Abundant and economic – Nuclear power delivers

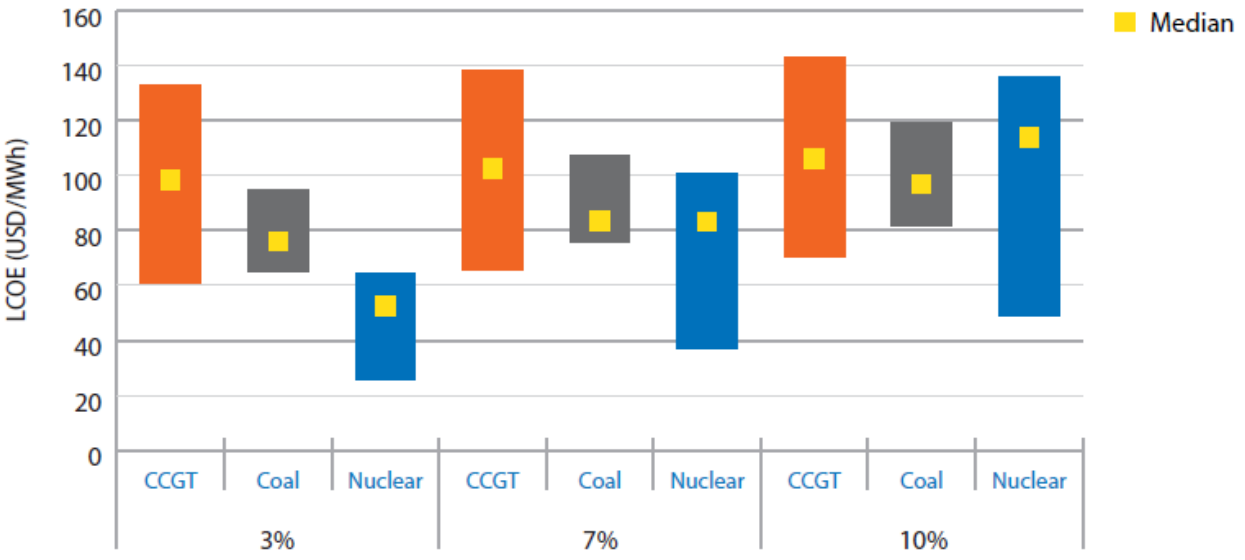
The past few weeks have seen lots of excitement as the world reached agreement to tackle climate change in Paris. What is key to the Paris deal is a requirement that every nation (all 195 of them) take part. Ahead of the talks, governments of 186 nations put forth public plans detailing how they would cut carbon emissions over the next 10 to 15 years. However, these plans alone, should they come to fruition, will cut emissions by only half the levels required to meet the targets set out in the agreement. The plans vary significantly from country to country with some like China depending upon nuclear power as part of their plan – and others not. With no concrete plan to achieve the goals in the agreement, one thing is clear; that if there is any chance of meeting these ambitious goals, there will have to be a larger role for nuclear power.

Critics of nuclear power generally focus on two main issues: safety, mostly concern that the consequences of a possible nuclear accident are not worth the risk; and cost, with many noting that nuclear is a high cost option that just diverts funds from the real environmental options for future generation, wind and solar. This month we will talk about cost and how to ensure that nuclear is seen for what it is, a capital intensive yet highly economic option for reliable 24/7 generation. If nuclear is to play the role that it can, and must play in the future generation mix, it can only get there by being the economic option of choice.

In our last post we noted the updated version of "Project Costs of Electricity" has recently been published. This is an important report that is now in its 8th edition from the IEA and NEA looking at the costs of various forms of electricity generation.

