World and U.S. Liquid Fuels Analysis: Crunch Time Is Upon Us

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Summary

The days of abundant and cheap oil are over. World crude oil production has been flat since 2005. New oil resources are in ever more remote locations, which mean that they are ever more difficult and expensive to find and produce. The world is relying on unconventional liquid fuels sources such as extra-heavy oil, Canadian oil sands, shale oil, and biomass to increase liquid fuels supplies to meet growing demand. The result is that world liquid fuels supply is failing to keep pace with demand, which is causing high prices and stagnant world economic growth.

The U.S. has limited ability to increase domestic liquid fuels production or to decrease liquid fuels consumption by 2020. Since motor vehicles account for the greatest quantity of U.S. liquid fuels consumption, a long-term solution to the liquid fuels problem is to enact aggressive policies for a rapid transition to electric vehicles. To get the transition into high gear, ASAP calls for a non-partisan "Energy Commission" that is independent of energy company interests.

The Energy Commission tasks are:

1) evaluate world and U.S. liquid fuels supply and demand dynamics
2) evaluate U.S. natural gas supply and demand dynamics
    a. shale gas production (and the same issues hold for shale oil production above)
        i. perform a comparative analysis of core and non-core area well production
        ii. evaluate when well saturation of the core areas of shale gas plays will occur
    b. natural gas demand and whether long-term natural gas supplies are sufficient
        i. space and water heating for residential, commercial and industrial end-use
        ii. electricity generation, including the use of natural gas used to firm intermittent wind and solar electricity supply
        iii. transportation fuel
    c. the effect of proposals to export U.S. natural gas to Asia and Europe
3) comparative analysis of battery and fuel cell electric vehicles
    a. vehicles that satisfy consumer preferences in terms of size, performance, and cost
    b. automobile manufacturers ability to produce vehicles that meet consumer preferences
        i. comparison of battery electric and fuel cell electric vehicle life cycle analyses
            1. emphasis on energy sources and material resource costs and impacts
                a. energy - electricity versus electrolytic hydrogen
                    i. natural gas versus solar and wind electricity
                    ii. interstate solar and wind transmission system
                        1. assess progress of FERC and Senate rules
4) evaluate policies such as a $2/gallon gasoline tax to induce consumers to purchase electric vehicles. Which is the greatest pain to bear – economic stagnation or change?
5) plan a media campaign to inform and involve the mass public in the process of making a rapid transition to electric vehicles.

The Energy Commission should be assigned sufficient staff to complete its work within six months. The Energy Commission should hold public hearings with full media coverage. The findings of the Commission should be implemented as soon as possible. The objective is to find a means to stabilize energy prices at their lowest possible levels. The liquid fuels supply crisis is for real and only gets worse until we enact policies to usher in a new 21st Century energy system.

A. World Liquid Fuels Consumption and Supply

A world liquid fuels supply shortage has emerged in recent years, which is causing chronic world economic stagnation. The only solution is to reduce demand for liquid fuels. Change in motor vehicle energy sources is a viable means to reduce demand since motor vehicles account for more than half of total liquid fuels consumption. The U.S. and Europe must lead the way in motor vehicle change since demand for motor vehicles in developing economies is driven by first time owners, which translates into increased liquid fuels consumption regardless of vehicle fuel economy measures. Also, the large capital investments to develop new vehicle energy sources and infrastructure are more readily accessible in the U.S. and Europe.

In 2007, world liquid fuels demand exceeded liquid fuels supply and caused world oil prices to soar above $100/barrel. High oil prices diminished consumer spending power, which was a major factor leading to the world economic collapse in 2008. World liquid fuels consumption and supply levels are presented in Table 1, and world oil prices and GDP are presented in Fig. 1.

From 1994-2007, average annual world GDP growth was 3.1%, and the average annual increase in world liquid fuels consumption was 1.7%. The world economy: 1) began to decline in the Fall 2007 as oil prices soared above $80/barrel; 2) collapsed in the Summer 2008 after oil prices peaked at above $140/barrel; 3) experienced a moderate recovery from the Summer 2009 through Spring 2011 with oil prices averaging about $75/barrel; and 4) is moving toward world recession again in the Summer 2011 after oil prices soared above $110/barrel in the Spring 2011. Crude oil and stock market index prices for 2011 are presented in Fig. 2.

There is an emerging trend between oil prices and economic growth and decline cycles. This trend is evidenced by the high annual correlations between oil and stock prices from 2008 through 2011 as shown in Fig. 3. The correlation between oil and stock prices in the volatile Summer 2011markets is a very high 0.96. In other words, oil prices are tracking stock prices closely, which is an indicator of a tight world liquid fuels market.

Table 1. World Liquid Fuels Consumption and Supply, 2007-2010.

	2007	2008	2009	2010	Change (2007-2010)	Annual Growth (2007-2010)
World Liquid Fuels Consumption	85.8	85.2	84.3	87.0	1.2	0.7%
World Liquid Fuels Supply	84.6	85.6	84.4	86.8	2.2	0.5%
China	7.5	7.8	8.3	9.2	1.7	5.4%
India	2.8	3.0	3.1	3.2	0.4	2.5%
Brazil	2.4	2.5	2.5	2.7	0.3	2.2%
Total					2.3	
North America	25.2	23.9	23.0	23.5	-1.6	-0.5%
Europe	16.2	16.1	15.4	15.2	-1.0	-2.0%
Total					-2.6	

Source: EIA, International Energy Statistics 2011.

