

Mike Doyle is the President of the CAGC – the Canadian Association of Geophysical Contractors - representing the business interests of the seismic industry within Canada. The CAGC website may be found at www.cagc.ca.

In December 2013 I attended an evening at the Bon Mot Book Club in Calgary featuring author George Friedman and his book *The Next 100 Years*. I think it is safe to say the farther out you try to predict the more likely you are wrong however the author's structure of modern history was very interesting. A couple of conclusions that I found interesting which he made were as follows: 1) In order to control the globe and/or be a superpower you must control the oceans; 2) China is split geographically with coastal areas being quite affluent and inner-land areas being quite poor. The only thing that has kept the country from civil war is the unbelievable growth curve. This will not be sustainable. Look for civil unrest to follow; 3) Russia is always concerned about the countries that border it to the west and the south in terms of maintaining distance from Europe and Turkey; 4) US Foreign policy is not to necessarily win wars but to create general instability in areas where it enters.

The book was written in 2009 and a number of his points are becoming more and more salient as Russia moves into the Crimean area of Ukraine. US Air force bases will close in July 2014 in Kyrgyzstan as the country has voted to not renew the agreement. Obama has been quite passive as far as anything to do with military during his tenure.

As it is Spring of a new year, it looks to be an interesting year ahead with geopolitics and the continuing dichotomy of the energy world we live in. Graham Campbell, has recently headed up the Energy Council of Canada. He gave a keynote address to the International Relations Society at the University of Toronto in January 2014. As part of the address he identified ten salient points on current and future energy features and trends, goals and strategies for sustainable energy. This portion of the talk follows. It is well worth the read.

Graham Campbell
Energy Council of Canada
Energy Features and Trends,
Goals and Strategies for Sustainable Energy
Keynote Address
Fueling the Future: The Role of Energy in International Relations
2014 Annual Conference
International Relations Society, University of Toronto
January 25, 2014

1. Projections Say That Energy Demand Will Continue To Grow– Energy is one of the key factors supporting ongoing growth of the economy. We enjoy more and more energy services - better lifestyles, more sophisticated products, bigger vehicles, and more electronic gadgets. Growth in energy demand is the inevitable consequence.

For example, the World Energy Council has projected that global energy demand will grow by between 27% and 61% by 2050. Why the wide range? Well, the lower projection arises from the "Symphony" scenario. It focuses on achieving environmental sustainability through internationally coordinated policies and practices. The 61% growth projection, called the "Jazz" scenario, focuses on energy equity with priority given to achieving individual access and affordability of energy through economic growth.

2. Most Growth Will Happen In China and India – This well-known trend has been apparent for a decade, but it is becoming even more pronounced.

The picture is even more dramatic as depicted by the International Energy Agency. Demand in China and India will more than double by 2030.

The International Energy Agency's projections of global demand growth, as published recently in the 2013 World Energy Outlook, make this point even more dramatically. From 2012 to 2035, 65% of the growth in demand will be in non-OECD (Organisation for Economic Co-operation and Development) Asia, the next largest share is 10% for the Middle East, 8% for Africa, 8% for Latin America. The demand growth from now to 2015 is only 4% for all 28 OECD countries taken together!

3. Fundamentally Different Supply Dynamics Are Happening – Think back no more than five years to the widespread dialogue, and anxiety, about 'peak oil'. According to that picture, we had just passed the all-time high in oil production. We looked forward, with much concern, to a steady decline in global oil production from then on. Much hand wringing prevailed, although every geologist and exploration manager knew that the resource endowment picture was not like that at all.

Geologists do not think of resources not as a fixed quantity, like a precise number of marbles in a jar. Rather they think of resources as being found in a continuum from cheap, easily recoverable resources, to greater quantities which are more difficult and costly to find and produce.

Conceptually think of a 'resource triangle'. The easily recoverable reserves have been produced. But technologies developed and used decades earlier to win production from tight reservoirs have been refined and applied to reservoirs previously believed to be uneconomic.

How quickly the supply scene has changed as a result of tapping into a new part of the resource base. The statistics are startling. As reported last week at a conference in Washington, natural gas production is expected to grow by 7.3 Bcf per day in the eight years between 2012 and 2020, compared to a growth in production of 7.3 Bcf per day over the 25 years from 1987 to 2012. The drilling time for a gas production well today is less than 7 days with a horizontal reach of 4500 feet, compared to 17.6 days and a reach of 2000 feet a few years ago. As expected, the new supply has caused a dramatic and sustained fall in market prices for natural gas.

Similar aggressive upward trends are seen for oil production from shale reservoirs.

As a result, the perception has changed from supply shortage to supply abundance due to aggressive application of new extraction technologies to a previously untapped component of gas and oil resources. As we shall see in a moment, this dramatically changed supply picture has equally dramatic implications for geopolitics as well.

