

The changing face of global energy – Is nuclear power being left behind?

I have just done my first pass of the World Energy Outlook 2012 issued by the IEA this November. Many of you will have seen some of the headlines – one of the most intriguing is that the US is expected to become the world's largest oil producer by 2017 exceeding the output of Saudi Arabia. With headlines like that how can you not want to read this report?

The trouble with trying to read and write about this report is that, as was the case with the Energy Technology Perspectives (which I talked about earlier this year), there is just so much in it to make you think that, agree or disagree, the report is full of interesting information that is worth discussing.

I have been a bit stuck on what perspective to take in this post. Ultimately I decided to focus on some general points this month (of course with the outlook on nuclear as the key talking point) and then I will undoubtedly use the report for future discussions on more focused topics.

Reading the Executive Summary the report starts off with ***“The global energy map is changing, with potentially far-reaching consequences for energy markets and trade. It is being redrawn by the resurgence in oil and gas production in the United States and could be further reshaped by a retreat from nuclear power in some countries, continued rapid growth in the use of wind and solar technologies and by the global spread of unconventional gas production.”***

When it comes to global energy production, this short phrase pretty much sums it up. Strong North American oil production, more coal, less nuclear, more renewables and much more gas.

And not surprisingly, this translates into more difficulty meeting climate change objectives. It continues, *"Taking all new developments and policies into account, the world is still failing to put the global energy system onto a more sustainable path. Successive editions of this report have shown that the climate goal of limiting warming to 2 °C is becoming more difficult and more costly with each year that passes. Our 450 Scenario examines the actions necessary to achieve this goal and finds that almost four-fifths of the CO2 emissions allowable by 2035 are already locked-in by existing power plants, factories, buildings, etc. If action to reduce CO2 emissions is not taken before 2017, all the allowable CO2 emissions would be locked-in by energy infrastructure existing at that time."* Another testament to the continuing lack of progress on meeting the world's climate change challenges.

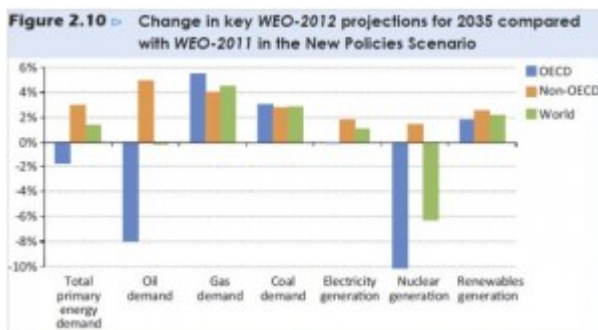
And finally when it comes to the future of nuclear power it recognizes the changes in some countries to cut back while others continue to move forward.

"The anticipated role of nuclear power has been scaled back as countries have reviewed policies in the wake of the 2011 accident at the Fukushima Daiichi nuclear power station. Japan and France have recently joined the countries with intentions to reduce their use of nuclear power, while its competitiveness in the United States and Canada is being challenged by relatively cheap natural gas. Our projections for growth in installed nuclear capacity are lower than in last year's Outlook and, while nuclear output still grows in absolute terms (driven by expanded generation in China, Korea, India and Russia), its share in the global electricity mix falls slightly over time."

I am showing all of the above quotes because in a few words from the Executive Summary, the report says so much. The figure below shows the key changes in projected energy use from the 2011 WE0. In summary, as I read this report we can conclude that:

- Fossil fuel use is thriving. Clearly North American policies to increase both oil and gas production are very effective. Coal use is up again globally from the last WEO even with a larger increase in (mostly unconventional) gas use. Fossil fuel subsidies continue to be the largest of any energy source estimated at \$523 billion, more than 6 times that for renewables and a 30% increase from 2010.
- Renewables use continues to grow without any real demonstration that increasing renewables to that extent is feasible. Subsidies are at \$88 billion and rise to \$240 billion in 2035
- Nuclear is being left behind as the 6% reduction in nuclear compared to 2011 is the largest single change in the new WEO New Policies Scenario.

And this path is taking us down the road to being unable to meet the 2 degree climate change scenario. After trying everything else in past reports, this year they try to demonstrate that increased efficiency is a potential path to delaying the inevitable and make time for more policy change to support the environment. This has the potential to extend the 2017 date for lock-in to 2022. However we can also ask, without a real and substantive global commitment to reducing carbon emissions, what will these extra few years actually achieve? Most likely – nothing!



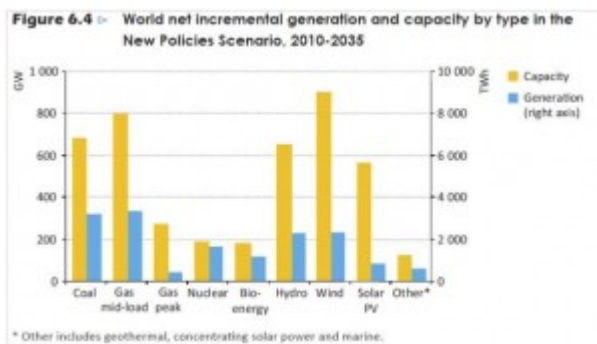
So let's look at the nuclear case in a bit more detail. Compared to the 2011 scenario, nuclear use is decreasing in those countries with the most to lose, Japan, Germany,