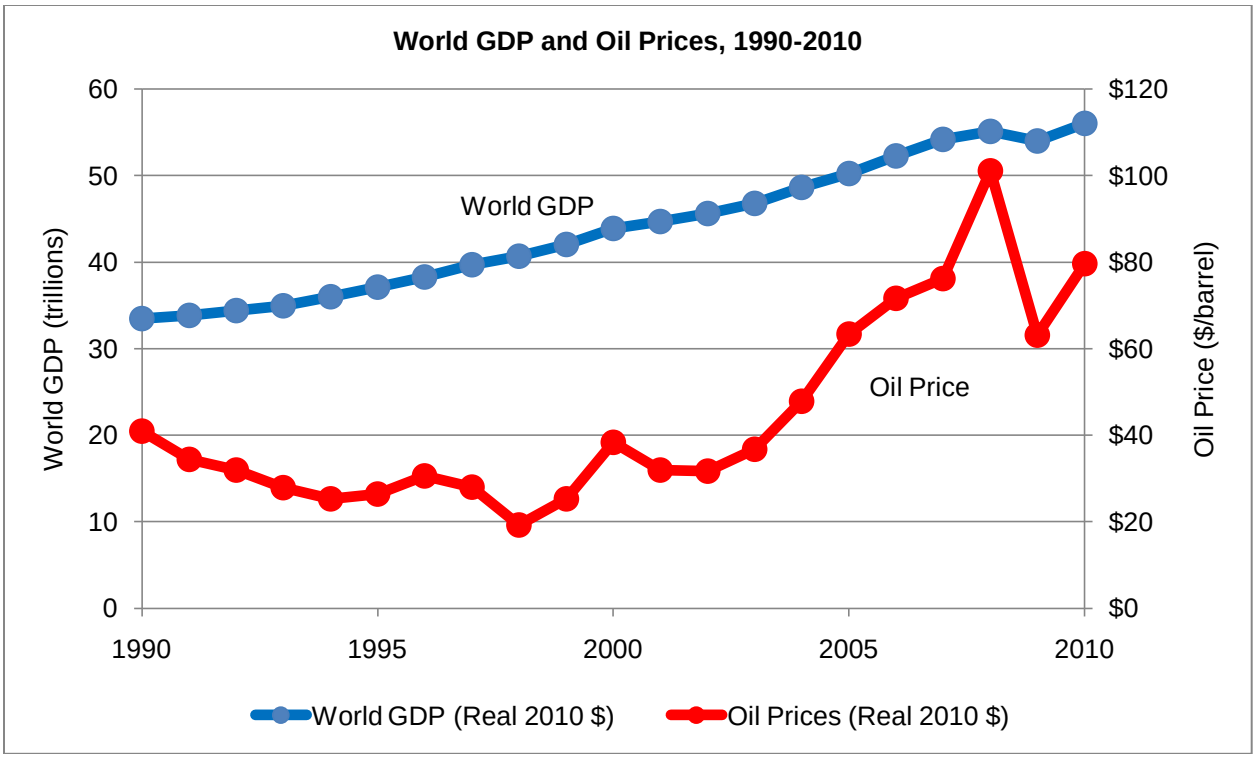

Figure 1. World GDP (real 2010 $) and oil prices (real 2010 $) from 1990 to 2010. Sources: World Bank for world GDP estimates and EIA for WTI Cushing spot crude oil prices.

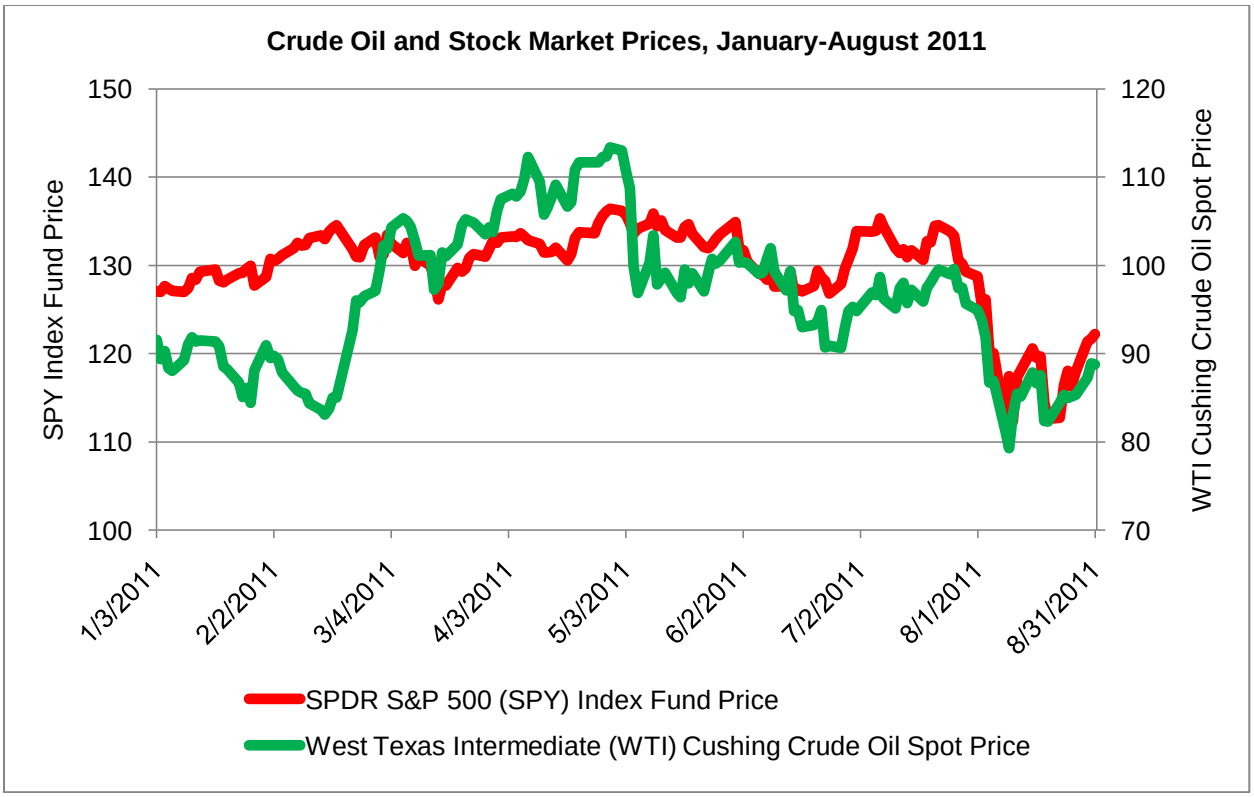

Figure 2. Correspondence between oil and stock market price movements in 2011.

The link between economic growth and increases in oil consumption is obvious. When the world economy grows, the increase in economic activity causes oil consumption to rise. In recent years, oil prices soar when demand increases because of supply constraints. The large increases in oil prices erode consumer spending power, which slows economic growth. The result is that from 2007 through 2010 average annual world economic growth was an anemic 1.1%. The cycles of economic growth and decline caused by oil price fluctuations are expected to continue into the foreseeable future and create an economic climate of chronic stagnation.

This conclusion is derived from an analysis of world liquid fuels supply/demand balances. The robust liquid fuels consumption growth rates of China and India are having and will continue to have a huge impact on world liquid fuels supply/demand dynamics. By 2015, China and India liquid fuels consumption is expected to increase 3.6 MMbbl/d above their combined 2010 level.

If the U.S. and Europe hold liquid fuels consumption constant at 2010 levels and the rest of the world increases liquid fuels consumption by an average annual rate of 1.5% from 2010 to 2015, then world demand will increase by an additional 2.7 MMbbl/d in 2015. Therefore, for the world to achieve desired levels of economic growth 2010-2015, the total increase in liquid fuels consumption needs to be about 6.3 MMbbl/d and brings 2015 world demand to 93.3 MMbbl/d.

The liquid fuels consumption projections for China and India are based on continuation of the average annual growth rates realized from 2006-2010. These growth rates are believed realistic since a relatively small portion of the populations in these two countries have been brought into the mainstream of industrial society, *e.g.*, car ownership rates. Liquid fuels consumption of China and India combined will exceed that of the U.S. before 2020. China surpassed the U.S. as the world's largest automobile market in 2010. These supply-demand numbers do not balance.