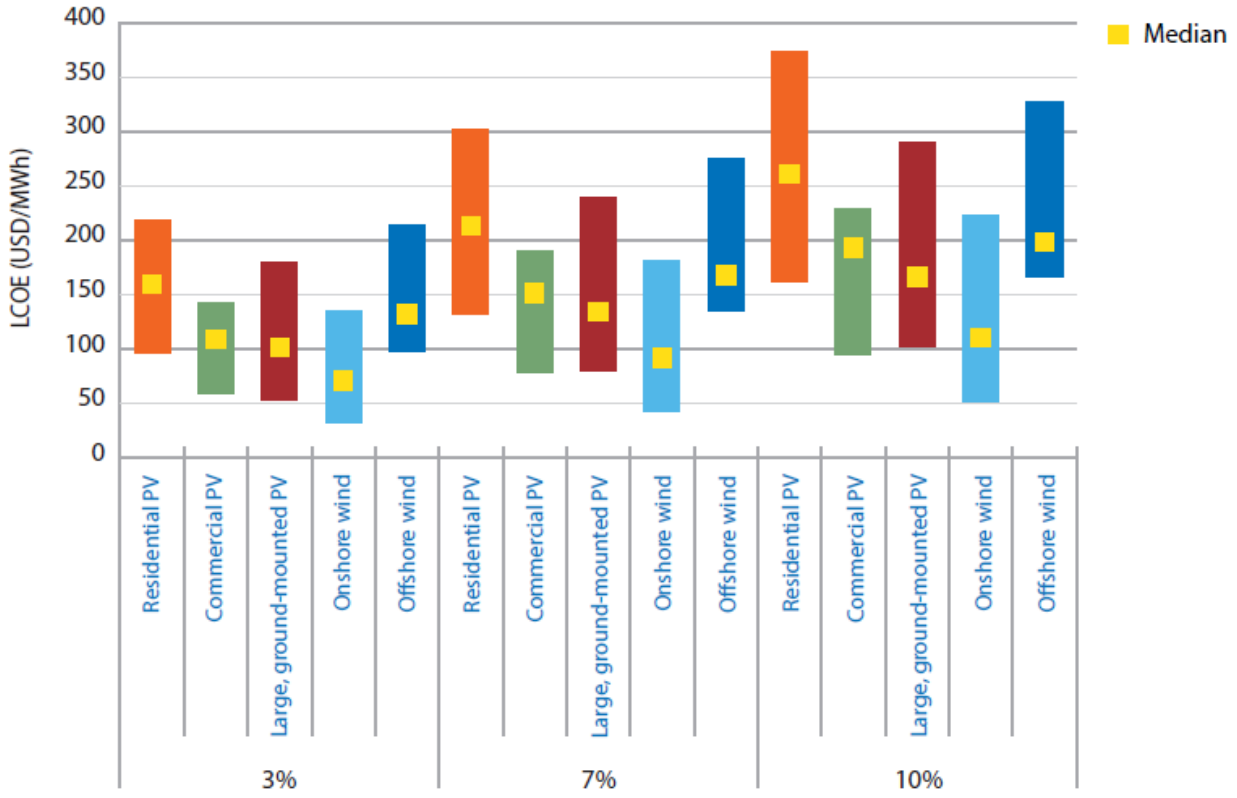
The results of this study are very clear. It shows that nuclear is a very competitive option on a Levelized Cost of Electricity (LCOE) basis.

Figure ES.1: LCOE ranges for baseload technologies (at each discount rate)



The ranges presented include results from all countries analysed in this study, and therefore obscure regional variations.

Figure ES.2: LCOE ranges for solar PV and wind technologies (at each discount rate)

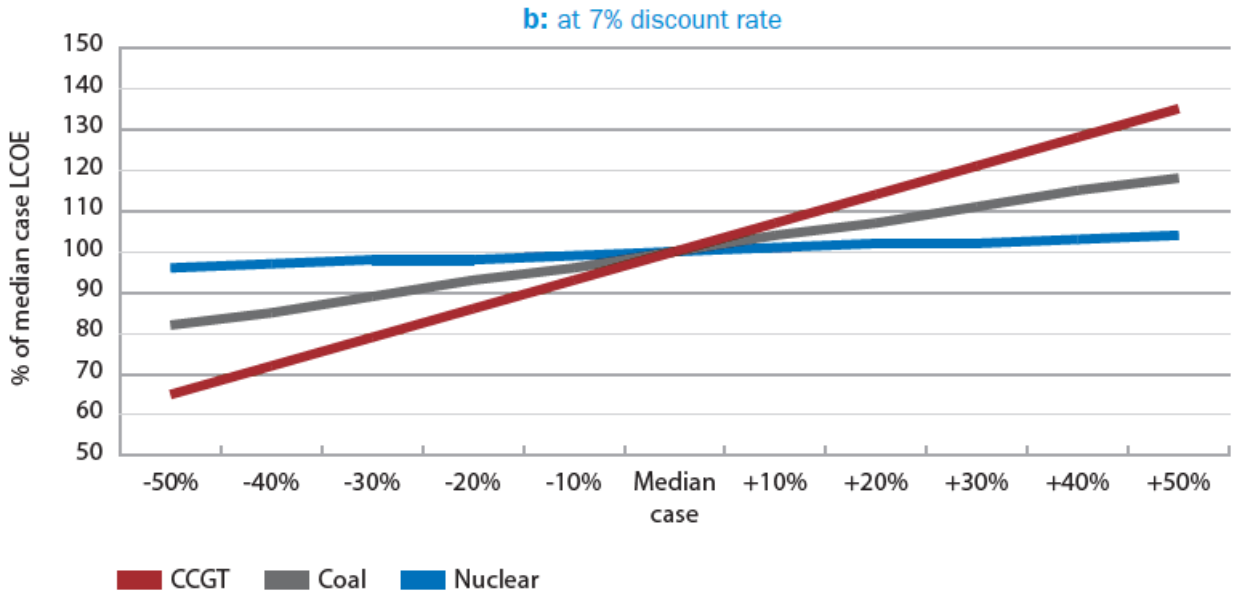


The ranges presented include results from all countries analysed in this study, and therefore obscure regional variations.

In fact, at low discount rates (3%), it is the clear winner among both traditional fossil technologies and the cost of renewables. While the report acknowledges the huge gains made by renewables in reducing their costs, it also notes the belief that nuclear costs continue to rise is false.

What is of interest is how the results are presented. The main comparisons in the executive summary are provided varying only one parameter, discount rates, that range from 3% to 10%. This represents a three-fold increase in the discount rate over the range. It is therefore not surprising that the technologies that are capital intensive, i.e. nuclear and renewables show the greatest sensitivity to this one parameter. This is one way to look at the comparative economics. On the other hand, generating stations powered by fuels like coal and gas are much more sensitive to fuel price. This sensitivity is only shown later on in the report in a sensitivity section.