Switzerland and even France, while being economically challenged in North America; and rising in the more rapidly growing economies of the east led by China. This leads to an important question. Is nuclear power becoming a transient technology that helps countries develop and then once there, can be phased out over time by a policy shift to renewables? This seems to be a possible theme going forward but in practice nothing can be further from the truth. It is interesting to note that this past week was the 70th anniversary of the first sustained criticality at CP-1 by Enrico Fermi. And here we are today with the countries named above all having substantial nuclear programs providing a large and important part of their electricity generation (Japan 30%, Germany 30%, Switzerland 40% and France 75%). Clearly, with this much nuclear, replacing it is not trivial and will have significant impacts. Even the WEO acknowledges that ***“shifting away from nuclear power can have significant implications for a country’s spending on imports of fossil fuels, for electricity prices and for the level of effort needed to meet climate targets.”***

And that is what we are seeing today as Germany and Japan wrestle with these impacts as they try to reduce the use of nuclear very quickly. Based on hysteria following the Fukushima accident, the politicians in these countries (even France) seem to have forgotten what they have achieved since that famous date 70 years ago and why they built such large nuclear fleets in the first place. Building a successful nuclear program is a major undertaking requiring investment in regulation, infrastructure and industry. Germany, Japan and France have all benefited from this investment as they developed significant technology, know-how and industrial capability with the result being, in all cases, a very large portion of their electricity generation being economical, clean and reliable. Reducing its use as a result of a misguided view on nuclear safety will result in a large negative impact to industry and their economies. In Germany,

utilities are suffering financially and in Japan, there is the risk of losing capability and business to the new nuclear powers of Korea and China while having staggering increases in imported fossil fuels and a devastating impact to the local economy.

In fact, looking at the following figure from the WEO shows the bigger story. Just compare the capacity bar with the energy bar in each case and one thing is clear. Nuclear power is a key workhorse of the global energy system. It is by far the most efficient investment as every GW of capacity produces more GWh of energy than every other type of electricity generation. As I stated in my earlier post on the ETP, one of the reasons for the enormous investment in renewables is that you have to build about three times as much capacity as nuclear to get anywhere near the same energy output – and of course even then this energy is not dispatchable. But even looking at the use of more traditional fossil fuels, because nuclear fuel costs are very small, they are dispatched before more expensive coal and gas plants and, as the figure shows, 3 times as much coal capacity and almost 4 times as much gas is projected to each only generate twice the energy as nuclear.



It is important to remember that the WEO is not a forecast per se; rather it is a projection of how government policies would look once implemented. And what we see is a world investing heavily in fossil fuels to protect the status quo while also investing in renewables as a token path to the future. The fall in nuclear power use in developed countries is an important testament to the ongoing impact of the Fukushima

accident on government policies in the west.

While the 2012 projection is less than 2011, nuclear power does continue to grow and in 2035 it is projected to supply 12% of world electricity (13% in 2011 projection). Yes, it is being left behind relatively but, as I see it, this report clearly demonstrates the importance of nuclear power as a clean, efficient and reliable source of non carbon electricity going forward. Implementing policies that reduce its use is folly as it definitely will result in expanded fossil use, higher costs, trade imbalances and higher carbon emissions; all leading us down an unsustainable path.

Therefore the policy answer is not to limit and reduce the use of nuclear energy, but to expand its use because even a small expansion in capacity results in a relatively large increase in energy generated. And that means that we need to work harder to address the issues resulting from the Fukushima accident in the developed world and remind those governments who are reacting to short term pressures why they went nuclear in the first place; and of the consequences of reducing its use to their societies so they can rethink potential policies that may move them away from this very important part of our global energy mix.

**Dr. Sylvia Fedoruk – A great
innovator bringing the
benefits of nuclear to the**

world.

I want to commend the Saskatchewan government for honouring Dr Sylvia Fedoruk by renaming the Canadian Centre for Nuclear Innovation located at the University of Saskatchewan the Sylvia Fedoruk Canadian Centre for Nuclear Innovation.

Dr. Fedoruk died on September 26 at the age of 85. When I thought about writing this post, I asked myself why would those who read this blog – who usually are from as many as 25 different countries want to read about Dr. Fedoruk? And the answer was simple. Probably not well known outside of Canada, you should all know her. She spent her life making the world a better place so I hope you will be as inspired by her as I am.

Dr. Sylvia Fedoruk defined the word “innovation” when it came to bringing the benefits of radiation and nuclear to mankind. Born in the small town of Canora, Saskatchewan Dr. Fedoruk was the only woman who in the 1950s was conducting medical-physics research in Canada. At a time when it was unusual for a woman to enter the field of medical biophysics, her groundbreaking achievements have earned her worldwide recognition, bringing honour to the University of Saskatchewan, her home province, and Canada.

In 1951 she was one of the team that developed Cobalt 60 therapy to treat cancer. It is estimated that this work led to the treatment of some 70 million people worldwide by the end of the century. She later was involved in the development of the dosimeter as well as the first uses of radioisotopes to scan for cancer in the thyroid and liver.

After a long career as a researcher, Dr. Fedoruk was the first woman member of the Atomic Energy Control Board (predecessor of the CNSC, Canada’s nuclear regulator), became the Chancellor of the University of Saskatchewan bringing her

drive for innovation to a new generation of young people and then served the people of Saskatchewan as its Lieutenant Governor from 1988 to 1994.

At a time when the nuclear industry is fighting to demonstrate the numerous benefits we bring to society; we must always remember those like Dr. Fedoruk who spent their lives using nuclear technology to save lives and made the world a truly better place for us all.

Today, the world still has many great young innovators but we are having trouble inspiring them to turn their passion to the nuclear industry like many did a generation ago. Rather it is a calling in IT or other industries that seem to be of most interest. Yet we all recognize the need for clean reliable economic energy for a better future. And we recognize that the latest developments in physics at the Large Hadron Collider which confirmed the existence of Higgs boson particles and the complementary experiments at the Sudbury Neutrino Observatory (SNO), recently revisited by Stephen Hawking have the potential to radically revise our understanding of the world. With these and other developments we need to reinvigorate the imagination of young people, be it in physics, nuclear medicine or electricity from nuclear power plants so that the world's brightest students still come and spur innovation in the nuclear industry to ensure that we meet the needs of future generations.

