Illustration by: **Larry Stewart**, Ottawa, ON

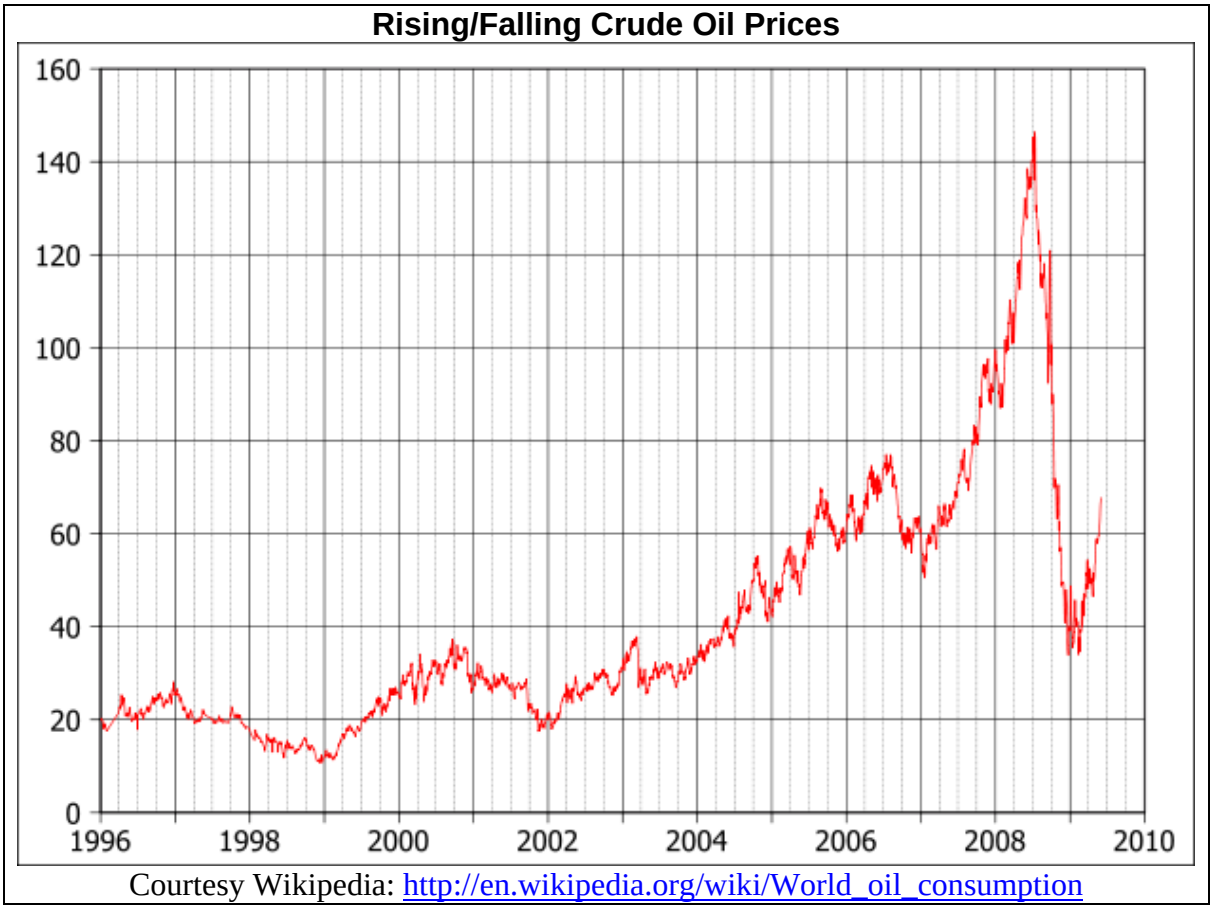
Looking at our Future: The Impact of Oil on Aviation & Daily Life

By: Walter Shawlee 2 walter2@sphere.bc.ca
(Writer, Avionics News; President, Sphere Research Corporation) Rev. 2.29 /June 30, 2009

Understanding The Issues:

Readily available energy has been the catalyst for all industrial development since the 1800's. We have used livestock, waterpower, steam, coal, oil, electricity, nuclear and solar energy relentlessly as we moved our civilization up the industrial development ladder. The increasing use and ready access to energy has transformed all our activities both personal and public, and virtually no aspect of modern life is untouched or unaffected by it. ***Powered aviation in particular*** was ***only*** enabled by the relatively recent creation of high energy, low weight ***petro-chemical fuels***. There were no early generation oxen-powered or steam-driven aircraft, for example, that we later abandoned in favor of better Jet-A fueled ships.

For clarity and to help understand our future situation, oil and natural gas are the chemically stored solar energy of millions of years. They are the result of the conversion of ages of biomass under heat and pressure below the Earth's crust, and therefore is something that really has no true equivalent waiting in the wings. While there were billions of barrels of oil and billions of cubic feet of natural gas under the Earth, we have almost used all the easily accessible material in only 120 years, an unfortunate global accomplishment, and a bad timeline for our future.

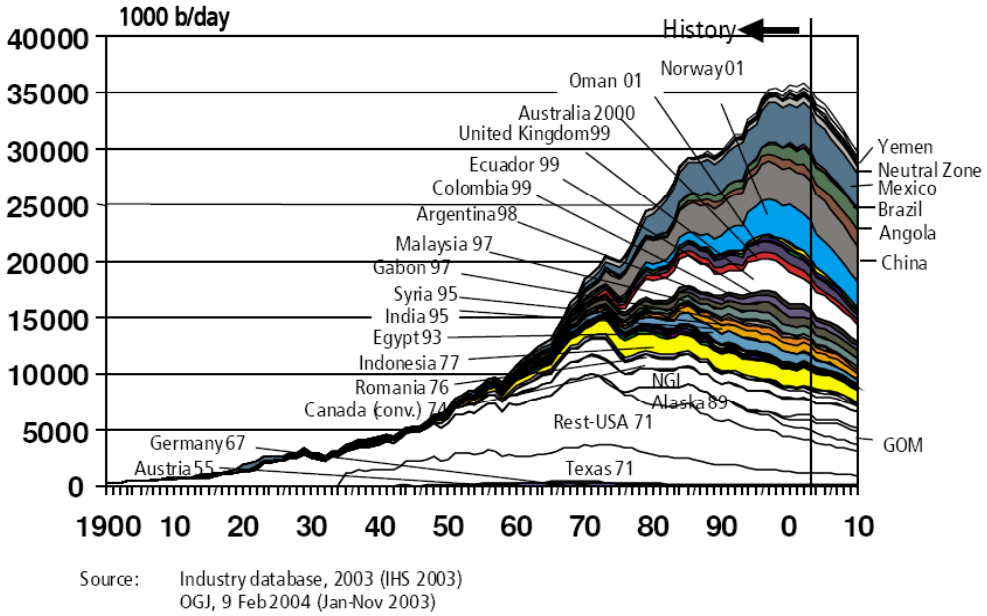


Courtesy Wikipedia: http://en.wikipedia.org/wiki/World_oil_consumption

Crude oil prices as high as US$147/barrel (a barrel is 42 US Gallons), or to put it in better perspective, ***about 7 times the cost of 2002 oil***, highlights three issues nobody really wants to talk about, but which unfortunately won't go away for our personal comfort. Keep in mind, June

2009 oil prices of US$70/barrel show how volatile this commodity is, and how easily it can experience huge price swings ***simply because consumption is unavoidable***.

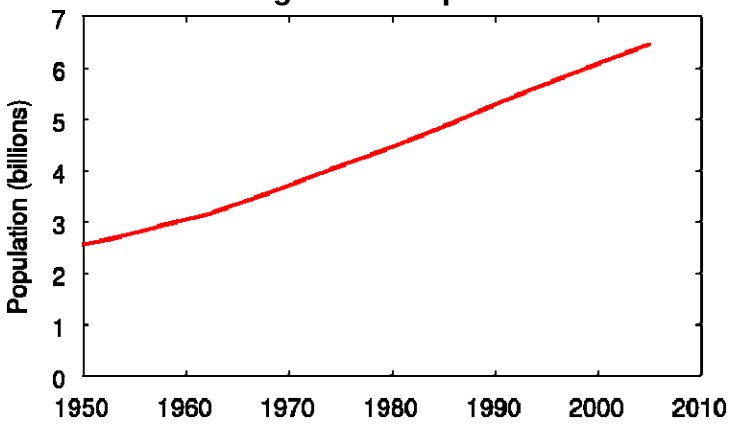
World Production Figures (note the Hubbert Curve shape)



Courtesy Wikipedia: http://en.wikipedia.org/wiki/Oil_consumption#Demand_for_oil

First, there is only so much of it (Oil and Natural Gas), and no matter whose fantasy estimates you want to believe, the industry observer's consensus is that we have already passed global peak oil in 2008, and are now on the ***downward slope of availability***. A few professional industry skeptics believe the real peak date is 2010, but that is not any comfort in our situation, and real data actually points at 2005 as the more likely date, which is even worse for us. Plus, new oil discoveries lag behind consumption by a very considerable 6 to 1 barrel ratio. Unfortunately for our petrochemically-based world, there just isn't that much left to find.