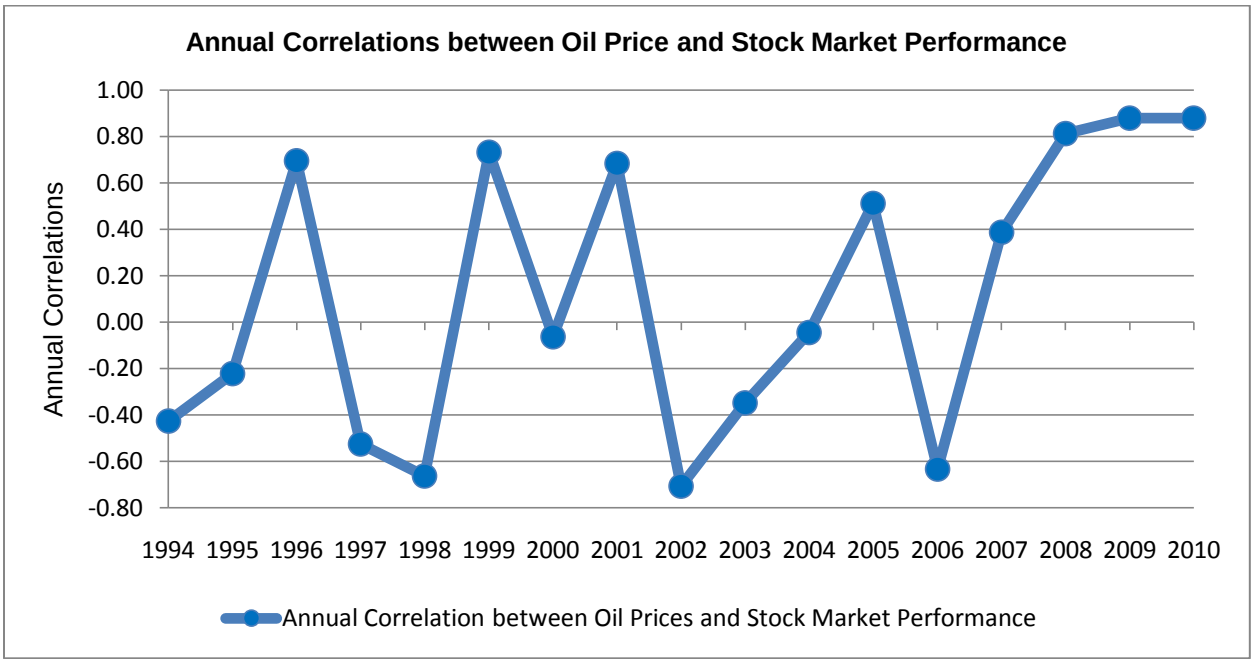

Figure 3. Annual correlations between nominal oil prices (West Texas Intermediate, WTI) and stock market performance (SPDR S&P 500 Index Fund, SPY), 1994-2010.

To summarize the findings, the forecast for world liquid fuels demand in 2015 is 93.3 MMbbl/d, which is a 1.4% average annual world growth rate in liquid fuels consumption from 2010 to 2015. This forecast is based on the following average annual growth rates in liquid fuels consumption: 5.4% for China and India combined, which is their 2006-2010 average annual growth rate; 0.0% for the U.S. and Europe combined; and 1.5% for the rest of the world.

This means that world liquids fuel supply will need to increase by 6.3 MMbbl/d in 2015. The world struggled to supply 87 MMbbl/d in 2010, which begs the question of whether an additional 6.3 MMbbl/d of liquid fuels supply in 2015 is possible. The supply problem becomes an order of magnitude greater when we look past 2015 to 2020 and world demand tops 100 MMbbl/d.

For the past hundred years, the world has relied almost exclusively on conventional light crude oil for its liquid fuels supply. Today, new conventional light crude oil resources are becoming ever more difficult to find and more expensive to produce. World light crude oil production levels have been relatively flat from 2005 to the present. New sources of conventional light crude oil supply are coming from ultra-deep offshore and Arctic fields.

To increase liquid fuels supply, the world now has to rely on unconventional liquid fuels sources such as extra-heavy oil, Canadian oil sands, biomass, and shale oil.[1] This is shown in Fig. 4.

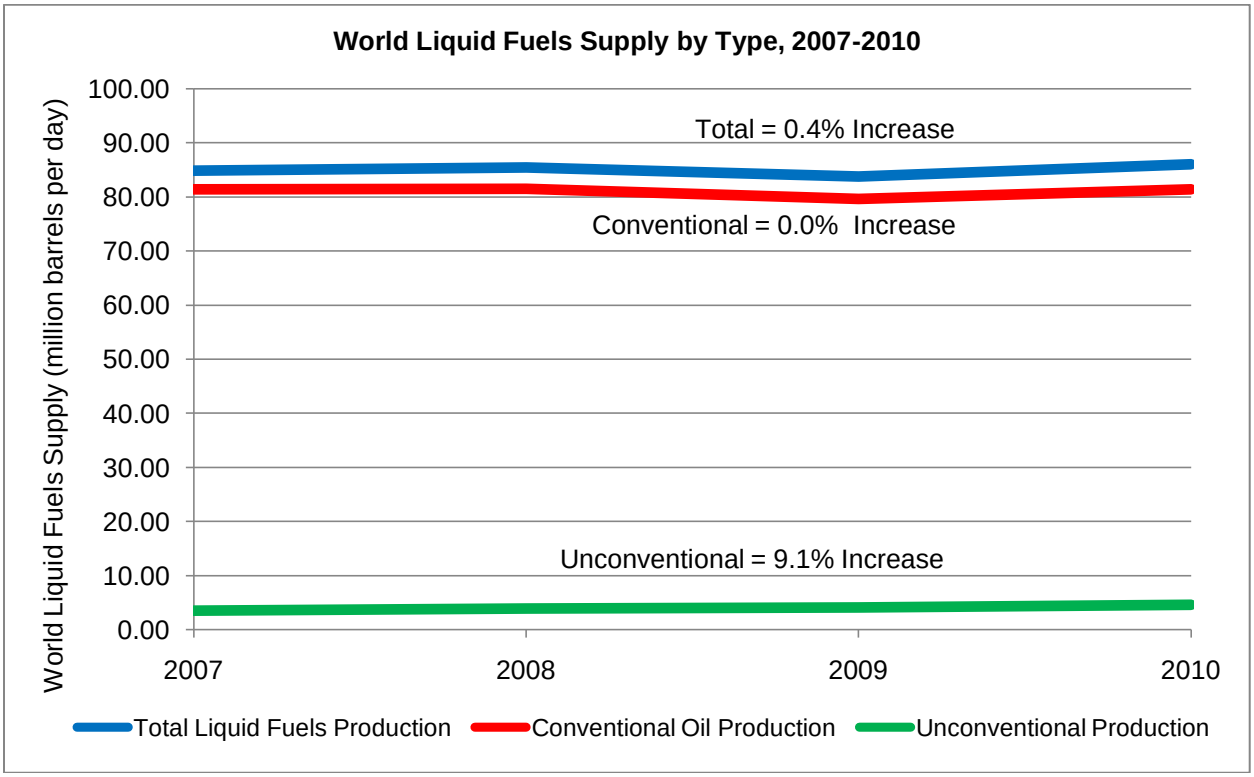

Figure 4. World liquid fuels supply, 2008-2010 (EIA, International Energy Outlook 2011).

