, if no new skyscrapers are being built than the elevator company will have no orders and need many less workers. What parts are in an elevator? Well the plastic buttons that you push to select a floor are made by a company, the metal cables that lift the elevator up and down are made by a different company, the metal comes from a mine somewhere which will dig less and need less workers. You can do this trace back with each and every product they come up with. All the way down the line the good or service will be less needed or used. What do they think about it? Will it affect them, someone in their family or their country?

C.) Shift gears. What throughout history has been used to pay for something? Follow the mediums (forms) of payment from the gold standard/silver standard (hard currencies) to today's payment methods of credit, cash (fiat money). Also traded/bartered were, labor, food, gems, tools etc…

As currencies (physical money) of certain countries loose value, what will the medium (form) of payment change to? This will include all stocks, bonds, futures, credit, real estate, currency and futures markets.

** Expect long-term bull (expanding) market in oil, metals, grains/sugarcane and farm animals**

The Creature from Jeckyll Island Griffin, Edward G. ISBN: 0912986212 3rd Edition 1998
The most informative book I have ever read about the creation of money on our planet. How the Federal Reserve in the US began and how it operates along with the IMF (International Monetary Fund) and World Bank. After reading this you will run out and buy gold.

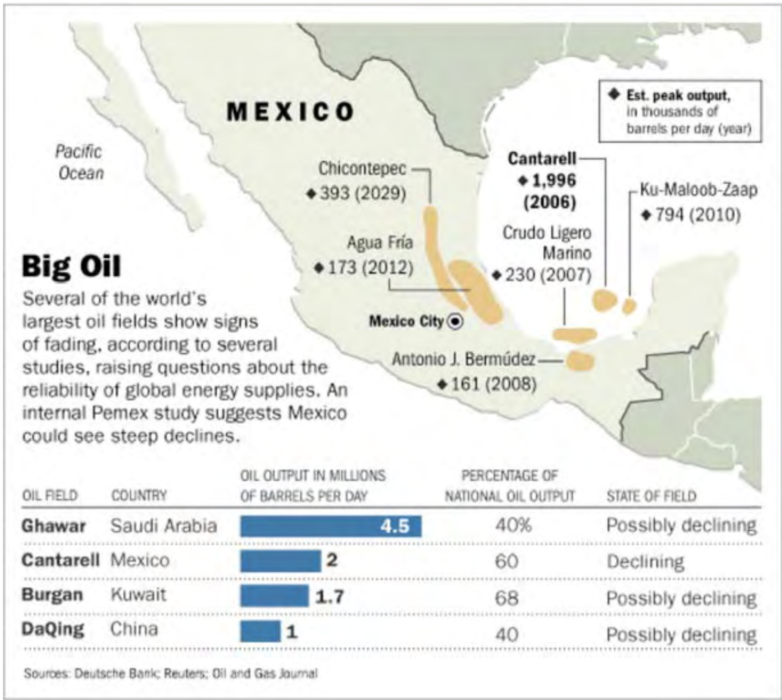
The World is Flat Friedman, Thomas L. ISBN 0141022728 Penguin Publishing 2005
Great book about the future of commerce using the internet to do business from the office or home without traveling to conduct business. Visionary look at one possible future where all commerce is done over the internet.

MEXICO
Cantarell Field in Decline
http://en.wikipedia.org/wiki/Cantarell_Field

Cantarell Field or Cantarell Complex is the largest oil field in Mexico, located 80 kilometers offshore (underwater) in the Bay of Campeche. This field comprises (is made up of) four major fields: Akal, Nohoch, Chac, Kutz and the recently discovered Sihil. The first field was discovered in 1976, and then became known as Cantarell complex in 1996. Oil production peaked in 2004 and has declined in the following years. Cantarell complex produced 1.16 million barrels per day of oil in 1981. However the production rate dropped to 1 million barrels per day in 1995. Nitrogen injection projects, started in 1997, that increased the production rate to 1.6 (mbd) to 1.9 (mbd) in 2002 and to 2.1 (mbd) of output in 2003 which ranks Cantarell the second fastest producing oil field in the world behind Ghawar Field in Saudi Arabia. Luis Ramirez Corzo, head of PEMEX's exploration (look for) and production division, announced on August 12, 2004 that the actual oil output from Cantarell is forecast to decline steeply (extreme decline) from 2006 onwards, at a rate of 14% per year. In March 2006 it was reported that Cantarell had already peaked and output is expected to be 14-25 % lower than in 2005.

By 2008 it is estimated only 1 (mbd) will again be all that is produced from Cantarell as it declines. The steep decline is a result of delaying the natural decline using nitrogen injection as the procedure (method) only extracts the oil faster; it does not affect total production volume. The likely ramifications (results) of this decline on world oil markets is highly disturbing.

To maintain heavy crude production of the Bay of Campeche, PEMEX focuses on the development of Ku-Maloob-Zaap complex in adjacent (next to) area, which can be connected to the existing (already in place) facilities of Cantarell. Ku-Maloob-Zaap complex is expected to produce 800,000 barrels per day by the end of decade. PEMEX has been hoping that increased production from newer fields will obscure (cover up) the problem caused by the swift (fast) decline at Cantarell. It is expecting to add 650,000bpd from Ku-Zaap-Maloob and the Chicontepec project. If it hits this target the overall fall in crude oil output will be about 850,000bpd.



Mexican Oil Fields
Map source: http://www.theoildrum.com/story/2006/7/12/10421/4972

PEMEX predicts production drop

El Universal
Viernes 19 de Enero de 2007

According to estimates by the state oil company, Pemex, petroleum exports will decline dramatically during the Calderón administration (time in office). PEMEX is anticipating (expecting) a 13% drop in its crude exports over the next six years as Mexico´s proven reserves continue shrinking. Analysts contacted by EL UNIVERSAL agree that PEMEX's inability to increase production is due to decreasing reserves - particularly the Cantarell field in Campeche Bay which is the source of roughly (about) 60% of the nation's proven reserves.

The first symptoms of a genuine oil crisis are becoming more and more evident. Documents acquired by EL UNIVERSAL indicate (show) PEMEX will be forced to cut back on exports to the United States. The reduction could reach 150,000 barrels per day in the next four years. In the final two years of the Calderón administration, the reduction could reach 500,000 barrels per day. Currently, around 1.5 million barrels of oil go to the United States daily.

Furthermore, Pemex has already canceled shipments of crude to the Deer Park (Texas) refinery it owns along with Shell for the next 12 months. According to Raúl Muñoz Leos, a former PEMEX director, the primary (major) problem lies in the rapid decline of Cantarell reserves and the failure to develop other fields. Muñoz said production levels rose steadily (evenly) from 2002 to 2004, encouraging company directors to predict a continuation of this trend. "We established a production goal of 4 million barrels a day by 2006, but by mid-2005 production levels began to decline," he said "It is impossible to ignore the fact that our reserves are rapidly shrinking."

PMI Comercio Internacional, PEMEX's export management company, has already begun to notify (tell) some clients (customers) in the United States that it will have to cancel some contracts because production levels are declining. Rosendo Zambrano, the director of PMI, explained that due to the 150,000 barrel-a-day cutback planned for 2007-2010 some contracts that will be sacrificed (given up). Energy analyst David Shields author of two books on PEMEX says "Cantarell is probably going to decline very sharply in the next three years, starting now. Mexico currently produces just under 3.3 million barrels a day. We can expect production to fall to 2.5 million barrels a day, or perhaps even less next year."

Mexico's Oil Output Cools

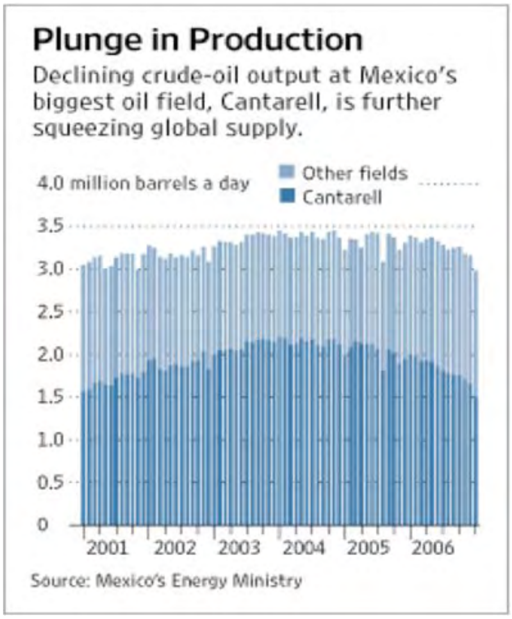
by David Luhnow Dow Jones Newswires Monday, January 29, 2007

MEXICO CITY, Daily output at Mexico's biggest oil field tumbled (fell) by half a million barrels last year, according to figures released Friday by the Mexican government. The ongoing (continuing) decline at the Cantarell field could pressure prices (make go higher) on the global oil market, complicate U.S. efforts to diversify (change to a different style of doing something) its oil imports away from the Middle East, and threaten Mexico's financial stability (economic stability). The virtual collapse at Cantarell -- the world's second-biggest oil field in terms of output at the start of last year -- is unfolding (progressing) much faster than projections from Mexico's state-run oil giant Petroleos Mexicanos, or PEMEX. Cantarell's daily output fell to 1.5 million barrels in December compared to 1.99 million barrels in January, according to figures from the Mexican Energy Ministry. Mexico's overall (total) oil output fell to just below three million barrels a day in December, down from almost 3.4 million barrels at the start of the year. It marked Mexico's lowest rate of oil output since 2000.

This will subtract valuable oil from the world market, which is under pressure from rising demand by growing economies like China and India. It also means less oil going to the U.S. from Mexico, which has long relied on (depended on) Mexico as one of its top-three oil suppliers.

Mexico's growing economy is demanding (requiring) more fuel each year, which is expected to translate to (equal) even lower oil exports. Last year, Mexico's daily average oil exports fell to 1.79 million barrels a day from 1.82 million the previous year. PEMEX says it expects daily exports to fall to an average 1.65 million barrels this year. But some analysts say that is too optimistic (positive). December's daily exports were a meager (small amount) 1.53 million barrels.

Based on the state company's track record so far at Cantarell, including its current rates of recovering the oil that remains in the field, Mr. Shields expects the field's output to drop another 600,000 barrels a day by the end of this year (2007). He says that PEMEX will likely increase output by 200,000 barrels a day at other fields -- leaving the country with a net decline of 400,000 barrels a day by year's end and daily exports of less than 1.4 million barrels.



Mexican Yearly Oil Production
Graph source: http://www.rigzone.com/news/article.asp?a_id=40538

Kuwait and Oil Reserves

Source ASPO, May 05, 2006 (Association for the Study of Peak Oil) updated Jan 20, 2007

During the last two months we now have seen two articles with alarming (bad) news about the production of crude oil from Kuwait. The first came in November by James Cordahi and Andy Critchlow at Bloomberg and was entitled: Kuwait Oil Field, World's Second Largest, 'Exhausted'.

The plateau (leveling out) in output from the Burgan field will be about 1.7 million barrels a day, rather than as much as the 2 million a day that engineers had forecast could be maintained (continued) for the rest of the field's 30 to 40 years of life, said Farouk al-Zanki, the chairman of state-owned Kuwait Oil Co. Kuwait will spend about $3 billion a year for the next three years to expand output and exports, three times(3X) the recent average. To boost oil supplies," 'Burgan by itself won't be enough because we've exhausted that, with its production capability (amount of oil an oil field can produce) now much lower than what it used to be," al-Zanki said during an interview. "We tried 2 million barrels a day, we tried 1.9 million, but 1.7 million is the optimum (best) rate for the facilities and for economics."

Kuwait Oil Reserves Only Half Official Estimate-PIW

http://today.reuters.com/news/articlebusiness.aspx?type=tnBusinessNews&storyID=nL20548125&from=business

LONDON, Jan 20 (Reuters) - OPEC producer Kuwait's oil reserves are only half those officially (actually) stated, according to internal Kuwaiti records seen by industry newsletter Petroleum Intelligence Weekly (PIW). "PIW learns from sources that Kuwait's actual oil reserves, which are officially stated at around 99 billion barrels, or close to 10% of the global total, are a good deal (much) lower, according to internal Kuwaiti records," the weekly PIW reported on Friday.
It said that according to data circulated (passed around) in Kuwait Oil Co (KOC), a subsidiary (smaller company that the original parent company) of state Kuwait Petroleum Corp, Kuwait's remaining proven and non-proven oil reserves are about **48 billion barrels not 99 billion.** PIW said the official public Kuwaiti figures do not distinguish (identify) between proven, probable and possible reserves.

CHINA

PetroChina has jump in natural gas output

By Wing-Gar Cheng and Loretta Ng
Bloomberg News, Tuesday, January 18, 2005

PetroChina is drilling more gas and oil wells in China's western provinces and exploring abroad to compensate (make up for) for depletion at Daqing, the country's largest oil field. The failure of China's oil companies to match increased demand from economic expansion (growth) meant that imports rose 35% last year. Crude oil output in the fourth quarter of last year declined 2.2% from the third quarter and was 0.5% lower than a year earlier. The company produced 192.6 million barrels of oil in the fourth quarter of 2004.

Production from Daqing fell to 46.4 million tons last year from 48.4 million tons in 2003. (multiply by 7 to get barrels) Output from the field in the northeastern province of Heilongjiang, which accounts for half of PetroChina's production and a third of the nation's total, is being cut to prolong (continue) Daqing's life. The company's West-East pipeline, which carries gas to Shanghai, started operating in the third quarter of last year (Oct-Dec). The 4,000 kilometer, or 2,500 mile, pipeline, built for 46 billion Yuan, carries natural gas from the Tarim Basin and Changqing fields in Xinjiang province. 'PetroChina is pumping more oil from fields in the western provinces" to make-up the shortfall, said Chu. "The only drawback (bad point) is this oil has higher sulfur content and sells for less."

Good forecasts/Bad forecasts: How does the US DOE/EIA Come Out?

by Roger Blanchard, Published on 2 Dec 2006 by Energy Bulletin.
http://www.energybulletin.net/23196.html

Future Oil Production in China, The IEO2001 stated (said) the following concerning (about) China’s future oil production: In China, oil production is projected to decline to 3.0 mb/d by 2020. I had stated that the 3 largest fields (actually the 3 highest producing oil regions) would experience significant production declines in coming years that would drag down China’s future oil production and that a production level of 3.0 mb/d in 2020 appeared very optimistic. Those three regions have been experiencing declining production since 2001 but there has been intense (busy activity) offshore oil development as well as intense oil development in western China.

China's total petroleum production has increased from ~3.4 mb/d in 2001 to ~3.8 mb/d in 2006. It appears likely that China's oil production will peak around 2008. When oil production from offshore (underwater) regions and western China start declining, it will add to the decline from Daqing, Shengli and Liaohe oil regions. I will state again that a total petroleum production rate of 3 mb/d appears very optimistic (positive) for 2020.

(Note DD) These declines will only make China more desperate for imports. Eight to ten percent yearly economic growth takes a lot of energy, which they rely on Iran. From now on the US and China will compete for the same resources

Big Oil Fields Beginning to Fade				
Oil Field	Country	Oil Output (MBD)	% of Nat'l Output	State of Field
Ghawar	Saudi Arabia	4.5	40%	Possibly declining
Cantarell	Mexico	2.0	60%	Declining
Burgan	Kuwait	1.7	68%	Possibly declining
DaQing	China	1.0	40%	Possibly declining

Four Largest Oil Fields Worldwide Daily Output
Graph source: http://www.financialsense.com/captain/2006/0223.html

U.K. and Norway

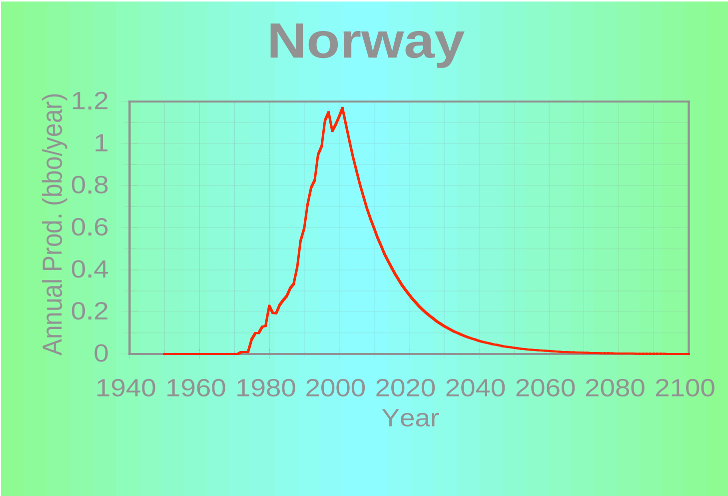
Summed Production for Norwegian Oil Fields and Production for U.K. Oil Fields EIA/DOE Report

Virtually all of Norway's oil is located in the North Sea but the U.K. has oil in areas other than the North Sea. Many of the major fields in the North Sea are now in decline. To counteract (stop) the rapid decline of mature fields, new but smaller fields are being brought on-line (started up) at an accelerated rate (faster pace). As an example, in Norway 23 out of 34 fields (67 %) listed in the Sept. 1999 Field Data Press Release by the NPD have start-up dates after January 1,1993. In the U.K. sector (area) of the North Sea, the 200th oil and gas field was recently brought online. **It took 25 years for the first 100 fields to be brought on-line but only 6 years to bring the second 100 fields on-line.** According to the U.S. DOE/EIA, the average EUR (Estimated Ultimate Recovery) of new U.K. oil fields is approximately 50 million barrels. That is small compared to the large early U.K. fields. The fields that are now being brought on-line in both the U.K. and Norway are coming on-line at or near maximum production and many will have lifetimes of 10 years or less. In an extreme (severe) example, the Durward and Dauntless fields were brought on-line in August 1997 and were terminated (finished production) in April 1999.

As an oil province becomes more extensively (thoroughly) explored, there are fewer places to search for new fields. The North Sea has been extensively explored and consequently (as a result) the oil discovery rate has declined. Decline rate after the peak is expected to be 7.2 %-14 %/year.

