North American Energy Security

by Edward Glab

The boundaries of energy security are defined not by geography, but by technology, capital, access to resources, politics and regulation. Energy is a global commodity affected by global developments. To understand North American energy security, one needs to understand the global energy picture today, and how it is likely to evolve over the next three decades. What follows is a snapshot of where we stand today and where we are most likely to be in 2040. (1)

Today, oil, coal and gas supply approximately 80% of the world's energy. In 2040 global energy demand will be about 30% higher compared to 2010, and oil, gas and coal will continue to make up nearly 80% of energy consumption. Oil and gas will account for 60% and oil will remain the world's number one energy source largely because of a 70% growth in liquid petroleum demand outside the 34 countries of the Organization for Economic Cooperation and Development (OECD). In fact, OECD demand will be essentially flat out to 2040, but non-OECD demand will grow by close to 60%.

The number of personal vehicles in the world will double by 2040, and as early as 2030, the world will use more fuel for trucks and other heavy-duty vehicles than for all personal vehicles combined. Demand for aviation and marine fuels will also double over the next three decades. Therefore, in 2040 90% of global transportation will run on liquid based fuels, compared to 95% today.

Electricity generation will account for more than 40% of global energy consumption by 2040 and is the largest and fastest-growing source of global energy demand. Virtually all of this growth will come from non-OECD countries. Compared to 2010, worldwide electricity demand will be 80% higher in 2040, with industrial demand accounting for roughly 45%, residential 30% and commercial 20%. By 2040 Africa's residential/commercial energy demand is likely to be nearly equal to China's.

Coal usage will decline between today and 2040, dropping from 26% of global primary energy to 19%. This would be the first time coal usage will have declined since the

Industrial Revolution began over two hundred years ago. Coal's share of electrical generation will drop from 40% today to under 30% by 2040, replaced by gas and other clean and renewable sources of energy. These changes will be driven over concerns about the environment and CO2 emissions, as well as the abundance of cleaner burning alternatives such as natural gas.

Wind, solar and biofuels will see strong growth through 2040. Wind is expected to grow 8% annually, or 900% between 2010 and 2040. However, because all of these renewables start from such a low base, by 2040 they will still comprise only about 4% of global energy. Nuclear is expected to account for 8%, biomass and waste (wood and dung) 8%, and hydro and geothermal about 3%. The outlook for wind and solar could improve dramatically if new technology were to achieve a significant breakthrough in low-cost, large-scale storage of electricity.

According to the International Energy Agency (IEA), to meet energy demand through 2035 will require an average investment of $1.5 trillion per year, with about 50% of that related to oil and gas. Just as importantly, major gains in energy efficiency in all of the world's economies must be achieved to hold demand to a 30% increase by 2040. Without conservation and efficiencies, assumed in the global energy outlook, energy use could be four times as great, with a 90% energy demand increase in OECD countries and 250% in non-OECD countries.

This energy efficiency will be achieved in a number of ways. By 2040, it is expected that 50% of the world's personal vehicles will be hybrids. The use of diesel-fueled vehicles will grow, as will those powered by compressed natural gas (CNG) and plug-in electrics. New power plants will be more efficient, with two units of primary energy needed to generate one unit of electricity, instead of the three-to-one ration of today. It is also assumed that "line losses" in the transmission of electricity can or will be improved significantly. All of these predictions assume OECD carbon costs reaching $80 per ton by 2040, with non-OECD's reaching $20 and in China $30.

To meet this growing energy demand will require vast amounts of capital, technology and trained manpower. It will also require the development of vast, new energy resources around the globe. Contrary to "peak oil theory,"

global crude and condensate resources are estimated at nearly 5 trillion barrels. Two trillion will have been consumed by 2040, meaning 55% of the world's oil resources will remain to be produced beyond 2040. A huge portion of these global resources are to be found in the Western Hemisphere.

There is a Western Hemisphere energy boom under way, from Canada to Argentina. The Western Hemisphere in general and North America in particular possess vast amounts of both oil and gas. All three countries of North America, Canada, the United States and Mexico hold impressive resources of oil and natural gas which could form the foundation for strengthening North American energy security.