Figure 7.12: LCOE as a function of fuel cost



So for example, while gas plants (CCGT) vary little with discount rates due to their relatively low capital costs and higher fuel costs, their LCOE is very sensitive to fuel

prices. In the chart above, the sensitivity only varies fuel prices by up to 50%; rather small in comparison to the three-fold change in discount rates in the earlier chart. Yet we all know that today's very low gas prices in North America are easily less than half as much as they were only a few years ago. Doubling gas prices or more would have a huge impact on electricity costs.

As would be expected, the economics also vary by region. It is no accident that China is building the most nuclear plants in the world. Even though they are also building many more coal plants to meet their ever increasing hunger for energy, nuclear plants provide clean reliable energy at about half the cost of coal in China making it an easy decision to move forward with new nuclear plants as quickly as they can. On the other hand, this past month we have once again heard about nuclear plants in the United States that are likely going to close prematurely due to poor economics. This results mostly from very low gas prices that impact the economics in those parts of the country that have open competitive markets. The units that are most impacted are the older smaller single unit stations that are requiring capital investment at this stage of their life cycle. Without any acknowledgement of the low carbon characteristics of nuclear, or the reliability of fuel supply (gas plants generally are fed by pipelines that are at risk in cold winter months), these units are struggling. Yet the industry in the USA is not standing still. As reported in the December 10 Nucleonics Week, the US industry is targeting to reduce its costs for the existing fleet by 30%. Once achieved, this will ensure that once again nuclear will be the lowest cost generation on the system.

However, this is only the first step. Being a low carbon generator is only sufficient to ensure that nuclear remains an option. The key to long term success is the ability to reduce the capital costs of constructing the plant; producing low cost energy is what will really drive a strong new build

program. This can be seen in countries such as China and Korea, where capital costs are relatively low, making nuclear by far the most economic option available. Lessons learned in these markets must be shared and implemented globally to bring down capital costs in other markets as well. China and Korea are showing the way. If the rest of the world follows, abundant nuclear power will play a large role in tackling climate change as the electrical grid workhorse of reliable low-carbon and mostly, economic generation, for decades to come.

Dreaming of a future with abundant clean reliable energy – then dream about nuclear

When we look to the future, people the world over are hopeful for an era of abundant reliable electricity supplying all of our energy needs; all at a reasonable cost and with little to no impact to the environment. Unfortunately, in many western countries the politics of electricity planning has become largely a case of exploring the depths of our imagination with no real path to achieving this essential goal.

As stated by Malcolm Grimston at the World Nuclear Association (WNA) Annual Symposium last month in his brilliant talk "***Sclerosis at the heart of energy policy***" (in advance of a book he has coming out), we have become so accustomed to reliable and cost effective electricity supply that we can no longer ever consider a scenario where this can be at risk. He

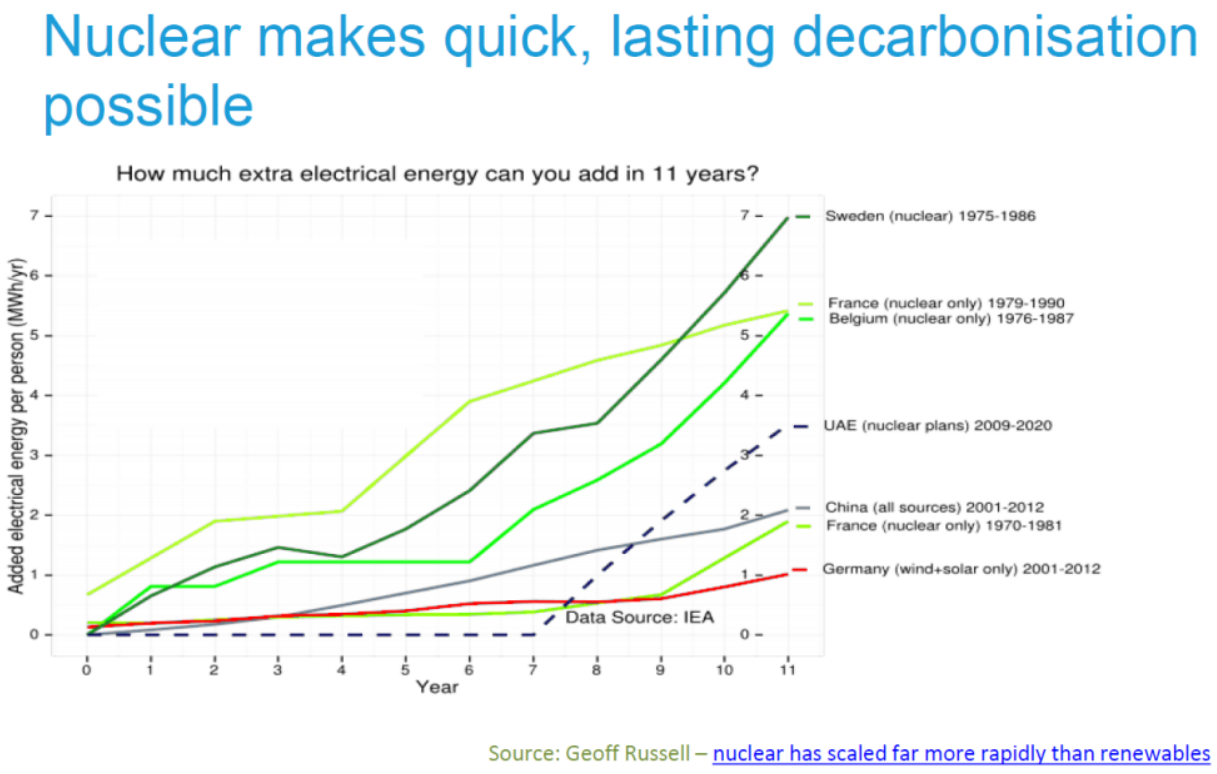
noted we even use the less than frightening phrase “keeping the lights on” when talking about reliability which greatly understates the importance of reliable electricity supply to our modern society. (As he said, he turns out his lights every night without concern – certainly a large scale disruption to our energy supplies would be much worse than having the lights go off.)