Climbing World Population



Courtesy Wikipedia: http://en.wikipedia.org/wiki/Oil_consumption#Demand_for_oil

The second issue is that ***demand and scarcity elevates prices***, and with billions of people (especially in India and China) moving up economically to a more western style of life (which includes cars, energy and food), the upward demand pressure is simply inescapable. Prices today are nothing compared to where they will be when significant supply shortages really appear. And it requires only a tiny shortfall (roughly 2%) so that demand is not met, and all prices will inevitably rise. A similar surplus, and prices drop. This is such a fundamental economic concept, it simply can't be legislated or dictated out of existence. Price stability is only possible when there is at least ***some available over-supply, so that no demand goes un-met.*** Miss that critical target, and all bets are off, as nobody wants to be that guy left standing with the unhappy empty fuel tank and long face.

The third issue is that ***nothing else can possibly replace oil and all its products in our current economy***. We will ***not*** be flying transport planes on battery power, charged by solar energy and lubricated with banana oil. ***In fact, virtually every aspect of modern aviation we know today, unless it can be performed with balloons, gliders and dirigibles, is going to eventually pass away as viable technology, and probably no farther than 20-25 years from now.*** Unless of course, there is a truly astonishing Area-51 surprise in alien energy sources still waiting to be revealed. ***There simply won't be any way to power it.*** Air transport as we knew it is already under fierce economic attack, as fuel prices are changing it from an everyday affordable option to a scarcity tool of high necessity only. The common movement of goods by air, or by powered ship from far away is going to become a very expensive proposition in a few years, and globalization is about to meet the ***unhappy reality of staggering petro-fuel shipping costs***. The shock from that gigantic sea change will be profound to the world's economy.

Understanding Oil and How We Use It:

Approximately 84% of raw petroleum volume from the wellhead is directly used for some kind of combustible fuel, including gasoline, diesel fuel, jet fuel, heating oil and related fuels and liquefied petroleum gas (LPG) including propane and butane. The other 16% is used in everything from lubricants, solvents and pharmaceuticals to fertilizer, plastics and pesticides.

Critically, and hardest to replace, is that 16% of oil that is the raw feed stock for thousands of essential industrial processes. In addition, natural gas (converted to ammonia) is especially critical for the production of nitrogen rich fertilizer (although coal is a workable but less convenient alternative).

High oil and natural gas prices are now also dramatically affecting food prices because of their heavy use in fertilizers, and the cumulative effect of rising transport, processing and machinery fuel costs. In addition, exacerbating an already bad situation is the diversion of key food crop production (soybeans and corn in particular) to methanol production in huge amounts. This is being done by EPA (Environmental Protection Agency) mandate, to serve as an imported oil substitute. All of these factors are working together to massively elevate foods costs as an unintended consequence.

In the aviation world, Jet-A fuel or AvGas are the key oil products (along with lubricants and hydraulic fluids), and their rising prices have had serious consequences. The **NBAA** (National Business Aviation Association) summarized it this way in July of 2008:

"Skyrocketing Fuel Costs Impact Everyone In General Aviation

There's no question that fuel costs are adversely impacting organizations and small businesses using general aviation. Historically, the general aviation community has paid nearly twice the price for fuel than that paid by the commercial airlines. The impact of continuing price increases on the industry is visible in all parts of the country, and businesspeople are struggling to grapple with the situation." Full details are here: http://web.nbaa.org/public/govt/issues/fuel_costs.php

According to the NBAA, the high price of fuel has grounded many general aviation aircraft, cut aircraft movements by up to 50% in some locations, and made many pilots shift flights and FBOs just in search of affordable fuel. With GA (General Aviation) customers routinely being hit with ***twice the prices car drivers or airlines are paying***, it's very easy to understand the huge impact it is having on flight hours.

Bloomberg reported on July 14th of 2008 that airlines are preparing their biggest cutback in fuel use since 1991, with plans to ground 413 aircraft (8.8% of global seating capacity). This is being forced by current period, industry wide fuel-driven losses now estimated at a massive **US$13B** according to the Air Transport Association (ATA). The full article is here: http://www.bloomberg.com/apps/news?pid=20601109&refer=home&sid=a4f4NqjVsrW8
The only real approach possible now for most users is simply to use less fuel, and a drop in aviation consumption of about 7.5% was already seen as a result in 2008. Forbes (March 24, 2009) is already forecasting a 12% further drop in airline revenues for 2009, and a combined loss of US$4.7B, on top of existing debt of US$170B. This is the result of decreased ridership, and exploding fuel costs. See http://www.forbes.com/2009/03/24/air-transport-travel-markets-economy-airlines.html

Trying To Find Other Ways To Do It:

The oil replacement issue is really the killer for aviation. Because oil (in the form of jet fuel or aviation gasoline) represents such concentrated energy with a massive power to weight ratio, our existing flight technology for air transport is going to be dead on the runway, and not very long from now. We simply have nothing light enough and powerful enough to serve as a viable turn-key fuel replacement, nor as a source for the wide range of required fluids and lubricants. A battery powered car ***only has to overcome inertia and rolling friction to move***, and like a train (watch for ***this*** technology to make a huge comeback soon for heavy freight) can move large weights (such as heavy batteries or freight) with only modest amounts of energy if the grade remains low. ***But planes and helicopters have to also completely overcome gravity to operate, through enormous lift and thrust***, and this is not really destined to be a battery powered application, as the energy to weight ratio is simply inadequate for the task.

NASA as been sponsoring fuel efficiency competitions to try and encourage the "greening" of aviation, and if possible, alternate energy techniques and improved efficiency, but we remain a very long way from any viable electric aircraft, nor is it likely to see any emerge in time that can practically serve the roles required today. A quick review of their progress is here: http://news.cnet.com/8301-11386_3-10012892-76.html

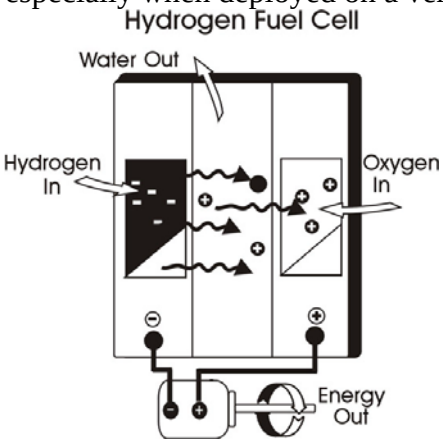
Sadly, so far, they can't even give all the prizes away, and cars still get much better mileage than these aircraft. Plus, the only proposed "electric" airplane is a glider.

I know, you are saying to yourself, ***wait***, ***what about the Hydrogen highway***? What about fuel cells (which run on hydrogen)? Well, what ***about*** them? The crushing issue for all hydrogen technology is that, well, while it ***IS*** the most common element in the universe, it exists on Earth mainly as water and hydrocarbons, ***not*** as readily usable H_2 gas. Rats! Such a small, but virtually insurmountable problem unless we choose to relocate to the surface of the sun. Considerable energy is required to extract usable hydrogen for fuel, and thus hydrogen is more properly defined as an ***energy storage medium*** than a viable fuel.

Considerable hydrogen is already produced today, approximately 11 million metric tons in 2003, which has been rising at about 10% per year. Approximately half of this is already used in the Haber process for ammonia production, to create nitrogen rich (ammonia based) fertilizer. The other half is used to create lighter fractions (used for fuel) from heavy petroleum in a process called hydrocracking. This is critical for the use of oil shales and tar sands, and could not easily be diverted without making those critical sources unusable as a result.

Where does hydrogen production come from? Approximately 48% comes from natural gas, 30% from oil, 18% from coal, and ***only 4%*** comes from the electrolysis of water (breaking up water into hydrogen and oxygen by electrical force). While possibly the electrolysis production could be driven by some clean, renewable source, it's clear the overwhelming majority will disappear along with the petro-fuel world. As a final point, the supply chain efficiency (sometimes called well-to-tank factor) for gasoline is roughly 80%, electricity 90-95%, and hydrogen a dismal 40%. Electrical cars are typically at least 3 times as efficient as any hydrogen powered type (Wang, 2002, as cited here) http://en.wikipedia.org/wiki/Hydrogen_economy

And while you are at it, don't forget that fuel cells EAT oxygen while they work, like combustion engines. Think it's non-polluting? You may dislike conventional engine exhaust and greenhouse gasses, but ***just try and breathe without oxygen.*** This is one "green" issue sidestepped in virtually all hydrogen fuel discussions, but of huge importance ecologically, especially when deployed on a very large scale.