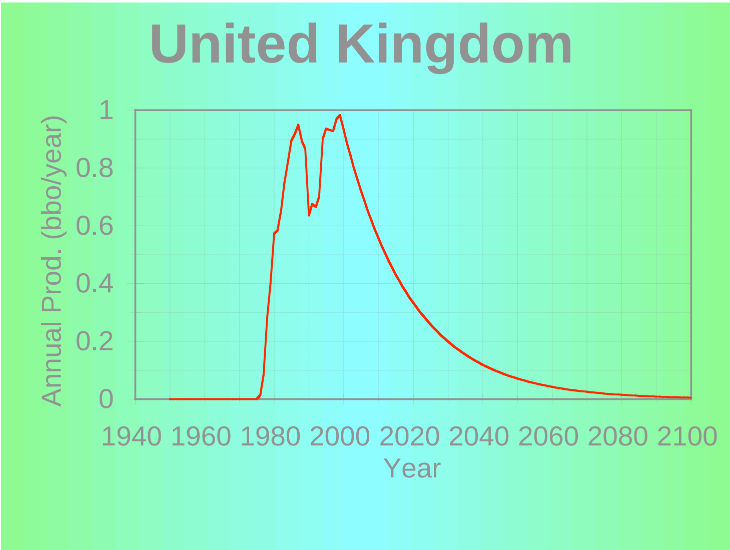
Norway January Oil Output Falls to 2.419 Million Barrels a Day

by Bunny Nooryani Feb. 7, 2007 (Bloomberg) -- Norway pumped about 2.419 million barrels of crude oil a day in January, falling 1.2 percent from the month before, according to preliminary figures from the Norwegian Petroleum Directorate. In 2006 as a whole, Crude oil output dropped 7.8%, while natural-gas production rose 3.1%.
http://www.bloomberg.com/apps/news?pid=newsarchive&sid=ao0mYBObQqsE



Historical and Projected Production for Norway
Graph source: http://www.dieoff.org/page180.htm

The total area under the curve represents 36 billion barrels of oil and the decline rate after the peak is 8.0 % year. A 1995 report by the U.K. Offshore Operator's Association projected a similar 8% year decline rate after peak production.



Historical and Projected Production for U.K.
Graph source: http://www.dieoff.org/page180.htm

Author's and U.S. DOE/EIA'sProjections of Norwegian and U.K. Oil Production to 2020

Author's Projections	Peak Year	Peak Oil Production (mb/d)	2010 Oil Production (mb/d)	2020 Oil Production (mb/d)
Norway	2001	3.2	1.6	0.77
U.K.	1999	2.7	1.5	0.92
U.S. DOE/EIA's Projections[4]				
Norway	2005	3.9[a]	-	3.2[a]
U.K.	-2006	3.3[a]	-	2.2[a]

No Turning Back

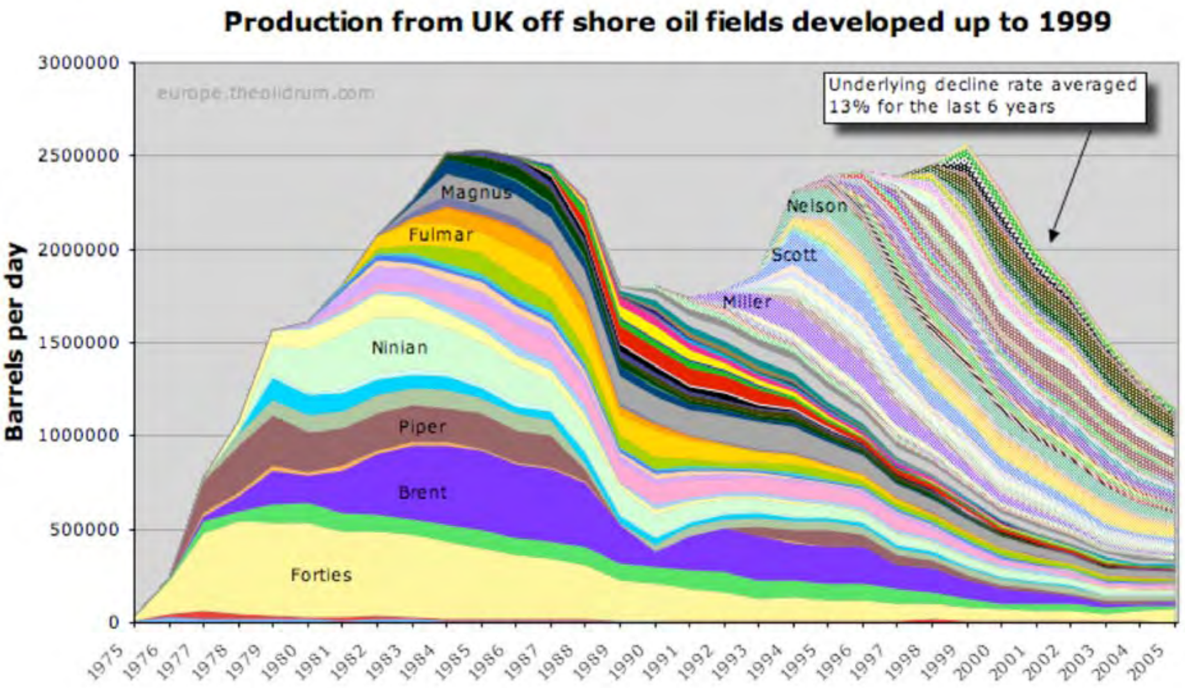
Lundin Petroleum Third Quarter 2005 Operations Summary
http://www.lundin-petroleum.com

The UK produced an average of 2.72 million barrels a day (mbpd) in 1999, hitting a high of 3.1 mbpd in August, but by June 2005 this had fallen to 1.7 (mbpd), a drop of 34%.

"These declines do seem to be irreversible now," says Deborah White, senior energy analyst at Societe Generale. "In my experience, even when [oil] prices are extremely high and spending [on extraction] is extremely high, it has been virtually (almost) impossible to reduce decline rates below 3%."

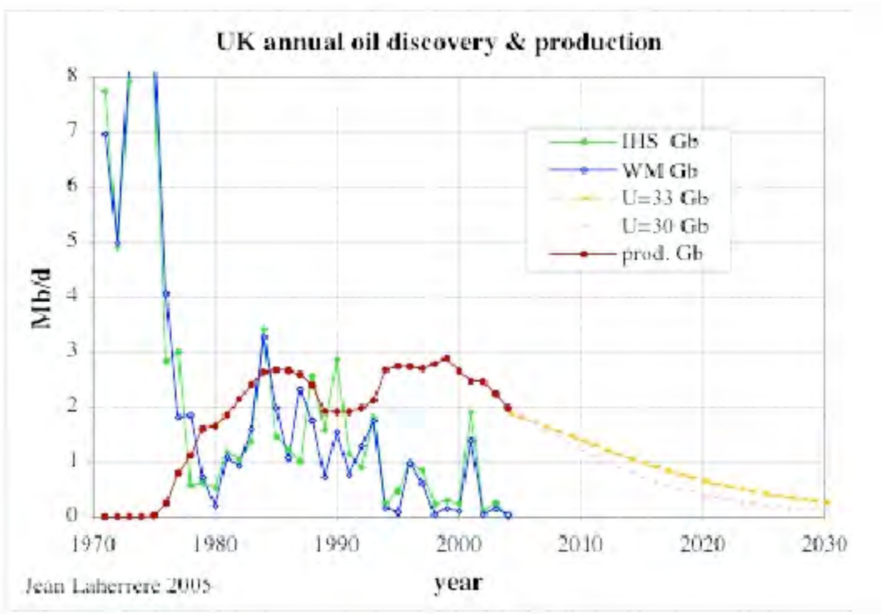
What is also interesting about the UK's declining oil output (production) is that it has been rather consistent. In 2000, production was down 8.1% from its 1999 high, then falling 6.8% in 2001. The decline slowed to 0.5% in 2002, prompting (causing) calls that an output 'rebound' was on the cards (Slang for something is likely to happen), but 2003 saw an 8.8% decline, rising to 10% in 2004. This year has seen a similarly startling (shocking) decline. In February, year-on-year levels were down 13%, rising to 17% in March.

Discovery shortages continue, "Declines will continue. There is only one new field of any size - the Buzzard field -set to come online. Otherwise it's just bits and pieces." The UK Offshore Operators Association (UKOOA) says that declines are inevitable. Even with increased spending of about £4.3bn (billion) a year, it believes the decline will still be about 7%. At least that is what the Department of Trade and Industry says. "Eight new fields started production during the past year/' it reported.**"But production from these fields was insufficient to make up the general decline in production from older established fields." (fields already in production)**



Graph source: http://europe.theoildrum.com/story/2006/11/19/135819/75

The stacked production profiles for all UK offshore oil fields from 1975 to 1999 - the year of UK peak oil production. Fields brought on production since 1999 are not shown. Note that without new fields, the underlying rate of post - peak decline is 13% per annum. Click on chart to enlarge (applies to all charts).



UK oil field production curve projected to 2030
Graph source:http://www.mnforsustain.org/images/oil_lisbon_laherrere_uk_prod_discv_fig17.jpg

Norway and the U.K. have perhaps the best documented oil fields in the world. And in the last couple of years, they have very honestly admitted that their oil fields are peaking. Norway has not exploited (overused) their fields as thoroughly (moderately) as the United Kingdom. However, the effect of modern pumping technology can still be plainly seen in their production statistics: production was brought up quickly, the fields had a relatively short life, and the depletion curve (model) is steep. Norway's production peak is occurring this year (2003). Their depletion rate is currently 7%. By the year 2020, they will be lucky to pump 800,000 barrels per day.

Russia

Russia says Oil Reserves Repletion Lags Production

Reuters, Tuesday April 6, 2006

MOSCOW - Russia is not renewing its oil reserves quickly enough to compensate (equalize) for booming (greatly increasing) production and could therefore lack enough resources to sustain (continue) current output levels after 2010, the government said on Tuesday.

The Natural Resources Ministry said in a statement Russian oil firms discovered a total of 240 million tonnes of new oil reserves last year, when they produced 421 million tonnes. In 2002, output stood at 380 million tonnes, while only 254 million tonnes of new reserves were discovered. “But starting from 2010 and especially after 2010 [the country] might lack proven reserves.” The Ministry said in a statement.

(ESL LESSON 4) Delivery Systems

A.) Wandering back through history how do you think delivery systems evolved/developed? One person had more than they could carry, so a cart was used to transport (move) the goods to be traded. Depending from the part of the world it could have been a mule, camel, donkey, elephant, reindeer, buffalo, cow or human pulled cart. But through the years it evolved into our modern delivery system. We use just-in-time systems that rely on computer ordering to allow just the right amount of product to be delivered to stores. The warehouse is now the delivery system itself. There are ships that carry containers, ships that carry oil, and airplanes that carry boxes across the planet in two days. We have FedEx, UPS, and DHL, if that isn't good enough there are home shopping channels like HSN and QVC that allow us to shop from home.

B.) As the planetary oil source dwindles (become smaller) each year, so will delivery systems dwindle. Have your students talk about how delivery systems evolved. Examples might be horse drawn wagon-sailboats-steamships-trains-cars/trucks-airplanes, and how these will de-evolve.

C.) Which companies will be affected first? Surely three day air and over-nite delivery will be the first to go. As oil declines, which will be the last systems in place still functioning (working)? Will the factories in China still be able to ship their goods across the oceans?

Focus on the delivery system as the most important part of the production chain, because it is.

1. Which items will disappear from store shelves, markets and malls first?
2. When companies stop ordering from overseas factories they will once again start ordering close to home. What areas of business will boom? (Recyclers)
3. Getting the raw materials themselves to the factory to begin production could be another point. (Mining)
4. If factory X can't deliver worldwide, companies from country Z will not order from factory X, which will cause un-employment in nation Z.
5. If container ships depart (leave) less frequently which ports will be affected, and the economies of the port towns? (The companies and ports themselves need less workers)
6. Will crime increase with fewer (less) jobs in towns and less goods in the stores?
7. How will unemployment worldwide be handled by governments?
8. Which companies/industries will go out of business?
9. Will we return to coal fired steamships for travel?
10. How will food prices rise in relation to delivery costs?
11. How long before the world economy grinds to a halt (completely stops) without global delivery?
12. Which places will once again boom in a country? (Towns along railways that were put out of business by cars and airplanes) Rail and waterway are the cheapest delivery method.

D.) How far down the line of possibility can you make a chain of causes and effects? Even the candles are delivered by truck! If product X is not delivered for what ever reason, how will that effect product Y and product Z? Example: If the toothpaste factory doesn't deliver any longer, how will that effect the toothbrush company? Your teeth? Your dentist? What would you use to keep your teeth clean? You would need to find a substitute, baking soda, suddenly the baking soda company sees record sales, so would the peppermint oil factory.

E.) For a brain teaser ask students to come up with a list of goods that are not delivered by a fossil fuel powered form of transport. This goes for any major city on our planet. Good luck! If you come up with more than ten items please email me.

The Caspian Region Central Asia

Shell set to pull-out of Turkmenistan, AFP.
http://www.cacianalyst.org/view_article.php?articleid=1272

This leaves the much touted (talked about) Central Asian Caspian Sea region. Yet, as the author reported last December, exploration of this area has yielded (shown) dismal (discouraging) results. The latest news to add is that Shell Oil is pulling out of Turkmenistan, following on the heels (Slang for behind) of Exxon-Mobil. When we factor (add) in problems inherent (included) with the Central Asian and Caspian oil; the problem of transporting it to areas of demand, and unresolved (unsettled) political squabbles (arguments) about ownership of Caspian Sea oil. And dare we mention (should we say) that most of the **oil discovered in this region has a high sulfur content, which makes it even less desirable?**

The Battle for Oil **by Michel Chossudovsky** 26 Jul 2006 Energy Bulletin

The inauguration (celebration of the beginning of something) of the Ceyhan-Tblisi-Baku (BTC) oil pipeline, which links (connects) the Caspian sea to the Eastern Mediterranean, took place on the 13th of July. The BTC pipeline totally bypasses (goes around) the territory of the Russian Federation transiting (passing) through the former (old) Soviet republics of Azerbaijan and Georgia, both of which have become US "protectorates" (protected by the USA military). The BTC pipeline dominated (controlled) by British Petroleum, has dramatically (seriously) changed the geopolitics of the Eastern Mediterranean, which is now linked through an energy corridor (route), to the Caspian sea basin. The pipeline is 1,776 km from the Azeri-Chirag-Guneshli oil field in the Caspian Sea to the Mediterranean Sea.

BTC Pipeline Route Map
Pipeline map source: http://www.energybulletin.net/18656.html

Turkmenistan's Karakum Desert holds the world's third (3rd) largest gas reserves—three trillion cubic meters. Other oil fields in adjacent (next to) Uzbekistan, Tajikistan and Kyrgyzstan further increase the known reserves of cheap energy available to oil-dependent economies. Estimated at up to 25 billion barrels (4 km^3) of oil originally in place, Tengiz is the sixth (6th) largest oil field in the world; recoverable crude oil reserves have been estimated at 6 to 9 billion barrels (0.9 to 1.4 km^3). Like many other oil fields, the Tengiz also contains large reserves of natural gas. **Since the oil from Tengiz contains a high amount of sulfur (up to 16%), a 6 million ton mountain [and still growing] is being used to store the sulfur byproduct (waste leftovers from production).**

The TengizChevroil (TCO) joint venture has developed the Tengiz field since 1993. In Tengiz Chevroil are Chevron, ExxonMobil, the Kazakhstani government through KazMunayGas and Russian LukArco.During World War II, Hitler wanted to conquer (control by military force) these oil fields, and the Battle of Stalingrad was fought over the Baku Oil Fields.

The 692km South Caucasus Pipeline planned to be operational (opened and in operation) by the end of 2006 will transport gas from the Shah Deniz field in the Azerbaijan sector (area) of the Caspian Sea, to Turkey through Georgia, along a Baku-Tbilisi-Erzurum path. Estimations are that Caspian output more than doubles, to 4.2 million barrels per day, in 2015 and increases steadily thereafter, although **there still is considerable (much) uncertainty about export routes (ways) from the Caspian Basin region.**

Summit Forges Military Ties in Central Asia

Boston Globe, 18 June 2006
"Leaders of the six-member Shanghai Cooperation Organization,(SCO) which includes China, Russia, Kazakhstan, Uzbekistan, Tajikistan, and Kyrgyzstan, embraced a Chinese-led plan during the summit to increase military cooperation and discussed (talked about) a Russian proposal (idea) to create a regional 'energy club' that would exclude (keep outside) the United States. The SCO also indicated it would soon invite Iran, India, Pakistan, and Mongolia -- nations that have observer status in the organization -- to become full members.

The economic endgame in all this is to dilute (lessen) Washington's hold over the Caspian Sea's energy reserves, said Robert Karniol, Asia-Pacific editor for Jane's Defense Weekly. China and India, the world's fastest-growing energy consumers, want to divert Central Asia's energy resources toward their own economies, and Iran and Russia, the region's largest energy suppliers, are keen to reduce their dependence on sales to the West. For complete list of pipeline projects throughout the region (area) check EIA site at http://www.eia.doe.gov/emeu/cabs/caspgrph.html

Table 1 B1582

Estimated Oil and Gas Reserves in the Caspian Sea Region

Estimate Source:	Energy Information Administration			International Energy Agency		
Commodity	Proven reserves	Possible reserves	Total	Proven reserves	Possible reserves	Total
Oil (in billions of barrels)	18–34	235	253–269	15–40	70–150	85–190
Gas (in trillion cubic feet)	243–248	328	571–576	237–325	283	520–608

Source: Energy Information Administration, at http://www.eia.doe.gov/emeu/cabs/caspgraph.html#TAB1-Original, and International Energy Agency, at http://www.iea.org/pubs/studies/files/caspian/overview.htm.