Canada has the second biggest reserves of oil in the world, after Saudi Arabia, most of which is found in the rich oil sands of Alberta province, according to a recently updated estimate by the U.S. Energy Information Agency. Alberta is almost as big as Texas and the oil sands cover an area nearly as big as Florida. According to the most recent estimates, Canada has reserves of 180 billion barrels of oil, 175 billion of which are oil sands. Oil sands are processed into a heavy crude, similar to other heavy crudes found in the Western Hemisphere. In recent years higher oil prices and new technology have enabled them to be profitably extracted and upgraded to usable products. Currently, Canada is the largest supplier of crude oil and petroleum products to the U.S. with about 2.5 million barrels per day exported to the U.S. in 2010.

In 2010, Canada's total oil production was about 2.8 million barrels per day, of which around 1.5 million were from oil sands. By 2025 it is estimated Canada will be producing nearly 4.7 million barrels per day of oil, 3.7 million of which will come from oil sands, according to the Canadian Association of Petroleum Producers (CAPP).

By importing more oil from Canada, the U.S. strengthens its national security by building on a very strong and equitable trading partnership with one of the America's oldest and most reliable allies in the world, while at the same time, lessening U.S. dependence on oil from places such as the Middle East and Venezuela. It is in the economic and security interests of the U.S. to continue to expand its trade relationship in energy with Canada. For every dollar in goods and services the U.S. buys from its

northern neighbor, Canada buys back ninety cents. Oil exporting nations in the Middle East buy back less than one-third of that amount.

Approval of the Keystone XL pipeline project could potentially increase oil imports from Canada to the U.S. by over 800 thousand barrels per day. Those additional barrels are approximately equal to current U.S. imports from Venezuela, or the combined total from Algeria, Iraq, Kuwait, UAE and Russian. Finding more secure sources of supply outside of unfriendly and unstable regions, while further cementing a strong and equitable trading relationship with Canada, would represent a solid step in building North American energy security.

The United States has one of the biggest, technically recoverable oil and natural gas resources in the world, according to a report by the Congressional Research Service. (2) Including recent shale gas discoveries, the U.S. combined oil and gas resources are estimated to be about 377 billion barrels of oil equivalent (BOE). To put that in perspective, Saudi Arabia's oil and gas resources are estimated at 311 billion BOE. According to the Bureau of Ocean Energy Management, Regulation and Enforcement, offshore the U.S. possesses over 100 billion barrels of oil and 480 trillion cubic feet of gas. (3) Onshore, according to the Bureau of Land Management, about 33 states have an estimated 88.6 billion barrels of oil and 654 trillion cubic feet of natural gas. (4)

The U.S. is currently the third biggest oil producer in the world, behind only Saudi Arabia and Russia, with 5.4 million barrels per day last year. U.S. oil and liquids production has also been rising in the past few years, and in 2011 reached nearly 8.85 million barrels per day. In fact, as has been widely reported in the press, in 2011 the U.S. became a net exporter of petroleum products for the first time since 1949. The value of those exports of gasoline, diesel and jet fuel was $88 billion, making fuel products the single biggest U.S. export in 2011.

The U.S. Energy Information Agency predicts the U.S. will be producing over 6 million barrels per day of oil by 2020. This is consistent with a recent report from the Cambridge Energy Research Associates organization, (5) in which they say U.S. production of oil and related liquids grew by 1.3 million barrels per day from 2008-2011. That put total U.S.

oil and liquids production at 8.9 million barrels per day in 2011. The same report said production could reach 10.2 million barrels per day by 2020.

What do these enormous resources and growing production in both the U.S. and Canada portend for North American energy security? According to a study done by the American Petroleum Institute (API), with policies and a regulatory regime that strongly encourage the development of the oil and gas resources of the U.S., both onshore and offshore, Canada and the United States together could supply 100 percent of U.S. liquid fuel needs by 2030 and become a major energy exporter, particularly of natural gas. (6)

Mexico is the third part of North American energy security. In 2005 the U.S., Canada and Mexico announced the North American Security and Prosperity Partnership (SPP). The energy goal of the partnership was to maintain both Mexico and Canada as reliable suppliers of oil and gas to the U.S. Mexico has been a supplier of energy to the United States for close to a century and will likely continue to be given the mutual economic and security benefits of the relationship. The U.S. Energy Information Agency reported that in 2010 Mexico and Canada together accounted for 33% of U.S. oil imports. Mexico's oil production in 2010 was 2.88 million barrels per day, of which 1.22 million per day were exported to the United States, also as reported by the EIA.