So I ask you two questions when you comment on this post. First, who inspires you in the industry today? Let's celebrate those (and there are many) who keep moving the nuclear industry forward. And second, what are your thoughts on inspiring a new generation of innovators to enter into this industry so that we continue to have the world's best and brightest?

The nuclear renaissance gathers steam.....the importance of Southern Company receiving its COL for Plant Vogtle.

If 2011 was all about the events at Fukushima, 2012 is shaping up to be a big year in moving forward with the nuclear renaissance.

For the Chinese, this is the year of the dragon. This is, in fact, the major symbol of good fortune in Chinese Astrology. Of the 12 signs of the Chinese zodiac dragon is the most special, as it is a mystical being rather than an earthly animal. In this context that means we can expect grand things this year. Bigger than life is very much a dragon thing.

And bigger than life is what was achieved last week – the granting of the COL for Plant Vogtle in Georgia – the first COL ever granted under the NRC process and the first license issued for a new nuclear plant in the USA in over 30 years.

We have been writing for some time now on how the nuclear industry is moving from west to east with China and India having more than 50% of the new plants under construction and planned while they only have 3% of the current nuclear capacity. This shift is important but so is the restarting of nuclear new build in the established nuclear countries of the west. Of the over 400 plants in operation globally about half of them are in Europe and one quarter are in the United States alone. With 104 plants in operation, the US by far has the

world's largest nuclear operating fleet.

Recent global decisions are starting to show a broad based nuclear renaissance with new build finally taking hold in the west. In the UK, regulators have granted interim design acceptance of both Areva/EDF's UK EPR and Westinghouse's AP 1000; and planning application from EDF Energy for Hinkley C was accepted late in 2011. More recently Finland accepted bids for its next nuclear plant following the first of a kind EPR under construction at Olkiluoto; and the French have embraced life extension for the current fleet and the French regulator has given its preliminary approval of the safety options for the Atmeal reactor design. So even without the good news in the US last week, nuclear power is alive and well in the western world.

So why is the granting of the COL for Plant Vogtle so important to the future of the industry? First of all, it clearly demonstrates that the US, the world's largest nuclear operator remains committed to nuclear power going forward and what can be more important for the industry than that? With the COL for SCANA's Summer plant expected to follow shortly, there will be five nuclear units under construction in the US including TVA's Watt's Bar 2 which is nearing completion. TVA also plans to complete its idled Belefonte plant.

It is somewhat unfortunate that in its decision to grant the COL, the chairman of the NRC was the sole abstaining vote – still overly focused on the impact of Fukushima, wanting conditions related to post Fukushima improvements added to the license. To their credit, the remaining commissioners felt differently with Kristine Svinicki stating *"There is no amnesia individually or collectively regarding the events of 11 March 2011 and the ensuing accident at Fukushima."* She added that NRC staff did not recommend and did not support Jazcko's idea of a condition being attached to the licence, *"because we found it would not improve our systematic regulatory approach to Fukushima, nor would it make any*

difference to the safety of operating or planned reactors."

It is interesting that just a few days earlier, a NRC sponsored long running study concluded *"A severe accident at a US nuclear power plant would not be likely to cause any immediate deaths, while the risks of fatal cancers caused by such an accident would be millions of times lower than the general risks of dying of cancer"*. This study is very important going forward because as we have written before, while Fukushima has been a terrible accident, the actual consequence to human life of radiation releases has been very modest with no immediate deaths and no longer term deaths expected.

Now the other issue, again as we have written about in the past, is the price of gas. Recent prices have been below \$2.50 mmBTU – which is making it even more difficult for any alternative form of generation to gas to be economic. So what does this mean for future commitments to nuclear power in North America? Well, while gas prices are low right now, the gas industry is not without its own issues. Recent studies are suggesting that at today's prices, gas companies are losing money and that the cost of subsequent shale fields will continue to rise. And of interest is new study reported in Nature magazine suggesting that with fracking, the carbon footprint of gas is becoming similar to coal, rather than half that of coal as it is for conventionally produced gas. Now I don't want to start a big conversation on the future of gas – the issue is that nothing is perfect and we can expect gas to have its issues as well.

So what's the next step? The industry needs to remain focused. The cost of gas is not within our control. However, delivering on our promises is! After delays in Olkiluoto 3 and Flamanville, it is essential for the new US projects to be successful – meaning achieving costs and schedules. As stated by Southern CEO Tom Flannery *"We are committed to bringing these units online to deliver clean, safe and reliable energy*

to our customers. The project is on track, and our targets related to cost and schedule are achievable.” Good luck Tom.

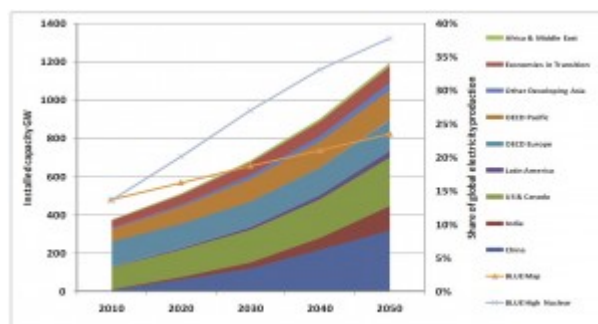
These units will be the 5th and 6th AP1000s to be built and we know that the first units in China are on schedule. The industry is behind you and we are counting on you to make this project a success demonstrating that plants built in the west can indeed meet targets and be important parts of our future generation mix.