Given we can’t imagine electricity reliability to be at risk; and given we have relatively slow growth in most western advanced economies there is a major reluctance to take decisions to protect and invest in our infrastructure for the future even while we want to work towards decarbonizing the system. Yes electricity demand growth is modest, but our lives depend more on reliable electricity supplies than ever before. Without electricity society quickly becomes paralyzed with no ability to communicate, travel, maintain our food supply, sanitation, deliver health care and so on…in fact it is very difficult for us in all of our modern comfort to imagine how severe the consequences would be. Therefore in our great complacency we continue to do nothing because we all expect that the next great technological breakthrough is just around the corner. All we need to do is wait and advanced renewables will be available so we can have clean limitless energy forever. And so goes the narrative.

Ben Heard in his excellent WNA presentation “***World without Nuclear***” quotes Naomi Klein as she spoke to the media against the nuclear option in South Australia – “*What’s exciting about this renewables revolution spreading around the world, is that it shows us that we can power our economies without the enormous risk that we have come to accept*”. She said the latest research showed renewables could power 100 per cent of the world’s economies. “*We can do it without those huge risks and costs associated with nuclear so why wouldn’t we*?” she said.

But of course if it sounds too good to be true, it probably

is. Ben's presentation goes on to review 20 studies that suggest that a world powered by 100% renewables can be a reality. However, in his review he rates most of these studies as poor. Overall he concludes that there is actually scant evidence for 100 % renewable feasibility while the literature affirms large dispatchable, i.e. guaranteed 24/7 supply is indispensable. His final conclusion is that global decarbonization requires a much faster-growing nuclear sector.



Source: Geoff Russell – nuclear has scaled far more rapidly than renewables

Reproduced from Agneta Rising Presentation at the WNA Annual Symposium 2015

But how can we have more nuclear when it has this perception of huge risks? We have written extensively on the issues associated with the perception of nuclear as a dangerous technology when in reality it has the best safety record of all technologies out there so we won't talk about that again now. In his presentation Malcolm Grimston places much of the responsibility for this public perception squarely on the nuclear industry noting that the industry "*spends half of its time implying that it is the new priesthood, with superhuman powers to guarantee safety; and the other half of its time*

behaving as if radiation is much much more dangerous than it actually is." While it is hard to know what comes first, the fear or the industry reaction to it, we certainly agree that Malcolm makes a good point.

Then there are those that say nuclear power is way too expensive to be part of our future electricity system even though there is no doubt that wind and solar power are clearly the more expensive options. The most recent edition of "Project Costs of Electricity"; an important report that is now in its 8th edition from the IEA and NEA looking at the costs of various forms of electricity generation has just been published. (This report is a must for anyone seriously looking at trends and costs of electricity generation around the globe.) While the report acknowledges the huge gains made by renewables in reducing their costs, it also demonstrates that nuclear power is one of the lowest cost options available depending upon the scenario. Of more importance, the report notes that the belief that nuclear costs continue to rise is false stating that, in general, baseload technologies are not increasing in costs and specifically "t*his is particularly notable in the case of nuclear technologies, which have costs that are roughly on a par with those reported in the prior study, thus undermining the growing narrative that nuclear costs continue to increase globally*".

We will have more to say about this report in upcoming posts. But for now, let's all do more than dream about a future of abundant, reliable, clean and yes, economic electricity; let's make this dream a reality by making sure that the electricity system of the future includes highly reliable 24/7 nuclear power.

Optimism is the way forward – Nuclear Power delivers

We had an important piece of good news this month as Sendai Unit 1 was restarted in Japan, ending a long period of no nuclear generation in that country after the Fukushima accident in 2011. Sendai Unit 2 is following close behind and Japan will continue to restart many of its nuclear plants as it moves to put the accident behind it and reap the benefits of nuclear generation once again. Recent experience without nuclear has led the country to import vast quantities of fossil fuels, increase its carbon emissions and damage its balance of trade. While difficult for many, the Japanese understand the benefits of continuing with nuclear power are essential to the well-being of their society.