[1] There are two types of shale oil: 1) oil produced by vertical and horizontal well fracturing of brittle matrix shale formations; and 2) oil produced by the intense heating of solid shale rock formations. The EIA classifies type 1 shale oil as conventional oil and classifies type 2 shale oil as unconventional oil. It is believed that both types of shale oil should be classified as unconventional oil. Also, a classification change is needed: type 1 should be classified as shale oil, and type 2 should be classified as oil shale.

It is more difficult and costly to scale unconventional liquid fuels production to the million barrels per day level compared with conventional crude oil production. Flat conventional crude oil production coupled to the emerging reliance on unconventional liquid fuels to increase world supply are responsible for the world liquid fuels supply/demand imbalances in 2007 and 2009, which are shown in Table 1. In turn, the liquid fuels supply/demand imbalances led to the sharp increases in oil prices from $80/barrel to over $100/barrel in 2008 and 2011.

The importance of unconventional liquid fuels supply will increase in coming years as is shown in the liquid fuels supply forecast presented in Fig. 5. The 2015 forecast for world liquid fuels supply is 88.9 MMbbl/d. The supply forecast is 4.4 MMbbl/d less than the above world demand forecast. If world liquid fuels supply is only 88.9 MMbbl/d in 2015, then the forecast 1.4% average annual demand growth rate is reduced to a 0.4% average annual demand growth rate.

A disturbing observation is that if world liquid fuels supply can only increase to 88.9 MMbbl/d in 2015 then China alone will absorb most of the 1.9 MMbbl/d increase in world liquid fuels supply. In other words, the world is at or is fast approaching the breaking point in the ability of liquid fuels supply to support desired levels of economic growth. None of the untapped unconventional sources of liquid fuels can be scaled up fast enough to solve the world's liquid fuels supply/demand imbalance. And the problem only gets worse as we move forward in time.

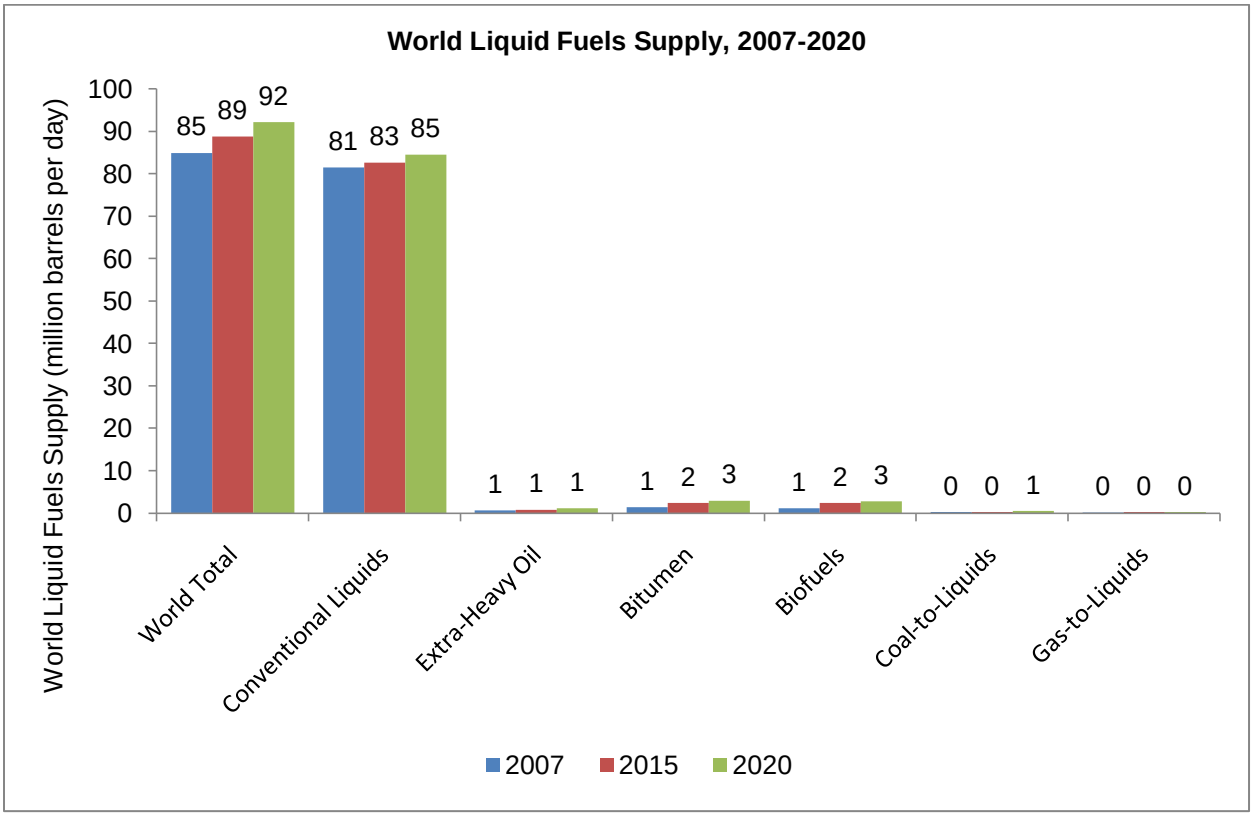

Figure 5. Sources of world liquid fuels supply, 2007-2020. Source: EIA, International Energy Outlook 2011, reference case. The EIA includes shale oil in the conventional liquids category and increases in shale oil production accounts for a large part of the increase in conventional liquids supply.

It is important to recognize that China is largely in control of its liquid fuels supply to support robust growth for the next five years. China is increasing domestic oil production, particularly its offshore resources in the South China Sea and the East China Sea. Also, it is looking to develop its domestic shale oil resources. In addition, China has positioned itself to increase oil imports from Russia, the Middle East, Africa, and South America. In essence, China accounts for a large portion of world liquid fuels growth through 2015.