Courtesy, alternative energy news:
http://www.alternative-energy-news.info/technology/hydrogen-fuel/

The energy required to split water is considerable, as is the energy to crack natural gas (not to mention the issue of where the gas itself comes from) to extract hydrogen. Alas, there's just no

free lunch in physics. Or, to put it this way: a fuel that takes as much fuel to make it as it generates is not really a very good fuel for us because we are running out of fuel. And by the way, the point of fuel cell technology is to generate electricity, which then runs electric motors as in the prototype "green busses" now already in Europe and Canada. Once again, not really a good fit for aviation, and not as efficient over-all as all-electric systems. Have a look here for a good round up of current Hydrogen fuel info:
http://www.alternative-energy-news.info/technology/hydrogen-fuel/

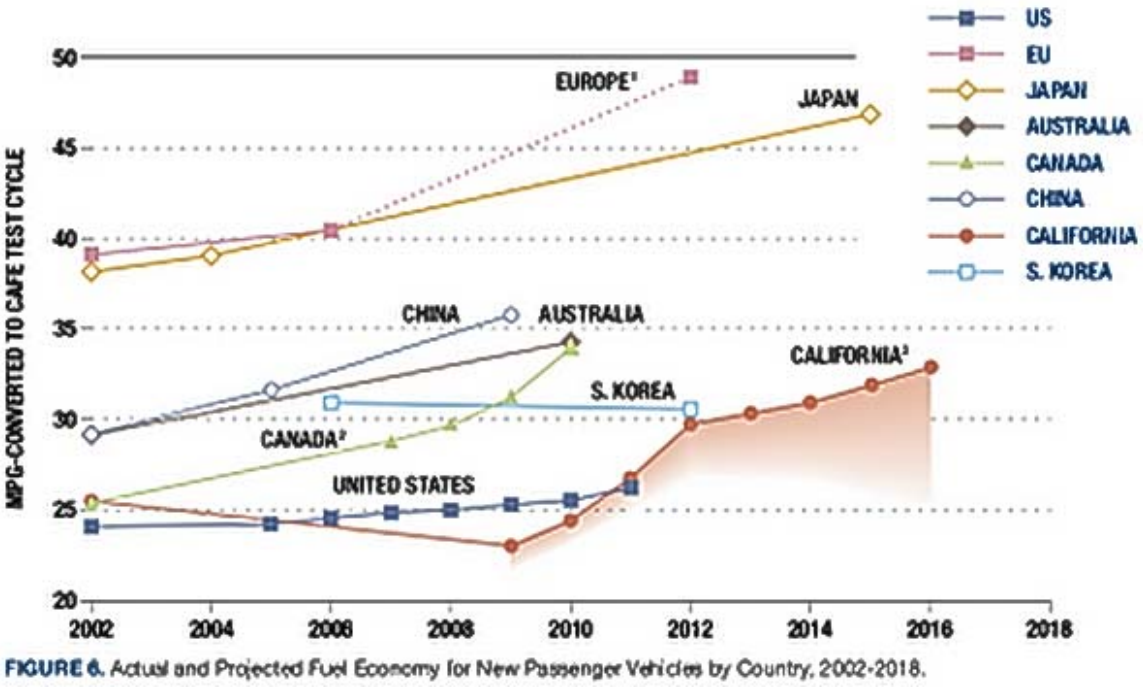
Avoiding the electrical stage altogether, pure hydrogen scramjets are certainly possible to replace existing jet technology, but where would their massive hydrogen fuel requirements come from in a shrinking petrochemical-world? While I can easily picture helium dirigibles in the future with electric steering motors powered by fuel cells or other electrical sources, I have real trouble with the basic science magically making the leap to fuel cells or secondary batteries running a Boeing 747, Beech Bonanza or Bell Jet Ranger. And of course, that nagging issue remains, where will the needed hydrogen come from, and why not use direct electrical systems anyway? By the way, remembering the Hindenburg, let's not forget that hydrogen is highly flammable, and not so easy to contain or handle under the high pressure required, due to the unavoidable and serious hydrogen embrittlement problems that inevitably causes the metallic lines and tanks to fail. It's worth noting that 3 different Shuttle launches have been aborted ***due to hydrogen leaks*** in 2009 alone.

The Social Side of Oil:

Every aspect of North American modern life, including suburban living, high output industrialized farming, distant food production, urban-centric industry, global sourcing of goods and large daily travel distances is totally and irreversibly dependent not only on available oil, but ***CHEAP*** available oil. I can certainly remember just putting a few dollars' worth of gas in my car as a kid and driving for days. That chapter in our history is now simply closed.
Here is a nation-by-nation comparison of oil consumption that really clarifies our especially consumption-oriented position in the world:
http://www.nationmaster.com/graph/ene_oil_con-energy-oil-consumption

It is inarguably accepted that America passed its self-sufficient internal peak oil point (the point of maximum ready supply) in 1970 (The Hubbert Peak Oil curve, see here for details: http://en.wikipedia.org/wiki/Hubbert_peak_theory), and natural gas back in 1971, and has been an inexorable and increasing net importer ever since. ***Unfortunately nothing whatsoever was done in terms of conservation way back then,*** so now the situation is far more desperate with more than 30 years of added sprawling infrastructure and inefficient transportation. In fact, every possible attempt at improving vehicle fuel economy, or general conservation has been met by concerted industry attacks, and thus has had almost no impact on mandatory standards.
Mandated North American vehicle efficiencies have been the lowest in the world, and so our oil consumption is the highest. Check yours here at the Department of Energy:
http://www.fueleconomy.gov/ plus, there is an excellent comparison study here:
http://www.theicct.org/documents/bellagio_english.pdf

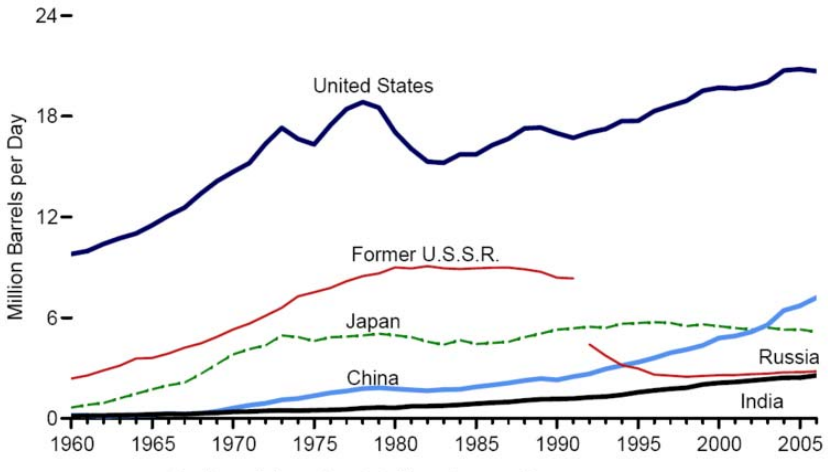
Mandated Vehicle MPG Ratings by Country



Courtesy International Council on Clean Transportation (2007): *Passenger Vehicle Greenhouse Gas and Fuel Economy Standards*
http://www.theicct.org/

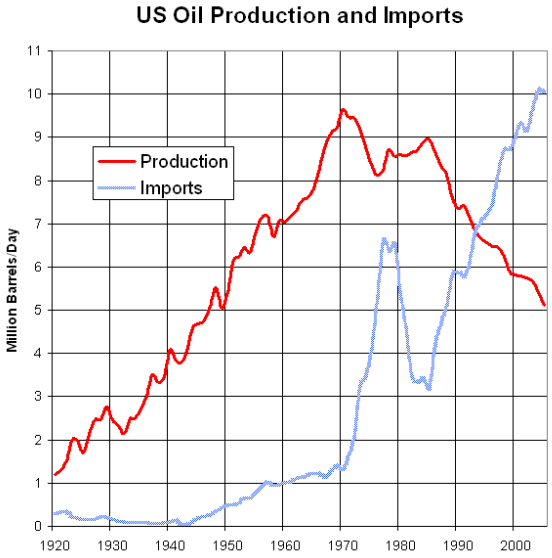
Now the issue is that there simply isn't enough oil left world-wide to satisfy all willing customers if the world economy is operating well, and each year, the available pool of oil will get smaller and more contentious as demand and population increases but remaining supplies decrease. A good look at the natural gas problem in particular from back in 2003 is here, which clarifies that this problem and all its serious ramifications have been well known for a long time: http://www.mnforsustain.org/natural_gas_supply_in_decline_youngquist_duncan_1203.htm

Top Consuming Countries, 1960-2006



Source: http://www.eia.doe.gov/emeu/aer/pdf/pages/sec11_20.pdf

It always ***sounds*** like a lot when some one announces a new field has been found, and it will produce ***1 MILLION*** barrels of oil a day! For example, the proposed drilling in the currently protected Arctic National Wildlife Refuge in Alaska is thought to be able to deliver that level for a few years, ***after*** about 5-15 years of preparation. But, since US consumption ***ALONE*** is now averaging ***18-20 MILLION barrels a day***, it soon becomes clear that it will make only a very small difference ***unless we radically alter our rate of consumption today.*** Current **w**orld consumption in March 2009 is estimated at approximately ***83.9 million barrels a day***, a truly staggering figure when considering any replacement. You can see regularly updated US and world oil consumption data here at the Energy Information Administration (EIA): http://www.eia.doe.gov/



Courtesy Wikipedia: http://en.wikipedia.org/wiki/Hubbert_peak_theory

Oil Psychology:

It is not necessary for there to be no oil or gas for there to be serious problems, ***merely for there to be just not quite enough oil, or even the fear that there is not enough***. As recent price swings show, even the smallest shortfall triggers rising prices and stockpiling, and more dangerously, severe shortages or the thought of supply disruption or interference triggers desperation, hoarding, speculation, and sometimes war. ***Oil linked wars*** in the last few years ***already include*** the Iraqi invasion of Kuwait, the Gulf War, the current Iraq war, and now the conflict between Russia and Georgia (where pipeline control is at stake). Once the reality of a genuine end for a reliable supply is seen to be unavoidable, human behavior will become unpredictable, but we should expect it to be very self-serving. Fear and greed are extremely powerful forces when scaled up to the volatile national level. This type of oil conflict is not in the future, ***it is happening now***.