Sendai

Unfortunately as we have learned from this accident so far, it is fear of radiation that is having the largest impact on peoples' health rather than the radiation itself. To date no one has died from radiation at Fukushima and no one is likely to die from radiation in the future, yet fear is what is consuming these people and their lives – and the policy decisions being taken by government.

Of course, we must always think about those that were directly impacted by the accident. Many remain out of their homes and those that are permitted to return are often afraid. We must continue to understand their plight and work together to help them get their lives back and of most importance, once again have hope for their future.

A couple of weeks ago I was watching Fareed Zakaria on CNN interview President Obama about the Iran nuclear deal. I don't want to talk about that here but I do want to share Fareed's thoughts on President Obama's optimism. He suggested that Obama is an optimist and noted that "*history suggests that it's the optimists who have tended to be right*". He went on to say that "*today we are awash in pessimism, with people who see the world as a dark and dangerous place, where threats are growing and enemies are gaining strength*."

It made me think of our own world of nuclear power, where we are awash in pessimism; And it is easy to be pessimistic when articles such as the one by Michael Ignatieff, (who has previously run for Prime Minister of Canada) concludes after his visit to the Fukushima area with a message that seems to be the prevailing view of nuclear power to many. *"For the rest of us, outside Japan, we have moved on, more dubious about nuclear power than before, but still locked into the energy and economic system that requires it. Fukushima is now classed with Three Mile Island and Chernobyl in a trio of warning disasters, but so far none of these has persuaded the world,*

***at least so far**, to exit nuclear*." Clearly the message is – we need it for now, but when are we going to realize that the risk is just not worth the benefits?

It is easy to be pessimistic when there are documentaries that reach similar conclusions. In "Uranium – Twisting the Dragon's Tail" by Dr. Derek Muller, a physicist by training, the two part series focused on the bomb in Episode 1 and on the accidents at Chernobyl and Fukushima in Episode 2. Watching one can see that positive facts are presented such as radiation is not as dangerous as people think but the series is not about the benefits of nuclear power – rather it focuses on fueling the fear.

And there is no doubt the biggest issue is fear of radiation. As stated in Mr. Ignatieff's article, "*Today, Tokyo shoppers still won't buy rice, soya, or miso produced in the region and nobody will touch the catch from the local fishermen, even though the fish have been pronounced safe*." On his visit to the region he says "*In the enclosed valleys, as our bus climbed up the winding roads towards the coast—still many miles from the nuclear plant—radiation rose to double the levels in Tokyo. We're told it's safe to travel to Namie but it's still not clear what safe means*." After this accident trust is in short supply and lack of trust definitely increases the fear.

What is also clear is that setting policy based on fear does not result in good policy. In Germany, they prematurely shut down safe, effective and economic plants much earlier than needed. Even while building a huge amount of renewable generation, the Germans had to also build new coal plants both increasing electricity costs and emissions. It doesn't take much to realize that even with a strategic goal of eliminating nuclear power, taking the time to build clean replacements and shutting the existing plants down more slowly would have worked just fine – but setting policy driven by short-term fear of radiation doesn't allow for sensible decisions. With

over 200 nuclear plants throughout Europe, nuclear power has been a safe and essential element of electricity generation for decades without a single incident of harm.

Going back to what was said by Fareed Zakaria, "*history suggests that it's the optimists who have tended to be right*", we definitely choose to be optimistic and here is why.

The world needs clean and abundant energy for a better future for us all. For those with limited or no access to a reliable source of electricity, providing this resource makes a huge positive impact in their standard of living. And while we all agree that in richer countries there is opportunity to become more energy efficient, just look how dramatically our lives are impacted if there is an outage for any sustained period of time. Nuclear energy meets that need. It provides clean, abundant, economic and reliable electricity. Its energy density is matched by none so it can provide huge quantities of electricity from very small quantities of fuel, clearly what will be needed as the world population approaches 9 billion in the years to come.

The rapidly growing economies in the world like China and India are very aware of the benefits that come with robust nuclear programs as they embrace nuclear power to support their rapid growth in energy demand. Other energy-poor countries are also eager to move forward. The 67 units under construction around the world represents the largest new build program in decades and while many (25) are being built in China, the rest are distributed in 12 different countries.

But most of all what makes us optimistic about the future are the large numbers of energetic, bright and talented young people entering the industry. This month I had the opportunity to lecture at the World Nuclear University Summer Institute in Uppsala, Sweden. The current generation of young engineers and scientists have grown up in an era where they are strongly supportive of technology and believe that anything is possible

if they put their mind to it. It did not take long to see that the future of the industry is in good hands.

The time has come to get off our hind foot and stand up proudly and proclaim what we know to be true – that nuclear power has an important place in the world and will continue to expand its role as we need reliable economic and abundant energy for society. It is an essential energy option of choice, not of last resort, that we shouldn't wish we could do without.