Graph source: http://www.heritage.org/Research/MiddleEast/images/table1.gif

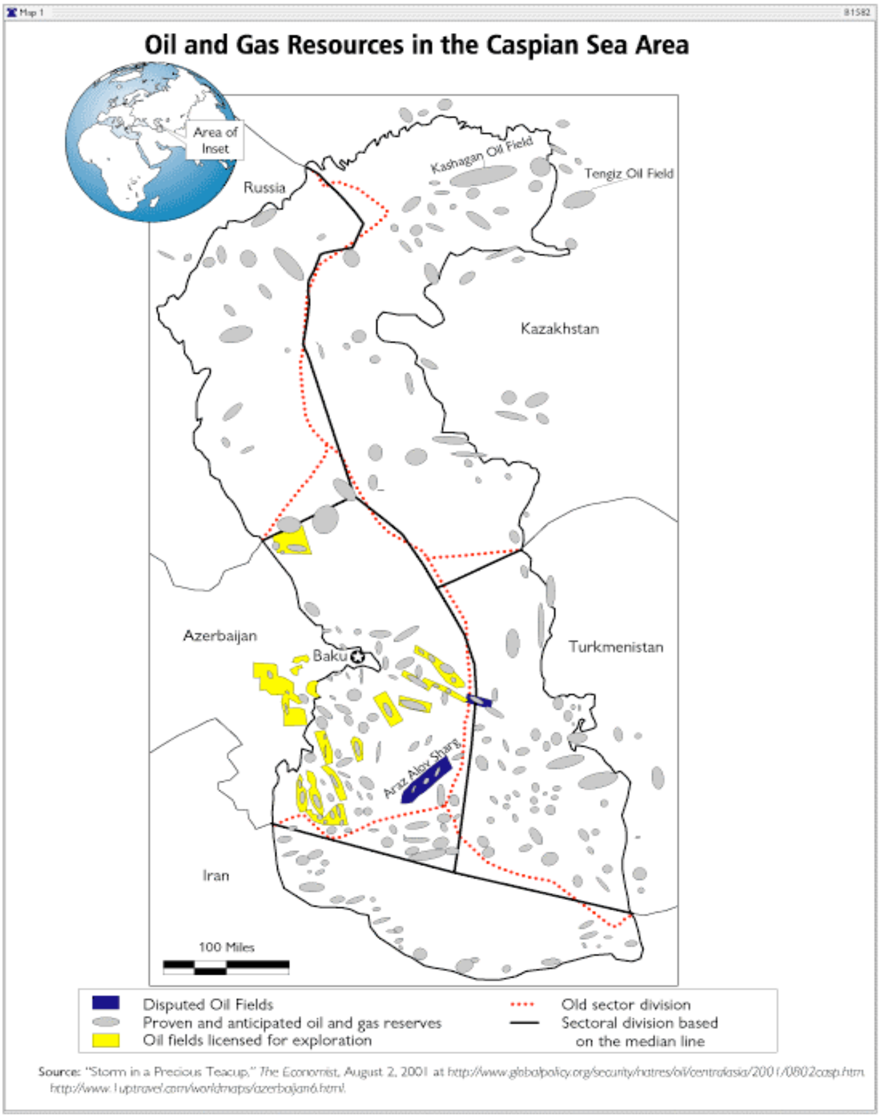
Table 2 B1582

Growth of Oil and Gas Production and Exports in the Caspian Sea Region

	Production			Net Export		
Energy source	1990	2000*	2010**	1990	2000*	2010**
Oil (in thousand barrels per day)	1,216.40	1,284.00	3,900.00	86.90	713.00	3,200.00
Gas (in billion cubic feet per year)	5,358.80	4,032.00	8,500.00	2,112.60	1,480.00	4,850.00

Notes: *Estimated production. **Possible production.
Source: Energy Information Administration, at http://www.eia.doe.gov/emeu/cabs/caspgrph.html#TAB1-Original.

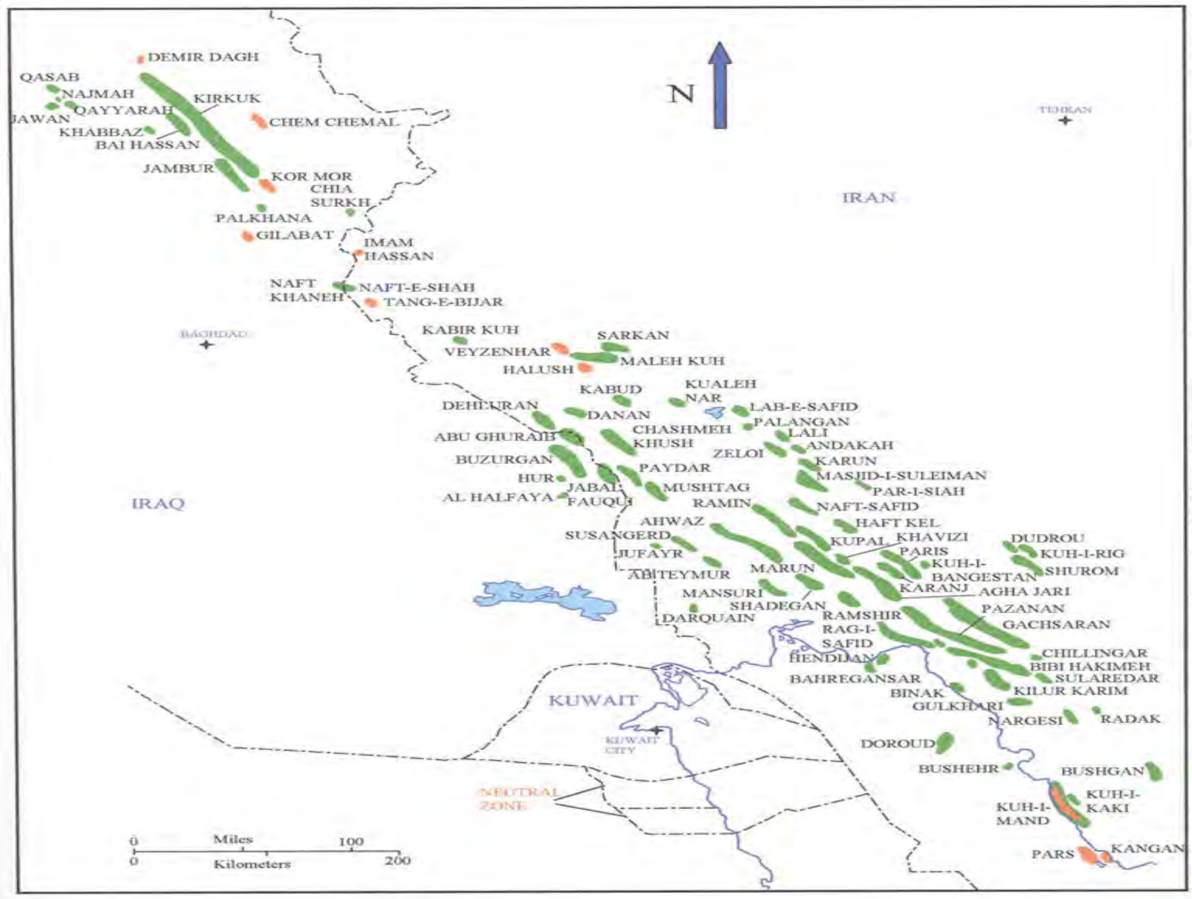
Graph source: http://www.heritage.org/Research/MiddleEast/bg1582.cfm



Caspian Sea map source: http://www.heritage.org/Research/MiddleEast/images/map.gif

Iran

Just a quick word on Iran, it is a country that can increase its oil production, but internal usage (consumption) is increasing fast, so exports year on year will decline, not from peaked oil production but from the population if Iran using more oil internally. On a positive note it does still have one of the largest reserves of oil and natural gas left (remaining) on the planet after Iraq and Saudi Arabia. Militarily, check out how all of the oil and gas fields are in the extreme western part of the country bordering Iraq. An invading army would only have to control a small percentage of the total land mass (total country area) to secure (control) a major chunk (amount) of the worlds remaining oil reserves. All of the supertankers out of the region pass through a chokepoint at the Straights of Hormuz.



Iranian Oil Field Map
Map source: http://www.gregcroft.com/reports.ivnu

Africa

African countries have proved reserves of 73.4 billion barrels (6% of the world's total) Five countries dominate Africa's oil production. Together they account for 85% of the continent's oil production and are, in order of decreasing output, Nigeria, Libya, Algeria, Egypt and Angola. Other oil producing countries are Gabon, Congo, Cameroon, Tunisia, Equatorial Guinea, the Democratic Republic of the Congo, and Cote d'Ivoire. Exploration is taking place in a number of other countries that aim (try) to increase their output or become first time producers. Included in this list are Chad, Sudan, Namibia, South Africa and Madagascar while Mozambique and Tanzania are potential gas producers. The amounts of oil and gas from Africa are not large, I discuss Nigeria below so I will stop here. If you wish to study further on your own start with the mbendi.co.za web site.

More information at http://www.mbendi.co.za/indy/oilg/ogus/af/p0005.htm

NIGERIA

Nigeria Unable to Meet Demand REUTERS 14/09/2006

OPEC member Nigeria is the world's eighth (8th) biggest exporter of crude oil, but it is unable to meet domestic (inside the country) demand for refined products (finished oil products) because sabotage, mismanagement and corruption have crippled (slowed down and broken) its refineries. Its sweet, low-sulfur crude is the largest single (one) source of petroleum for Philadelphia refineries in the USA. Nigerian crude makes up more than 40% of the feedstock (base ingredient) at Sunoco's refineries in Philadelphia and Marcus Hook. The Sunoco refineries buy one of every ten barrels that Nigeria produces. Attacks on the oil industry by militants (or freedom fighters, one mans freedom fighter is another mans militant) in the southern Niger Delta, which have shut down more than 500,000 barrels per day of crude production, have compounded (added to) the problem recently. Both Warri and Kaduna refineries are supplied by one crude oil pipeline that was bombed by militants (freedom fighters) in a series of attacks on February 18,2006.

Forced to Import

Even at full capacity (maximum output), Nigerian refineries supply less than half the country's fuel needs, forcing it to import costly fuel from refineries in Europe. From 1,500 wells in the Niger delta, Nigeria sent $9 billion worth of crude oil last year to refineries in the US. In the marshes, sweltering (hot and humid) swamps of mangrove and palm of the Niger Delta, young men armed with fast boats, old weapons and an ancient warrior tradition (custom) have taken on the government of Africa's most populous nation. Angered by decades of exploitation (being used by other people like slaves), the rebels (or freedom fighters) have launched a war of sabotage. They have kidnapped foreign workers, commandeered (taken control of by force) oil installations and blocked pipelines in an attempt (try) to force the oil companies and the government to return more of Nigeria 's wealth to its source (return money back to the countries people). The uprising has reduced Nigeria's 2-million-barrels-per-day production by as much as a third (1/3).

Nigeria is among the poorest third of African countries - its per capita income (average yearly income) has fallen from a high of nearly $1,000 in the 1970s to $260 a year, about half that of the average African nation. Delta villages are largely (mostly) without schools, clinics, electricity or roads. Most residents drink directly from the Niger River, which also serves as their toilet. Because more money can be made by importing fuel and selling it on the black market, Nigeria's four refineries have fallen into disrepair. It is practically (almost) impossible to find a gallon of gas (petrol) in a region that rests atop (sits on top of) 22 billion barrels of oil. Natural gas reserves are well over 100 trillion ft^3 (2,800 km^3), the gas reserves are three times (3X) as substantial (large) as the crude oil reserves.

In one of the most significant instances (best examples), a delta tribe of about 500,000 people called the Ogoni organized (came together) to protest the practices of Royal Dutch/Shell Group Co., which has the largest oil operations in Nigeria . The Movement for the Survival of the Ogoni People (MOSOP) demanded a share of royalties (profit from oil and gas business), a halt (stop) to oil spills, clean up contaminated (polluted) areas, and political autonomy (independence). Shell suspended its operations in Ogoni territory in 1993. **But still has not cleaned up its mess**

The recent uprising (coming together to demand change) of ethnic Ijaws is perhaps even more ominous (threatening). The Ijaw area is the heart (center) of the oil region. In December, the Ijaws issued a proclamation (statement) claiming ownership of the oil still in the ground and insisted (required) the oil companies leave the delta. It is a story without an end. The Ijaw Youth Council, wonders what might happen if their dream comes true and the oil companies pack up and pull out. "If the oil companies went away, the oil companies would lose and the government would lose," they said. "The only people who would be better off are the people who actually live here."

More info about Nigeria and oil at: http://en.wikipedia.org/wiki/Petroleum_in_**Nigeria**

(ESL Lesson 5) Cities and Population Movement

A.) Start by asking students if their grandparents lived in the countryside or in a city. Most will say yes, their grandparents and possibly parents lived in the country side. Then ask for ideas why they think people moved from the countryside into cities? Usual answers include some type of job they were taking, or machines took jobs from farmers that once used buffalo to plow rice fields etc…. Each country may be different so ask your students for a history of the transition (change and shift) from the countryside to the city. Again talk about the modern opportunities (chances) of work and lifestyle that a city offers over the countryside. One question I like to ask is "would you like to live in the rural countryside?" 99% say no it's too boring and nothing to do after dark.

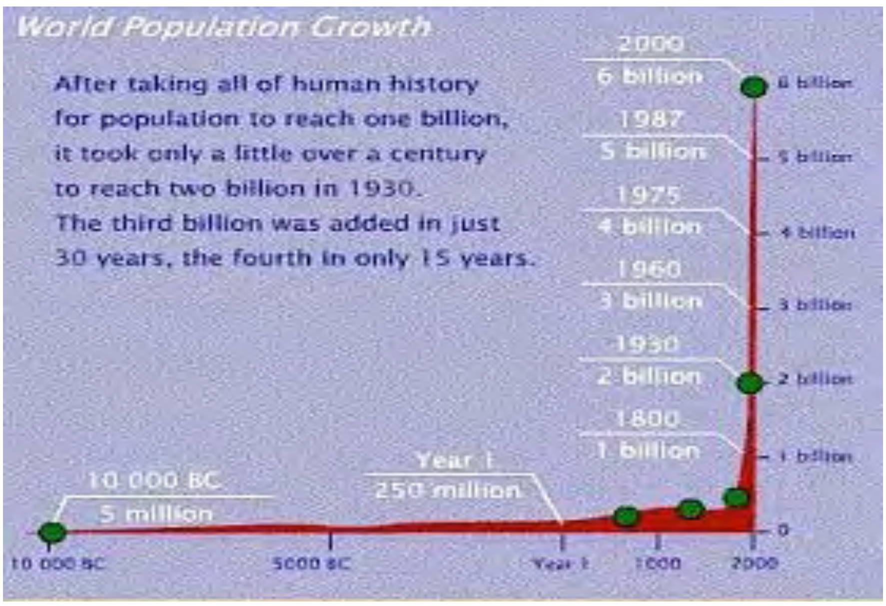
B.) The warm up was strictly about the country that you are in. Now ask them what they know about immigration during the last few centuries around the planet. Anything at all. Why did people move from country X to country Z? Opportunities for better life and more money, marriage, overpopulation, famine, war, floods, droughts, plagues, etc…. I'm sure a few more ideas will come up.

C.) Talk about the modern large cities on earth now, Are they too big? How many people live there? What countries these cities are in? Which cities are the best to live in? Worst? What makes a city 'good' or 'bad' to live in? Ask what their dreams are and which cities they plan to move to or live in.

Since you already traced the migration into the cities, ask what would make people move back to the countryside? Unemployment is the number one reason so far. Secondly ask if everyone emptied out of the cities because there were no more jobs would there be enough housing or space for everyone to return to the countryside. What would people do when they got there?

D.) Change the subject just a little and start asking how suddenly in the last 150 years the population has gone from seven hundred fifty million (750,000,000) to six and a half billion (6,500,000,000) people. What has allowed this population explosion? Oil has! From this point just ask a general question, How has oil made our lives easier over the last 150 years? We can get places easier by car or motorbike, machines do the work that 100 men would do ten times faster plowing fields, we can buy different foods because they are delivered to a market etc… There are many examples to brainstorm on this topic.

E.) Lastly to spin your students heads, ask them, As oil supplies decline year on year will population growth continue to grow, level off, or decline? Explain that **since 1950 we have consumed more resources than in all of previous history of mankind combined.**



Graph source: http://www.smalltownproject.org/wp-content/my-images/populationgrowth.JPG

Possible Alternatives to Replace Crude Oil

Tar sands

Tar sands, also referred to as **oil sands** or **bituminous sands,** are a combination (mixture)of clay, sand, water, and bitumen. Technically speaking, bitumen is neither oil nor tar, but a semisolid, form of oil which will not flow toward producing wells (pumping oil wells) under normal conditions, making it difficult and expensive to produce. Tar sands are mined to extract (get out) the oil-like bitumen which is upgraded (converted/changed) into synthetic crude oil or refined directly into petroleum (oil) products by specialized (specially built) refineries. Conventional oil is extracted by drilling a well into the ground, but tar sand deposits are mined using strip mining techniques, or persuaded (made) to flow into producing wells by in-situ techniques which reduce the bitumen's viscosity (thickness) with steam and/or solvents.

Location

Tar sands deposits are found in over 70 countries throughout the world, but three quarters (3/4) of the world's reserves are in two regions (areas), Venezuela and Canada. Tar sands have only recently become considered to be a major part of the world's oil reserves, that is, they have become economically extractible at current prices with current technology. To distinguish (identify the difference) the bitumen and synthetic oil extracted from tar sands vs. the free-flowing hydrocarbon mixtures known as crude oil that oil companies have pumped from oil wells, **tar sands are often referred to as Non-Conventional Oil**. Tar sands represent as much as 66% of the world's total reserves of oil, with at least 1.7 trillion barrels in the Canadian Athabasca Tar Sands and 1.8 trillion barrels in the Venezuelan Orinoco tar sands, compared to 1.75 trillion barrels of conventional oil worldwide, most of it in Saudi Arabia and other Middle-Eastern countries. Between them, the Canadian and Venezuelan deposits contain about 3.6 trillion barrels of oil in place.

Canada

Most of the oil sands of Canada are located in three major deposits in northern Alberta. The three deposits are the Athabasca-**Wabiskaw oil sands** of north northeastern Alberta, the **Cold Lake deposits** of east northeastern Alberta, and the **Peace River deposits** of northwestern Alberta. Between them they cover over 140,000 square kilometers and hold at least 175 billion barrels ($175x10^9$ bbl) or 28 billion cubic meters ($28x10^9$ m^3) of recoverable (able to mine and produce) crude bitumen, which amounts to three-quarters of North American petroleum reserves. The Alberta oil sands deposits contain at least 85% of the world's total bitumen reserves but are so concentrated (high concentration) as to be the only such deposits that are economically recoverable for conversion (change) to oil are the Athabasca Oil Sands along the Athabasca River. The mineable (able to mine) area as defined (marked) by the Alberta government covers (about 3400 square kilometers or 1300 square miles) north of the city off Fort McMurray. All three Alberta areas are suitable (appropriate) for production using in-situ methods such as cyclic steam stimulation (CSS) and steam assisted gravity drainage (SAGD).

The Canadian oil sands have been in commercial production since the original Great Canadian Oil Sands (now **Suncor**) mine began operation in 1967. A second mine, operated by the **Syncrude consortium** (a group of businesses), began operation in 1978 and is the biggest mine of any type in the world. The third mine in the Athabasca Oil Sands, the **Albian Sands consortium** of **Shell Canada**, **Chevron Corporation** and **Western Oil Sands Inc**. began operation in 2003. However, with the development (invention) of new in-situ production techniques (methods) such as steam assisted gravity drainage and the oil price increases of 2004-2006, there are now several dozen companies planning nearly 100 oil sands mines and in-situ projects in Canada, totaling nearly $100 billion in capital investment.

Venezuela

Located in eastern Venezuela, north of the Orinoco River, the Orinoco oil belt competes with the Canadian oil sand for largest known accumulation (amount) of bitumen in the world. Venezuela prefers to call its tar sands "extra-heavy oil", and although distinction (difference) is somewhat academic, the extra-heavy crude oil deposit of the **Orinoco Belt** represent nearly 90% of the known global reserves of extra-heavy oil. Bitumen and extra-heavy oil are closely related types of petroleum, differing (different) from each other, only in the degree (amount) by which they have been degraded (broken down) from the original crude oil by bacteria and erosion. The Venezuelan deposits are less degraded than the Canadian deposits and are at a higher temperature (over 50 degrees Celsius versus freezing for northern Canada) which means they are easier to produce by conventional techniques (use a well to pump it from the ground). Although it is easier to produce, it is still too heavy to transport by pipeline or process in normal refineries.