Mexico's national oil company, Pemex, is also a 50% partner in a 340kbd capacity refinery located in Deer Park, just outside Houston. About 250kbd per day of Mexican crude oil is refined there, with a substantial portion of the refined products exported back to Mexico. In fact, a recent *Wall Street Journal* article pointed out that Mexico imports 60% of its gasoline from the U.S. This is a mutually beneficial relationship between Mexico and the United States that contributes to North American energy security. Mexico exports most of its oil production to the U.S. and the U.S. exports finished products back to Mexico because of that country's lack of refining capacity.

Unfortunately, a long legacy of oil nationalism dating back to 1938 negatively affected Mexico's ability to maintain its oil production, which continues to decline due to a lack of investment and technology. The country's biggest oil field, Cantarell, was the world's third largest when

discovered in 1970, but is being rapidly depleted. Mexican oil production and exports peaked in 2004 and have continued to decline since then. Poor management of Pemex, coupled with corruption, feather-bedding and the syphoning off by Mexico's central government of most of Pemex's revenue, leaves the national oil company without the resources to further explore and increase production. Coupled with an oil nationalism that prevents foreign investment in exploration and production, Mexico's future as an important oil producer and exporter is in doubt. Overall, if Mexico's production continues to decline, the country could become a net importer before the end of this decade. This could have serious implications for North American energy security.

In spite of the above, Mexico could still continue to play an important role in sustaining North American energy security because the country's deep-water resources are potentially world class and remain largely unexplored. Mexico has the potential to reverse its declining energy output if it can find a way to reform its policy toward foreign investment in exploration and production of oil and gas. An important step in this direction was taken in February 2012 when Mexico and the U.S. signed a trans-boundary maritime agreement that will provide access to as much as 172 million barrels of oil and 304 billion cubic feet of gas. Significantly, the agreement sets up a framework for Pemex and U.S. oil and gas companies to explore for oil and gas in areas previously off-limits, and could open the door to greater U.S. Mexican cooperation in Mexican deep-water resources.

Based upon the above overview, what steps must be taken to strengthen North American energy security? First, because of the overwhelmingly dominant role of fossil fuels in the global energy mix today and decades into the future, the key element for North American energy security must be to continue the aggressive pursuit of new discoveries and production to satisfy the growing global demand for both oil and gas. In the United States this would mean opening up much more of the federal onshore and offshore areas to exploration. Today, 85% of the offshore acreage of the United States is off-limits, as is 60% of the onshore acreage. Leasing and permitting processes should be accelerated and the regulatory regime should be transparent and designed to facilitate the production of more energy, not to impede it. The Keystone XL pipeline should also be

approved, bringing close to an additional one million barrels daily of Canadian oil to the United States, thereby making the U.S. less dependent on Venezuela and the Middle East.

The second step to enhance North American energy security should be the goal of replacing as much coal and oil as possible with natural gas. In a world where lowering carbon emissions and developing renewable clean energy technologies are nearly every country's stated energy goals, gas produces far fewer emissions than either coal or oil. In addition, new gas discoveries in the U.S. and new technologies to find and produce shale gas mean gas will replace coal as the second most important primary source of energy in the U.S., as well as become an important U.S. export. As pointed out earlier, in 2011 the major export of the U.S. was oil liquids, much of which are gathered during gas production. The reserves of gas in the United States and throughout the Western Hemisphere, and much of the rest of the world for that matter, are enormous and likely to be sufficient to meet demand for much of the 21st Century.

The third step in enhancing North American energy security is conservation and greater efficiency in the use of all forms of energy. The American Council for an Energy Efficient Economy (ACEEE) is a nonprofit organization dedicated to advancing energy efficiency as a means of promoting economic prosperity, energy security, and environmental protection. Their studies show that energy consumption, per dollar of economic output, is today less than one-half of what it was in 1970 because virtually every energy consuming activity and device we use today is more efficient than they were in 1970.

This is dramatically illustrated in refining activity and recycling. In 1970 there were over 300 refineries in the United States. In 2011 there were 137 operating refineries producing enough product to meet U.S. demand and reach record levels of exports. (8) In recycling aluminum, 95% of the energy required to turn bauxite ore into aluminum is saved. The EPA estimates that recycling one ton of aluminum saves the equivalent of almost 32 barrels of oil, significantly reducing the carbon footprint of the manufacturing process and a savings of many millions of barrels of oil every year.