What a difference a year makes! With New Build taking hold in the west in 2012 now is the time to sell the benefits of nuclear power to overcome the Fukushima effect.

The good news is that as 2011 comes to a close, Fukushima has achieved cold shutdown and the recovery is moving to the next stage. The emphasis is now on decontamination and getting the dislocated people back into their homes as soon as possible. Does this mean that nuclear will overcome the effects of Fukushima starting in 2012?

It was only a year ago that the International Energy Agency (“IEA”) issued its Nuclear Roadmap 2010. This report clearly demonstrates the important role that nuclear power can play in

meeting climate change targets. With a 50% CO₂ reduction targeted by 2050 in the so-called IEA Blue Map scenario, nuclear capacity triples and its share of electricity generation rises from 14% today to 24%, the largest of any generation technology. Under a postulated High Nuclear scenario, the nuclear share would reach as much as 38%!



IEA Nuclear Roadmap 2010 share of nuclear

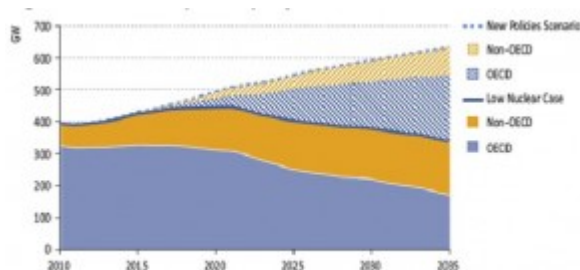
But that was then and this is now. On March 11, as we all know, a devastating earthquake and tsunami struck Japan with horrific consequences – killing more than 20,000 and causing a nuclear accident at the Fukushima Daiichi Nuclear Plant.

There was significant fuel melting in three units resulting in radioactive releases to the environment. Even though there have been no fatalities due to radiation and there is little risk of any future radiation health impacts, the global impact of this event to the nuclear industry was overwhelming. While many countries re-confirmed their commitment to nuclear power after reviewing plant safety and implementing lessons learned, some countries in Europe led by Germany have taken the decision to scale back or even move away from nuclear power.

In the IEA's World Energy Outlook 2011 released in early November they added a new scenario – Low Nuclear – to account for a possible post-Fukushima shift away from nuclear power in addition to the New Policies (reference) and Current Policies scenarios. In the reference case, global nuclear power is expected to rise 70% by 2035 with China, Korea and India leading the growth. This case is only slightly less than the

projection last year. In the new Low Nuclear Case, the total amount of nuclear capacity actually falls from 393 GW at the end of 2010 to 335 GW in 2035. According to the IEA, this scenario has severe implications for energy security, diversity of the fuel mix, spending on energy imports and energy-related CO2 emissions.

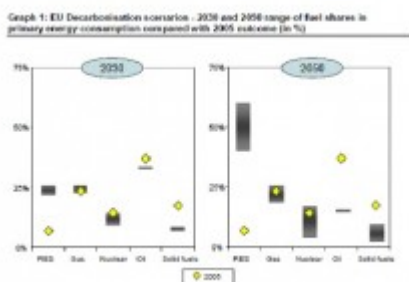
In this low nuclear scenario, by 2035, coal demand increases to over twice the level of Australia's current steam coal exports. The increase in gas demand is equal to two-thirds of Russia's natural gas exports in 2010. The increase in renewables-based generation is equal to almost five-times the current generation from renewables in Germany. Energy-related CO2 emissions also rise with increased use of fossil fuels in the power sector. This clearly has significant implications for global energy supply making it extraordinarily difficult to meet carbon targets. As stated in the IEA's WEO report *"Following this trajectory would depend on heroic achievements in the deployment of emerging low-carbon technologies, which have yet to be proven. Countries that rely heavily on nuclear power would find it particularly challenging and significantly more costly to meet their targeted levels of emissions."*



WE0 New Policies (Reference) and Low Nuclear Scenarios nuclear capacities

And now, Europe has issued its Energy Roadmap 2050 with the overall emphasis on renewables and energy efficiency; a policy document that has been clearly impacted by the post Fukushima shift in thinking in Europe. As illustrated in the chart below, even with five different scenarios, the one thing they

all have in common is a large increase in renewable energy generation. No other form of generation increases anywhere near to that of renewables; and in fact most other forms decline over the plan period with only the size of the decline depending upon the specific scenario. But even with this emphasis on renewables, the report does make important positive points on the role of nuclear power noting that nuclear energy is an important contributor to meeting the roadmap objectives.



In fact the report notes that today nuclear energy is the decarbonisation option providing most of the low-carbon electricity consumed in the EU. It then goes on to note the post Fukushima reality. *“Some Member States consider the risks related to nuclear energy as unacceptable. Since the accident in Fukushima, public policy on nuclear energy has changed in some Member States while others continue to see nuclear energy as a secure, reliable and affordable source of low-carbon electricity generation.”*

When it comes to cost, the impact is clear. Consistent with the IEA Nuclear Roadmap, this report states *“the scenario analysis shows that nuclear energy contributes to lower system costs and electricity prices. As a large scale low-carbon option, nuclear energy will remain in the EU power generation mix.”*

This is critical since the average capital costs of the energy system will increase significantly due to investments in power plants and grids, industrial energy equipment, heating and cooling systems, smart meters, insulation material, more

efficient and low carbon vehicles, devices for exploiting local renewable energy sources (solar heat and photovoltaic), durable energy consuming goods etc. And the reality is that renewables are expensive with the highest electricity costs in the “near 100% RES power” scenario which the RES power generation capacity in 2050 would be more than twice as high as today’s total power generation capacity from all sources (I am assuming primarily due to the low capacity factors of renewable generation). Other scenarios such as the High Energy Efficiency scenario and the Diversified Supply Technology scenario have the lowest electricity prices due to somewhat lower renewable penetration (60 to 65%) taking advantage of the lower costs of efficiency, gas and nuclear. The report notes that many renewable technologies need further development to bring down costs.