Because oil companies are making staggering profits during these huge price increases, and we can be certain there is every kind of price fixing, deceit and fear mongering in play to suit various corporate and personal agendas, we easily forget that it ***really makes no difference. In the end, when the tank is dry, it's dry for us all.*** Oil producers (especially in North America) know that they are living on borrowed time, with a rapidly vanishing resource, and so they are not shy about maximizing their revenues while they can, all the while convincing you that no

change in your high consumption behavior is really needed. The strange thing is that when there just isn't any more, we will all be in the oil-driven world we created together, but with no oil left to run it. The windfall profits and high share prices just won't seem quite so important then.

It can be very puzzling to watch the huge and rapid gyrations of oil prices when the actual shift in world consumption or supply does not change that significantly. Since demand dropped first in the USA (the world's largest coil consuming country) as recession hit (from 20+ to 18 million barrels/day), this was the catalyst for the rapid price declines, just as new demand in China and India helped fuel the initial increases.

It is important to look past local patterns and look at total world consumption to see the full dynamics of the process clearly. Studying the last few years of prices shows ***that swings of 50% in terms of barrel price can be linked to near-term shortages or surpluses of as little as 2% in terms of world consumption***. This is due to several factors, but chiefly because oil, once extracted from the ground ***HAS*** to go somewhere. It is too volatile and polluting to simply toss into a pond, so it has to go into costly storage tanks, be loaded into pipelines, or onto tankers. In that way, it closely resembles the market volatility of fresh fruit, but think of it as fresh fruit that is also highly flammable and vastly polluting, and incredibly awkward to store.

Once "***in transi***t", ***oil has to be off-loaded in a timely manner***, making firm commitments essential to the industry, as well as known current and future pricing contracts for purchase. Tankers can't simply sit around waiting for clients, nor can pipelines be easily stopped (pipeline failure would result in many instances), so sale at whatever currently agreed price has to take place. This helps to explain why even small shortages or surpluses have such a sudden and serious impact on pricing. Producers have to scale back on primary extraction quickly to stabilize falling prices, and then have difficulty re-starting and re-loading the delivery system quickly if consumption suddenly rises, which pushes prices up rapidly. The entire oil extraction and delivery system ***has huge inertia issues***, especially in terms of additional supply, and no easy way to accommodate extracted oil that has no quick customer, or to supply oil to unexpected demand.

Oil producers want to maximize sales, and ideally ship the least oil for the greatest price. Consumers want assured oil at the lowest price, and this delicate dance of conflicting desires is acted out mainly through the control of extraction rates and pricing control agreements, and to a lesser degree by government controls such as mandated fuel economy ratings, and various excise and use taxes, which can be a significant portion of the end user cost. Both suppliers and consumers are constantly adjusting their positions so that they can be assured of customers and supply, and each is constantly looking for price advantage.

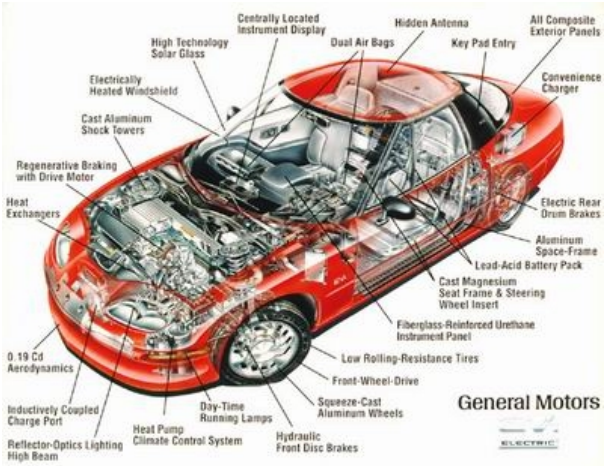
Pricing psychology is a critical market issue, and there is often huge resistance by consumers to oil increases, while they seem to simply accept drops with little if any fanfare. Of real concern in a global sense is that as each "psychological threshold" price is passed (such as C$1/liter in Canada or US$4/gallon in the USA), it can rebound to that point ***much quicker the second time***, as it is already established that the market ***will bear it***. Now that it is established that the world can survive US$147/barrel, the scenario is set for its rapid return and eventually its increase.

Life ***does not stop*** simply because prices increase, and gasoline sold for US$8.67 a gallon in the UK, US$9.39 in Belgium and US$4.95 in Canada in 2007, while people bemoaned a much lower US$3.78 a gallon price in the US. You can find a nice index of current world gasoline prices here: http://en.wikipedia.org/wiki/Gasoline_usage_and_pricing

Europe has a far different consumption pattern, however, and fuel economy is considered one of the ***essential design criteria for a marketable car***. They have readily accepted much higher fuel taxes (to fund infrastructure and also to deter consumption) and fuel prices, ***yet their actual cost per mile traveled is about the same as North America. Much higher fuel economy achieved that.*** They also have shorter commute distances, tend to do more joint commuting, do far more travel by walking or rapid transit, and buy far fewer cars to start with. It is amusing but depressing to note that the fuel-efficient cars Ford is now thinking of quickly re-tooling to introduce in America to satisfy consumers (since demand for many of their US models has collapsed) are all established and more economical European Ford models. The irony there is considerable, as apparently what's impossible to achieve in fuel economy in the US without "serious industry hardship" is apparently quite possible in the UK and Europe.

While US automakers smiled indulgently at compact, fuel efficient imports, and then concentrated on the really important stuff like huge engines, cup holders, and dual tires on pick-up trucks, an entire generation of new high efficiency automotive technology displaced US designs world wide. Hybrids, compact high performance engines, electric cars, and much smaller and lighter designs became the rule elsewhere, ***leaving us with woefully inefficient vehicles***.

Ironically, GM had a wonderful electric car in 2002, the EV1, a very highly regarded design that received rave reviews from the test users of the vehicles. GM then totally scrapped the EV1 program, and destroyed or disabled all the vehicles; most were crushed. This bizarre behavior was covered well in the 2006 movie called "*Who Killed the Electric Car*?" For those interested, it is a fairly telling commentary on how oil companies and automakers acted to maintain the oil-based fuel monopoly. Now, hoping to stave off the near collapse of its low fuel efficiency car offerings and attempting to regain it's vehicle sales, GM will rush to introduce the semi-electric Volt car by 2010. It appears that the argument and demand for electric vehicles was simply inevitable.



Original EV1 (Scrapped)


New Proposed Volt (2010)
Courtesy GM

Life ***does stop*** however, when ***fuel supplies disappear***, and no amount of money can readily produce fuel when there just isn't any available. We can use many alternate energy sources for daily use, and this can be transformed for use in vehicles (although no electric transport trucks are yet on the horizon for the bulk movement of freight, a very worrisome concern), chiefly through the transfer medium of electricity. This can be from secondary batteries charged via the grid or solar, or on-board primary generation from fuel cells, assuming somebody actually solves all the highly problematic Hydrogen fuel issues.

Collapsing vehicle sales, due to poor fuel economy and high cost of ownership, paved the way for the shocking multi-billion dollar bankruptcies of both Chrysler and GM in 2009. It is clear that no matter what "Industry Pundits" want, and misleading commercials promote, customer's opinions and choices are the only ones that really count in the marketplace.

Energy And Physics And Arcane Things You Need To Understand:

How much alternate energy is actually available to us free without burning ***any*** fuel? The total solar constant (incoming radiation of all kinds/unit area) ranges from roughly 1321W/m^2 to 1412W/m^2 depending on the time of year. (see: http://en.wikipedia.org/wiki/Solar_radiation) Keep in mind, only ½ of the Earth faces the sun at any one time, and there is a marginal energy zone at the twilight boundary, so a ***24 hour daily average*** is less than half this figure for any given spot, and less as one moves up or down in terms of latitude from the equator, so about 500W/m^2 represents a realistic ***24 hour continuous average*** for North America, with Canada being a bit lower, and Mexico a bit higher.

This represents all the ***solar energy that could possibly be captured passively***, and the reality is that if we actually ***did*** that, the Earth's surface would soon freeze. So, to be clear, it is not likely we will suddenly be able to convert the Earth as-is to a solar economy ***in an easy plug-and-play sense*** to replace our petro-fuel based model, although I am certain it will be a very critical and essential tool for future survival. Not really sure why this is true? One horsepower is equal to about 746 watts, which brings it into perspective. There just isn't enough energy there to be captured. You can only harness about 0.67 horsepower per square meter per hour. It's just not a lot of energy for doing work. For solar to work, efficiency of both collection and most importantly, ***the intelligent USE of that energy is critical***. Incidentally, 22% conversion efficiency is currently about the best for solar panels, so make that only 0.15 horsepower/m^{2}/h, in the interest of full disclosure. This is why directly solar-powered (only) cars are unlikely, but large-scale power farming is quite practical if enough collection area is available.