Of course, these supply cost decreases are not just for fossil fuels. We have witnessed comparable changes in trends in cost reduction for solar PV cells. According to the Solar Energy Industries Association, costs per watt for solar PV cells in 2013 have dropped to one third of the costs seen 12 years ago.

4. Fuel Shares Will Change – But Fossil Energy Remains Dominant

With all the expectations for generating electricity from renewable energy resources, projections by well-respected researchers all point to the same conclusion – fossil fuels will continue to be the mainstay for meeting global energy demand for the foreseeable future.

The International Energy Agencies projects this in their forecast out to 2030. Total demand grows by 50% Mtoe (million tonnes of oil equivalent) over this period, and natural gas and coal show the most aggressive growth in this 2005 projection.

The IEA's 2013 World Energy Outlook, which has captured the latest changes in the supply picture, compares the growth in components of total primary energy demand from 2011 to 2035. The growth in the use of fossil resources natural gas and coal dominate this picture. 58% of the demand growth will be met by fossil fuels, with 32% from natural gas, reflecting the shale gas revolution. Over 30% comes from renewables, reflecting the growth in the use of wind technology and solar PV. This is an encouraging pace of growth for renewables from 2011 to 2035.

But our thinking about international energy supply can remain based on continued use of fossil fuels for some time to come.

5. Energy's Negative Impacts Are Increasing

Matched to the ongoing use of fossil fuels are the trends in environmental impacts from energy-related activities. Unfortunately, the environmental impacts are worsening. Of course, this view is based on the assumed continued use of conventional technologies – for example, coal-fired power plants without carbon capture and storage, and conventional vehicles powered by fossil fuels. This conventional approach, coupled with the combination of growing demand for energy services, the projections for continued reliance on fossil fuels, and the lack of effective regulations and practical technologies to control the environmental impacts, suggests that the negative impacts will continue to grow.

Most of the growth comes from developing countries. For instance, absent widespread use of new capture technologies within fossil-fuelled electricity plants, the pattern of growth of emissions matches the growth in energy demand.

The International Energy Agency has published an interesting way to look at the gradually increasing level of CO₂ concentration in the atmosphere in three time slices. If we look back to the start of the industrial revolution to 2011 and add up all emissions that have been put into the atmosphere since then, we are 56% of our way to the CO₂ concentration level that is expected to produce a +2 C in global temperatures. Projections of emissions levels from 2012 to 3035 add another 39% to the concentrations to produce

+ 2 C. It is clear that we don't have far to go after 2035 to reach the threshold concentration limit.

In addition to GHG emissions, energy activities are responsible for other significant environmental impacts – fresh water consumption, land-use impacts, and a variety of other environmental emissions such as mercury and particulate emissions from coal-fired power plants. On a positive note, technologies and operating practices are being implemented now by the leading companies in industry to reduce and remediate such impacts.

6. Global Attempts To Tackle Environmental Issues Have Failed

This part of the story has both negative and positive dimensions.

First, on the negative side of the equation, the failure of international agreements to bring global focus on real solutions only makes matters worse. The underlying causes include the tendency for countries to be concerned about their competitive attractiveness rather than implement GHG policies which could potentially damage their economic performance. Also, countries which are projected to make the largest contributions to future environmental impacts have not, prior to 2009, been parties to the agreements.

The 2009 Copenhagen Accord, the most recent international mutual target-setting agreement, was based on the strategic goal of limiting the increase in global temperatures to + 2 C. 114 countries signed on, representing 80% of global emissions.

For Canada and the United States, the target was set at 17 % below 2005 levels by the year 2020.

On the positive side of the GHG picture, for some countries the amount of GHG emissions has been declining gently for the last five years. This is due partially to the downturn in economic activity starting with the 2008 recession, and also to economic restructuring. But energy policies are also having an effect. Examples are the impact of fuel efficiency standards for vehicles and energy efficiency improvements in buildings and industry.

For Canada, the recent trends are also heading in the right direction. Another positive development is the steady decline in emissions intensity. This is great news, particularly since the downward trend has been maintained over four decades.

7. Energy Infrastructure Is Aging

For many countries, a significant fraction of their facilities for power generation and power transmission were constructed in the decades following World War II.

Power plants have a useful life of something like 40 to 50 years, although refurbishments towards the end of the plant's life cycle can extend the expected lifetime by one to two decades.

For example, the graph shows the "Projected Decommissioning of Coal-fired Power

Plants in Canada'' assuming a 40-year lifetime. Roughly 50% of Canada's capacity, or 8000 MW, will be decommissioned by 2015 and over 16,000 MW by 2030. Although the country-specific details will differ, this pattern of upcoming retirements is similar for much of the energy infrastructure in place today.