Reliability means being connected – we need a strong integrated electricity system with nuclear generation as its workhorse

It was with great fanfare that Tesla launched its home battery recently. Headlines like "*Tesla launches Powerwall home battery with aim to revolutionize energy consumption*" were the norm as the public read about this revolutionary jump forward in energy storage. A recent article on where famed author Margaret Atwood is investing says it all …. "*if [Tesla CEO] Elon Musk was putting his Powerwall on the market, I would certainly buy a piece of that. My feeling is that, once that becomes affordable, everyone is going to do that. I think that's definitely the wave of the future*."

After all, this is the dream isn't it? We can all generate our own electricity with clean energy efficient solar panels and

store enough on our home batteries to keep us going when the sun goes down. What can be better for our common future?

Well, in fact, just about everything.

It must be my age and my years in the energy industry that remind me of what are the real essential attributes of electricity supply. **Reliability and Economics**. Yes, that's right. For anyone who works in a modern electricity utility, that is what they focus on; delivering cost effective reliable electricity to users. And in today's energy intensive world where we need electricity for every aspect of our hyper active and energy intensive lives, this is even more critical. We have all experienced temporary blackouts and know well the negative impact it has. The problem then with renewable energy generated at home is that, at least for now, it is neither reliable nor economic. Since the announcement from Tesla there have been a number of articles that explain this in detail, but of course supporters will just say that in time all problems will be solved. And frankly they may be right.

" Will I be able to have a night light if we switch to *solar power ?*

So let’s step back and ask ourselves a more important question – are we trying to solve the right problem? Most people have no idea what it takes to generate and deliver the electricity (the so-called “grid”) we take for granted in the modern world. In fact, many just think electricity is something that comes out of the wall outlet. What we all want is that when we turn on the switch, or plug in our phones, it just works. We are not in any way prepared for a world in which we say – oh, it’s cloudy so we better not charge our iPhone today! I love the recent TV ads where BMW is explaining how they build their new I3 electric car in wind powered factories. Yet, do any of us really think that on days when it is not windy, these factories sit idle? No, of course not.

In most advanced economies around the globe we have achieved a high level of reliability in electricity supply. In fact this is one of the measures that makes an economy ‘advanced’. **The problem is that much of our electricity is generated with fossil fuels; primarily coal.** (Coal continues to be the largest source of Germany’s electricity where BMW has its factories, at nearly 50% of total supply). And along with this comes both pollution and a high level of carbon emissions. Therefore, the only way to address these environmental issues is to reduce the use of fossil fuels, not to eliminate an integrated grid.

Just like being connected to the internet improves our lives, so does being connected to a reliable electricity grid. Do we really want to live a life where if it is cloudy for a few days and our batteries run dry we do without? Of course not. Just imagine how much excess battery capacity we would each need to avoid this possibility. Even Elon Musk notes that his battery is currently for emergency backup – not for daily use – and yes it would be great to have some amount of reasonably economic backup for when we experience an outage. But as is starting to be seen in California where there are numerous discussions of the “duck curve”, people want it all – they

want to generate their own electricity when they can believing this is the best approach, but they also want the system to be there just in case they need it; and at a moment's notice. The result – higher costs all around. The less the grid system is used, the more it costs to keep the infrastructure in place to make up the shortfall when needed.

The answer is simple, let's take what works and make it even better. That is a large interconnected grid that includes large scale reliable economic generation based on nuclear power, and hydro where available, supplemented by wind and solar depending upon the local availability of these resources. To be reliable and cost effective, a system needs generation that can run all the time, not just when the wind is blowing or the sun is shining. As storage technology improves, it can then contribute to both help manage the intermittency of renewable generation as well as flattening the demand curve to enable an even larger share of nuclear generation.

Remember, our economy, and in fact our very way of life, is completely dependent upon the availability of reliable, clean and economic electricity. So while we may dream of not needing the grid as we each generate our own electricity, what we really need is a strong well interconnected grid made up of reliable economic nuclear power as its work horse, with wind, solar and other forms of generation contributing when they can; all coupled with new forms of large scale storage to both even out demand and supply. Now this is more likely to be the system of the future.

It’s time to put nuclear on the offensive – and make it the low carbon energy generation option of choice

Have you ever seen something that just amazed you? We were wowed by a recent YouTube video showing what the Chinese have achieved in turning conventional high-rise construction on its head. A 57 story building was built in 19 days – yes – 19 days! Who would ever believe this could be possible? I live in Toronto, a city that has been undergoing a huge hi-rise building boom over the last few years and the time it takes to build these tall towers can be measured in months and years, not days. This just shows what can be achieved when the imagination is let loose and innovation results in outcomes never before thought possible.

We first wrote about the importance of innovation in the nuclear sector last year. In its history nuclear power has shown incredible innovation, leading the way in a range of technologies especially with respect to delivering a level of safety and security not seen in any other industry. More recently there have been dramatic improvements in operations as the global fleet has reached a level of performance never even dreamed of in the early days of the industry. Current new build projects are using the most up to date methodology in modularization and other advanced construction techniques.

And yet when the IEA issued the 2015 version of its Energy Technology Perspectives (ETP 2105) report focusing on the need for energy technology innovation if the world is to address climate change; it doesn’t mention this innovation, nor does it include discussion of potential future innovation with

respect to the nuclear option.