The only viable mitigation strategy for the world liquid fuels supply/demand imbalance is to reduce motor vehicle liquid fuels consumption since motor vehicles account for over half of total liquid fuels demand. Alternative fuel vehicles such as electric vehicles will be required to reduce liquid fuels demand at the required level. If true that a 90+ MMbbl/d world liquid fuels supply rate is not going to be realized by 2015, then alternative fuel vehicles need to be marketed at affordable prices as quickly as possible. Also, there needs to be a massive media campaign to build public awareness of the problem and the consequences if the warning is not heeded.

It is critical that the public becomes aware that the current problems are in no way similar to the world oil supply problems of the 1970s. In the 1970s, it was known that large undeveloped oil fields existed in the North Atlantic, Alaska, the Middle East, West Africa, the former Republics of the Soviet Union, and the South China Sea. This is not the case today.

The new oil field discovery rate is a small percentage of what it was in the 1970s. The oil field discoveries touted in recent years such as offshore Brazil and the Alaska National Wildlife Refuge (ANWR) are relatively small compared with the large oil fields brought into production in the 1970s. While there are large deposits of unconventional oil in oil sands and shale oil, these resources are difficult and expensive to bring into production at the multi-MMbbl/d scale and will not be able to supply the quantities of oil needed to replace declines in conventional oil production. There simply are no mega-large conventional oil fields left to find. Even if the Arctic Ocean should prove to hold massive oil reserves, they will not be able to be developed and brought to market in time.

The world liquid fuels supply-demand numbers do not come close to balancing in either the short- or long-term. It is extremely important that these facts are recognized and acknowledged by policy makers. The stakes are too great to not lift the veil of ignorance.

The world liquid fuels supply crunch is now a permanent reality and presents a challenge to the advanced developed nations. If the advanced developed nations do not have strategies to either reduce consumption through efficiency gains or shift to new forms of energy, then energy shortages are going to be a huge obstacle to economic growth in the developed world. Economic stagnation in developing countries will only exacerbate the economic problems in the advanced developed nations.

Attention is now turned to an analysis of U.S. liquid fuels supply and consumption.

B. U.S. Liquid Fuels Supply and Consumption

From 2008 to 2010, U.S. liquid fuels production increased 14% with the development of ultra-deep Gulf of Mexico oil fields, shale oil fields, and biofuel crops. The increase in U.S. liquid fuels production along with a reduction in consumption reduced net U.S. liquid fuels imports 15%.[2] Net U.S. liquid fuels imports as a percentage of consumption has declined from 57% in 2008 to 50% in 2010. U.S. liquid fuels totals for 2008-2010 are presented in Fig. 6.

From 2010 to 2020, U.S. liquid fuels production is forecast to increase 18%, which is presented in Figs. 7 and 8. If the U.S. can hold liquid fuels consumption constant at the 2010 level, then liquid fuels imports can be reduced 18% in 2020 compared with 2010. However, net U.S. liquid fuels imports are still 41% of consumption in 2020, which means that the U.S. remains exposed to world liquid fuel supply/demand dynamics and prices.

The U.S. will not be able to produce its way out of its liquid fuels import problem. This conclusion is based on a review of the liquid fuels sources for the EIA 2020 forecast, which are presented in Table 2, and an analysis of new sources of U.S. liquids fuels supply, which are listed in Table 3. While increasing production is important, the U.S. needs to focus on means to significantly reduce liquid fuels consumption if it wants to be free of world market effects.

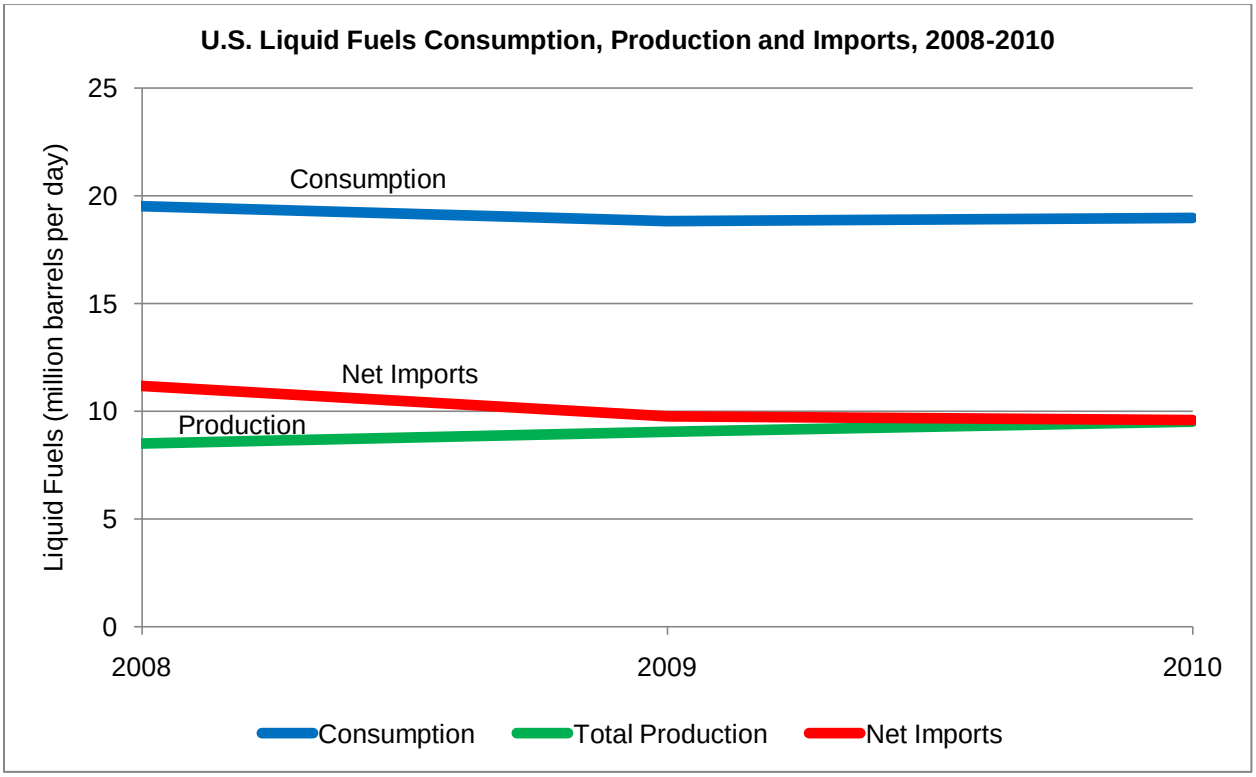

Figure 6. U.S. liquid fuels consumption and production, 2008-2010. Liquid fuels are light oil, extra-heavy oil, tar sands, shale oil, lease condensate, natural gas liquids, refinery gains, and biofuels. Source: EIA, Annual Energy Outlook 2011.

[2] The U.S. exports and imports liquid fuels, and the net balance is the difference.