A similar situation of aging infrastructure prevails for the major gas pipelines which span the continent. Installation of TransCanada's main line from Alberta to Ontario was started over 50 years ago. Loops have been added since then to increase capacity. And replacements are done regularly of the most vulnerable sections in a carefully planned program.

What does this mean for international energy? One answer is that significant capital requirements to replace aging infrastructure will be needed across the globe just to maintain the same level of energy supply. This reinvestment provides an opportunity to deploy the latest clean energy technologies and novel approaches to electricity generation. However, this opportunity will only be realized if companies invest in new technological solutions and new approaches.

8. Many New Technologies Are Emerging

Carbon capture and storage, electrified transportation, advanced distribution grids, second and third generation biofuels, and advanced reactor designs have emerged from research and development programs. These promising technology solutions are the verge of being commercialized. Such new technologies offer the potential to reduce emissions, use energy more wisely, and stimulate investment in new ways of doing energy across the globe.

Grid-scale electricity storage is an important missing piece in modern energy systems. Although practical examples of successful storage technologies are in operation today, such as pumped storage for hydroelectric systems as at Niagara, there is an acute need for large-capacity and cost effective storage technologies for use in regional and LDC (Local (Electrical) Distribution Companies in Ontario) networks.

9. Many Social Impacts Related To Energy

Here again there are both positive and a negative social impacts of energy supply, transportation, and end-use.

Energy activities support economic growth, contribute significantly to the international balance of trade for energy exporting countries, and create much-needed jobs, often in areas where there is little other economic activity. The revenues and taxes from energy activities help pay for public services such as health care and education.

But at this point in global development, the benefits are not widely distributed.

Looking globally, one in six people, totaling 1.2 billion of the world's 7.2 billion people do not have access to electricity for their homes. This results in little opportunity for reading or study at night, limitations on family life and higher public safety risks. Further, 2.8 billion do not have clean cooking facilities. Clearly, there are significant social issues associated with today's

global energy picture.

10. Geopolitics and Energy

There are many emerging examples of the interplay between energy developments and geopolitics. One example is the implication of potential increased LNG exports from the United States to Europe. A recent estimate of LNG exports is 4 Bcf per day to 8 Bcf per day by 2020 from the increased US supply from shale gas production. The impact of this new supply on the European natural gas market could be lower prices for natural gas in Europe, even though European gas prices are significantly higher than current prices in North America. The International Energy Agency has projected that increased global gas supply from shale gas reservoirs will lower international gas prices. For the European market, prices could decrease from levels which are close to three times higher than prices in the US in 2012 to levels just two times higher than US prices by 2035.

Let me illustrate this point about the geopolitical implications of increased natural gas supply in the United States. The Centre for Strategic and International Studies in Washington published a short article in July 2013 on *The Shifting Geopolitics of Natural Gas*. The article starts by pointing out that shale gas production has surged from 1.3 Tcf per year to 8.5 Tcf per year between 2007 to 2012, making up 35 per cent of total U.S. gas production. The share from shale gas is expected to rise to close to 50% by 2030. The CSIS article observes that “... *the unconventional gas revolution is already influencing geostrategic energy dynamics in important ways.*”

First, as noted above, the current supply picture suggests that the U.S. is not going to need imported LNG. This frees up global LNG supplies for other markets and it is already resulting in a reduction in natural gas imports from Canada. This means that countries that had previously been dependent on pipelined gas supplies will now have additional supply options and additional leverage when they re-negotiate long-term supply contracts.

Second, new shale gas technologies have opened up gas supply opportunities for countries with unexploited shale gas resources. The opportunity to develop a new domestic source of supply also opens up new questions – the environmental impacts of shale gas drilling and production, implications for use of water, and likely the need to develop new infrastructure to bring gas to market. These can be tough questions to resolve, possibly with the additional challenge of negative public opinion.

The third point is in balance a sense the corollary of the previous point. For countries which were counting on gas supply and revenues from gas production projects, the advent of abundant U.S. supply could have an impact on their investment plans and revenue projections. Quoting from the CSIS paper “*For regions of the world whose development depends on investment and government income generated by natural resource production, this re-evaluation of project competitiveness may have significant consequences for domestic policy and economic reform.*”

And fourth, the recent shale gas technology breakthrough has resulted in a significant change in perceptions about the long-term availability of oil and gas resources. As noted earlier, rather than earlier anxious statements about “peak oil”, shortages in the near

future, and rising prices, the tone has shifted to a more optimistic message about availability of resources in the long term. As the CSIS article points out, *“Instead of asking if the world will run out of oil and gas, many people are starting to wonder what other frontier resources we will be able to access as technology progresses”*.

As we struggle to find balance in an uncertain world the only thing for certain is that change will continue. Competing priorities rarely allow for balance and often the unintended consequences have greater ramifications than the intended consequences.

From the Thursday Files

The farther reason looks the greater is the haze in which it loses itself.

Johann Georg Hamann