In the early 1980's the state oil company, PDVSA, developed a method of using the extra-heavy oil resources by emulsifying (mixing) it with water (70% extra-heavy oil, 30% water) to allow it to flow in pipelines. The resulting product, called **Orimulsion**, can be burned in boilers as a replacement for coal and heavy fuel oil with only minor modifications (changes to the machines). Unfortunately, the fuel's high sulphur content and emission (out flow) of particulates (small particles) make it difficult to meet increasingly (more and more) strict international environmental regulations.

Extraction Process

Surface Mining

For the last 38 years or so, bitumen has been extracted from the Athabasca Oil Sands by surface mining (strip mining). In these oil sands there are large deposits of bitumen with little top cover, making mining the most efficient method of extracting it. The top cover (overburden) consists of muskeg (peat bog) over top of clay and sand. The oil sands themselves are typically (usually) 40 to 60 meters deep, sitting on top of flat limestone rock. In recent years companies such as **Syncrude** and **Suncor** have switched (changed) to much cheaper shovel-and-truck operations using the biggest power shovels (100 tons) and dump trucks (400 tons) in the world. This has reduced production costs to around $15 per barrel of synthetic crude oil.

After excavation (digging it up), hot water and caustic soda (NaOH) is added to the sand, and the resulting slurry (wet mixture) is piped (sent by pipe) to the extraction plant where it is agitated (shaken) and the oil skimmed (removed) from the top. It is essential (most important) that the water chemistry is appropriate (correct) to allow bitumen to separate from sand and clay, the combination of hot water and agitation (shaking) releases bitumen from the tar sand, and allows small air bubbles to attach to the bitumen droplets. ****This is why they need so much clean water and where the problems of processing bitumen arise if the water source dries up or is not available**** The bitumen froth floats to the top of separation vessels (tanks), and is further treated (again treated) to remove residual (extra) water and fine solids (tiny pieces of sand) Bitumen is much thicker than traditional crude oil, so it must be either mixed with lighter petroleum (either liquid or gas) or chemically split (broken down into smaller parts with other chemicals) before it can be transported by pipeline for upgrading into synthetic crude oil. Recent enhancements (improvements) to this method allow the extraction plants to recover over 90% of the bitumen in the sand.

Three oil sands mines are currently in operation. The original Suncor mine opened in 1967, while the Syncrude mine (the biggest mine in the world) started in 1978 and Shell Canada opened its Muskeg River mine in 2003**. New mines under construction include Shell Canada's Jackpine mine. Imperial Oil's Kearl Lake mine, Svnenco Energy's Northern Lights mine, and Petro-Canada's Fort Hills mine.**

It is estimated that around 80% of the Alberta tar sands and nearly all of Venezuelan sands are too far below the surface to use the open-pit mining technique used by the large producers. A number of in-situ techniques have been developed to extract this deeper oil.
More info at: http://www.oilsandsdiscovery.com/oil_sands_story/insitu.html

Cold Flow or Cold Heavy Oil Production with Sand (CHOPS)

In this technique, the oil is simply pumped out of the sands, often using specialized pumps called progressive cavity pumps. This only works well in areas where the oil is fluid enough to pump. It is commonly used in Venezuela (where the extra-heavy oil is at 50 degrees Celsius), and also in the Wabasca, Alberta Oil Sands and the southern part of the Cold Lake. Alberta Oil Sands. It has the advantage of being cheap and the disadvantage that it recovers only **5-6% of the oil in place**. Some years ago Canadian oil companies discovered that if they removed the sand filters from the wells and produced as much sand as possible with the oil, production rates improved remarkably. This technique became known as Cold Heavy Oil Production with Sand (CHOPS). Further research disclosed (showed) that pumping out sand opened "wormholes" in the sand formation which allowed more oil to reach the wellbore (well opening). The advantage of this method is better production rates and recovery (around 10%) and the disadvantage that disposing (get rid of) of the produced sand is a problem. A novel way to do this was spreading it on rural roads, which rural governments liked because the oily sand reduced dust and the oil companies did their road maintenance for them. In recent years disposing of sand in underground salt caverns has become common.

Cyclic Steam Stimulation (CSS)

The use of steam injection to recover heavy oil has been in use in the oil fields of California since the 1950's. The Cyclic Steam Stimulation or "huff-and-puff" method has been used since 1985. In this method, the well is put through cycles of steam injection, soak, and oil production. First steam is injected (forced) into a well at a temperature of 300 degrees Celsius for a period of weeks to months, then the well is allowed to sit for days to weeks to allow heat to soak into the formation (oil filled sands), and then the hot oil is pumped out of the well for a period of weeks or months. Once the production rate falls off (decreases), the well is put through another cycle of injection, soak and production. This process is repeated until the cost of injecting steam becomes higher than the money made from producing oil.(Becomes and energy sink) The CSS method has the advantage that recovery factors are around **20 to 25% of oil in place** and the disadvantage that the cost to inject steam is high, as well the energy input to create the steam.

Steam Assisted Gravity Drainage (SAGD)

Steam assisted gravity drainage was developed in the 1980s by an Alberta government research center and coincided (happens at the same time) with improvements in directional drilling technology that made it quick and inexpensive to do by the mid 1990's. In SAGD, two horizontal (sideways) wells are drilled in the oil sands, one at the bottom of the formation and another about 5 meters above it. These wells are typically drilled in groups off central pads (areas) and can extend for miles/kilometers in all directions. In each well pair, steam is injected into the upper well, the heat melts the bitumen, which allows it to flow into the lower well, where it is pumped to the surface. SAGD has proved to be a major breakthrough in production technology since it is cheaper than CSS, allows very high oil production rates, and recovers up to **60% of the oil in place**. Because of its very favorable (positive) economics and applicability (usability) to a vast area of oil sands, this method alone quadrupled (4X) North American oil reserves, and allowed Canada to move to second (2^{nd}) place in world oil reserves after Saudi Arabia.

Vapor Extraction Process (VAPEX)

VAPEX is similar to SAGD but instead of steam, hydrocarbon solvents (chemicals made from oil) are injected into the upper well to dilute (make thinner) the bitumen and allow it to flow into the lower well. It has the advantage of much better energy efficiency than steam injection and it does some partial upgrading (changing) of bitumen to oil right in the formation (area of oil sands).

The above three methods are not mutually exclusive (used only by themselves). It is becoming common for wells to be put through one CSS injection-soak-production cycle to condition (get ready) the formation prior to going to SAGD production, and companies are experimenting with combining VAPEX with SAGD to improve recovery rates and lower energy costs.

Toe to Heel Air Injection (THAI)

This is a very new and experimental method that combines (mixes) a vertical air injection well with a horizontal production well. The process ignites (lights on fire) oil in the reservoir and creates a vertical (up and down) wall of fire moving from the "toe" (front) of the horizontal well toward the "heel" (back), which burns the heavier oil components (parts) and drives (pushes) the lighter components into the production well, where it is pumped out. In addition, the heat from the fire upgrades (changes) some of the heavy bitumen into lighter oil right in the formation. Historically fireflood projects have not worked out well because of difficulty in controlling the flame (fire) front and a propensity (thing that usually happens) to set the producing wells on fire. However, some oil companies feel the THAI method will be more controllable and practical, and have the advantage of not requiring energy to create steam. **I wonder how much smoke this releases? Discussion topic: Pollution emissions.

Environmental Impacts

Tar sands development has a direct impact on local and planetary ecosystems (nature). In Alberta, the strip mining form of oil extraction completely (100%) destroys the boreal forest, the bogs, the rivers as well as the natural landscape. The mining industry believes that the boreal forest will eventually colonize (grow again) the reclaimed lands, yet 30 years after the opening of the first open pit mine near Fort McMurray. Alberta, no land (0%) is considered by the Alberta Government as having been "restored" (regrown).

Furthermore**, for every barrel of synthetic oil produced in Alberta, more than 80 kg of greenhouse gases are released into the atmosphere and between 2 and 4 barrels of waste water are dumped into tailing ponds that have flooded about 50 km^2 (square kilometers) of forest and bogs. That is in addition to the 500 to 1000 cubic feet of natural gas used for each barrel.** The forecast growth in synthetic oil production in Alberta also threatens Canada's international commitments (contracts). In ratifying (certifying with other countries) the Kyoto Protocol, Canada agreed to reduce, by 2012, its greenhouse gas emissions (out put) by 6% with respect to the reference year (1990). In 2002, Canada's total greenhouse gas emissions had increased by 24% since 1990. In 2005, University of Toronto researcher Charles Jia developed a means (way) to convert (change) the fluid coke byproduct of oil sand extraction to activated carbon, potentially reducing waste in the extraction process.
http://en.wikipedia.org/wiki/Tar_sands
http://ostseis.anl.gov/guide/tarsands/index.cfm

In 2004, oil sands production surpassed 160,000 cubic metres (one million barrels) per day; by 2015, production is expected to more than double to about 340,000 cubic metres (2.2 million barrels) per day.

Natural gas requirements (usage) for the oil sands industry are projected to increase substantially (greatly) during the projected period from 17 million cubic metres (0.6 billion cubic feet) per day in 2003 to a range of 40 to 45 million cubic metres (1.4 to 1.6 billion cubic) feet per day in 2015. To transport natural gas to existing or new markets, pipelines will have to be expanded or new pipelines will have to be built. **Please remember loss of production due to decline vs. amount of syncrude/ non-conventional oil that will be produced during the same time period to 2015.**

Previous paragraphs are excerpts from Canada's Oil Sands: Opportunities and Challenges to 2015, Energy Market Assessment.
http://www.neb.gc.ca/energy/EnergyReports/EMAOilSandsOpportunitiesChallenges2015_2004/EMAOilSandsOpportunities2015QA2004_e.htm

Oh, Canada! - Natural Gas and the Future of Tar Sands Production

Update: Dave Cohen on June 20, 2006
http://www.theoildrum.com/story/2006/6/19/1571/97105
Perhaps this should be considered a follow-up to the excellent post Mining Canadian Oil Sands Into the Future. However, the real path and story became natural gas usage to carry out (start and continue) production of the tar sands. There turns out to be a possible supply issue. Here are some claims (statements) made about tar sand production going forward.

Tar sands production of approximately 1.0/mbd in 2005 also used 0.72/bcf (billion cubic feet) of natural gas as I read in this brief press release. According to the NEB's [National Energy Board of Canada] 2006 oil sands Energy Market Assessment, the amount of gas used in oil sands production will rise to 2.1 billion cubic feet a day in 2015 from about 700 million cubic feet last year.

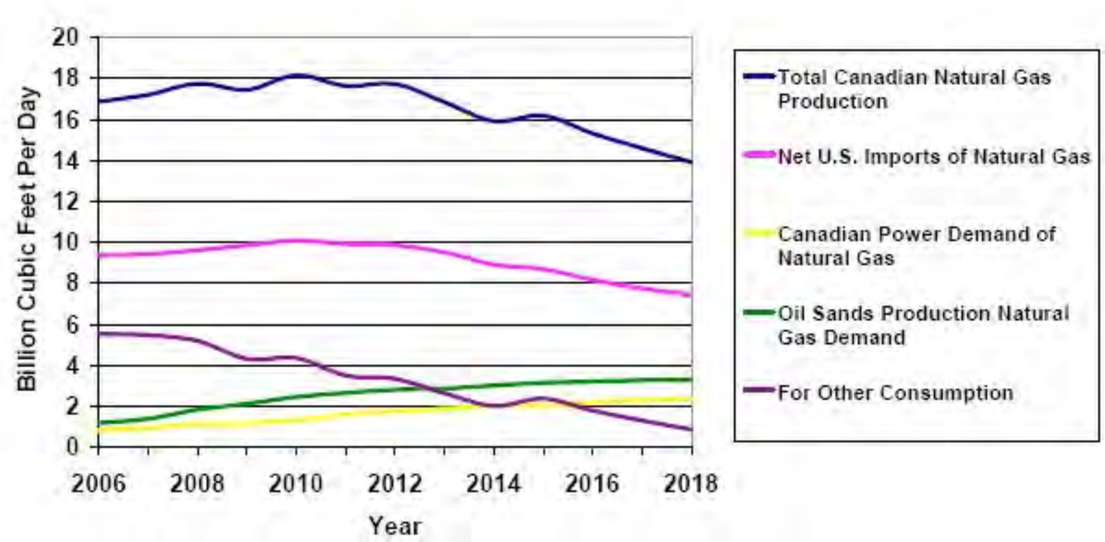
But first, we must discuss how and why natural gas is necessary for producing the tar sands. The newest most efficient *in-situ* method for tar sands recovery uses Steam Assisted Gravity Drainage [SAGD]. Natural gas-fired (powered) facilities (power plants) generate steam [for SAGD] and provide heat for bitumen recovery, extraction and upgrading. Further, natural gas also provides a source of hydrogen used in hydro-processing and hydro-cracking (breaking into basic parts) as part of the upgrading process. Although there is considerable (large) variation (difference) between individual projects, an industry rule of thumb (Idiom for average) is that it takes 1000 cubic feet of natural gas to produce one barrel of bitumen. The demand (usage) for mining recovery is about 250 cubic feet per barrel. Current natural gas demand (usage) for up-grader hydrogen amounts to approximately 400 cubic feet per barrel. Future hydrogen additions (add to) for upgrading into higher quality SCO [synthetic crude oil], may reach another 250 cubic feet per barrel. Therefore, a future barrel (one barrel) of in situ produced high quality SCO may require 1000 standard cubic feet of natural gas.

As Canadian conventional gas production declines, this may be offset (replaced) by increases in natural gas from coal (NGC) production, and bio-mass gasification. **(See Page 69)**

Natural gas from coal, which is also known as coal bed methane (is environmentally damaging with 21 times (21X) the global warming potential of carbon dioxide, large amounts of polluted wastewater, and reduces agricultural activity through soil pollution) Check out more details at: http://72.14.235.104/search?q=cache:6QTZkQktWswJ:www.wcel.org/wcelpub/2006/14250.pdf+coal+bed+methane+environmental+problems&hl=en&ct=clnk&cd=9

Tar sands natural gas usage (ONLY) will reach 1.01/bcfd by October of 2006 from 0.72/bcfd in 2005. According to the CAPP production data, there will be an increase of 0.225/mbd (222,500 bbl) of oil production from 2005 to 2006 accompanied by (together with) an increase of 0.29/bcfd of natural gas required for that new production, **an astonishing 29% increase in just one year**. This is related to increased use of SAGD for *in-situ* bitumen extraction, heat requirements.

Future Availability of Natural Gas for the Tar Sands



http://www.theoildrum.com/story/2006/6/19/1571/97105

Eyeballing (looking at) the graph, we find that by 2018, Canadian natural gas production will be about 14/bcfd (billion cubic feet per day) and consumption (usage) is projected to go something like this-numbers approximate, of course!

1. Exports to the US -- 7.5/bcfd
2. Canadian power demand - 2.2/bcfd
3. Tar Sands production--3.1/bcfd
4. Other Consumption -- 1.2/bcfd

That covers it all, the whole shooting match (Slang for total), which is 14/bcfd**. Incredibly, tar sands production is higher than internal Canadian electrical power demand and this leaves a paltry (very small amount) 1.2/bcfd for *all other Canadian usage,* which would include any industry, agriculture or manufacturing there that uses natural gas.** Clearly, this is not going to work. Even if the MacKenzie pipeline comes online successfully in the 2010/2011 timeframe as projected and *all the gas transported* from the Arctic is used for tar sands production and finally, we assume the WCSB 2005 contribution of 1.1 /bcfd (which is almost certainly very generous), there would still be a **0.8/bcfd *shortfall* of natural gas supply for tar sands production in the year 2018**. Something's got to give (Slang for something must balance out). So, where’s the extra gas going to come from in the longer term? LNG (liquefied natural gas) imports? How are you going to get them to Alberta, which is geographically in the middle of nowhere? Natural gas from coal (NGC), also known as coal bed methane (CBM)?

A potential (possible) source that is almost completely undeveloped in Canada. Development of the resource is at an early (beginning) stage with the production in 2004 at 4.3 million m3/d (0.15 Bcf7d) or less than 1 percent of Canadian gas output.   To me, the future scenario (plan) is completely unattainable (not possible to make happen), both logistically and politically. It is a fantasy (dream) world for those who espouse (believe and say) it. Keep in mind that coal bed methane may come into large production, which will take the strain off of the natural gas supply.

(Note: DD) Since natural gas is the single largest feedstock (ingredient) used to produce fertilizers (substance put on plants so they grow faster), an increase in natural gas prices will push up food costs, in addition to the increase in transportation costs of delivering food.

Fears growing in wake of expected 50% cost increase at Shell oilsands plant

James Stevenson, Canadian Press Published: Friday, July 07, 2006
http://www.canada.com/edmontonjournal/news/business/story.html?id=4fc07137-c4a7-485d-bd25-c9c779455afb&k=69262&p=2

CALGARY (CP) - Fears that cost pressures have spiraled (multiplied)out of control in the northern Alberta oil sands spooked (sacred) investors Thursday in the wake (result) of news that Shell Canada's (TSX:SHC) & Western Oil Sands (TSX:WTO) Athabasca oil sands project could potentially (possibly) pay upwards of $11 billion to generate an extra 100,000 barrels of oil a day.

Even in an industry that has seen its share (portion) of multibillion-dollar cost overruns (pay more than they thought) to build mega projects, word (information) that Athabasca's first major expansion could cost 50% higher than the current $7.3 billion price tag (cost) hit oil sands producers hard on the stock market. Bob Gillon, an energy analyst with John S Herold in Connecticut, said the Athabasca **expansion would now cost six times (6X) what the original project did, on a daily per barrel basis**. Gillon said **at $11 billion, the company is paying twice as much for 100,000 barrels of oil sands crude** as it would by buying conventional production (oil by pumping from ground). “The dramatic (startling) cost escalations (increases) could ultimately (at last) put an end to oil sands companies drawing (getting) the largest investment dollars in the energy industry. A long list of new projects that have not yet begun development might be dropped off the list”, said Gillon. While projects that have already been built or are well underway, such as those owned by Canadian Natural Resources (TSX:CNQ) or Nexen Inc. (TSX:NXY) might even attract greater (more) market interest.

(**Note DD) Imagine if they put all of that cash, enthusiasm, tax breaks and energy used up in exploration into alternative/renewable energy sources that would break us free of oil usage, we wouldn’t need oil any longer on a large scale. Bio-diesel and Ethanol will help, but it is a larger problem that needs to be fixed, not simply stretched out a few extra years**

(ESL Lesson 6) Recycling

A.) Let's look at what is most commonly recycled, there are other things like car batteries, tires, refrigerators, air conditioners but these are a different subject of recycling than the items below.