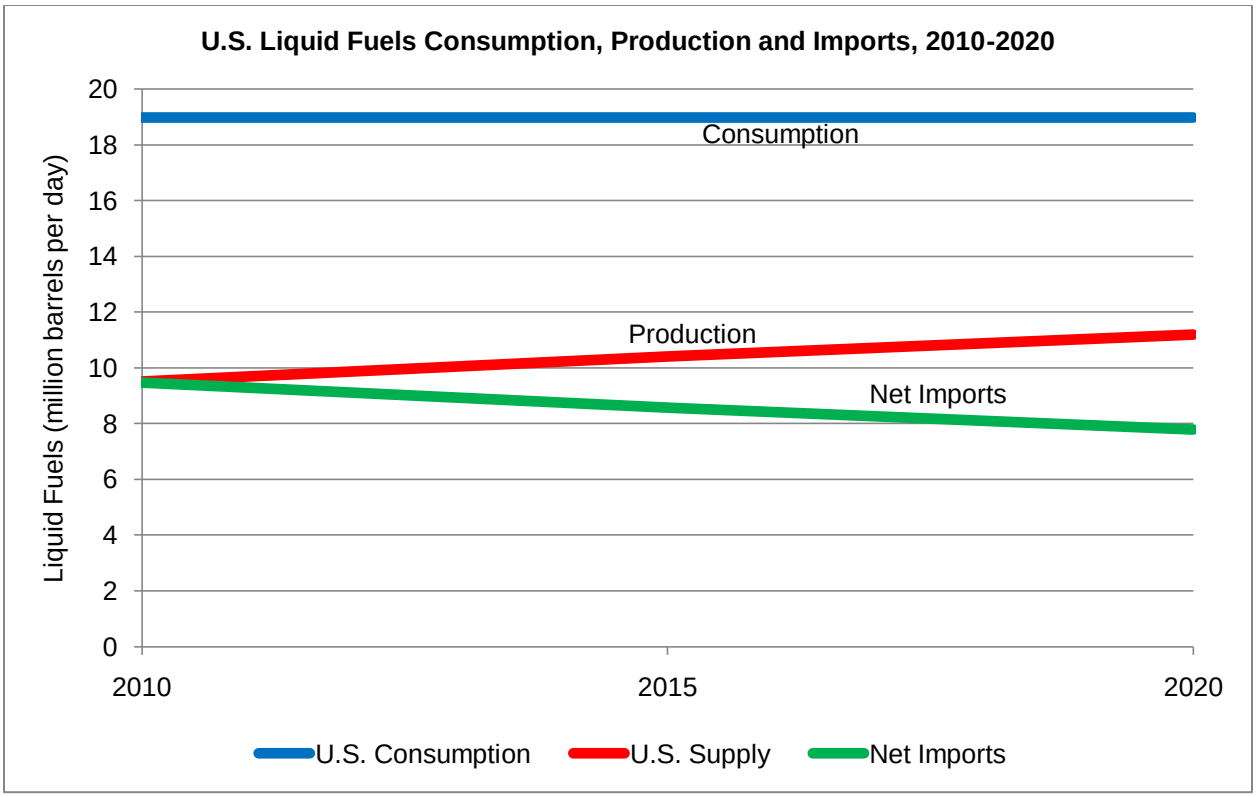

Figure 7. U.S. liquid fuels consumption, production and imports, 2010-2020 (EIA, AEO 2011).

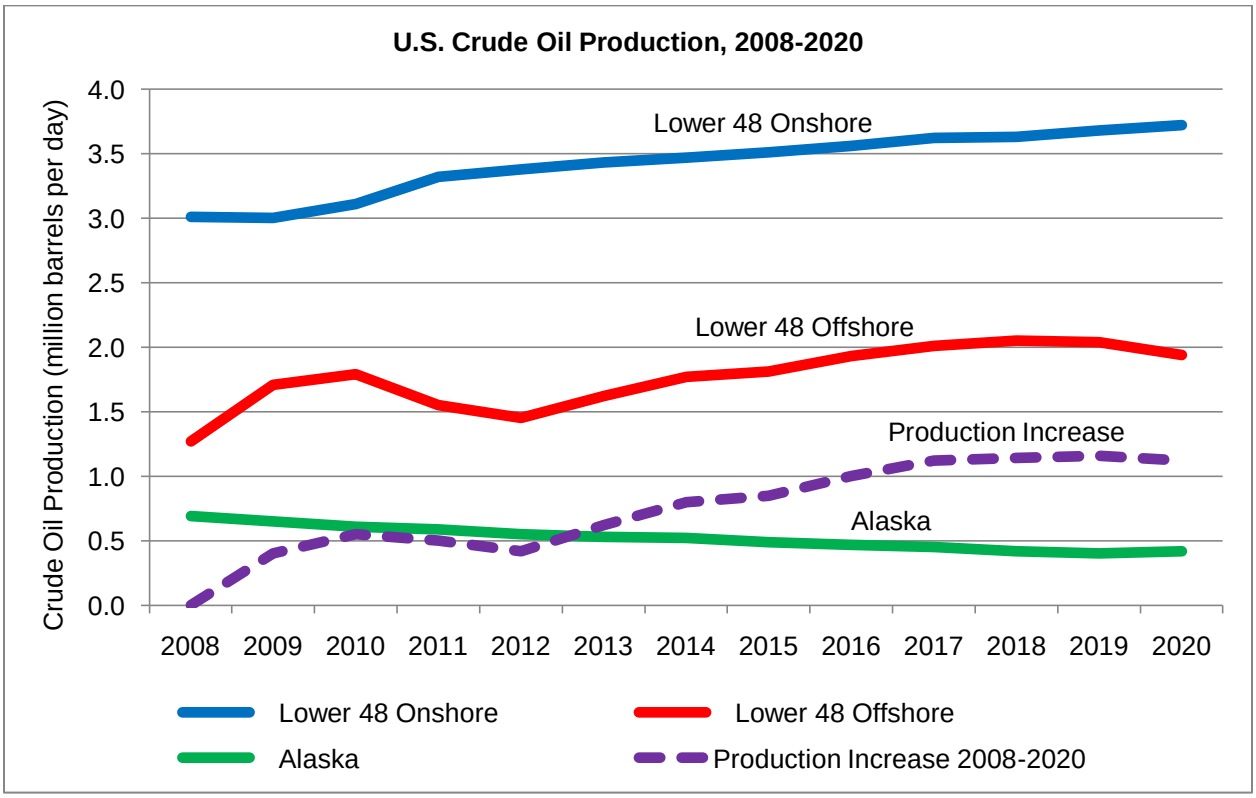

Figure 8. U.S. crude oil production, 2008-2020. Source: EIA, Annual Energy Outlook 2011.

Table 2. U.S. Liquid Fuels Production, 2010-2020 (million barrels per day) (EIA, AEO 2011).