Solar energy "farming" is already underway in a serious fashion in Europe, especially Germany, as Europe has a high density, very efficient and tightly coupled electric infrastructure easily converted to at least partial solar power. Solar hardware and energy farming is highly encouraged and subsidized in Europe, and has already had a significant impact on power generation and industrial development. In addition, Europe has only modest native energy sources (coal, some hydro, and North Sea oil and gas) to fall back on. For them, it will likely be solar, wind, hydro, and nuclear energy as future primary energy sources, and they have a good chance of arriving at a workable oil-free model, although it will be painful. There is a good summary (although a bit dated) of European Union solar efforts here on their web site to help understand their plans: http://ec.europa.eu/energy/res/sectors/photovoltaic_en.htm

Astonishingly, the ITC (Investment Tax Credit) for solar conversion of US homes and businesses was about to expire at the end of 2008. Already passed by the House, ***it failed 8 times to pass in the Senate***, and only passed in late September on the 9th try, and only got funding as a hurried last-minute addition to the $700B Economic Growth and Financial Stabilization Act (popularly known at the Wall Street Bail-Out). Uncertainty over the renewal issue had stalled thousands of larger scale installations that couldn't be completed by the year-end deadline. Full details on this energy issue and the ramifications of the ITC as a catalytic agent for this industry are here: http://news.cnet.com/8301-10787_3-10018380-60.html?hhTest=1&tag=nl.e703

Fighting backward Federal policies, as it already has on mandated vehicle fuel economy and pollution, California has committed to several hundred-megawatt+ solar installations planned for deployment by 2012. These are to supply electric grid demands to meet its internally state-mandated solar power sourcing requirements, as they see no practical alternative for energy.

In North America, where distances are much larger in our urban settings, and we have very distant food production far from consumers, there is unfortunately also very little electric rail or rapid transit, ***so no smooth transition is really possible though a simple substitution of electrical energy sources for petrochemical sources***. Too much infrastructure is road and individual vehicle dependent, and too much work and energy has to be expended for even the simplest food supply or living activity. Too much food is inefficiently processed, and everything is simply too far apart. The physical infrastructure upheaval to arrive at a working model that can be powered by much less primary energy thus will be very difficult, and extremely painful to achieve in the USA, especially in large urban areas or any suburban location with a spread out building plan.

Wind power is also largely a byproduct of solar heating (but also includes planetary core heat, planetary rotation and gravity influences), so while it offers another way to capture what significant free energy is present, it also will be limited to some degree by the solar constant. We are simply NOT going to pull more energy out of the total Earth ecosystem ***in real time*** than the sun or planetary motion puts in on a daily basis, although all non-polluting energy is very welcome! This is the miracle of oil, it is the ***stored chemical energy of millions of years*** of solar radiation generating biomass, which was then converted by geologic heat and pressure to an easily combustible fuel and treasure trove of hydrocarbons. The critical issue for us is the time it took to do that, versus the brief instant we use it. ***The million to one time-compression ratio from creation to consumption is what makes oil magical to us, and makes replacement so incredibly difficult.***

We have made some good and some bad decisions as a group; our handling of oil was not a particularly good one. While it made our model of industrial development possible, we did not consider the time frame or exhaustion carefully, and we let it completely dominate our decisions in far too many areas. We are now sitting with a very complex and far-flung, inefficient infrastructure that inhales oil at a fierce rate, but we really have no substitute for all its purposes. We have built a world not easily convertible in a graceful way to any ready alternative. Kunstler's book "***The Long Emergency***" does a very good job of explaining this complex situation. If you need more convincing or background, I strongly recommend it.

How Things Actually Get Fixed:

It should be clear to everyone by this point that energy conservation, improving fuel economy wherever possible, and recycling of waste to recover usable fuel are all critical steps in human survival right now. No matter what you believe about oil, it is inarguable that we need to develop better and more efficient methods for everything while ***time still permits this gracefully***.

Our current techniques for transportation, lighting, heating, insulation and cooling all have huge potential savings in energy consumption. Our vehicles need to undergo a transformation from inefficient heat engines to more efficient electric ones. Rail and electric rail transport needs to be re-adopted. Even short term improvements in fuel efficiency offer us much more time to re-think our living patterns, and stop the inexcusable waste that seems to be our trademark in modern civilization, especially in North America. Every improvement is worthwhile, and every one we make will help to some degree. What is not possible is to just keep on the way we are, and assume some miraculous event will occur to allow us to continue our bad patterns. We are a lot like that frog in the slowly boiling pot of water, we can feel the heat, but are still not taking it seriously enough to alter our actions. I used to own a VW rabbit back in the 80's that routinely got 40MPG, so I am totally unmoved when US automakers complain that better than 25MPG fuel efficiency is an "industry hardship". What complete, self-serving hogwash.

At the core of this problem is the issue of will. Tremendous social restructuring will be required along with fundamental changes in business philosophy to achieve any useful effect. Interference with sound and truly responsible government policy has become institutionalized, with every special interest group pushing their agenda for the sake of individual profits or benefits. We are nearing a phase where this self-serving strategy will not only collapse horribly, ***but in doing so will cause such an erosion of public support for government and business that no useful action could then be implemented, and no one with good advice will be believed.*** Every alternative technique has issues, and the only stand-out irrefutable strategic winner right now is immediate conservation and improvement while we try and implement the best possible long term escape from the oil trap we are in. Google has proposed an excellent, ambitious and coordinated plan to completely eliminate fossil fuels by the year 2030, and you can see the full

details here: http://news.cnet.com/8301-11128_3-10056099-54.html?tag=nl.e703 For some contrast, here's an interesting summary of problems already encountered in implementing alternate energy sources you will find quite interesting: http://blog.heritage.org/2008/08/15/morning-bell-unintended-consequences-of-wind-energy/

The Problem of Time:

What does this mean for us all? The near term window of 5 years will be difficult, as we will be faced with all the problems of world-wide economic recession, erratic price inflation and looming scarcity, ***while everyone in a position to really effect change remains in denial that there are even any problems***. In addition, both the USA and Canada have had major elections, and what policies and actions may result are now even less certain, especially in the light of a serious global economic recession of unknown duration. If we do not get some useful changes, it will be "stay the course, keep consuming foolishly, and ignore that looming cliff up ahead." That is just not great advice.

No one in government or industry seems to feel they can discuss any part of this oil situation publicly, rolling out that tired old self-serving argument "it would cause panic" everybody uses to cover their biggest and most wart-covered sins. In fact, people would really like to know for a change what is actually going on, although you can be certain they will not fail to detect who has been grotesquely abusing them once they know the details, and react accordingly.

It is particularly interesting to note that it is mainly the "developed" world that is headed for trouble. Less developed, mainly agrarian nations will see little difference in their lives in the post-petroleum world, and some areas such as South America are sufficiently endowed with both original and substitute petro-resources that their situations are especially good compared to North America. The Third World will really have the last laugh in this global drama, it is ***the First World that will suffer the most, and fall the farthest and hardest in the years to come.***

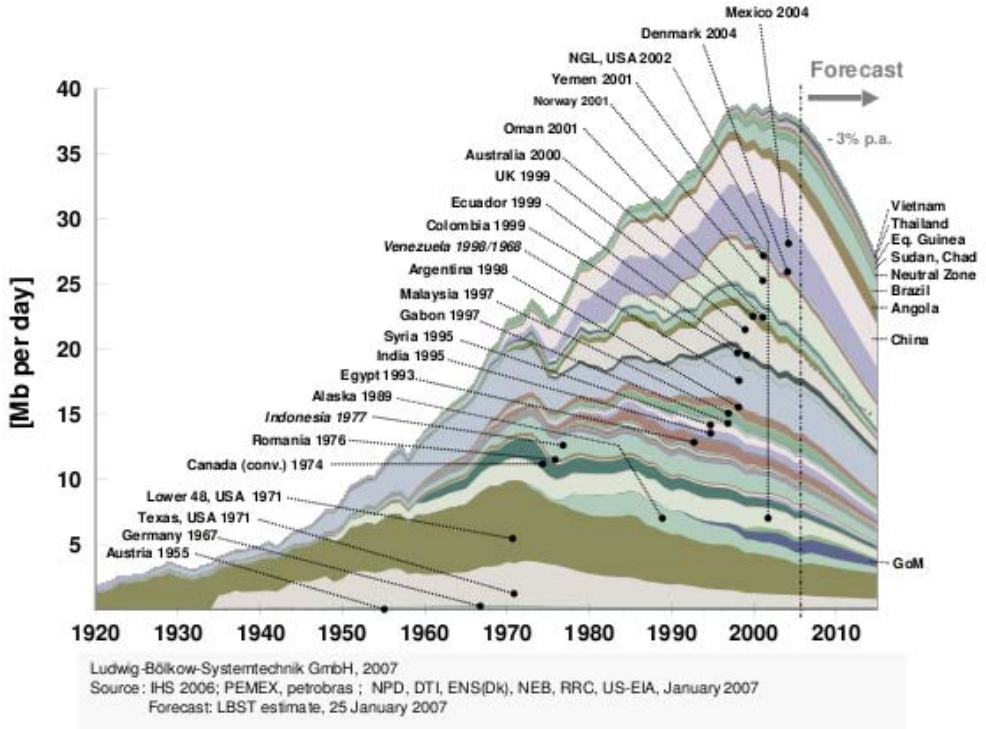
2009 ushered in a wide range of economic problems, triggered first by sub-prime mortgage failures, then banking failures, and then secondary industrial and commercial failures made worse by constricting credit. Many economists are now defining this situation as a global depression. Despite a staggering drop in the stock markets world wide (over 50%) and an estimated loss of US$50 Trillion in asset "value", ***one interesting thing remained true, oil consumption was hard to stop***. From a high of 87.3 million barrels per day in early 2008, the world is still consuming a staggering ***83.9 million barrels today*** (march 2009), despite this global collapse of economic activity. ***That is a drop of only 3.9%, trivial compared to world events, and clearly illustrates how incredibly hard it will be to move away from a world run on oil.***

The IEA (International Energy Agency) ***still estimates world demand at 84.4 million barrels/day*** for 2009, even in the very bleak current economic conditions.