Paper: *Newspapers* are commonly recycled into paperboard, new newspapers or insulation. *Office paper* can be recycled into other writing paper, tissue and towel products. *Corrugated paper* is used to make new paperboard and corrugated boxes. Newspapers can only be recycled 4-6 times maximum. Each time a newspaper is recycled the paper fiber gets a little shorter until it unusable. In England 75% of the newspapers printed each day are printed on recycled paper. Black ink is removed with either hydrogen peroxide or chlorine bleach.

Plastic: *PET* (polyethylene terephthalate) the material used to make plastic soda bottles. *HDPE* (high density polyethylene) is used for plastic milk jugs and food packaging. The plastic used in one-gallon milk and water jugs is also recycled to make products such as trash cans, flower pots and plastic pipes. *LDPE* (low density polyethylene) for plastic grocery and produce sacks/bags, dish racks it's a softer fluffier plastic. *PP* (polypropylene) is used to make fishing nets and many types of ropes used in saltwater.

Metals: *Aluminum* is the most valuable of household recyclables. Aluminum cans are recycled to produce new aluminum cans. Other sources of household aluminum such as clean aluminum foil, clean pie tins, aluminum siding, and the metal frames of aluminum lawn furniture *Steel cans* are sought (wanted) by the steel industry because they are a good source of steel scrap and their tin coating also can be recovered and recycled.

Glass: Glass is completely (100%) recyclable, clear glass containers are recycled into new clear glass products, while colored glass containers are recycled into new colored glass products.

Motor oil: used motor oil can be recycled into heating fuel, industrial lubricants and even new motor oil.
http://www.dep.state.pa.us/dep/deputate/airwaste/wm/RECYCLE/Recywrks/recywrks2.htm

B.) Start asking your students what happens after they drink that bottle of soda? What happens to the bottle and how does it get back to the store shelf during the recycling process? Trace the chain of recycling from trash collector-consolidator-reprocessor-end use factory-manufacture of new product-store shelf.

Along the streets you see people digging in the trash cans **collecting** bottles; they collect bottles all day long and then go to a consolidator to sell them. The **consolidator** is a person with a small warehouse that buys plastic from the guy on the street, businesses, restaurants or recycle locations. The consolidator then sells these metric tons of plastic bottles to a **reprocessor**. A reprocessor is a factory that takes the bottles and grinds them into small pieces called Flakes, or melts them into small pellets called Granules. The reprocessor sells flake or granules by the container load and will put 25 metric tons of plastic in each 40 foot long container. From here an **end use factory** will buy the flake or granules, melt it and make new bottles that are sold to companies that refill with soda. The refilled bottles are then back on the shelf in a store ready to start the process all over again. The chain of recycling is similar with all of the plastics, papers and metals mentioned above.

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Oil shale

Oil shale is a general term (common word) applied to (for) a group of rocks that has enough organic material [called kerogen] to produce petroleum upon distillation (process of removing oil from rock). The kerogen in oil shale can be converted (changed) to oil through the chemical process of pyrolysis. During pyrolysis the oil shale is heated to 445-500 °C in the absence of air (with no air) and the kerogen is converted (changed) to oil and separated out, a process called **"retorting".** Oil shale has also been burnt directly as a low-grade fuel (type of very polluting fuel). The United States Energy Information Administration (EIA) estimates the world supply of oil shale at 2.6 trillion barrels of recoverable oil, 1.0-1.2 trillion barrels of which are in the United States. Estonia, Russia, Brazil, and China currently mine oil shale; however production is declining due to (because of) economic and environmental factors.

Extraction

Mining

With mining, the oil shale is mined either by traditional underground mining or surface mining (strip mining) from the ground and then transported (moved) to a processing facility. At the facility, the shale is heated to 450-500 °C and enriched with hydrogen (hydrogen is added by adding superheated steam). The resulting oil is then separated from the waste material.

In-Situ

With in-situ processing, the shale is fractured (broken) and heated underground to release gases and oils. Most of these methods are still experimental. The Shell Oil Company has been developing a new method under the name the Mahogany Research Project that uses electrical heating in Colorado. A heating element (unit) is lowered into the well and allowed to heat the kerogen over a period of approximately four years, slowly converting it (turning it into) into oils and gases, which are then pumped to the surface. This greatly reduces the footprint (environmental damage) of extraction operations—to no more than a conventional oil well. It could also potentially (possibly) extract more oil from a given area of land, as the wells can reach much deeper than surface strip-mines can.

History

Oil shale has been used since ancient times and can be used directly as a fuel just like coal. The modern use of oil shale to produce oil dates to 1847 when Dr James Young prepared lighting oil, lubricating oil and wax from coal. In 1850 he patented the process of "cracking" oil into its constituent parts (basic parts). Oil from oil shale was produced in that region (area) from 1857 until 1962 when production was cancelled (stopped) due to the much lower cost of petroleum. Oil shales were not exploited (used frequently) until fuel shortages during World War I. Mining began in 1918 and has continued since, with the size of operation increasing with demand. Once heavily processed (large amount of chemicals and heat added), the oil produced will be suitable for production of low-emission (low-pollution) petrol. Two large power stations burning oil shales were opened, a 1,400 MW plant in 1965 and a 1,600 MW plant in 1973. Oil shale production peaked in 1980 at 31.35 million tonnes. In Australia from June 2001 through to March 2003 produced 703,000 barrels of oil, 62,860 barrels of light fuel oil, and 88,040 barrels of ultra-low sulphur naphtha (flammable liquid similar to oil, varnish is the most well known).

Reserves

Estimated Shale Oil Reserves (Millions of Tonnes)

Region	Shale Reserves	Kerogen Reserves	Kerogen in Place
Africa	12,373	500	5,900
Asia	20,570	1,100	–
Australia	32,400	1,725	36,985
Europe	54,180	600	12,500
Middle East	35,360	4,600	24,600
North America	3,340,000	80,000	140,000
South America	–	400	9,600

Graph source: World Energy Council, WEC Survey of Energy Resources

Therefore, worldwide there are approximately 620 billion barrels of known recoverable kerogen. This compares with known worldwide petroleum reserves of 1200 billion barrels *(Source: BP Statistical Review of World Energy, 2006).*

Economics

Below forty dollars a barrel, oil-shale oil is not competitive with (cost effective compared to) conventional crude oil. If the price of oil were to stay permanently over forty dollars a barrel [with no chance of declining], then companies would exploit (begin to manufacture) oil shale. Generally, the oil shale has to be mined, transported, retorted, and then disposed of, so at least 40% of the energy value is consumed (used) in production. **Best estimates by Royal Dutch Shell put the EROEI at (3:1) Every 1 unit of energy put in you get 3 positive units of energy out. This compares to a figure of typically 20 to 100 for conventional oil extraction.** Water is also needed to add hydrogen to the oil-shale oil before it can be shipped to a conventional oil refinery. The largest deposit of oil shale in the United States is in western Colorado a dry region with no surplus water, so the water has to be piped in (sent by pipe). The oil shale can be ground into slurry and transported via (by) pipeline to a more suitable (better) pre-refining location.
In 2005, Royal Dutch Shell announced that its in-situ extraction technology could be competitive at prices over $30/bbl, the Shell method has produced in commercial (larger) quantities after a pilot project shown successful.

US Companies in Oil Shale

Companies	**Method**
Shell	In-situ Conversion Program
Exxon Mobil	
EGL Resources	
Oil Tech	
Oil Shale Exploration	Unknown

Environmental Considerations

Surface-mining of oil shale deposits (an area of oil shale) has all the normal environmental effects from open-pit mining. In addition (also), the pre-refining process to obtain crude oil generates (makes) ash, and the waste rock [a known carcinogen] (cancer causing substance) must be disposed of. Oil shale rock expands by around 30% after processing due to a popcorn effect from the heating; this waste then needs disposal (to take away and get rid of). Oil shale processing also requires large amounts of water, which may be in short supply.

The energy demands of blasting, transporting, crushing, heating the material, and then adding hydrogen, together with the safe disposal of huge quantities of cancer causing waste material, are large. These inefficiencies (wasteful ways to do something), plus the cost of environmental restoration (repair), mean that oil shale exploitation (usage) will only be economical when oil prices are high and projected to remain so. Currently, the in-situ process is the most attractive due to the reduction (less of) in normal surface/strip-mining environmental problems. However, in-situ processes do involve possible significant (large) environmental costs to aquifers (area of drinking water underground), especially since current in-situ methods may require some other form of barrier (wall) to restrict (stop) the flow of the oil into these groundwater aquifers.

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Shale Oil Extraction Imminent

Posted by Robert Rapier on Sunday June 18, 2006
http://i-r-squared.blogspot.com/2006/06/oil-shale-development-imminent.html

Shell says that despite (even though) the process being very energy intensive (the process uses a lot of energy), it has a positive EROEI. To do it on a large scale you'd need a power plant larger than any power plant in the history of Colorado. And you'd need a new power plant for each 100,000 barrel increment (amount). Davis said those figures come from coal-fired electricity, off the grid. But Shell hasn't decided how to create the electricity that would be used on a commercial (large scale) project.

An EROEI of 3.5 is not great, but it is comparable to tar sands. But how is that EROEI defined? Is it based on the actual electricity used to heat the field? Or is it based on the coal used to make the electricity? That distinction (difference) is very important. If it is based on the electricity used, then we must take into consideration the energy efficiency of turning coal into electricity. That is only around 30%, so that would reduce the "net" EROEI down to about 1 (1:1). Proponents (defenders of the use of oil shale as a fuel source) might argue that this doesn't matter, since you are taking something that can't be directly used as transportation fuel - coal - and turning into a usable liquid fuel. I have seen this argument applied to producing ethanol from corn using coal as the heating source.

I strongly suspect that the net EROEI is around 1 or less. If the overall EROEI was 3.5, the U.S. would probably already be exploiting (using/producing) oil shale instead of depending on Canada to develop their tar sands. The EROEI of tar sands is in the 2-3 range, and due to the similarities of the process, the capital costs (amount of investment costs) should be comparable. So, I am left to conclude (think) that the EROEI of oil shale is poor compared to tar sands.

It is important to note that the EROEI calculations also don't take into consideration the steps that will be required to protect and replace/restore the environment. Shell is just now getting ready to do those experiments.

But with today's technology, the potential (possible) energy comes with a steep price, says Udall and others who are opposed to producing oil from shale. The energy required is a 'giga bunch,' Udall said. To produce 100,000 barrels a day, would require raising the temperature of 700 billion tons of shale by 700 degrees Fahrenheit. How much coal, how many power plants? One million barrels a day would require 10 new power plants and five new coal mines. Just the amount of energy to get the kerogen out of the rock, oil shale is a poor choice to solve the world’s energy problems, Udall said.

Call me a skeptic. **Current U.S. oil usage is over 20 million barrels a day, and it would require 10 new power plants and five new coal mines to replace less than 5% of consumption.** Add to that a multi-billion dollar capital expenditure (investment), increased greenhouse gas emissions, and a process with a marginal (not so good) EROEI. Consider that we could "create" the same amount of oil by simply cutting consumption (usage) by 5%. **It seems to me that enacting (starting) conservation policies (laws) would be far more cost effective than developing oil shale.**

Robert also believes that production from coal bed methane (CBM) and bio-mass gasification will increase, relieving the supply problems for factories using natural gas for heat.

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Huge Mines Rapidly Draining Rivers, Cutting Into Forests, Boosting Emissions

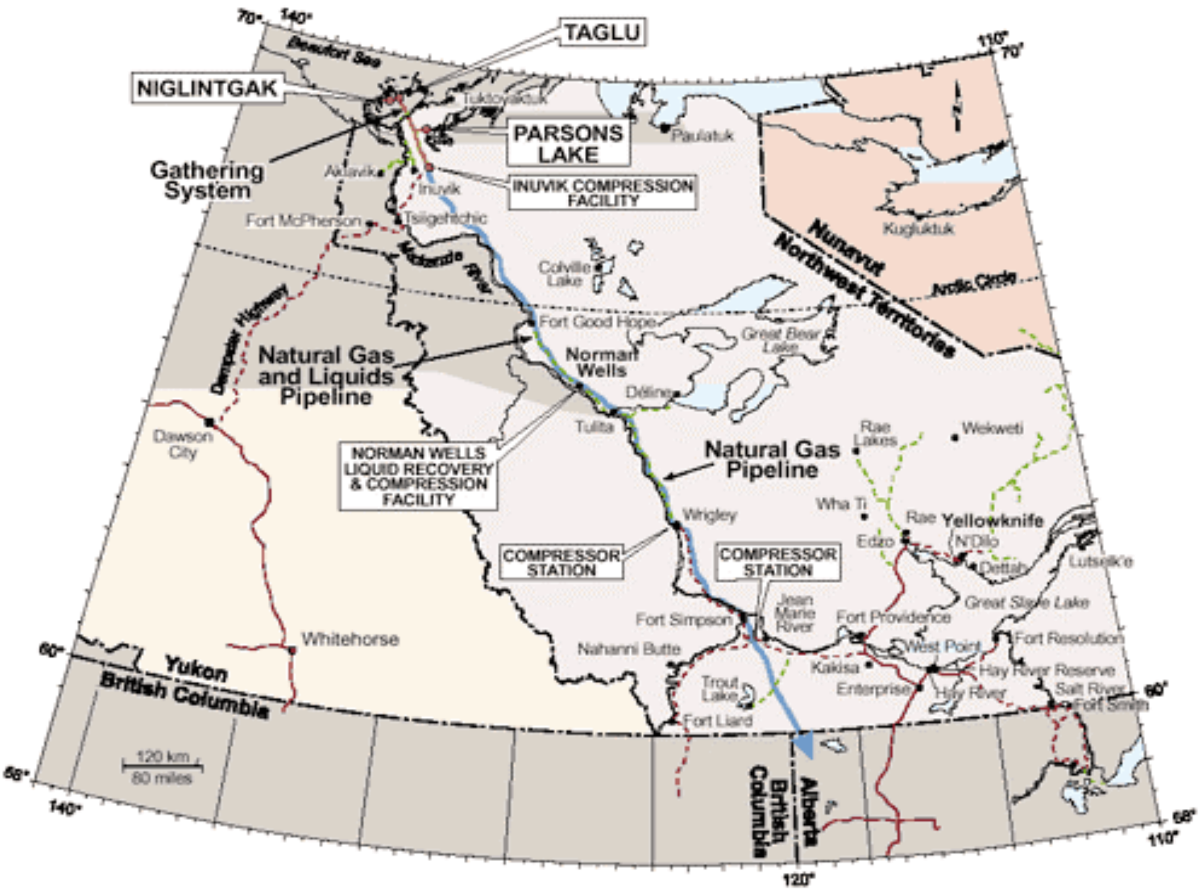
By Doug Struck Washington Post Foreign Service Wednesday, May 31, 2006; Page A01

FORT MCMURRAY, Alberta ~ Huge mines here turning tar sands into cash for Canada and oil for the United States are taking an unexpectedly (unpredictably) high environmental toll (cost), sucking water from rivers and natural gas from wells and producing large amounts of gases linked to global warming. Digging into an area the size of Cambodia-- at gold-rush speed, spurred (pushed) by high oil prices, new technology and an unquenched (unsatisfied) U.S. thirst for the fuel. The expansion has presented ecological problems that experts thought they would have decades to resolve (fix).

"The river used to be blue. Now it's brown. Nobody can fish or drink from it. The air is bad. This has all happened so fast," said Elsie Fabian, 63, an elder in a native Indian community along the Athabasca River, a wide, meandering waterway once plied (traveled) by fur traders. "It's terrible. We're surrounded by the mines." From her home on the bluff of the river, she can see billowing (cloud like) steam rising from a vast strip mine 10 miles away. There, almost 200 feet/65 meters below what was once a forest, giant machines cleave (dig) the earth into a cratered moonscape (landscape that looks the same as the moon). Immense (very large) shovels plunge into the ground, wresting out (pulling out by force) massive chunks. Trucks the size of houses prowl the pit, delivering the black soil to clanking conveyers (noisy conveyor belts) and vats that steam the tar from the sand.

But the price of that alchemy (magic) is high: **Each barrel of oil requires two to five barrels of water, carves up four tons of earth, uses enough natural gas to heat a home for one to five days, and adds to the greenhouse gases slowly cooking the planet, according to the industry's own calculations.**

"The environmental cost has been great," said Jim Boucher, chief of the Fort MacKay First Nations Council, which includes Cree and Dene Indians, 35 miles north of Fort McMurray. He grew up on land that is now a clawed-out mine pit. But he has led his people into the mines by creating native-owned companies providing catering, truck driving, surveying and other services. "There is no other economic option (choice)," he said. "Hunting, trapping, fishing are gone." Operators of the mines, which have helped make Canada the largest supplier of oil to the United States, believe they can find technological solutions to the environmental problems (use technology to fix a problem). Increasingly, environmental organizations are calling for a moratorium (a ban/ a restriction) on the growth of the mines.



Map of the Mackenzie Valley Pipeline and Tar Sand Area
Map source: http://www.arcticgaspipeline.com/Reference/Maps/MackenziePipelineMap.gif

(ESL LESSON 7) Rubber

A.) Let's look at rubber. Have your students brainstorm to think of what is made from rubber. Tires are always first on the list followed by, soles of shoes, rafts, garden hoses which are common. There are also airplane emergency slides, engine hoses that can handle hot liquids and earphone coverings. Within every car there are door, window and trunk sealings that keep the rain out. Conveyor belts in mines, grain factories and recycling plants. There quite a few rubber based products that we use every day but don't think about. Don't forget that mouse pad next to your computer, its rubber based too.

What are some common rubbers and what are they used for?
Natural Rubber Latex- Natural rubber sap from the trees grown in rubber plantations..
SBR- Styrene/Butadiene is excellent for underground mining when mixed with flame retardants.
NBR- Acrylonitrile/Butadiene has excellent resistance to oil, solvents, chemicals and fuel.
EPDM- Ethylene Propylene Diene has excellent resistance to ozone and sun rays.

The above rubbers SBR/NBR/EPDM are 100% synthetic (not natural) made from oil, so when the price of oil goes up, rubber companies look for natural rubber latex from trees to use as filler because it is cheaper, but not as strong as synthetic. Use the example of adding flour as filler when baking a cake. It adds volume and makes the cake bigger.

Remember: When the oil price goes up there is more demand for natural rubber, when oil price goes down there is more demand for synthetic rubber. It is an inverse (opposite reverse) relationship

B.) As prices for oil continue upward, what countries will increase their rubber exports? Have students make a list of countries in Asia and Africa that grow rubber trees and collect natural rubber latex for export.

Thailand, Indonesia, Vietnam and Malaysia account for 80% of worldwide exports, what countries does the other 20% come from? Answer: Liberia, Nigeria and Cambodia. Keep in mind 70% of worldwide exports go to United States, China, Japan, Korea Republic, Germany, and France.