So as we enter 2012, where does this leave us? One lesson from Fukushima is that many in the world are still very afraid of nuclear power because of the huge fear of radiation. There was an interesting piece on this in a CNN Health article this past week which argues that public trust in nuclear energy should be built on the existing acceptance of medical radiation dose levels. The public welcome moderate medical radiation levels from both internal and external sources, for medical imaging (CT, PET, SPECT scans) yet fear the much smaller levels from nuclear plants. And as I stated in my last blog entry, as an industry our work is cut out for us in changing this thinking. Reducing the public fear of radiation is no small task and will take time and a carefully coordinated approach from us all. Professor Wade Allison argues that the ALARA principle has hurt us and increases this fear of radiation and suggests that this policy should be replaced with “As High As Relatively Safe (AHARS)”, mindful of other dangers, local and global. An interesting approach indeed.

One thing is clear from the above IEA studies and the European

Roadmap 2050. Reading between the lines nuclear power is essential to meeting long term carbon reduction goals. Relying too much on renewables is far too risky an approach and is more of a wishful thinking scenario than a realistic one. To achieve global carbon reduction objectives, it makes no sense to not take advantage of the one true large scale low carbon technology – nuclear power. It is here today – it is safe and in most jurisdictions it is economic.

So what about 2012? So far it looks like it can be a good year for nuclear power. Important progress in new build is being made in the UK; the US will see its first COLs enabling the first new builds to start construction in a generation; Canada may make a decision on its new build; and, of course China and others in Asia will continue to expand their programs.

Work in Japan will continue and will not be easy as the government works to decontaminate the area around Fukushima and hopefully many will get to return to their homes. Of importance we can expect to see many of the idled plants in Japan get approvals to restart easing the electricity shortage caused by these units not running. Again a recent Japanese study shows that nuclear remains the low cost option to 2030.

But of most importance, this is not time for industry complacency. This has to be the year where the industry marshals its forces to get the message out – in a thoughtful, clear, unambiguous way. The future is up to us so let's get on with it and tell our story. Even though truth may be on our side, the path is going to be long and the work hard.....but in the end it is worth it for us all.....

We offer a proven large scale clean, economic and, of utmost importance, safe option for electricity generation. As the only proven large scale low carbon option that can meet the world's energy needs, nuclear power must continue to be an important part of the electricity generation mix now and into

the future.

Climate change or peak oil – does it really matter?

Has it been that long since my last blog entry? Been extremely busy this winter and of course, busy is good! But on the other hand, I have a set of topics piling up that I would like to write about.

Earlier, I blogged when I read Jeff Rubin's book "How the World is going to get a Whole lot Smaller". When I posted the blog, I had good feedback. I was told that if I read this book, then I should definitely read "The Long Emergency" by Jeff Kunstler. Having been written in 2005 it is getting a bit dated. This makes it even more interesting because as you read, reality can be compared to the author's predictions over the last 5 years.

I really did enjoy the book. The concepts are similar and predate Jeff Rubin. In summary, Jeff Kunstler is convinced that the age of peak oil is upon us and that the world is going to be a very different place sooner rather than later. A number of his predictions have come to pass including the housing crisis and the very deep economic recession that we are just coming out of. Unfortunately the book then goes on to predict doom and gloom- basically the complete collapse of society as we know it. While he may be right, and I hope not, the trouble with this is that it discourages readers from paying attention to the main message. And this message is an important one now being put forward by Jeff Rubin as well.

I do believe him when he says that we are at or near peak oil. I also believe that there is no magic bullet to replace oil and that those who postpone decisions to adapt on the basis that "technology will save us" tend to be somewhat deluded – or in reality are just avoiding the issue. On the other hand, I don't believe that the world will come to an end and I do believe that there is technology that will help us delay the large scale effects to give us even more time to adapt. But remember, adapting means changing behaviour.

For example, look at one industry. Publishing. How much carbon is used in the manufacture and distribution of books, magazines and newspapers? Look at the business model. Books are published in a big print runs. They are then transported to book shops where they are to be sold, generally on consignment. If not sold, the books are returned (more transport) to be destroyed. While I don't have the numbers I can assume the carbon costs to be significant. So why am I talking about this? Well, along comes technology – an e-reader or now an Apple iPad and what happens? Millions of books, magazines and newspapers no longer have to be distributed in hard copy, but can now be distributed electronically thus reducing the carbon footprint of this one industry by a huge amount. Now I don't want to get into the discussion about the merits or e-readers here – and in fact I do want to blog about it at a later date – but just assume that it does come to pass. Then assume there are other industries that can also do the same. You see where I am going.

So now let's bring climate change into the equation. I am one who certainly does believe that the carbon we are putting into the atmosphere is having an impact on our climate. But even if you don't, then focus on peak oil. If we take action to curb climate change then we can put in place policies to reduce oil consumption before the natural economics affect us too drastically. i.e by implementing carbon reduction

policies to reduce carbon, we must price it and thus try and reduce use. Because as we all know from the recent events, nothing is as effective in changing behaviour than changing costs. This artificially pushes us to the same situation that would come naturally once peak oil has come and oil becomes scarcer. Of course people like Jeff Kunstler believe we are already too late!