As stated, *"Energy technology innovation is central to meeting climate mitigation goals while also supporting economic and energy security objectives. Ultimately, deploying proven, cost-effective technologies is what will make the energy system transformation possible. Continued dependence on fossil fuels and recent trends such as unexpected energy market fluctuations reinforce the role of governments, individually and collectively, to stimulate targeted action to ensure that resources are optimally aligned to accelerate progress. Establishing policy and market frameworks that support innovation and build investor confidence over the long term is a first-order task to deliver."*

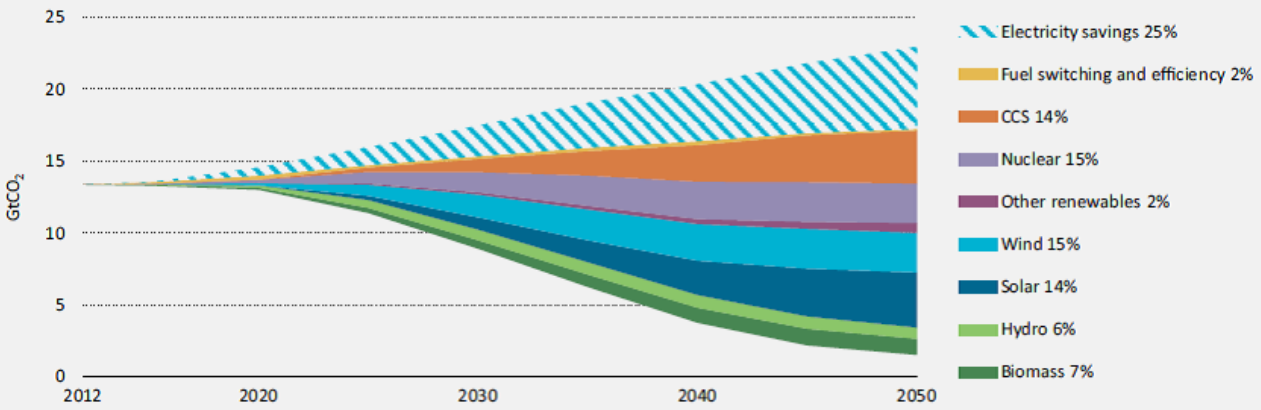
The report is clear when it says that "*Innovation support is crucial across the low-carbon technology spectrum".* The discussion focuses on renewable technologies in the short term due their relative readiness and lack of a need for long term investment in development; and carbon capture (CCS) in the medium to longer term even though it requires substantive investment in development as it remains essential to address the large number of fossil plants being built and still in operation by 2050 that will require decarbonizing.

As usual, the same issues that have plagued nuclear for the last 30 years; primarily public acceptance issues, mute a positive discussion for the nuclear option. While recognizing its importance in achieving increased energy security, diversity of fuel supply and lower emissions, the report goes on to state "t*his awareness has yet to be translated into policy support for long-term operation of the existing fleet and construction of new plants" … "to recognize the vital contribution that nuclear energy can make."*

Yet the actual IEA scenarios have changed little from last year. As shown below, when considering technologies individually (rather than grouping into "renewables"), nuclear

actually plays the largest role of any single technology in meeting carbon reduction targets showing that, even as it is stands today, the nuclear option is absolutely essential to moving to the IEA 2 Degree Scenario (2DS).

Figure 1.11 Key technologies to reduce power sector CO_2 emissions between 6DS and 2DS



Note: Percentage numbers refer to the contribution of the technology area to the cumulative CO_2 reduction between the 6DS and 2DS over the period 2012-50.

Key point *Electricity savings in the end-use sectors would stabilise power sector emissions at levels slightly above today's; a portfolio of low-carbon generation technologies is needed to sufficiently decarbonise electricity for 2DS targets.*

This can only be the case if nuclear is currently meeting its responsibility to be economic and reliable while being an essential large scale low carbon option. Given that we know the largest challenges in building new nuclear plants is related to their relatively high capital costs and long project schedules relative to other options; consider the role nuclear can play if improvements similar to those demonstrated in the Chinese YouTube video were implemented. Not marginal improvements, but mind blowing changes in approach that shake current thoughts about the costs and schedules of nuclear projects to their very core. This is the way forward. While discussion of next generation plants and SMRs is of interest, we need continued innovation that takes what we know now and improves it beyond what anyone can imagine.

The report shows that government investment in nuclear R&D has

been dropping and in renewables has been increasing. This investment must be refocused on project improvement and innovation rather than the traditional areas of research such as safety and waste management where it has been spent for decades. While important for the nuclear industry, too much of this spending is focused in these areas just to pander to the ongoing public beliefs that safety and waste issues remain unresolved. Rather, emphasis should be on continuing to improve new build project performance. Let’s think about new build nuclear in the same way we think about renewable technologies; that more investment and research will lead to shorter construction schedules and lower costs. It is time to let the innovation genie out of the bottle, stop being on the defensive and move forward with great things. With changes like this, the nuclear share will grow well beyond current expectations bringing a real solution to climate change while keeping electricity bills low and system reliability high.