If oil price get too high (say 100-130$ a barrel) every company on the planet will want natural rubber, will there be enough at that time or will demand out strip supply? Will new plantations be started to make a fast buck (Slang for to make money fast)? Where will this land come from to plant all of these new trees? Will more rainforest be cut to plant rubber trees?

C.) Now have students review Delivery Systems lesson and give ideas about how delivery systems will affect the rubber export trade. Especially the trade-off of buying natural rubber which is cheaper than synthetic rubber vs. the high shipping costs around the world.

In Asia most rubber deliveries are done by Break-Bark where a ship is loaded with rubber slabs without containers in a central hold area. This delivery method is cheaper than containerization. Be sure to ask if they think rubber is important, or can we live without it?

**(Note: David DuByne) Watch for natural rubber latex prices to go high from Sept 2007- Dec 2007 and Jan 2009- Dec 2009. Also watch for an increase in (Copra) Coco-diesel and Palm Oil (oil from Oil Palm tree) prices, used as bio-diesel fuels. There could be competition between crops for available/usable land space to be grown. As the price goes up everyone will want to grow for profit and start new plantations of all three trees at the same time. [Lag time] **

Bio-fuels and Ethanol

Key questions on energy options

by Robert Rapier Published on 24 January 2007
http://www.energybulletin.net/25102.html

A question was recently posed (asked) here: What is the most important question concerning (with regard to) ethanol production? That got me to thinking about important questions regarding (be concerned with) not only ethanol, but all of our energy sources. There are a number of issues (points) that we must carefully consider for any of our potential (possible) energy sources.

In my opinion, they are:

1. Is the energy source sustainable?
2. What are the potential negative externalities (effects) of producing/using this energy source?
3. What is the EROEI?
4. Is it affordable?
5. Are there better alternatives?
6. Are there other special considerations?
7. **In summary**, are the advantages of the source large enough to justify (allow) any negative consequences? (Are there more "good benefits" or "bad results" for human health and the environment when putting energy in to get energy out?)

For the purposes of this essay, I want to focus on **energy sources for transportation**. Let's look at some of our options (choices), and get a better handle on (get a better idea of) why we have opted (chosen) for the energy sources we presently use. I will not cover all of the options.

A few comments here, as some of the questions warrant (demand) additional comment. Sustainability, just because a fuel is not sustainable does not immediately disqualify it (take it off of the list) from consideration. It just means that there must eventually be something else to take its place. This could even be another unsustainable option, but these unsustainable options are unsustainable for a reason, they cannot continue forever. It would be preferable (a better idea) to move to something sustainable.

Likewise (equally) on the negative externalities (effects). There are negative externalities that we can tolerate (live with), and some we can't, but most fall in between (in the middle). Is increased pollution a tolerable negative externality? Not unless you live in China and are forced to accept it. It depends on the level and type of pollution. If the pollution level for a relatively benign (non-cancer causing) substance goes from undetectable to barely detectable, that is probably an externality that we can live with. Others aren't so clear cut, but all need to be weighed (balanced) against the perceived (observed) benefits.

Liquid Fossil Fuels

1. Clearly not sustainable.

2. The potential negative externalities are many. Among them are Global Warming, increased pollution, using militaries of the world to keep supply options open, and potentially enabling (possibly allowing) the earth to be populated beyond its carrying capacity (overpopulated).

3. The energy return on fossil fuels is quite high. Despite publications that have suggested that the energy return on fossil fuels is less than 1.0, the actual energy return (from oil in the ground to fuel in the tank) is in the range of 6.0 – 7.0. That is, for 1 BTU of energy expended, at least 6 BTUs of fossil fuel can be extracted from the ground and processed into liquid fuels for a net of 5 BTUs.

4. Yes, this is our most “affordable” energy option with respect to the price we pay at the pump.

5. It depends on the definition of “better.” If better means a cheap option that supplies the world with the current level of energy consumption (usage), then “No.” But I would define better as the energy source is sustainable and negative externalities are minimized (smallest amount possible). In that case, there are better alternatives, which will be covered.

6. One special consideration here is the relying on fossil fuels puts our energy security squarely (100%) in the hands of the Middle East.

7. No.

Grain Ethanol

1. Not sustainable.

2. Again, many potential negative externalities. Among them are loss of topsoil, increased pollution from pesticide and herbicide runoff, aquifer depletion, and an increase in food prices due to increased grain demand [a positive externality (effect) for those who farm].

3. The energy return on grain ethanol is very low. Published studies put this number at around 1.3, but the return for fossil fuels in (used in production) and ethanol out (amount gained during production) averages less than 1.1. Animal feed byproduct that is given a BTU value pushes the EROEI up to 1.3. Therefore, for 1 BTU of energy expended, less than 1.1 BTUs of ethanol can be produced, along with an additional 0.2 BTUs of animal feed. The net is then 0.3 BTUs with the byproduct credit, or **about 1/17th of the fossil fuel net.**

4. It is affordable, due to direct subsidies. But based on the current spot price (daily world price) of ethanol, it is slightly (a little bit more) over twice the cost of regular unleaded gasoline on a BTU equivalent basis.

5. Yes. Even staying within the ethanol category, there are better choices.

6. The business of grain ethanol has revitalized (renewed and re-energized) many rural communities, and has made farming much more profitable. However, it also encourages farmers to plant corn instead of less environmentally harmful crops. The fossil fuel inputs into ethanol production are also largely non-liquid (natural gas). In the case of natural gas, this makes a fine transportation fuel.

7. No.

Grain ethanol is not sustainable for primarily two reasons. First, it involves a loss of topsoil, and in many areas a depletion (emptying out) of ground water aquifers. The amount of topsoil loss has been subject (put to) to much debate, but it will vary (be different) based on many factors (pieces of information). The other concern is the large amount of fossil fuels usage required for grain ethanol production. This means that in addition to the direct negative externalities, you can add secondary (2^{nd}) negative externalities caused by the usage of the fossil fuels to continue the cycle of planting, plowing, harvesting the corn.

The pollution issue, in my opinion, is quite serious but is typically (usually) ignored (not talked about) by ethanol boosters (advocates). This issue of pollution caused by corn farming: Modern corn hybrids require more nitrogen fertilizer, herbicides, and insecticides than any other crop, while causing the most extensive (wide spread) erosion of top soil. Pesticide and fertilizer runoff from the vast expanses of corn in the U.S. prairies (flatland areas) bleed (seep/get into) into groundwater and rivers as far as the Gulf of Mexico. To understand the hidden costs of corn-based ethanol requires factoring in (also including) "the huge, monstrous (gigantic) costs of cleaning up polluted water in the Mississippi River area and also trying to remedy (fix or stop) the negative effects of poisoning the Gulf of Mexico,"

"Corn farming substantially tops all crops in total application (total amount) of pesticides, according to the US Department of Agriculture, and is the crop most likely to leach (slowly seep into) pesticides into drinking water." says Tad Patzek of the University of California's Civil and Environmental Engineering department.

While banned by the European Union, Atrazine is the most heavily used herbicide in the United States – primarily (mostly) applied to (put on) cornfields - and the EPA rates it as the second (2^{nd}) most common pesticide in drinking wells. The EPA has set maximum safe levels of Atrazine in drinking water at 3 parts per billion, (3 parts per 1,000,000,000) but scientists with the U.S. Geological Survey have found up to 224 parts per billion in Midwestern streams and 2,300 parts per billion in Corn Belt irrigation reservoirs.

In my opinion, these are negative externalities just as serious as those posed by fossil fuel usage. Yet this is the alternative that we are scaling up (starting up) just as fast as we possibly can. The real problem is that the negative externalities don't directly and immediately impact (affect) most people's lives, so they pay no attention to them. Sure, increased ethanol production might cause Atrazine levels in drinking wells to increase, but it's in someone else's water. "It's not my problem if it's not in my water" is the attitude of most people. But I doubt anyone personally affected by this is going to consider it an acceptable externality.

DISTILLERY DEMAND FOR GRAIN TO FUEL CARS VASTLY UNDERSTATED
Lester R. Brown January 4, 2007
http://www.earth-policy.org/Updates/2007/Update63.htm

Because of inadequate (insufficient) data collection on the number of new ethanol plants under construction, the quantity (amount) of grain that will be needed for fuel ethanol distilleries has been vastly (greatly) understated. Farmers, feeders, food processors, ethanol investors, and grain-importing countries are basing (making) decisions on incomplete data. The U.S. Department of Agriculture (USDA) projects that distilleries will require only 60 million tons of corn from the 2008 harvest. But here at the **Earth Policy Institute (EPI)**, we estimate that distilleries will need 139 million tons—more than twice as much. If the EPI estimate is at all close to the mark, the emerging (beginning) competition between cars and people for grain will likely drive (push) world grain prices to levels never seen before. The key questions are: How high will grain prices rise? When will the crunch come? And what will be the worldwide effect of rising food prices?

USDA relies heavily on the **Renewable Fuels Association (RFA)**, a trade group, for data on ethanol distilleries under construction, but the RFA data have lagged (fallen) behind movement in the industry. We drew on (used information from) four firms that collect and publish data on U.S. ethanol distilleries under construction. RFA is the one most frequently cited. The other three firms are Europe-based **F.O. Licht**, the publisher of *World Ethanol and Bio-fuels Report*; **BBI International**, which publishes *Ethanol Producer Magazine*; and the **American Coalition for Ethanol (ACE)**, publisher of *Ethanol Today*.

Unfortunately, the lists of plants under construction maintained by RFA, BBI, and ACE are not complete. Each contains some plants that are not on the other lists. Drawing on these three lists and on biweekly reports from F.O. Licht, EPI has compiled a more complete master list. For example, while we show 79 plants under construction, RFA lists 62 plants. This list can be viewed at
www.earthpolicy.org/Updates/2007/Update63_data.htm

According to the EPI compilation, the 116 plants in production on December 31, 2006, were using 53 million tons of grain per year, while the 79 plants under construction—mostly larger facilities—will use 51 million tons of grain when they come online. Expansions of 11 existing plants will use another 8 million tons of grain (1 ton of corn = 39.4 bushels = 110 gallons of ethanol). **The grain it takes to fill a 25-gallon tank with ethanol just once will feed one person for a whole year.**

In addition, easily 200 ethanol plants were in the planning stage at the end of 2006. If these translate into construction starts between January 1 and June 30, 2007, at the same rate that plants did during the final six months of 2006, then an additional 3 billion gallons of capacity requiring 27 million more tons of grain will likely come online by September 1, 2008, the start of the 2008 harvest year. This raises the corn needed for distilleries to 139 million tons, half the 2008 harvest projected by USDA. This would yield nearly 15 billion gallons of ethanol, satisfying 6 percent of U.S. auto fuel needs. [And this estimate does not include any plants started after June 30, 2007, that would be finished in time to draw on (use) the 2008 harvest.]

This unprecedented (never before happened) diversion of the world's leading grain crop to the production of fuel will affect food prices everywhere. **As the world corn price rises, so too do those of wheat and rice. Consumer substitution (replacement) among grains, and the same crops compete for the same land.**

Sugarcane Ethanol

1. Sustainable, for reasons I outlined in this article.
2. Few potential negative externalities to my knowledge. I have heard mention (heard about) that expanded sugarcane production will be at the expense of rain forest, but the sugarcane plantations in Brazil are not near the rain forests. I do not know if rainforests in other tropical countries may be put in danger by expanded sugarcane production.
3. The energy return on sugarcane ethanol appears to be in the (8:1) range, which would make it better than gasoline. More on that below.
4. It is affordable, but the U.S. punishes Brazilian ethanol with a $0.54/gallon tariff to protect its unsustainable corn ethanol production.
5. For a liquid fuel that will fit in the current transportation infrastructure, I don't think sugarcane ethanol can be beaten (find something better) with existing technology. But it can't provide our current level of energy usage.
6. The industry can provide an economic boost to tropical countries, where it is sorely needed.
7. In my opinion, the advantages of sugarcane ethanol justify the costs, provided habitat (ecosystem/forest) is not being destroyed to grow more sugarcane.

I find it shameful that the U.S. subsidizes an unsustainable and polluting industry like grain ethanol, and punishes a sustainable industry like sugarcane ethanol. Farmers in the U.S. can grow sugarcane in some areas within the country, but the subsidies are for corn not sugarcane. Yet even with those tariffs in place, Brazil can still ship their ethanol to the U.S. and compete with homegrown corn ethanol prices.

The energy return on sugarcane ethanol as it has been calculated does appear to be in the (8:1) range, which would make it better than gasoline. On the face of it, this seems absurd. Nature has already done the major processing for fossil fuels, and turned ancient plant material into long-chain, energy dense compounds. In the case of sugarcane ethanol, a lot of energy inputs are required, especially for purifying the ethanol, but those inputs are being satisfied **by burning the sugarcane ethanol residues (wastes) to produce process heat. Therefore, they are not being counted against the energy output.**

However, gasoline accounting is not done in this manner (way). When oil is refined to liquid fuels, a lot of fuel gas is produced. That fuel gas tends to be burned in the refinery to produce process heat, but I have still charged that against the energy balance I calculated above. If I had done the energy accounting as is done with sugarcane ethanol, one could state that the energy return of gasoline is actually only the initial energy required to get the oil out of the ground, which averages about (17:1) worldwide. The refining step would get a free pass, since the energy in the oil is ultimately used to refine the oil. So no, the energy balance of sugarcane ethanol is not in fact better than that for gasoline.

Worlds' largest producer is Brazil which can produce at an EROEI between 8.3 and 10.2
More info at: http://i-r-squared.blogspot.com/search/label/CAFE

Cellulosic Ethanol

1. Sustainable.
2. Few potential negative externalities depending on the biomass (plant) source.
3. Unknown.
4. Presently, despite (after all of) frequently optimistic (positive) claims, it costs significantly (much) more to produce cellulosic ethanol than to produce corn ethanol.
5. Yes.
6. There are numerous sources of biomass (plant sources) that could be used to produce cellulosic ethanol.
7. Time will tell, but cellulosic ethanol did not just come onto the scene. Researchers have been trying to commercialize it for many years without much success. It will require several breakthroughs (new ideas in chemistry and science), none of which are certain (guaranteed) to occur before cellulosic ethanol contributes to our energy requirements.

Due to the lack of commercial cellulosic ethanol plants, the energy return is largely unknown. On the one hand, fossil fuel inputs for growing the biomass will likely be much lower than for corn. However, the ethanol concentration yielded (% given) from a cellulosic ethanol process tends (usually seems) to be significantly (much) lower than the concentration obtained (gained) in conventional ethanol production. A presentation at last year's St. Louis Renewable Energy Conference from Keith Collins, Chief Economist at the USDA, showed that **corn ethanol yields 14-20% ethanol, while cellulosic is a paltry (very small amount) 4%**.

In addition, more processing steps are required. I have seen EROEI estimates for cellulosic ethanol that range from less than 1 to greater than 8. Based (depending) on the factors mentioned (talked about) here, the true estimate is likely to be closer to 1. The truth is we just won't know until some commercial facilities (factories and distillery plants) are up and running.

I believe that technical improvements will occur with cellulosic ethanol. But many people who don't understand the nature of the challenges (problems with today’s technology) assumed that new technology will magically start by itself one day. If I announced that we would be making regular trips to Mars within 10 years, most people would reject this idea because they have some understanding of both the technical difficulty involved, and they understand that the costs would be enormous (very large). Yet these are the same people who have no problem believing that we are going to transition (change) our fossil fuel infrastructure (for cars) to a cellulosic ethanol infrastructure. Yet the technical challenges involved are of the magnitude (equally as difficult and complex) of ferrying (taking) us all back and forth to Mars.

Unlike normal ethanol, whose original raw materials are sugars and starches, cellulosic ethanol's starting raw material is cellulose from plants. Since cellulose cannot be digested by humans, the production of cellulose does not compete with the production of food. The price per ton of the raw material is thus much cheaper than grains or fruits. Also, since cellulose is the main components (parts) of plants, the whole plant can be harvested. This results in much better yields per acre—up to 10 tons, instead of 4 or 5 tons for the best crops of grain.

"We have made it work with straw from barley, wheat, oats, and rice; with cornstalks; with bagasse (remains of sugar cane after crushing) left over from sugar-cane processing; and with chips of hardwoods such as poplar and aspen. There's also research going on with energy crops like switchgrass". Said Brian Foody of Logen Corporation. You can also use agricultural wastes like corn stover (stalks and leaves) and sugarcane scraps. Industrial and municipal solid wastes like paper sludge; forest industrial wastes like sawdust; and energy crops like switchgrass or hybrid poplars. A few fast-growing trees, shrubs, and grasses stand out as premium candidates for cellulosic conversion.

More information:
http://en.wikipedia.org/wiki/Cellulosic_ethanol
http://www.powerenergy.com
http://www.seco.cpa.state.tx.us/re_ethanol_cellulosic.htm
http://news.mongabay.com/2006/0824-purdue2.html

Biodiesel

1. It depends on the source.

2. Biodiesel in general suffers from far fewer negative externalities than most biofuels, but palm oil gets mixed reviews. On the one hand, it is a tropical crop like sugarcane ethanol, and the EROEI appears to be very good. On the other, rainforest is being destroyed to grow new palm oil plantations.

3. By most accounts, the EROEI is greater than 3, which is respectable for a biofuel.

4. It is more expensive than conventional diesel. Current subsidies (government helps pay part of the price per liter or gallon) make it affordable.

5. Biodiesel can be a sustainable contributor (input) toward energy security.

6. Diesel engines are much more efficient than gasoline engines, which reduces the overall (total) fuel requirement.

7. Again, it depends on the source. If we are going to chop down rainforest to plant palm oil plantations, then no. If we are going to use waste oils and existing (already in place) high oil-yielding crops [grown sustainably], then yes.

I think the U.S. made a mistake by not favoring the diesel engine over the gasoline engine as has been done in many other countries. **Diesel engines are much more efficient than gasoline engines**, so a diesel fleet would stretch the fuel supply. Keep in mind the USA uses mostly gasoline powered automobiles and will use mostly ethanol in the conversion (switchover), while Asia and Africa use mostly diesel in their engines and will convert (switch) to bio-diesel. Different continents, different engines, different crops for fuel oils.

Bio-diesel can be produced sustainably, but caution is warranted (needed). We first need to make sure that absolutely all of the waste vegetable oil in the country gets collected and turned into biodiesel. But even growing crops for biodiesel may be done sustainably. Biodiesel derived (produced) from soybeans, while expensive to produce, comes at a much lower environmental price and a much better EROEI than corn ethanol. Then there is the added benefit of 1). A higher BTU/heat value per gallon; and 2). The higher (better) efficiency of the diesel engine. **These factors combined mean that we would need less than half the biodiesel to drive the same amount of miles we could if using ethanol.**

Biodiesel refers to a diesel-equivalent, processed fuel derived from biological sources (such as vegetable oils), which can be used in unmodified (no special changes) diesel-engined vehicles. This is distinguished (show differences) from the straight vegetable oils (SVO) or waste vegetable oils (WVO) used as fuels in some modified (changed with parts to allow special fuels to be burnt by the engine) diesel vehicles.