Cynicism among consumers will be (understandably) high while trying to educate and prepare everyone for needed changes, and constructive action will probably not be much in evidence except on an individual or local level unless we get very lucky in government. ***You need to be sure you are that individual or part of that local effort.*** The simple and inescapable fact is that our current petro-industrialized pattern of living will be replaced, and our daily life will have a

lot less travel, and a lot more time spent in the direct production of food, and that will occur probably within 20-25 years. Our world in many ways will become local, not global, and our settings will be more rural and less metropolitan. Our limits will be where you can walk or ride in one day, and our critical skills will be what we can make or grow locally. ***We are going to eventually and inevitably find ourselves back in 1850***, before oil, but with some electricity and modern communication. It will be a genuine Twilight Zone-like experience for all of us.

Figure 5: Oil producing countries past peak



courtesy: http://sydney.indymedia.org.au/files/sydimc/images/Oil-producing-countries-past-peak-Oct-2007.png

When does the tank run dry enough to cause real problems? This is a hard question to answer as so many have their vested interests tied up in the most optimistic answer, and truly accurate data for some issues is difficult to find. For virtually everyone producing something that requires fuel, their adamant position is: Never, which makes them look more than a bit foolish. Keep in mind that actual fuel exhaustion or shortage is ***not required to trigger serious disruption, only the fear of it,*** which means that the world situation will decay much quicker than physical circumstances would actually dictate. As I pointed out earlier, it requires only a 2% shortage or surplus to seriously destabilize the pricing in the petroleum market.

I think based on the current very high salt water levels seen in Saudi oil pumping (caused by salt water injection to force recovery on failing wells), trouble is not very far away, perhaps only 2-3 years. Of concern to many in the oil industry is that since Saudi Arabia nationalized its oil fields in 1979, public access to levels of reserves and data about exploration has vanished. They still report the same reserves they did 30 years ago, despite pumping out billions of barrels, and minimal new discovery (which is also unverified). This makes outsiders very skeptical about the

validity of those numbers, which have been the cornerstone of world price stability and availability.

You are probably thinking that those production curves should lead out for a few years yet, ***but*** they are being seriously skewed from the ideal symmetrical Hubbert curve because of the double problems of rapidly increasing population ***and*** their rapidly increasing demands for petroleum and its industrial benefits. The falling slope of the production curve is steepening dramatically as a result, compared to the slower rising curve of early use. Production is being forced to the inefficient maximum to satisfy that demand, thus stripping supplies much faster as a result. Yet more unintended consequences of increasing urbanization, and even global recession is not halting this trend.

The Problem of Where:

To be useful, and affordable, fuel in whatever form has to be close by. Long distance shipping forces up the price of any fuel, and excessively so as fuel prices rise. Distant oil or gas is uncertain, adjacent fuel is attractive.

NAFTA (the North American Free Trade Agreement) has a seldom discussed but very critical element in it for the US, which is quite harmful to the other signatories. While in this 2008 election season, every US candidate said they'd love to scrap NAFTA, thus somehow mystically saving some un-named US factory jobs, the reality is that it would devastate the US in terms of oil imports overnight. Of the top three countries exporting to the US, two are NAFTA members, Mexico and Canada, with ***Canada being the largest single oil exporter to the US***. Don't think it's true? Look here at the US Department of Energy's own figures to see for yourself: http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/company_level_imports/current/import.html

In fact, about 35% of total US oil imports comes from just these two countries, and NAFTA prohibits them from scaling back export production or increasing prices to the US unless they do the same internally. As oil continues to skyrocket in value and decrease in availability, this is the only force keeping the US adequately supplied with secure oil. Put simply, if NAFTA collapses, so will America's primary and most secure oil sources. As a further annoyance, Canada actually has to import 55% of its own oil consumption to service mainly eastern provinces, as only marginal Canadian pipelines from Alberta feed all the way to the east, they are mainly to the south and west into the US. NAFTA actually prevents the Canadian market from being better serviced internally.

American oil is in deep depletion mode, with only the off-shore rigs in the Gulf of Mexico and the fields in Alaska still offering meaningful oil and gas in volume. Canada has natural gas, but is rapidly reaching the point where it can no longer export and still meet internal demand; only the Alberta tar sands are really significant net oil producers for export, but they are truly viable ***only above $60/barrel***. Mexico is also in oil depletion mode, and will soon be completely exhausted (most estimates say ***in as little as 6 years***). Since its own industrial development has exploded, dramatically increasing consumption, this poses a frightening future scenario for Mexico. A collapsing petroleum and economic situation in either Mexico or Canada is certain to trigger serious friction with the USA, which somehow ***never sees conservation*** as an element in

its long term strategy, only continued and increasing supply. What a rude awakening that situation is going to be.

North Sea production ***is already in rapid decline*** (having peaked in 1995), and will rock Europe, especially the UK and Norway, when it stops providing first oil and then natural gas in the next few years. Russia is pumping oil and natural gas in a frenzy to generate needed hard currency, but an honest state of supply is simply unknown, although production seems to have peaked by last year, 2008, with the most optimistic forecast being 2010, followed by the inevitable decline thereafter. Europe got a sudden surprise in early 2009 when Russia and the Ukraine were in disagreement over the transit of natural gas to Europe. Russia cut off pipeline supplies entirely, claiming the Ukraine was stealing gas. One quarter of Europe's natural gas now comes from Russia, but 80% of that has to pass through the deeply troubled economy of the Ukraine.

Europe is now in an especially awkward political position, having become highly dependent on Russian natural gas and oil in the last decade, and with their easiest non-OPEC source (The North Sea oil fields) now headed towards a steady decline. Please see more details of this here: http://dieoff.org/page180.htm It is really worth noting at this point that it is now ***Russia***, **NOT** Saudi Arabia, that is now the ***world's largest oil producer***, with more oil produced than Saudi Arabia in 2008, and it has used this new capacity to gain significant economic and political influence over both Europe and the US as their other sources dwindle. Russia has recently moved into Georgia militarily to get control of the Baku-to-Ceyhan oil pipeline, and soon whether many Europeans have a warm or freezing winter will be firmly in their control. Full details for current world production by nation are here ("Former Soviet Union" is Russia): http://www.worldoil.com/INFOCENTER/STATISTICS_DETAIL.asp?Statfile=_worldoilproduction Even 2007 data shows Saudi Arabia and Russia literally tied for oil production rates.

It is useful to know that within OPEC, member nations get group permission to export oil based on "proven reserves", so for decades everybody routinely inflated those numbers about the extent of reserves to get the highest possible production rates (and thus income) under their rules. But now we are at the point where every lie comes home to roost, and every deceit is plainly exposed. We all hope the optimistic stories are true, but we are going to be sorely disappointed by real events. You can visit the official OPEC website here to learn more about how they operate: http://www.opec.org/home/


Oil Sands, courtesy Glenbow Museum
http://www.glenbow.org/

Is there more oil? Yes, absolutely, it is in additional oil shales and sands both in the US and Canada, and in residual wells that cannot be extracted conventionally. It is difficult, dirty and expensive to extract (and only really feasible well above the $60/barrel threshold), and only possible while we still have some significant oil energy and available time left to exploit it, as well as build the truly massive and costly infrastructure required to do so. ***Extraction is also intensely polluting of both air and water, a significant problem with no real solution.***

There is also some remaining untapped deep-sea offshore oil world-wide, and some possibility of Antarctic or Polar development, although the pollution from extraction in this region would almost certainly have a serious and immediate unwanted impact on global warming.

Even if the answer was somehow a smiling "Yes, Virginia, there's a lot more Oil (and a Santa Claus, too)", we are just pushing back the event horizon slightly, not fixing it, or improving our habits (which are the real issues), and the costs and consequences are truly prohibitive in any case. Current fuel prices have already devastated car companies, crippled airlines, sent food prices soaring, crushed budgets, triggered widespread famine for the poorest in the world, and led to an irreversible fall in value of distant suburban housing. Just imagine what the next round of increases or shortages will do. No one will escape or enjoy the varied effects to come.

We still have considerable coal left (formed just as oil was, another stored biomass energy gift from millions of years ago), but its conversion to a liquid fuel is not really a net energy benefit, nor very practical unless all other sources fail, or petro-feedstocks are simply not available. Synthetic jet fuel is already made by this method in South Africa (Sasol Fuel). Coal also remains the largest source of primary fuel to run US electrical power generation, although most new plants being built are switching to natural gas for reduced pollution, ***even though it is very uncertain that continuing supplies will be possible in many locations***. Our best long-term strategy for coal is not to simply burn it unless we have to, but to use it as an industrial feedstock as oil disappears. We are ***really*** going to miss those complex hydrocarbons when they are finally gone somewhere down the road.