This is why Copenhagen was such a big disappointment, In a sense it re-enforces the views in the Long Emergency that our dependence on oil is so great that we just don't have the political will to go in the right direction. Very discouraging.

As we saw from this last recession, when demand drops so does the price of oil. In fact what we see is that it doesn't really take that much of a change to impact the price quite dramatically. With the price rising to almost \$150/bbl in early 2008, it dropped to less than \$50 by the end of 2008 and has continued to rise modestly since then. Now at over \$80, once again there is fear that high oil prices will impact the economic recovery! Therefore the only policy is to price carbon and keep the price of oil from dropping by adapting the carbon price as necessary. Anything else will just lead to short term change and then back to the status quo.

One thing is certain. Oil is a finite resource. Yes we may find more but yes it will be more expensive to exploit. At some point we are going to have to accept that we need to start to shift to a less oil dependent economy. And given oil's uses outside of energy doesn't it make sense to use alternatives? So I will conclude by suggesting that climate change is our warning – start to act now to save the environment or wait until the oil is well past peak and have no plan to save society.

What do you think?

Happy New Year 2010!!

As usual at this time of year I find myself asking "Where did the time go?" Seems like just yesterday the year was beginning. And in this case, it was a very busy year. I am thankful to have been busy as we have been going through the worst economic times in recent history.

There have been a number of events that have defined the year in the nuclear sector. And it was a decision at the very end of the year that clearly demonstrated the nuclear industry strength moving from west to east. The announcement that the Koreans have won the bid for four new nuclear units in the UAE was HUGE. With an estimated value of \$40 billion (\$20 billion for construction of 4 units and \$20 billion for their operation), this is an absolute "game changer" in the nuclear industry. The Koreans have now achieved their desire to become a global nuclear player exporting their domestic designed APR 1400. Of more importance it shows that commercial issues have won out over political strength in this case. The Korean bid was reported to be significantly less costly than the alternatives from Areva and GEH. So far I have not seen any mention of the commercial conditions, so I cannot comment on if or how much the actual commercial conditions (i.e. how much risk the Koreans were willing to take) impacted the decision.

Never under estimate the capability of Korea!! The nature of international nuclear competition has changed! Of course, they still have to deliver. Given my own long experience in Korea, I would expect them to succeed.

This caps a year where nuclear growth in the east was substantial. Sticking with Korea for a moment, in addition to

winning their first nuclear export, their new electricity plan calls for a large increase in nuclear capacity within the country to 2030. Korea also made a big investment in uranium as KEPCO purchased 17% of Denison Mines this year.

In China, nuclear growth exploded! With 11 units in operation, China now has 18 under construction. They have increased their target for 2020 from 20 GW to 60 GW or more and growing even faster after that. With construction under way for AP1000 units and EPR units as well as the existing CPR1000 units, their program is as broad as it is large. As domestication of the industry continues, the first CAP1400 – a Chinese derivation of the AP1000 was announced this year to be launched in 2013. China also continued its entry into international uranium development. CNNC bought Western Prospector with a property in Mongolia this past year and CGNPC bought a 70% interest in Energy Metals in Australia.

And of course, there is India. In 2009 India truly joined the international nuclear community. With just under 4,000 MW in operation, India is now on track to meet its target of 20,000 MW in service by 2020 and more than 60,000 MW by 2030. With new agreements from Russia for VVER units, agreements to build the EPR from France and new agreements anticipated to build US designed units, the PWR program is expanding quickly to supplement their home grown PHWR program.

Of more importance, India now has access to international supplies of uranium to meet its domestic fuel needs. So far there have been arrangements made with Russia, France and Kazakhstan to import uranium and agreements are in place to enable uranium importation from Mongolia and Namibia. Towards the end of the year, India also concluded a Nuclear Cooperation Agreement with Canada opening the door for uranium imports. Cameco has opened an office in India and has big plans for this country.

With all this activity in Asia, how about the west? Well,

while there was progress with projects in the USA and the UK program is continuing to develop, there have been no new firm commitments this year. Hopefully 2010 will see the continued growth with a new build project formally starting in the US. In the UK government support for new build nuclear has continued to grow while EDF concluded its purchase of British Energy. In the US, there was progress in a number of states. The DOE has announced that it will provide its first loan guarantee when a utility receives a COL from the NRC. Activity is increasing in both markets.

In Canada, the year started with a bang. Ontario looked to be leading North America with its international bidding process for new units. This fizzled later in the year when the project was suspended. The other three provinces with nuclear ambitions also had major decision points. In New Brunswick, the government is proposing to sell its utility NB Power to Hydro Quebec, Saskatchewan has decided against nuclear power in the short term and Alberta has stated that it is open to keeping nuclear as an option for implementation by the private sector.

Definitely a busy year for the nuclear industry. Of course, 2009 was also an important year for the climate change issue. I think that this posting is already long enough so I will comment on Copenhagen and the move to reduce green house gases in a subsequent posting. There were also many developments with renewables that deserve attention. More to come.

One thing is for sure, energy continues to be high on the agenda. With the economy starting to recover, energy issues are expected to continue to be of importance going into 2010.

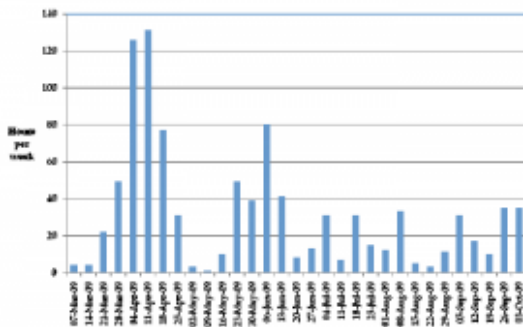
Is there a future for base load generation? Please respond to the poll?