	2010	2015	2020	+/- 2010-2020
Crude Oil Lower 48 Onshore[1]	3.1	3.5	3.7	0.6
Crude Oil Lower 48 Offshore[1]	1.8	1.8	1.9	0.2
Crude Oil Alaska[1]	0.6	0.5	0.4	-0.2
Natural Gas Liquids	2.0	2.2	2.4	0.4
Refinery Processing Gain[2]	1.0	1.0	1.0	0.0
Biofuels	0.9	1.1	1.4	0.5
Liquids from Gas	0.0	0.0	0.0	0.0
Liquids from Coal	0.0	0.1	0.1	0.1
Other[3]	0.1	0.3	0.3	0.2
Total	9.5	10.4	11.2	1.7

Notes:

1. Includes lease condensate and shale oil (Bakken, Marcellus, Eagle Ford, etc.).
2. The amount by which refinery output is greater than input due to additives for oil processing.
3. Includes domestic sources of other blending components, other hydrocarbons, and ethers.

Table 3. New Sources for U.S. Liquid Fuels Production (Million Barrels per Day).

	2011-2020	Post-2020
Onshore (Shale Oil)[a]	1.7	
Offshore[b]	0.5	0.2
.Alaska (North Slope)[c]	-0.2	1.5
Ethanol (Biomass)[d]	(0.4-1.0)	?
Biodiesel (Algae)[e]		?
Total	2.4-3.0	1.7

Notes:

a. Bakken shale oil production is expected to increase from 0.4 million barrels per day (MMbbl/d) in 2010 to 1.1 MMbbl/d in 2020. The Bakken 2020 oil production estimate of 1.1 MMbbl/d estimate is optimistic but conceivable. Another 0.9 MMbbl/d of shale oil is projected to be produced in other shale oil fields such as Eagle Ford in Texas, Marcellus in southwest Pennsylvania, and Niobrara in Colorado and Wyoming.

b. Offshore oil production is expected to peak at about 2.0 MMbl/d between 2015 and 2020, which is 0.5 MMbl/d greater than 2010. Oil production from the Eastern Gulf of Mexico and Pacific and Atlantic outer Continental shelves is expected to yield 0.2 MMbbl/d.

c. Alaska's oil production is expected to decline from 610,000 bbl/d in 2010 to 420,000 bbl/d in 2020. Half of 2020 production will be new North Slope oil production, but total production will still be 190,000 bbl/d less than in 2010. Oil production from the Alaska National Wildlife Reserve (ANWR) will not begin before 2020. While the ANWR field is large, it is about half the size of the Prudhoe Bay field, which produced about 1.5 MMbbl/d for ten years before going into decline in 1988. Alaska's North Slope is projected to produce at the rate of 1.5 MMbbl/d in the 2020's.

d. Ethanol production in 2010 was 13.2 billion gallons; the 2020 forecast is 18.4 billion gallons; and the U.S. goal of 36 billion gallons of ethanol, which accounts for the range in the Table.

e. Exxon reports that biodiesel production from algae oil will not occur before 2020.

From Tables 2 and 3, the U.S. has the ability to increase annual liquid fuels production by about 1.7 MMbbl/d from 2010 to 2020. This enables an 18% reduction in net liquid fuels imports by 2020. The net imports estimate is premised on U.S. liquid fuels consumption and the import-export balance remaining constant at the 2010 levels. The important conclusion is that the U.S. cannot increase liquid fuels production to free itself of dependence on liquid fuels imports.

In other words, the U.S. remains exposed to world liquid fuels supply/demand dynamics. As stated above, the world is facing a 3 MMbbl/d supply shortage by 2015. By 2020 the world supply/demand imbalance is likely to be even greater. The implication is that world economic growth will be stagnant until world liquid fuels supply is brought back into line with demand.

Since new sources of world liquid fuels supply are not sufficient to meet world demand, which is largely driven by automobiles, liquid fuels consumption will have to be reduced by utilizing alternative energy sources. Increasing vehicle fuel economy will not do the job since growth in the number of motor vehicles is coming from first time owners in developing nations. Reducing liquids fuel consumption is doubly important to the U.S. because of its need to reduce dependence on liquid fuels imports and to maintain world economic stability.

In the U.S., motor vehicles account for about 60% of liquid fuels consumption; refer to Table 4.

Table 4. U.S. Liquid Fuels Consumption by End-Use Sector, 2008-2010.

(million barrels per day)	2008	2009	2010	Change (2008-2010)
by Sector				
Residential and Commercial	1.06	1.04	1.00	-0.06
Industrial	4.69	4.25	4.37	-0.32
Transportation	13.87	13.61	13.74	-0.13
Electric Power	0.21	0.18	0.20	-0.01
Total	19.52	18.81	18.98	-0.55
Transportation Gains and Losses				
A. Commercial Transportation				
Commercial Light Trucks	0.32	0.30	0.30	-0.02
Freight Trucks	2.26	2.05	2.12	-0.13
Rail, Freight	0.27	0.24	0.25	-0.02
Shipping, Domestic	0.11	0.09	0.10	-0.01
Shipping, International	0.39	0.34	0.35	-0.05
Air	1.31	1.29	1.25	-0.06
Total Commercial	4.66	4.31	4.37	-0.29
B. Non-Commerce Transportation				
Light-Duty Vehicles	8.55	8.62	8.68	0.13
Recreational Boats	0.13	0.14	0.14	0.01
Military Use	0.34	0.36	0.37	0.03
Total Non-Commercial	9.03	9.12	9.19	0.16

Source: EIA, AEO 2011.

Light vehicles, commercial and non-commercial, consume the greatest quantity of liquid fuels. The heavy freight truck fleet is the second largest user of liquid fuels. These modes of transportation account for a little more than 11 MMbbl/d of liquid fuels consumption; light vehicles consume 9 MMbbl/d and heavy freight trucks consume 2.3 MMbbl/d. The question is how to provide an alternative fuel vehicle that will be acceptable to the mass public.

The following is a list of alternative fuel vehicles types, which need to have sufficient market penetration as soon as possible to achieve significant reductions in U.S. liquid fuels consumption:

1) Hybrid vehicles
2) Natural gas vehicles
3) Battery electric vehicles
4) Hydrogen fuel cell vehicles
5) Biofuel vehicles (biofuels are already accounted for in the Table 1 liquid fuel supplies)

Which of the above vehicle types can meet consumer preferences in terms of size, performance, and cost to achieve maximum market penetration, while at the same time reduce liquid fuels consumption at the needed rate?

To significantly reduce U.S. liquid fuels consumption over the next ten years, sales of alternative fuel vehicles will have to be in the neighborhood of ten million vehicles per year by 2020, which is about 65% of average annual U.S. light vehicle sales. It takes thirty million alternative fuel vehicles to reduce liquid fuels consumption one million barrels per day. To provide perspective to the scale of the challenge in making a timely transition to alternative fuel vehicles, U.S. hybrid vehicle sales in 2011 will be only about 225,000 vehicles or 2% of total light vehicle sales.