The Techno-Band-Aid Technique:

The "green appeasement" strategy for oil scarcity, ***without any real structural or conservation changes*** (which would have actually been ***useful***), has been the legislated use of Ethanol. Unfortunately only slightly more energy comes from using Ethanol in the USA (if all steps are considered) than is required to make it (the most optimistic net surplus energy figure is only 36% using corn). In an amazing policy decision, the US EPA mandated that the US is to use 9 billion gallons (214 million barrels) of ethanol annually by 2008 (as an imported oil replacement for gasoline production), rising to an astonishing 36 billion gallons (857 million barrels) by 2022. Many other countries including China, Brazil, The EU, and Canada have also developed large ethanol industries for fuel. Brazil is the largest exporter of ethanol fuel in the world (but using highly efficient ***sugar cane feedstock***, which gives ***six times more energy output*** than is required for production). 70% of the world ethanol supply comes from the western hemisphere. Full ethanol industry details are here: http://www.ethanolrfa.org/resource/facts/trade/

Theoretically, this might have all been very useful and a pollution improvement (although US current ***annual production*** is less than ***eleven day's consumption***) had the process ***used waste cellulose or unwanted crop byproducts,*** but unfortunately prime, ***critical food crops*** were used, since they produced the most ethanol. Processes are not even developed yet for large-scale commercial generation using waste materials (referred to as cellulosic ethanol), although they are coming. This meant that corn, soybeans, sugar cane and sorghum prices exploded as these crops were diverted to ethanol production, and millions were left starving as the exports of these food crops disappeared world-wide or rose in price to the point of unaffordability. Needless to say, nobody on the production side now wants to go back, as the much higher crop prices for

government subsidized ethanol production are simply far too appealing. ***Note that continued high-volume corn-based ethanol production in the USA is simply impossible without fertilizer to maintain viable soil, which in turn requires oil or natural gas to produce, negating the entire strategy as an "oil replacement" technique.***

Coupled with other world-wide crop failures in 2007 and 2008, especially Asian rice crops, plus hoarding in countries that used to be exporters, but feared for their own citizens as world conditions worsened, ***recent price escalation of primary food has punished the world's poor like nothing ever seen before***. People with very little money simply die when they cannot afford basic food, the more fortunate just complain a bit and look for bargains, ***a very big situational difference***. The state of Texas recently asked the EPA for a 50% reduction in the ethanol mandate due to concerns over the serious impact it was having on food prices, but was turned down as the EPA said no real harm had been proven. What exactly would ***real*** harm look like?

Vehicles can run on up to a 10% ethanol content mixed with gasoline without any major modifications, but beyond that level significant fuel control re-design is needed. Keep in mind that ethanol has far less heat energy than gasoline or kerosene, and thus produces less engine output in terms of horsepower. There have been some major experiments to arrive at bio-blended jet fuels, and there is an excellent government/industry joint research paper here on that topic from Boeing: http://www.boeing.com/commercial/environment/pdf/alt_fuels.pdf

It is clear from the research paper that synthetic or FT (Fischer-Tropsch) fuels ***that work*** require ***hydrocarbon feedstock*** such as coal or natural gas, and that even blended (with existing fuel) bio-fuels have some significant problems in aircraft engines (freezing and lower energy) than readily available Jet fuels. The article is also an excellent study of the ***inevitable effects*** of attempting to make high volume bio-fuels (food crop destruction, pollution, soaring food costs, etc.), but clearly nobody at the EPA looked at this document before implementing their national ethanol policy. ***It is an excellent analysis of possible fuel approaches, and highly recommended for insight into what is possible and the shortcomings of each technique*** as oil is exhausted. In the near term, however, it is not clear that any viable high volume, cost-effective plug and play solution exists once oil, natural gas or coal hydrocarbon feedstock is effectively depleted.

Oil extracted from Jatropha seeds was used successfully as a petroleum substitute in aviation fuel during an Air New Zealand test flight in December of 2008, according to a Boeing interview by Der Spiegel. (http://www.spiegel.de/international/business/0,1518,618859,00.html). The significance of that flight was that the mix ratio to conventional aviation kerosene was a 50/50 blend, while virtually all other substitutes are only in the 1-6% range, of no real useful significance. This blend also reduced CO_2 emissions significantly, and had a lower freezing point, all excellent factors in its favor. Whether it could be produced in sufficient volume ***without petrochemical fertilizer inputs*** is another matter entirely. See also: http://www.jatrophatech.com/ and http://www.jatrophaworld.org/ for data on raising this crop.

Clearly I am not the only one that sees fuel trouble ahead for a petroleum-based flight industry, ***Swift Enterprises*** is hard at work on an alternative jet fuel made from landfill waste, sorghum, algae and similar feedstocks, you can see this article for their details: http://cleantechnica.com/2008/08/27/swift-enterprises-joins-race-for-alternative-jet-fuel/

The Consumer Response:

Soaring prices trigger "***Demand Destruction***", which is to say that at the higher price, some people simply decide they don't need the item, or simply can't afford it. We have already seen this dramatically in 2007 and especially 2008. As US automakers quickly learned, this meant that ***any vehicle with high fuel consumption suddenly became un-salable***, and retailers, restaurants and anything else far from consumers suddenly saw a big downturn in business activity. ABC News reported that Americans drove ***12.2 billion fewer miles in June 2008 than the year before***, a clear indication of a change in habits and demand triggered by steep gasoline price increases. Many have also sold or defaulted on loans of poor mileage cars. Some used and new car values, especially for trucks, big SUVs and inefficient sedans have now completely collapsed, and both Chrysler and General Motors in the USA have filed for bankruptcy in 2009.

In the aviation world, the NBAA reports that nation-wide sales data shows a 10-20% drop in Jet-A fuel sales, and a large 30-40% drop in AvGas. Pilots also reported that 19% have cut back on flight hours, 28% are requesting more direct routing, 40% have reduced flight speeds to try and conserve fuel, and a huge 76% have switched FBOs to locate lower priced fuel. Airlines are already dramatically cutting fleets, people and fuel use.

For consumers, higher fuel costs also means less disposable income in general, which results in less over-all business activity. ***This downturn in consumption of every kind then causes a drop in oil prices, as demand simply falls off.*** This price drop then generates considerable skepticism among consumers, who see it as clear evidence of "price manipulation", speculation and other artifice that drove the price up, and many then simply revert to their old consumption patterns when prices do fall, but they fail to see that the current price is still ***much higher*** than even a few years ago, or understand the critical message it carries. The sawtooth shaped cycle of price rises and drops ratchets relentlessly upwards as true scarcity sets in, but is not always clearly visible to consumers for what it is, due to the momentary relief over any temporary price reductions.

After oil prices rose throughout all of 2007, ***demand destruction*** choked off the use of oil and refined fuels dramatically in North America by the end of 2008. This pushed global oil prices back below the hundred dollar /barrel level, but this did not result in any actual price relief for many consumers, as September's Hurricane Ike severely interrupted Gulf area refining activity around the Houston/Galveston area, which resulted in explosive gasoline price hikes, and massive shortages throughout the neighboring states as far as Georgia. Huge population evacuations required by the hurricane activity simply amplified this problem. Because of the tightly linked North American economy, prices rose nationwide in the US, and even in Canada, with the argument that cheap fuel locally would simply be bought and moved to affected areas, then creating a shortage elsewhere. ***This event effectively models the future disruptive results that can be expected when supplies are simply not available in a more general way.***

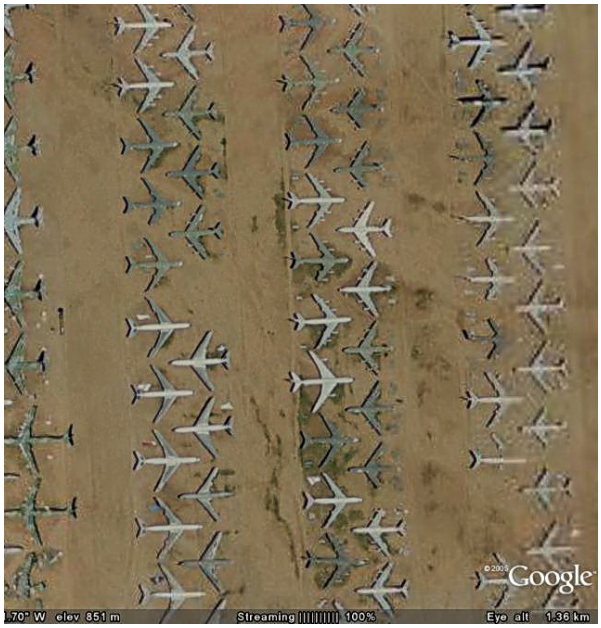
The global recession triggered by collapsing marginal credit transaction, sub-prime mortgages and worthless derivatives hammered the price of oil as well as industrial and consumer demand evaporated. In mid-2009, US unemployment rose above 9.4% for the first time in decades (well over 10% in many states), and every oil producing country found itself in a sudden over-supply situation (of only roughly 3%), with oil loaded on tankers and clogging pipelines, but with no deeply motivated buyers thanks to the paralyzed economy.

Production was scaled back twice by OPEC and then unilaterally by Saudi Arabia, removing millions of barrels of oil per day from production, as prices tumbled all the way down to US$40 a barrel by early 2009. Meanwhile, in the background behind all the economic chaos, critical decisions were being made that will have terrible consequences in the years to come. Virtually all petrochemical infrastructure additions and upgrades were stopped world-wide, a complete billion-dollar tar sands project was cancelled, and almost every alternative energy project lost their critical cost and supply advantages. The entire alternate energy industry sector slumped as "cheap(er) oil" suddenly re-appeared. These moves all set the stage for much worse future oil cost spikes and new problems just over the horizon, now estimated to become critical by 2013.