System operators have recently seen something rather new – SBG – or “Surplus Baseload Generation”. This is due to falling demand related to the current economic situation and a newer phenomenon; the displacement of base load by variable load renewable generation.

With governments everywhere and the public strongly supporting new renewable generation, primarily wind and solar; these forms of variable generation are displacing base load by being must run when the resource is available. So the question is “Is there a future for base load generation?”. Please respond to the poll at the bottom of this blog entry

This issue was addressed at last week’s Association of Power Producers of Ontario (APPrO) annual conference where a session was dedicated to this new phenomenon. The following shows the amount of time Ontario experienced SBG over the past 18 months. Excess generation of well over 1,000 MW was experienced! This resulted in shutting down low marginal cost nuclear plant as well as spilling water at hydro plants. The 18-month forecast by the IESO in Ontario expects SBG to continue to be an issue going forward.

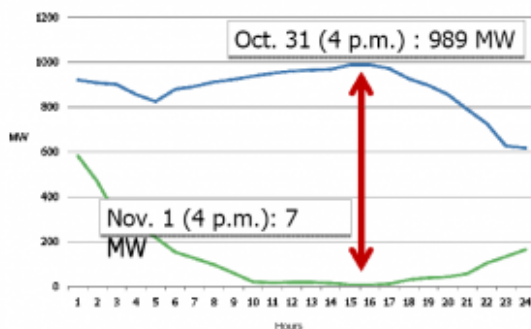
Surplus Base load Generation



IESO Presentation to APPr0 2009

The variability of the wind is shown in the following chart illustrating how two days in a row the wind at the same time varied from 989 MW to 7 MW on the following day.

Wind Capacity on Consecutive Days



IESO Presentation to APPr0 2009

So what does this all mean? In the smart systems of the future is the concept of large scale base load generation doomed? Do you have to be able to manoeuvre to survive? Or will policies change to ensure that low cost base load generation is not displaced for higher cost alternatives?

This is just the beginning of the discussion for this subject. Please answer the following simple poll. I would like to get your views. More work is needed on this issue as we plan the systems of the future.

[poll daddy poll=2259325]

Have we reached peak oil?

I just finished reading Jeff Rubin's book "Why Your World Is About to Get a Whole Lot Smaller: Oil and the End of Globalization". Was a good thought provoking read. In summary, Rubin is stating that the world has reached peak oil production and that ultimately prices will continue to increase post economic crisis and supply will continue to dwindle. The ultimate effect of this on society is that transportation costs will increase so high that it will no longer be economic to source goods from low labour cost countries like China and others. The cost of transportation will more than offset the lower production costs. The result will be a return to building factories much closer to market. So in the case of North America, jobs will return as making product locally will once again become economic.

In fact there are really two issues as I see it, combined into one. On the one hand, he notes that transportation costs will become so high that we move jobs closer to home. On the other hand, the high cost of oil will mean that we won't be able to sustain our current standard of living so we will have to do with less.

I think that a good case is made with some evidence that we may indeed have achieved peak oil. The case for the world getting smaller is somewhat more anecdotal in nature. Rubin also accepts that people are smart and that technology may indeed come to rescue although he does not think it will come fast enough for us to avoid large structural change in our economies.

There have been numerous reviews of this book so I will not try and do another review. In my case, I would like to focus

on making a few points that came to me as I thought about these issues. And yes, the book does make you think.

First, while the world may try and get smaller once again as it was in the past, we cannot forget the great strides in communications technology. So while we may not be able to travel as much, we will continue to be aware of the goings on all around the world. The internet will continue to bring us together with increasing global collaboration. Just imagine all of the ways that improved technology can reduce oil use. And we know from this recession that it doesn't take a really huge drop in demand for oil prices to fall. Think of all of the communications technology that can reduce consumption. For example, how much oil does it take to print and distribute newspapers? Well, it now looks like the future will have paperless newspapers fed to us on e-readers. How about magazines? Books? If we eliminate these from use (or even reduce their use dramatically as a start) what will the impact be? No oil to ship the paper to the factory, no printing requiring energy, no packaging and most of all, no distribution. And this is only one example. How about business travel? Of course, it will never go to zero but with improved video conferencing the need to travel by plane to far away places or even by car somewhere closer is being reduced. Look at the reductions in business travel already apparent in this recession. In these cases, it means that we will hopefully be able to use oil to transport only what needs to be transported as we get more efficient and reduce overall transportation.

He discusses climate change as well. This is also an important point. The global concern about carbon emissions is leading us to price carbon, thus increasing the cost of oil from its normal economic position. The goal is to use policy to change behaviour and find ways to move off oil to more carbon friendly forms of energy. This means that governments are working to try and encourage fuel switching BEFORE the oil

actually runs out due to concerns about its current use – not due to concerns about its scarcity. This should have a positive impact as policies continue to encourage demand reduction in advance of a global supply catastrophe.

Next, if he is right and factories once again move closer to home, yes, blue collar jobs long lost to far away places may indeed come back home to North America. But the current trend of white collar jobs moving off shore will not be reversed. It is ironic that the man on the factory floor may once again have a good job while the engineer designing the process may more often be in places with low cost professional labour. Engineering, accounting and other professions in the service sector that produce mostly paper will not see their jobs return as the internet will assure that quality work can be done literally anywhere around the world. So does this mean that in the next phase of globalization it is the higher paying jobs that will be moved away to lower cost locations while the low paying jobs return home?

Was an enjoyable read. I am interested in other's thoughts on this book. Let me know what you think.