There is a need for aggressive federal government policies and for automobile manufacturers to market alternative fuel vehicles with the size, performance, and cost desired by consumers. In the early 1970's, the sales of fuel efficient cars rapidly altered the U.S. transportation landscape with the introduction of low cost vehicles such as the Toyota Corolla, Datsun 510, Honda Civic, and Volkswagen Rabbit. Also, in the 1970's there was massive media attention to the oil supply crisis and the national need to reduce gasoline consumption with fuel efficient cars.

Now to explore, the realm of change that can be expected under the best of circumstances, i.e., aggressive public policies, low cost alternative fuel vehicles, massive media coverage, and public acceptance. Two alternative vehicle scenarios are presented with both premised on the attainment of ten million vehicle sales by 2020. The two scenarios are:

1) hybrid vehicles with a 50% increase in average vehicle fuel economy, which reduces liquid fuels consumption 33%, and with annual new sales reaching one million units in 2014 and ten million units in 2020; and

2) electric vehicles, either battery electric or fuel cell electric with a 100% reduction in liquid fuels consumption and with annual new sales reaching one million units in 2018 and ten million units in 2024.

In 2025, the cumulative number of vehicles for the two scenarios is: 84 million hybrids, which is 38% of the light vehicle fleet; and 52 million electric vehicles, which is 22% of the light vehicle fleet. While the marketing timeline for electric vehicles lags four years behind hybrid vehicles, the electric vehicle scenario enables a much greater reduction in liquid fuels consumption. The annual vehicle sales and liquid fuels reduction totals for the two scenarios are presented in Fig. 9.

The liquid fuels reductions for the light vehicle fleet with the vehicle sales rates in Fig. 9 are:

- 0.05 MMbbl/d in 2015;
- 0.5 MMbbl/d in 2020;
- 1.1 MMbbl/d in 2025 for the hybrid vehicle path, and
  2.0 MMbbl/d in 2025 for the electric vehicle path.

The U.S. has delayed too long for changes in fuel consumption by the light vehicle fleet to have much of an impact on reducing liquid fuels consumption or imports before 2020.

Another option to reduce liquid fuels consumption is to use natural gas to power the heavy truck and bus fleets. If 50% of the heavy truck and bus fleets are converted to natural gas by 2020, then the reduction in liquid fuels is 1.2 MMbbl/d. The natural gas option will increase natural gas consumption in 2020 by about three trillion cubic feet, which needs to be evaluated.

In conclusion, transportation liquid fuels reduction potential is less than 0.5 MMbbl/d in 2015 and is at best about 1.5 MMbbl/d in 2020 if natural gas is used for heavy trucks and buses.

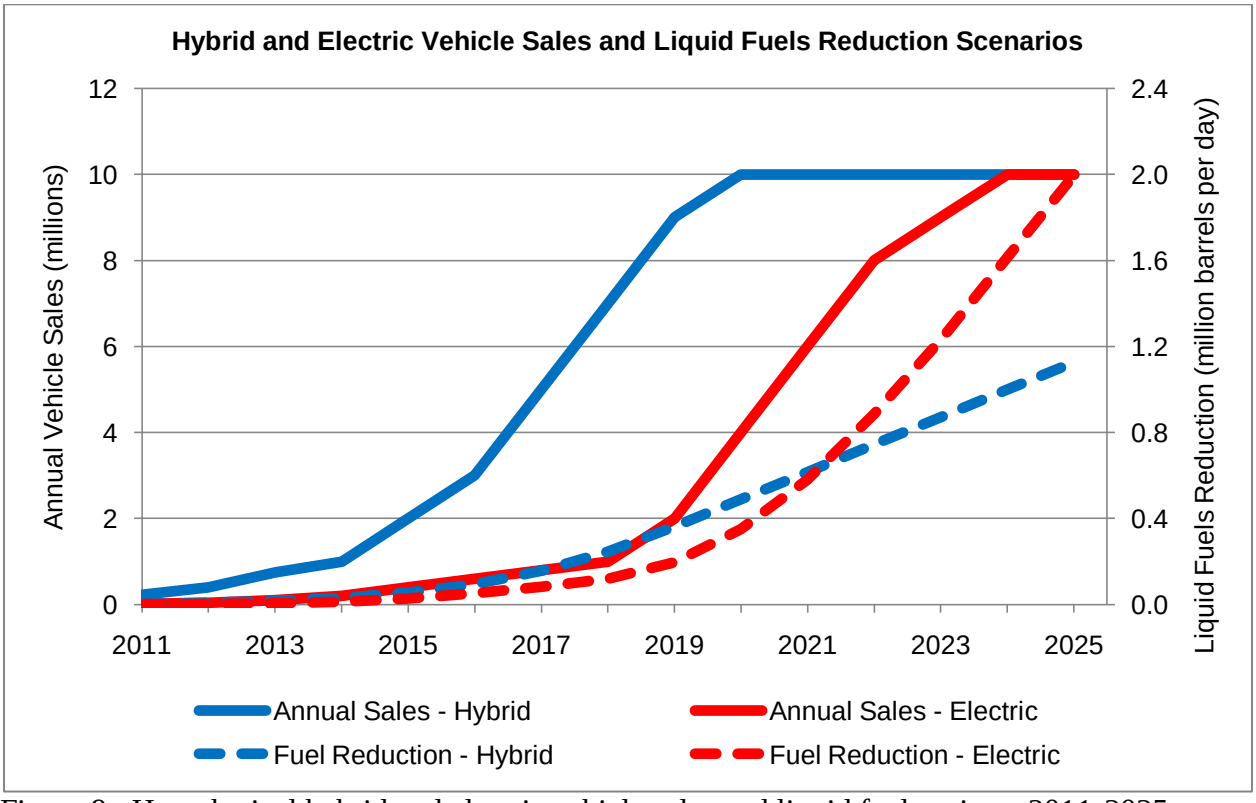

Figure 9. Hypothetical hybrid and electric vehicle sales and liquid fuel savings, 2011-2025.

The U.S. will be able to increase its liquid fuels production by about 20% over the next decade, and under the best of circumstances can reduce it liquid fuels consumption by about 10%. In 2020, even with a 30% reduction in liquid fuels imports, the U.S. is still dependent on liquid fuels imports. We have waited too long to deal with the problem and will have to bear the consequences for at least a decade before relief emerges.

Since world liquid fuel supply/demand dynamics do not appear promising post-2020 and since the U.S. has such a high stake in world economic stability, the U.S. has to find a way to wean itself from its addiction to liquid fuels for transportation. A sobering reality is that under the best of circumstances with average annual sales of ten million vehicles, it will take about twenty-five years for alternative fuel vehicles to reach 100% of the total U.S. light vehicle fleet. The question is how to make the transition to alternative fuel vehicles in any sort of timely fashion?

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