We are lucky to be sitting in a moment where we can think briefly about our options, and try and make the very best decisions we can, while there is enough supply, peace and stability to make them possible. Once we enter the period of real supply disruption, rational thought and planning will go right out the window. There is an old saying that "There are only 7 missed meals between civilization and chaos". In my observing of recent human behavior, I think it's become more like one or two missed meals, and suddenly any behavior is somehow acceptable to obtain what people want. As multiple problems begin to intersect in everyone's daily life (global warming, water shortages, rising food costs, widespread financial problems, shrinking fuel supplies, etc.), anger and fear inevitably overtake and then overwhelm patience and planning.

The View From the Air:

Except for the air transport world, which is working furiously to develop more fuel-efficient engines and aircraft to counteract the industry poison pill of high fuel prices, few in the aviation world seem to have been deeply focused on fuel economy as a critical design element. As a result, many popular smaller aircraft (both fixed and rotary wing) with the significant and ***notable exception of Robinson Helicopter***, are simply not optimized for low fuel consumption, and are rapidly becoming too costly to operate in many situations. Certainly operating budgets are being shattered by the cost of current fuel bills for every aircraft user. Long design, test and certification cycles mean that it will be years before any real improvements, driven by current prices, percolate down to the marketplace in the form of new fuel-efficient engines and airframes.



US Airplane Graveyard in Arizona,
Courtesy of Google

Because it is so time consuming and excessively expensive to retrofit and re-certify older aircraft to be more efficient, many planes are simply accumulating in storage fields as they become un-economical, especially transport category aircraft. Unless huge improvements are somehow possible in fuel economy, and as oil supplies dwindle, virtually all current production transport aircraft will wind up here eventually.

In terms of practical aviation examples, 2008 ATA figures showed a +265% increase in the price of airline jet fuel from 2000 to 2008, based on a current price of US$3.29 (clearly airlines have access to much cheaper bulk fuel rates than the rest of us do), but 2008 survey prices for Jet A seem to be more like a higher retail average of US$6/gallon as of (August 12, 2008) as shown here: http://www.100ll.com/ and here: http://www.airnav.com/fuel/local.html. KLAX (Los Angeles) area fuel prices as of August 12, 2008 averaged $5.94, with a range of US$4.99 to US$7.59. In KSFO (San Francisco) and a whopping $7.98 for Jet A. ***For non-airline customers, fuel costs are clearly much steeper, and already deeply prohibitive.***

More incredibly, from a cost perspective, January 2009 Jet A prices (remember that crude oil in January 2009 was only $40/bbl, ***far less*** than it was back in August, 2008) still averaged about $4 a gallon. KLAX area prices spanned $3.59 to $5.75, averaging $4.44, and the KSFO area averaged $3.99. Refined fuels clearly are NOT tracking raw oil prices (due to accumulated high cost reserves, refinery space shortages and other market forces) in the aviation sector. They are significantly elevated, and remain very resistant to downward pressure.

A Typical Use Example

Courtesy Bell Helicopter http://www.bellhelicopter.com/en/index.cfm
Ship operating details are here for reference:
http://www.bellhelicopter.com/en/aircraft/commercial/pdf/B3_2006_jan_web.pdf

Those aviation fuel price averages mean that a full tank of fuel in KLAX for a popular Bell 206B3 Jet Ranger (91 gallons) in January 2009 (after a HUGE drop in oil prices) is ***still*** about US$404, for roughly 380nm of flight. That puts a full daily 8 hour Jet Ranger flight program for a police department at about US$808 just for fuel (well over 1/4 of a million dollars annually), a terrible cost burden for any essential flight operation such as law enforcement, and a dramatic change from about $200 a day only 8 years ago. Most government agencies and municipalities will have favorable price contracts for fuel that should moderate these retail prices somewhat, but it's clear they will simply not be able to stop the rise of fuel costs to and then beyond these levels over time. ***Very few essential services have enough budget elasticity to absorb this kind of massive fuel price increase, and this situation leads inevitably to a reduction in flight hours, services and coverage, and then finally personnel and aircraft.***

Incredibly, ***falling oil and gas prices have also seriously damaged the aviation world.*** This happened in the following way: Airlines and major fleet operators suffering under rising fuel prices began to buy futures contracts for delivery at current prices, hoping to lock in known fuel costs, and hedge against future skyrocketing fuel costs. Southwest Airlines was especially good at this as prices first rose, and was one of the few airlines to show profits as a result, while many others suffered serious fuel related losses.

This hedge strategy worked well as prices rose uncontrollably in 2007 and early 2008, but backfired when they dropped suddenly as the world-wide recession abruptly choked off demand. Rapidly falling prices surprised virtually every airline, and late 2008 and early 2009 brought serious losses ***caused by over-priced fuel futures***. Even Southwest was hurt, and had its first loss in 17 years due to this problem. UAL was also caught in this trap and wound up with a 4th quarter loss of over US$1.3B, with over $0.9B in just fuel related write-downs. The incredible volatility, and the ***unavoidable requirement for consumption*** has made all petrochemical fuels the delicate Achilles heel of modern aviation.

Unavoidable Government Issues:

To judge by the huge ***multi-billion dollar budget shortfalls*** in states like California (an unbelievable US$24B in June 2009, according to the Governor), New York (US$5B), Florida

(US$1.5B) and others, funds are simply not going to be available to put fuel in everything that needs it. Local policing, medical and emergency services are also certain to suffer as states, counties and cities find themselves with skyrocketing budget deficits, decreasing revenues and ***no alternative left but to do less with fewer resources, including aviation related ones***. California has been especially sweeping in its forced expense cutting, shedding tens of thousands of employees, and putting many of the remaining ones on minimum wage. See these articles for more detailed budget insight and what is affected: http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2008/08/14/ED3E12B9H5.DTL http://online.wsj.com/article/SB123491737158404543.html

On the federal level, Washington is already forecasting a 2009 budget deficit of ***US$1.2-3 Trillion***, which is on top of the ***US$11 Trillion*** already accumulated with the passage of the recent Wall Street banking bailout. Despite a federal willingness to toss out trillion dollar stimulus packages, it is clear that a point will be reached where governments can simply no longer fund or maintain their operations, as enough lenders will simply not be willing or available to make that possible. Many financial institutions from Fannie Mae and Freddie Mac to Bear Sterns, Lehman Brothers and AIG insurance have been pushed to the brink of financial collapse and over it in 2008 and 2009, triggered by cascading debt defaults in the sub-prime real estate market. Only massive intervention by the US government in direct loans and guarantees has temporarily stopped this effect, but where will the actual funds come from for this rescue and inevitably more when the federal deficit is ***already*** US$11T? There are ***real upset events looming in our near term future***, due to these financial factors, so be ***completely certain*** that fundamental patterns are going to change, no matter how it looks to you right now.

The hidden effect of such huge US deficits is the gradual devaluation of the currency, especially in terms of globally traded hard assets such as gold, food and oil. We are already witnessing this trend in a serious way, which causes these items to rise in price when denominated in US$. This pressure further chokes off demand, and damages every oil-related industry as a result.

Every decision you make now needs to be a thoughtful and long term one, and you have to consider that the worst-case scenario could actually be one of the nicer ones. We are sitting in a very brief (although expensive) calm period, created by a global recession that triggered a dramatic drop in oil consumption, demand and prices. This situation is a real gift, as it assures supply but one that we cannot afford to waste, mistakenly thinking all will now suddenly be well as oil momentarily drops to the $70/barrel range due to massive world-wide recessionary forces.

You have some time to plan well, both for your business and your personal life, so please don't ignore these issues, thinking everything will actually be OK with no extra effort or attention on your part. The serious issues everybody felt might possibly affect our grandchildren back in the 60's and 70's are sitting on our doorsteps right now; ***right on schedule*** and waiting for attention, and they are simply not going to go away. We failed to take any useful action when these problems first appeared, and the US went past its own peak oil in the 70's. Now we are living in the unpleasant consequences of that massive inaction and subsequent deliberate industry and government misdirection about the true state of oil availability, and what it really means for our way of life.

So what are the key things to take away from all of this information? The most important is that ***powered aviation is a very special energy case***, which can reap ***almost no benefit*** from either existing or planned alternate energy sources. Neither solar, wind, hydrogen nor nuclear offers us any effective solution as a petro-fuel substitute in flight. ***Bio-fuels have a serious oil-inked dependency, and simply cannot be generated indefinitely without exhausting their growing areas, no matter what crops or techniques are involved.*** As noted in the Boeing alternate fuels report, the choice for bio fuels would eventually have to be a choice for food or fuel, ***but not both***.

Eventual ***effective*** oil exhaustion (where extraction is no longer cost effective or practical) is a ***complete and inarguable certainty***, and not really up for debate. The only discussion we can have is ***over the date***, and what life will be like on the way there and afterwards.

Everything that follows oil scarcity and eventual exhaustion will be a very difficult industrial transition for the human race, and the biggest challenge we have faced, both socially and technically. ***The key to getting through that stage is to fully understand it and plan effectively for it now***, not to deny it, because our full attention is needed right now on all these significant problems.

All for now.