Virgin oil feedstock; rapeseed and soybean oils are most commonly used, soybean oil alone accounting for about ninety percent of all fuel stocks other crops such as mustard, flax, sunflower, canola, palm oil, hemp, jatropha.
List of crops below from http://en.wikipedia.org/wiki/Biodiesel
Check out Oil Palm information at: http://www.theoildrum.com/node/2214
Coco bio-diesel from the Philippines: www.alternativesource.org/tags/**coco-biodiesel**

Typical oil extraction from 100 kg. of oil seeds

Table source: http://www.globalpetroleumclub.com (but they forgot Hemp)

Crop	Oil/100kg.
Castor Seed	50 kg
Copra	62 kg
Cotton Seed	13 kg
Groundnut Kernel	42 kg
Mustard	35 kg

Palm Kernel	36 kg
Palm Fruit	20 kg
Rapeseed	37 kg
Sesame	50 kg
Soybean	14 kg
Sunflower	32 kg

Yields of common crops

Crop	kg oil/ha	litres oil/ha	lbs oil/acre	US gal/acre
corn (maize)	145	172	129	18
cashew nut	148	176	132	19
oats	183	217	163	23
lupine	195	232	175	25
kenaf	230	273	205	29
calendula	256	305	229	33
cotton	273	325	244	35
hemp	305	363	272	39
soybean	375	446	335	48
coffee	386	459	345	49
linseed (flax)	402	478	359	51
hazelnuts	405	482	362	51
euphorbia	440	524	393	56
pumpkin seed	449	534	401	57
coriander	450	536	402	57
mustard seed	481	572	430	61
camelina	490	583	438	62
sesame	585	696	522	74
safflower	655	779	585	83
rice	696	828	622	88
tung oil tree	790	940	705	100
sunflowers	800	952	714	102
cocoa (cacao)	863	1026	771	110
peanuts	890	1059	795	113
opium poppy	978	1163	873	124
rapeseed	1000	1190	893	127
olives	1019	1212	910	129
castor beans	1188	1413	1061	151
pecan nuts	1505	1791	1344	191
jojoba	1528	1818	1365	194
jatropha	1590	1892	1420	202
macadamia nuts	1887	2246	1685	240
Brazil nuts	2010	2392	1795	255

avocado	2217	2638	1980	282
coconut	2260	2689	2018	287
oil palm	5000	5950	4465	635
Chinese tallow	5500	6545	4912	699

Yield of Common Crops
Graph source: http://en.wikipedia.org/wiki/Biodiesel

Biomass Gasification

1. Sustainable.
2. Care has to be taken with respect to the source used for gasification. There are also potential air quality (pollution) issues from a large-scale gasification program.
3. I have not seen an EROEI calculation, but I expect it to be much higher than for cellulosic ethanol. I would estimate an EROEI in the 6-10 range (based on the method I use for calculating a fossil fuel EROEI).
4. Currently capital costs (investments) are too high to enable (allow) biomass gasification to compete.
5. Biomass gasification has a chance to be a highly sustainable contributor toward our energy demands.
6. Biomass gasification could be used either to produce electricity (e.g., use biomass instead of coal in a power plant application) or as the first step in a liquid-fuels program. More below.
7. Yes.

I have described what I believe are the advantages of biomass gasification over cellulosic ethanol previously in Cellulosic Ethanol vs. Biomass Gasification. Briefly, cellulosic ethanol converts a small portion of the available biomass. Gasification converts all of it into syngas, which can then be used to make a wide variety of chemicals, including methanol, ethanol, or diesel.

The main problem with implementing (starting) large scale biomass gasification is that it is presently just too expensive. The capital (investment) costs associated with processing (producing) the biomass are very high. Current estimates, which I documented in the afore-mentioned article, put the cost of a biomass gasification plant at about 7 times (7X) the per barrel cost of a conventional oil refinery or grain ethanol plant, and double the costs of a coal-to-liquids plant. At some point we may be willing to pay these costs for our fuel, but it won't be until other options are largely exhausted (almost completely finished).

Wind and Solar

1. Sustainable.

2. Few potential negative externalities to my knowledge. Wind turbines have been implicated (associated with) in the deaths of some bats and birds, and there may be some increased pollution as a result of solar panel manufacture.

3. The energy returns have been calculated in a number of different ways, but most sources show an energy balance more favorable (better) than that of most liquid fuels.

4. Wind-generated electricity is affordable, but solar is still out of reach (Slang for too expansive) for the average person.

5. For electricity generation, I think these are the best, most sustainable options.

6. There are a number of special considerations for this option. First, wide-spread electric transport – an absolute must in my opinion - is not yet a reality (not in place yet). Battery technology still doesn't quite have the cost/benefit ratio that many consumers desire. Also, if the world moves toward more electric transportation a lot of infrastructure will need to be upgraded. There are also currently issues (problems) with a shortage of silicon (element Si) for making solar cells, which is keeping prices elevated (high).

7. I believe that we need to move toward transportation electrification, which in my opinion would make wind and solar power more attractive options than any of the liquid fuel options with the possible exceptions of sugarcane ethanol and waste-derived(main ingredient is 2^{nd} hand oil) bio-diesel.

The potential advantages of a solar and wind-powered transport system are so great that our current infatuation (puppy love) with grain ethanol is a tremendous misallocation (giant misuse) of resources. My vision for the future would involve some solar panels on the vast majority (most) of houses around the world providing the electricity to run our small PHEVs (plug in hybrid vehicles) as a start.

Conservation

This essay wouldn't be complete without a discussion on conservation. Consider that we could save more fuel, while stretching our budgets, by choosing to embrace (choose and live with) conservation. If we chose more fuel-efficient cars, slowed down, took fewer trips, used solar panels and walked or rode a bike instead of driving, just think about the fuel we could save. We would immediately reduce our dependence (need) on the Middle East, because we just wouldn't need as much oil. We would increase the chance that some combination of alternatives could supply (give) a level of energy that would allow us to maintain a decent (medium to good) standard of living.

Yet in this rush to alternatives, conservation is typically given just a bit of lip service (Slang for talk about it to make some people happy, but do nothing). Our politicians will say "Ethanol, ethanol, ethanol, and yeah, we should conserve." But money is not being thrown at (given for) conservation. Imagine if instead of spending over $2 billion a year in direct ethanol subsidies (government pays using your tax money), we directed (put) that money into conservation measures. We could offer everyone in the country direct tax breaks for purchasing fuel efficient vehicles. To me, such a policy would make a much greater contribution toward our energy independence than the policies we currently have in place. I believe we have to demand that our political leaders put more emphasis (stress the importance) on conservation as a piece of our energy puzzle.

(Note: DD) It will also require a paradigm shift of all human consciousness to collectively decide at once, "This model we have been living no longer works." Putting greed aside and allowing ideas unfold that help all humankind without profit.

Also, keep in mind that **conservation relies on non-usage**, but non-usage=reduced profits for companies and corporations. These are the same companies that donate (give) politicians money to get elected. In the world of politics any announcement of policies and plans for conservation are almost 100% certain to kick that person out of office next election. Corporations will not give money to politician Z who wants conservation, they will give to politician Y that promotes more of the same, consume, consume, consume.

About grain prices: As prices increase farmers will rush to plant more corn so they can make quick money next planting season. Its obvious there will not be enough corn to meet demand in 2007. Prices up. But in 2008 as many farmers switch to the new cash crop, more land will be converted to plant corn, less land for soybeans. More corn and less soybeans in 2008. So price of corn not up as much in 2008, but soy way up because less will be grown.

Both corn and wheat futures were already trading at 10-year highs in late 2006. Lower-income countries that rely on grain imports, such as Indonesia, Egypt, Algeria, Nigeria, and Mexico will face higher food prices. As the US slows its exports; countries will shift to buy other human consumption crops. Look for emerging markets of the following to increase in price starting now. **Sorghum, Millet, Amaranth, Wheat, Barley, Rice, Oats, Buckwheat, Sesame, Flax and Rye** as corn substitutes for human consumption and animal feed.

Keep in mind that many **farm animals are fed with corn** so look for a price rise in the cost of farm animals, cows, pigs, and chickens as a spin-off effect.

Look for **Palm Oil** from (Oil Palms) and **Coco bio-diesel** from (Copra) to increase in price as these are the frontrunners for bio-fuels. Castor oil from Castor beans are just starting production in Indonesia and Thailand, Small market but it can only expand. Good yield of oil very little input for pesticides or fertilizers. Grows anywhere its dry and hot.**

Reaction to the U.S. State of the Union Address Jan 2007

http://www.theoildrum.com/node/2224#more

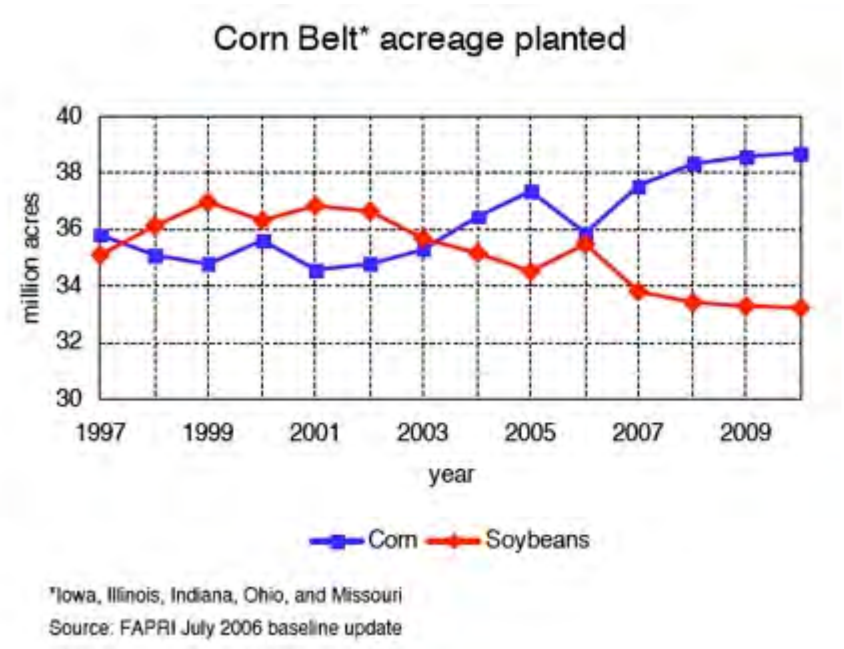
Bush's proposal would be to increase the level of bio-fuel production by 35 billion gallons in the next 10 years, and that brings me to my major concern: Is there a contingency plan (back-up plan)? Cellulosic ethanol will see technology improvements. No doubt. What if they aren't enough? What if, as is the case with a number of medical issues like cancer, we are still struggling with this issue in 10 years? (breakthroughs but no cures yet) Just in case, what is the backup plan? Are we going to operate without one? If world oil production peaks in the next few years, as I think is very likely, where will we be if cellulosic ethanol, grain or sugarcane ethanol or bi-diesel doesn't deliver? Will we merely count on sky-high prices to destroy demand? Will the US send troops to Venezuela, Mexico, Iran, Tajikistan and Canada to keep the oil and natural gas flowing?

Let's jump to 2015: Corn-based ethanol production would reach 31.5 billion gallons per year, or about 20% of projected U.S. fuel consumption in 2015. US corn production 2006 11.0 billion bushels. Ethanol yield is about (approximately) 2.5 gallons per bushel. (39.4 bushels of corn = 110 gallons of ethanol exactly)

Ethanol has less energy density (one gallon of ethanol produces 62% as much heat as one gallon of gasoline) so 25 billion X .62 = 15.8 billion gallons of gasoline equivalent **about 10%, Bush wants 20%** so these numbers have to be doubled?

One gallon net production requires three gallons input into that production because corn ethanol has an EROEI of 1.34 to 1 (1.34:1). When you multiply (+.34) the extra gained from production of each barrel, by 3 you get 1.02, or one extra barrel of positively gained energy. It takes 3 bbl to make 1 bbl. (.34 X 3=1.02)

Most of the additional corn acres come from reduced soybean acreage. Wheat and rice markets would adjust to fulfill increased demand for feed wheat and human consumption, and rice for human consumption. **Look for future prices of wheat, rice and corn to increase.**



Comparison Between the Amount of Corn and Soybeans to be Planted 2007- 2010.
Graph source: http://www.theoildrum.com/node/2224#more

(ESL Lesson 8) Farming

A.) Take a look at the country or society you are in right now, ask your students about their grandparents, where they lived, what they did for work and if they grew their own vegetables and used natural medicines. Explain that even in England in 1900 a full 40% of people worked in the fields in some way, and 90% grew their own food in addition to what they bought in stores. Compare to today and our modern society. Ask how many of them farm or grow their own vegetables.

Summary from Jeremy Leggetts' article published in The Guardian 29 Jan 2007, Take it to the Fields. http://www.energybulletin.net/25427.html So oil-dependent is modern industrial agriculture, and so relatively few are the people employed in it, that we will need to redefine (re-think) the very concept (idea) of a farmer after the peak hits us. Today our typical (average) farmer might tend 500 acres with tractors and other expensive bits of oil-addicted kit (slang for machinery). But in the post-peak era - with the oil price sky high, and oil supplies fast-shrinking and therefore probably rationed (controlled by the governments) our farmers will need to be tending (using) an area of maybe one-tenth ($1/10^{th}$) the size, using more human labor and strategic (pinpoint) use of a tractor powered by something other than petroleum, plus good old-fashioned draft animals (buffalos and cows). Many more people will need to be working the land if we are to feed ourselves. When the collapsing Soviet Union turned the oil taps off on Cuba, 15-25% of the population had to take to the fields in some form or other. (The good news is that they succeeded, to the extent that nobody starved.) Today in the UK, 1% of us farm. In 1900, before mass addiction to oil, fully 40% did.

We will need to be farming in the cities and towns as well as the countryside. The conference heard encouraging stories of urban farming in Cuba, and how surprising (larger than expected) amounts of fruit and vegetables can be grown on astonishingly (amazingly) small areas of land in cities.

To understand what exactly he means and how dependent the farming industry is on fossil fuel and natural gas lets look at the ingredients (main parts) of the modern farm.

What is pesticide?
Pesticide is a generic (common) name given to chemicals designed (made) to kill a variety of pests such as insects (insecticides), unwanted plants or weeds (herbicides), fungi (fungicides), soil worms (nematicides) and rodents (rodenticides).

Insecticides: chemical, biological, or other agents used to destroy insect pests.
Fungicide: any substance used to destroy fungi. Fungi is plural for fungus. One fungus, two fungi.
Herbicide: chemical compound that kills plants or inhibits (interferes with) their normal growth. Used to kill unwanted weeds. The most famous and dangerous cancer causing is DDT, Agent Orange is more of a defoliant (takes leaves off of plants) and a distant third is its toxic cousin Round-Up, available in stores now.

Spraying: horticultural practice of applying (putting on the plants) fungicides, insecticides, and herbicides, usually in solution (mixed with water), to plants. It may be accomplished (done) by various means (different styles), e.g., the watering can, sprinkler attachment, spray gun, power spraying machine, or airplane. The spraying of powdered chemicals is called dusting, which is done by airplane. **A common measure used is that it takes the equivalent of a gallon of diesel fuel to make one pound of active ingredient of pesticides.**

Fertilizers: compounds given to plants to promote (help) growth. Commercial fertilizers are made from anhydrous ammonia, which is made from natural gas. Fertilizers provide the three major plant nutrients (nitrogen, phosphorus, and potassium), called **N-P-K fertilizers** and manufactured or chemically-synthesized inorganic fertilizers (not in nature, must be done in a factory to mix the ingredients so the stay together) include ammonium nitrate and potassium sulfate.

Nitrogen: Nitrogen is the most important element you can add to your lawn, it is the element needed to make the grass grow and get its green color. It also helps to create thickness, shoot density, and sturdy growth to help fight-off weeds and pests.
Phosphorus: Phosphorus is used primarily to encourage strong grass root growth and establishment. You will commonly see an increase in phosphorus during times of new planting and renewing old lawns.
Potassium: Potassium is used to enhance (make stronger) your lawn's resistance (fight off) to disease, drought, wear, and cold weather. You will commonly see an increase in potassium during fall and winter fertilizations and times of new planting and renewing old lawns.

Reliable estimates from the Department of Energy show that 5 pounds of nitrogen has the energy equivalent of a gallon of diesel fuel**. In other words, 100 pounds of nitrogen fertilizer would have the energy of 20 gallons of diesel fuel.**

B.) In an open discussion have your students talk about the cost increases of these ingredients if the price of (petroleum) oil and natural gas increases. How will this affect the price of food? The farmer must pass along the higher cost of growing the food. The fertilizer and pesticide manufacturers (makers) must charge more to produce those things in the factory. The trucks charge more to deliver goods to the factory.

As reference include these facts below:

Most farming machinery such as tractors, plows and combines (a kind of harvesting machine) are constructed and powered using oil or natural gas of some sort. These machines also plow, plant, and harvest the crops on large farms.

Food storage systems such as refrigerators are manufactured in oil-powered plants, distributed across oil-powered transportation networks and use electricity, which most often comes from natural gas or coal.

In the US, the average piece of food is transported almost 1,500 miles before it gets to your plate. In Canada, the average piece of food is transported 5,000miles from where it is produced to where it is consumed. Ask students if they know in their country what the distance is from field to the plate?

C.) Topic for discussion on ethanol and bio-fuels: Knowing 100% for sure the amount of corn being grown will increase ….

1. It costs over double in fertilizer and fuel cost to grow corn vs. soybeans will there be enough fertilizer produced to meet demand?
2. What will happen to countries that will have corn and grain shipments stopped because the exports will now be used in an ethanol factory to produce fuel instead of food?
3. Can there be enough grain crop grown to switch to ethanol and bio-fuels for the planet to continue our economic growth?
4. .Which industries will benefit and increase profits during the switch over? Which will decline, more likely drop off of a cliff?
5. Can the world continue to be fed using organic farming techniques without modern pesticides and fertilizers? http://www.**soilassociation**.org

http://www.cfc-efc.ca/espaces-sante/pesticides_en.php
http://www.factmonster.com/ce6/sci/A0838556.html
http://www.lifeaftertheoilcrash.net
http://www.leopold.iastate.edu/pubs/nwl/2001/2001-1-leoletter/energy.htm
http://en.wikipedia.org/wiki/Fertilizer
http://www.allaboutlawns.com/lawn-maintenance-care/fertilizing/what-is-fertilizer-and-why-do-i-need-it.php

Iraqi regime set to hand over oil reserves to US energy giants

By Jerry White 11 January 2007
http://www.globalresearch.ca/index.php?context=viewArticle&code=WHI20070111&articleId=4417

As the Bush administration prepares to escalate (build up) military troop numbers in the Middle-East, the US-installed interim government in Baghdad is set to approve a new hydrocarbon law that will hand unprecedented (never before done) control of the country's vast (very large) oil reserves to US and British energy conglomerates (multi-national companies). The terms of which were detailed by the British newspaper the Independent on January 7.