It has become a truism that the cheapest and cleanest form of energy is that which we don't use. As the world's biggest supplier of energy, the fossil fuels industries must demonstrate an unswerving commitment to reducing consumption, as well as using the energy it consumes with greater efficiency. Energy intensive industries such as aluminum and other manufacturers must do the same, and utility companies can also do a lot more to improve the efficiency of their electrical generating facilities and power losses during transmission. The transportation industries globally must focus on producing energy efficient autos, trucks and other modes of transportation.

Finally, although fossil fuels are predicted to continue to dominate the global energy scene through mid-century, alternative fuels will grow increasingly important over the coming decades. Technology breakthroughs could also accelerate the pace of development in alternative fuels, displacing far more fossil fuel than currently thought possible. Nonetheless, most global energy outlooks predict that wind, solar and bio-fuels combined will still supply less than 5% of global energy demand by 2040, making essential the need to produce more oil and gas in North America as cleaner alternatives race to catch up with fossil fuels as the primary source of energy.

As the above examples illustrate, the enormity of the challenge to reduce emissions to address climate change and global warming while supplying humanity's future energy needs in a growing global economy is hard to exaggerate. While there are abundant fossil fuels in the world that could conceivably last until the end of the 21st Century, at some point they will be exhausted. The investment, research and development needed to find clean-burning renewable fuels must be strongly encouraged through government policy, including everything from taxes to regulatory policies.

When one looks at the outlook for continued dependence on fossil fuels and meager penetration by clean renewables in 2040, the challenges of finding alternative, clean burning energy sources to address global warming appear daunting. However, it is by no means impossible.

Five hundred years ago most humans thought the world was flat and sailing beyond the horizon one might fall off the end of the earth. Much to their surprise, they discovered a

new world. What new energy worlds are we going to find by the end of this century, as we rapidly approach the horizon marking the end of the "age of oil?" Once again, new energy realities await us just beyond the horizon, just as new technologies replaced old ones in the 20th Century. Those in the energy industry who do not understand this will likely become quaint relics in a museum, instead of the engines of a new energy age. Rapid change has been the rule for the past century, not the exception. It will continue to be so as we move inexorably through the 21st Century toward a sustainably renewable, low-carbon and clean-energy future.

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1) Most of this information has been distilled from "2012 The Outlook for Energy: A View to 2040," published in January 2012 by ExxonMobil. Other sources of energy data and future projections I have used for reference do not differ significantly from the ExxonMobil Outlook. For a comparison of the data, go to the Paris based International Energy Agency's (EIA) "World Energy Outlook," and the U.S. Energy Information Agency, (EIA) and Department of Energy (DOE) energy information websites, as well as the websites of other major international energy companies such as Shell, BP and Chevron.

2) Congressional Research Service, "U.S. Fossil Fuel Resources" (R40872), November 30, 2010, Table 5, "Total Fossil Fuel Reserves of Selected Nations," and Table 6, "Reserves of Fossil Fuels Plus Technically Recoverable Undiscovered Oil and Natural Gas." Available at: http://epw.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore_id=04212e22-c1b3-41f2-b0ba-oda5eaead952.

3) Bureau of Ocean Energy Management, Regulation and Enforcement (formerly Mineral Management Service, Offshore Minerals Management Program), "Report to Congress Comprehensive Inventory of U.S. OCS Oil and Natural Gas Resources Energy Policy Act of 2005 – Section 357," February, 2009 Table 1 (a): Total Endowment of Total Recoverable Oil and Gas of the OCS, 2006." Available at: http://boemre.gov/revaldiv/PDFs/InventoryRTC/pdf.

4) Bureau of Land Management, "Inventory of Onshore Federal Oil and Gas Resources and Restrictions to Their Development," May 21, 2008. Available at: http://blm.gov/wo/st/en/prog/energy/oil_and_gas/EPCA_III.html

5) (http://www.ihs.com/products/cera/index.aspx)

6) API calculations based on EIA data and WoodMacKenzie, “U.S. Supply Forecast and Potential Jobs and Economic Impacts (2012-2030),” September 7, 2011.)
7) ACEEE website: http://www.aceee.org/.
8) U.S. Energy Information Agency: http://205.254.135.24/dnav/pet/pet_pnp_cap1_dcu_nus_a.htm).