MIT Report Update “The Future of Nuclear Power”

This week MIT released an update to its 2003 report, “The Future of Nuclear Power”. Back in 2003 this report brought the economics of nuclear power in the United States to the forefront. It supported new nuclear as a low carbon option for electricity generation and considered a scenario that would see the increase in capacity by a factor of 3 (meaning

building about 200 new units) by the middle of this century. It is commonly accepted that this report was an important input into the policy that followed with respect to nuclear power including the nuclear power 2010 program and the Energy Policy Act of 2005.

This update looks at progress over the past 6 years and of most interest, updates the economics. The following table from the report shows the new versus old analysis.

Table 1: Costs of Electric Generation Alternatives					
			LCOE		
	Overnight Cost	Fuel Cost	Base Case	w/ carbon charge \$25/tCO ₂	w/ same cost of capital
	\$/kW	\$/mmBtu	c/kWh	c/kWh	c/kWh
	[A]	[B]	[C]	[D]	[E]
MIT (2003)					
\$2002					
[1] Nuclear	2,000	0.47	6.7		5.5
[2] Coal	1,300	1.20	4.3	6.4	
[3] Gas	500	3.50	4.1	5.1	
Update					
\$2007					
[4] Nuclear	4,000	0.67	8.4		6.6
[5] Coal	2,300	2.60	6.2	8.3	
[6] Gas	850	7.00	6.5	7.4	

Click on table to enlarge

As can be seen, the costs have increased significantly over this time period with the projected costs of nuclear increasing faster than the costs of the coal and gas alternatives. However, the authors draw the same conclusions as they did in 2003; that nuclear is competitive with the alternatives. The report continues to assume a higher project risk for nuclear than fossil. This translates into a higher cost of capital and the highest cost of electricity. Assuming the same cost of capital as the alternatives results in nuclear being extremely competitive.

I want to comment on the costs and assumptions. I have to admit, that back in 2003, when I worked for a nuclear vendor, I was not happy with this report assuming nuclear at \$2,000 /kW. At that time we all believed that we were making strides

to lower the cost of new plants and we wanted to see that reflected in the analysis. Well, I was wrong. Today the cost of nuclear power has increased and I do accept that \$4,000 /kW is a reasonable assumption to make in today's world. Does that mean that I think that it is OK for nuclear plants to cost \$4,000 /kW? I definitely think that more work needs to be done to bring these costs down but that is the subject for another discussion.

On the other hand, things have evolved so that the other assumptions do need to be challenged. While it may have made sense to assume different costs of capital in 2003, this is no longer the case. The argument in the report is based on the industry's poor track record of building on time and on budget. It states that issues with new plants since that date confirm this and that the risk premium can only be eliminated with proven plant delivery performance. While I do agree that the industry needs to prove it can deliver a new fleet of plants to budget and schedule, things have changed since 2003.

In the current environment, the majority of new plants under consideration in the United States are with regulated utilities. These plants will be financed on balance sheet so they will be financed at the cost of capital of the utility itself, no different than if it were to build a coal or a gas plant. And now that the cost estimates have escalated significantly, it is reasonable to assume that part of this increase is due to utilities being more conservative and taking the risks into account in the cost estimates themselves.

Also, the risks of the alternatives have changed significantly. The risk of new climate change initiatives being put into place after the coal or gas plant is committed has increased. This means additional costs to the utilities to implement new carbon control requirements or charges due to additional costs for releasing carbon are likely. Is \$25/t sufficient? At this stage nobody knows meaning higher risk.

And finally, it is interesting how the success of carbon capture and storage (CCS) is assumed, even though the technology has yet to be demonstrated while the success of building a new nuclear plant is consistently challenged. The MIT study itself recognizes that CCS is not proven. The costs of CCS seem to go up every time a new estimate is made, yet they assume that nuclear has a higher risk profile and cost of capital than coal with a yet to be proven technology attached to it.

In the case of a merchant plant, should there be one; it will very likely only be implemented under the US government loan guarantee program. This means that they can achieve the 80/20 debt/equity ratio assumed for the other technologies with even a lower potential cost due to the benefit of the government guarantee.

All that being said, the timing of this update is useful. Their conclusion that more needs to be done is important. As stated ***“The sober warning is that if more is not done, nuclear power will diminish as a practical and timely option for deployment at a scale that would constitute a material contribution to climate change risk mitigation.”*** It will be interesting to see how both government and industry respond.

Welcome to MZConsulting Inc

This is the beginning. MZConsulting Inc was started about four years ago. We are in the clean energy business. We work with technologies that are low carbon. This means renewables such as wind and solar and nuclear power as the major large scale low carbon option. Our primary business is advising companies and governments with respect to new build nuclear

projects. Our experience is mainly related to the commercial aspects of energy generation projects so our focus is on energy economics and competitiveness.

We also advise companies looking to make investments in the uranium sector. This is focused on companies in Asia as major users given their growing nuclear programs. We are not investment advisers in the sense of recommending stocks; we recommend and work with companies who have a need for uranium and help them find and implement suitable investments that meet their requirements.

We do have a web site at www.mzconsultinginc.com that summarizes our capability and records all of our public presentations and papers. So why start a blog? I have been thinking about it for some time now and what pushed me over the edge was recently reading a book by Jeff Jarvis called "What Would Google Do?" I thoroughly enjoyed this book as it made me think of how quickly things are changing and the direction that world is moving. I want to be part of the change. I want to contribute and get feedback from others to help me shape my own company direction for the future. Energy issues are certainly high on many people's agenda these days and the interaction between energy and the environment is crucial to creating the low carbon future that we seek.

I don't want to make this first post too long so I will stop about now. I hope to provide input on a somewhat regular basis on a number of energy related topics and get some interesting discussion going.

So as I said at the top "Welcome to our Blog".

Milt