The language of the new law—which is expected to be approved by the Iraqi parliament any day and put into place by March—was written by a US consulting firm Bearingpoint Inc. under a contract from USAID hired by the Bush administration and presented (shown) to the major oil companies and the International Monetary Fund (IMF) during the summer. As of December, many if not most Iraqi parliamentary members had still not seen the legislation.

The Independent, which obtained a leaked version of the law, reported Sunday, "The Iraqi Council of Ministers is expected to approve, as early as today, a controversial new hydrocarbon (oil) law, heavily pushed by the US and UK governments, that will radically (drastically) redraw the Iraqi oil industry and throw open the doors to the third-largest oil reserves in the world. It would allow the first large-scale operation of foreign oil companies in the country since the industry was nationalized (government controlled) in 1972." The newspaper added that **the new law would be a "radical departure from the norm for developing countries" and would be the first of its kind for any major oil producer in the Middle East**, where Saudi Arabia and Iran, the world's number one and two largest producers, "both tightly control their industries through state-owned companies with little foreign collaboration (partnership or help)," as do most members of the Organization of Petroleum Exporting Countries (OPEC).

The most significant (most important) legal aspect of the legislation (law) is the introduction of so-called "production-sharing agreements" (PSAs), in which the state maintains formal ownership of oil reserves but pours out billions in compensation (payment) to foreign oil companies for their investment in the infrastructure and operation of drills, pipelines and refineries.

According to the draft of the legislation, the **PSAs in Iraq would be fixed for 30 years or more**, allowing foreign oil companies to maintain favorable arrangements no matter what a future government might do to regulate their profits, tax rates or production levels. One provision (part) in an earlier draft of the new law—which may or may not be retained (kept) in the latest version—insists (requires) that any disputes with a foreign company must ultimately be settled by international, rather than Iraqi courts.

The terms granted under the new law will guarantee massive profits to ExxonMobil, Chevron, BP and other energy conglomerates. While recovering the costs of their initial investment to develop an oil field, foreign **companies will be able to retain (keep) 60% to 70% of oil revenue**. After recouping (getting back) their initial outlay (beginning cost), the companies can take up to 20 percent of the profit. By contrast, the French oil company Total signed a deal with Saddam Hussein before the second Iraq war to develop a huge field that would have allowed the company to retain only 40 percent of the profits while it was recovering its costs and 10 percent afterwards, according to Dr. Muhammed-Ali Zainy, a senior economist at the Centre for Global Energy Studies.

According to International Energy Agency figures, **PSAs are used in connection with only 12% of world oil reserves, in countries where exploration prospects (possibility) are uncertain and production costs are high. None of this applies to Iraq,** where the cost-per-barrel of extracting oil is among the lowest in the world because the reserves are relatively close to the surface, and many fields have already been discovered but not developed due to years of war and economic sanctions. **Most of Iraq's giant oil fields have already been mapped and therefore there are no exploration costs and risks**, unlike the North Sea, the Amazon, the Arctic or from tar sands in Canada, where huge outlays are required.

Chapter 4, Article 109 specifies that all new oil fields, the country's most valuable commodity must be developed in tandem (together) with foreign multinationals.

The agreement signed by the US-backed government in Baghdad states "Under the chapter entitled, 'Fiscal Regime,' the draft spells out that **foreign companies have no restrictions on taking their profits out of the country, and are not subject to any taxation when doing this.**" The draft law states, "A Foreign Person may repatriate its exports proceeds [in accordance with the foreign exchange regulations in force at the time]." Shares in oil projects can also be sold to other foreign companies: "It may freely transfer shares pertaining to any non-Iraqi partners."

More weekly updated information at: http://www.rigzone.com/news/article.asp?a_id=40132
Update Jan 16, 2007. The newly amended copy of the controversial law dated Dec.15, seen by Dow Jones Newswires, doesn't refer directly to PSAs, as the first draft did a few months ago. "We have changed the text of the law from PSA to "development and production contract" (DPC's) **in order to avoid (media) fuss,"** said the senior official, who is close to the committee entrusted with drafting the law.

The new draft law recommends the Iraqi government sign **"development and production contracts," or DPCs,** along with service or risk production contracts with foreign companies to upgrade the country's war-ravaged oil industry.

The Kurdish authority has already signed agreements with several small oil and gas companies, including U.S.-based Calibre Energy Inc. (CBRE), Canada's Addax Petroleum Corp. (AXC.T), Norway's Det Norske Oljeselskap (DNO.OS) and Turkey's Petoil.

Iraqi Oil Reserves

Iraq has 115 billion barrels of known oil reserves—10 percent of the world's total—and it is estimated that a fully functioning industry could generate $100 billion in annual (yearly) revenue. The most important resources are in the Majnoon and West Qurna fields, close to Basra in the south of the country, which contain nearly a quarter (25%) of Iraq's proven reserves. On top of this, Iraq is estimated to have between 100 and 200 billion barrels of possible reserves, including in the western desert.

These vast untapped (undrilled) reserves of easily reachable and low-cost oil and natural gas, have long been a crucial target of the US and British energy conglomerates (multi-national energy companies), particularly as the discovery of new oil deposits elsewhere in the world have drastically (greatly) slowed and existing (current) reserves have declined. With demand increasing from rapidly developing countries such as China and India, control of Middle East oil, and control of Iraq's vast reserves in particular, and now Iran's became a vital geo-strategic goal for world governments.

As early as the mid-1990s, there was growing concern that the unraveling (coming apart) of the United Nations sanctions imposed (put in place) after the first Gulf War would enable (allow) Saddam Hussein to establish (start) lucrative (high-income) agreements with French, Russian, Chinese and other oil companies that would leave the US and Britain out and realign (readjust) the global energy industry. Political writer Kevin Phillips noted in his book American Theocracy: The Peril and Politics of Radical Religion, Oil and Borrowed Money in the 21st Century, "So long as the United States and Britain could keep these sanctions in place, using allegations (hear-say) concerning weapons of mass destruction, Saddam could not implement (begin) his own plan to extend large-scale oil concessions (contracts estimated to be worth $1.1 trillion)" to their economic rivals in Europe and Asia.

Months after the US invasion of Iraq—and after a long legal battle with the White House—it was revealed that control of Iraq's oil fields was one of the chief (main) issues discussed in Vice President Dick Cheney's Energy Task Force meeting with oil executives in 2001. Check out: http://www.brusselstribunal.org/Oil.htm for issues related to the Energy Task Force in 2001. Among the items released under court order were maps of Iraq's oil fields, pipelines and refineries, with a supporting (additional related) list of "Foreign Suitors (other companies also interested in the oil contracts) for Iraqi Oilfield Contracts," naming more than 60 firms from 30 countries, most prominently France, Russia and China, that had projects either agreed upon or under discussion with Baghdad. **The French giant, Total, for example, was to get the 25-billion barrel Majnoon oil field, while Russia's Lukoil had deals to develop the West Qurna fields.**

The Independent article on the new hydrocarbon law noted that it was doubtful that these old contracts would be considered valid by the new Iraqi government, and that "ExxonMobil is now seen by insiders as the frontrunner (#1) to grab the rights to (get the contract to pump oil) the Majnoon field."

Final Note: David DuByne

The answers to these problems are not easy, and there is not a single answer solution. Switching to this or substituting that only draws out the problem, and never really tackles the cause head on. Switching to other fuels is a Band-Aid measure so corporations can continue to profit when there are solutions that already exist, but do not generate profit. Self-sustainability isn't about being a consumer; it is about getting off of the grid or minimizing your contact with it. This is 180 degrees opposite of modern business practice. The current mind frame in the global conscious about how banking, wealth and profit are made will have to be re-thought. The solution starts with humankind waking up and collectively saying, "Stop, I will not continue under this system, we need a new way forward with less or without fossil fuel" Quantum Physics is starting to prove what masters of thought and mind have said for thousands of years, thought creates the reality around you, it forms the third (3^{rd}) dimensional substance around you. So it may take collective thought of all human beings at once to re-adjust the paradigm of what we perceive as the world around us, without fossil fuels and re-form our world.

Until that happens, use the last 75 pages of information to lessen you impact, inform others, and help form the future. It never ever will be about running out of oil or hiding in a mountain cabin with two years of food, it will be about coming together with other people close to you, working together, living together, finding solutions together and celebrating life together. Embrace the change.

Suggested web sites with Oil depletion information and alternative fuels:

http://www.**peakoil**.ie/newsletter/en/htm/**Newsletter74**.htm (Information about all regions of the world)
http://www.**peakoil**.net (Association for the Study of Peak Oil, ASPO)
http://www.**energybulletin**.net (Energy Bulletin Peak Oil News)
http://www.**theoildrum**.com (Discussions about Energy and Our Future (Blog and discussion board)
http://www.**peakoil**.com (Peak Oil News, Analysis, and Mitigation Alternatives)
http://www.**graphoilogy**.blogspot.com (Many graphs of countries production)
http://www.**globaloilwatch**.com (Global Oil Watch - Extensive Peak Oil Library)
http://en.**wikipedia**.org/wiki/Peak_oil (All oil, alternatives and energy related topics)
http://www.**eia**.doe.gov/oil_gas/petroleum/info_glance**/**petroleum.html (Energy Information Agency, EIA)
http://www.**elsevier**.com/homepage/sai/encycofenergy/top.htm#2 (Encyclopedia of Energy)
http://www.**postcarbon**.org (Post Carbon Institute)
http://www.**globalpublicmedia**.com (Global Public Media)
http:**//**www.**peakoilinthenews**.com (Daily news roundup of Peak Oil news from around the world)
http:**//**www.**peakoiloptimist**.blogspot.com (Peak Oil Optimist)
http://www.**crisisenergetica**.org (Crisis Energética (Spanish language)
http://www.**chevron**wontyoujoinus.org (Will You Join Us (Chevron Corporation)
http://www.**dieoff**.org (The End of Fossil Fuel)
http://www.**wolfatthedoor**.org.uk (Wolf at the Door Beginner's Guide to Peak Oil)
http://www.**odac**-info.org (Oil Depletion Analysis Centre in the United Kingdom)
http://www.**thepowerswitch**.com (Power Switch in the United Kingdom)
http://www.**lifeaftertheoilcrash**.net (Life After the Oil Crash)
http://www.**drydipstick**.com (Oil related issues about peak oil)
http://www.**freeenergynews**.com (Oil news from around the world)
http://www.**crudeawakening**.org (Round up of news, gasoline and oil prices hourly)
http://www.**oilawareness-sf**.org (List of peak oil groups worldwide that meet regularly)
http://www.**brusselstribunal.org**/Oil.htm (Oil company related stories in Iraq)
http://www.**sciencedaily**.com/releases/2005/07/050705231841.htm (Bio-fuel information)
http:// www.**ethanolproducer**.com (Ethanol related topics)
http://www.**bluesunbiodiesel**.com/biofuel_research.php (Agricultural research on Bio-fuel crops)
http://en.**wikipedia**.org/wiki/Biodiesel (Crops that can be used for ethanol or bio-diesel; list)
http://www.**floraecopower**.com/Eng/BioDiesel/Crops.asp (Crop details for bio-fuels)

Movies

The End of Suburbia: The Electric Wallpaper Co.- Oil Depletion and the Collapse of the American Dream. http://www.endofsuburbia.com/, 2004, 78-minute documentary film. 52-minute version viewable at YouTube at: http://www.youtube.com/watch?v=Q3uvzcY2Xug

Australian Broadcasting Corporation Four Corners program on Peak Oil, 2006 (viewable online) Excellent documentary with interviews, explanations and footage in easy to understand English. ABC Australia - 4 Corners - Global Supply & Demand Theory-Analysis (ref: ASPO .au, ABARE, IEA & US DOE)

Oil, Smoke, and Mirrors -An independent 50 minute documentary on peak oil. http://www.oilsmokeandmirrors.com

The Power of Community: How Cuba Survived Peak Oil DVD- Community Service, Inc. (2006).

PEAK OIL-Imposed by Nature,DVD - 2005 Tropos Dokumentar

A Crude Awakening, Lava Productions AG

The Epic of Black Gold - Part4/4 - The Oil Depletion, Documentary 52':

Peak Oil - a short film by Larry Larstead Now streaming on YouTube, 4 min. film, 2006 (viewable online)

Richard Heinberg at the Vancouver Planetarium, 2003 (viewable online) Global Public Media

The Oil Factor (2005) Directed by Audrey Brohy and Gerard Ungerman. Some of the connections that regularly get left out of most of the mainstream media. The Oil Factor is also available at Google video.

Books

Colin J. Campbell, (Head, Association for Peak Oil) ASPO

Campbell, Colin J. (2004). *The Essence of Oil & Gas Depletion*. Multi-Science Publishing. ISBN 0-906522-19-6.

Campbell, Colin J. (2004).*The Coming Oil Crisis*. MultiScience Publishing. ISBN 0-906522-11-0.

Campbell, Colin J. (2005). *Oil Crisis*. Multi-Science Publishing. ISBN 0-906522-39-0.

Kenneth S. Deffeyes, (petroleum geologist)

Deffeyes, Kenneth S. (2002). *Hubbert's Peak:The Impending World Oil Shortage*. Princeton University Press. ISBN 0-691-09086-6.

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Friedman, Thomas L. *The World is Flat*. Penguin Publishing ISBN 0-141022-72-8

Goodstein, David (2005). *Out of Gas: The End of the Age Of Oil*. W. W. Norton. ISBN 0-393-05857-3.

G. Edward Griffin, *The Creature from Jeckyll Island* ISBN: 0912986212 3rd Edition 1998

Richard Heinberg, (writer on ecology)

Heinberg, Richard (2003). The Party's Over: Oil, War, and the Fate of Industrial Societies. New Society Publishers. ISBN 0-86571-482-7.

Heinberg, Richard (2004). Power Down: Options and Actions for a Post-Carbon World. New Society Publishers. ISBN 0-86571-510-6. (The gloom and doom scenario)

Huber, Peter (2005). *The Bottomless Well*. Basic Books. ISBN 0-465-03116-1. (There will be no oil shortage; the free market will provide.)

Kleveman, Lutz C. (2004). *The New Great Game: Blood and Oil in Central Asia*. Atlantic Monthly Press. ISBN 0-87113-906-5.

Kunstler, James H. (2005). The Long Emergency*: Surviving the End of the Oil Age, Climate Change, and Other Converging Catastrophes*. Atlantic Monthly Press. ISBN 0-87113-888-3.

Leggett, Jeremy (2005). *The Empty Tank: Oil, Gas, Hot Air, and the Coming Financial Catastrophe*. Random House. ISBN 1-4000-6527-5. (Discusses both peak oil and climate change)

Lovins, Amory et al (2005). *Winning the Oil Endgame: Innovation for Profit, Jobs and Security*. Rocky Mountain Institute. ISBN 1-881071-10-3. (The "small is beautiful" view)

Pfeiffer, Dale Allen (2004). *The End of the Oil Age*. Lulu Press. ISBN 1-4116-0629-9.

Rifkin, Jeremy (2002). The Hydrogen Economy: After Oil, Clean Energy From a Fuel-Cell-Driven Global Hydrogen Web. Blackwell Publishers. ISBN 0-7456-3042-1. (Politically influential work; vague on where the hydrogen comes from)

Ruppert, Michael C. *Crossing the Rubicon*: The Decline of the American Empire at the End of the Age of Oil. New Society Publishers ISBN 0865715408

Simmons, Matthew R. (2005**). *Twilight in the Desert: The Coming Saudi Oil Shock and the World Economy*.** ISBN 0-471-73876-X.

Shah, Sonia (2004). *Crude, The Story of Oil*. Seven Stories Press. ISBN 1-58322-625-7.

Simon, Julian L. (1998). *The Ultimate Resource*. Princeton University Press. ISBN 0-691-00381-5. (The "ultimate resource" is innovation, not oil)

Smil, Vaclav (2005). *Energy at the Crossroads: Global Perspectives and Uncertainties*. MIT Press. ISBN 0-262-19492-9.

Tertzakian, Peter (2006). *A Thousand Barrels a Second*. McGraw-Hill. ISBN 0-07-146874-9.

Yeomans, Matthew (2004). *Oil, Anatomy of an Industry*. ISBN 1-56584-885-3.

Conversion Chart for this Text

1 hectare = 10,000 square meters = 100 ares

1 meter = 1.094 yards

1 yard = 0.914 meter

1 acre = 4,840 square yards = 160 square rods

1 hectare = 2.47 acres

1 acre = 0.405 hectare, 1 acre = 4840 sq. yards

1 square mile = 3,097,600 square yards = 640 acres

1 U.S. bushel (basic unit of dry capacity in the United States) = 2,150.4 cubic inches

1 bushel Wheat or Soybeans = 60 lbs = 27.216 kg = 0.0272 metric tons

1 bushel Maize or Corn = 56 lbs = 25.4012 kg= 0.0254 metric tons

1 ton of corn = 39.4 bushels = 110 gallons of ethanol

1 metric ton = 1,000 kilograms

1 kilogram = 2.205 pounds

1 U.S. gallon = 3.8 liters, 1 gallon= 8 pints

1 Barrel Oil (bbl) = 159 liters = 35 British imperial gallons = 42 US gallons or 0.159 standard cubic meters.

(LNG) Liquefied natural gas, Main component Methane, liquefied by cooling to -163°C at atmospheric pressure. One tonne of LNG = 1,400 cubic meters of gas.

Abbreviated to (o.e.) It is defined as the **energy obtained** from burning the various types of petroleum oil, gas and NGL. One tonne (o.e) = one tonne of oil = 100 cubic meters of natural gas.

1Tonne of oil = 7.3 barrels

See page 9 units of energy compared by EROEI, page 13 API conversion, page 14 liquid measures, page 16 oil and gas conversion, page 62 ethanol and farming measures

peta [P] 1,000,000,000,000,000 = 10^15

tera [T] 1,000,000,000,000 = 10^12

giga [G] 1,000,000,000 (a thousand millions = a billion)

mega [M] 1,000,000 (a million)

kilo [k] 1,000 (a thousand)

http://www.sagis.org.za/Flatpages/CONVERSIONTABLE.asp

http://www.statoil.com/statoilcom/svg00990.nsf?opendatabase&lang=en&artid=8708FFB3823272BEC1256FA9003FC30D