So remember, nuclear power is essential in achieving increased energy security, diversity of fuel supply and lower emissions; and is already expected to have the largest impact on meeting climate goals of any other single technology. Today’s plants are economically competitive and provide safe and reliable electricity. Talking about investing in energy innovation without a discussion of investing in nuclear, when it’s currently the best option available, is absurd. Governments need to recognize the incredible innovation already achieved by the nuclear option, and unleash even greater potential by investing in this well proven technology.

A nuclear future means clean, reliable and economic electricity; yet fossil fuels reign supreme

This past month, following the fourth anniversary of the Fukushima accident, it is good to see there is less emphasis on the nuclear accident and more discussion of the significant natural disaster – the tsunami and earthquake that killed some 20,000 and destroyed so much, leaving 300,000 homeless. It is now clear that the nuclear accident will not be a cause for radiation-induced cancer, food is not contaminated, and most people can return to their homes should they so desire. While there continues to be a big mess to clean up and many important lessons in managing nuclear accidents to learn, there is no disaster in terms of either immediate or long-term health impacts. Yet we still see news such as was reported this week- that Fukushima radiation has reached the west coast of Canada – one then has to read the report to find out it is so minute as to be a non-event.

So now 4 years on, if we look at China one could conclude the nuclear industry is booming. CGN reported 3 new units were connected to the grid in March, with 2 more expected to be connected within this year. Overall China now has 24 units in operation and another 25 under construction targeting 58 GW in service by 2020 and then accelerating from there to bringing as many as 10 units per year into service in the 2020s targeting about 130 GW by 2030. Two new reactors have just been approved in the first approvals for new units post Fukushima. In addition to this, China is now developing its Hualong One reactor for export as it strives to become a major player in the global nuclear market.

China Hongyanhe 3 completed

China’s commitment to nuclear power is strong and unwavering. An important reason for this rapid expansion is the need for clean air. Pollution in China is a real and everyday problem for its large population. The Chinese see nuclear power as path to ultimately reducing their need to burn coal and hence help the environment.

On the other hand, in Germany a decision to shut down some nuclear units in 2011 immediately following the Fukushima accident and to close the rest by 2022 has led to a large new build construction program of lignite-fired units to meet short term energy needs. With several under construction and some now in operation, coal is producing about half of Germany’s electricity. Keep in mind that these new plants will likely be in service until about 2050. This is while Germany supposedly is focusing its energy future on ensuring a cleaner environment using renewables. I would expect their goal would be easier to reach without a number of new coal-fired units going into operation to replace clean carbon free nuclear energy.

The lignite coal fired power plant Frimmersdorf

It is with these two extremes in mind that I noted when attending the Nuclear Power Asia conference in Kuala Lumpur this past January that while almost all South East Asian countries are planning to start nuclear power programs, they have had little success in getting them off the ground. Currently Vietnam is in the lead and countries such as Indonesia and Malaysia are continuing with their plans, but with little progress. For example, Indonesia has been talking about nuclear power for more than 30 years. With a need for 35 GW of new capacity in the next five years and an annual expected growth of 10 GW per year after 2022, it is easy to ask why a decision for new nuclear seems perpetually stalled while there has been no problem building new fossil plants.

While in Malaysia I couldn’t help but think – why is it so difficult to make a decision to invest in new nuclear plants, especially for first-time countries? Is it a fear of nuclear itself and the issues associated with public acceptance – or is it the commercial aspects whereby nuclear plants have relatively large capital expenditures up front raising

financing and risk issues? Or, more likely, a combination of the two.

At the same time as decisions on new nuclear seem to be so difficult to take, literally hundreds of coal plants and thousands of gas fired plants are being built around the world. If the environment is actually important, why is it so easy to invest in fossil stations and so hard to invest in nuclear? One simple answer is the size of the global fossil industry. Countries like Indonesia and Malaysia have huge industries with fossil fuel development being an essential part of their economies. The public is comfortable with this industry and many either work in, or profit from the industry in some way. The same is even true in Germany, where coal and lignite mining is entrenched. While committed to reducing hard coal use over time, once again this is an important industry in the short term.

For a country looking at nuclear for the first time, like those in South East Asia, there has to be a strong base of support to get the industry off the ground. They need to be serious about their consideration of the nuclear option, not just dabbling with little real interest. While these countries have modest research and other programs, there is simply not enough going on nor a strong belief that there are no alternatives to garner the political support to move forward. Starting a nuclear program is a large undertaking and the fear of securing public support and concerns about safety and financial ability to support the program are paramount. This makes it difficult for decisions to be taken. A strong and committed view from within government is needed and this can only be achieved with a strong need for energy and an even stronger belief that the public is on side.

China has passed this milestone and now has a large and vibrant domestic industry. Government support is assured so long as the industry continues to thrive. To the Chinese, the issue is clear. Nuclear plants are economic and their

environmental benefits are essential to helping solve their huge environmental issues. The Chinese have CONFIDENCE in their ability to deliver safe, economic and reliable nuclear power stations.

On the other hand, the Germans have decided their fear of nuclear is stronger and more urgent than their need to reduce their carbon emissions in the short term even though they had a large and strong domestic nuclear industry. In this case, Germany is an outlier and to this end they justify building new coal units even when their overriding goal is environmental improvement.

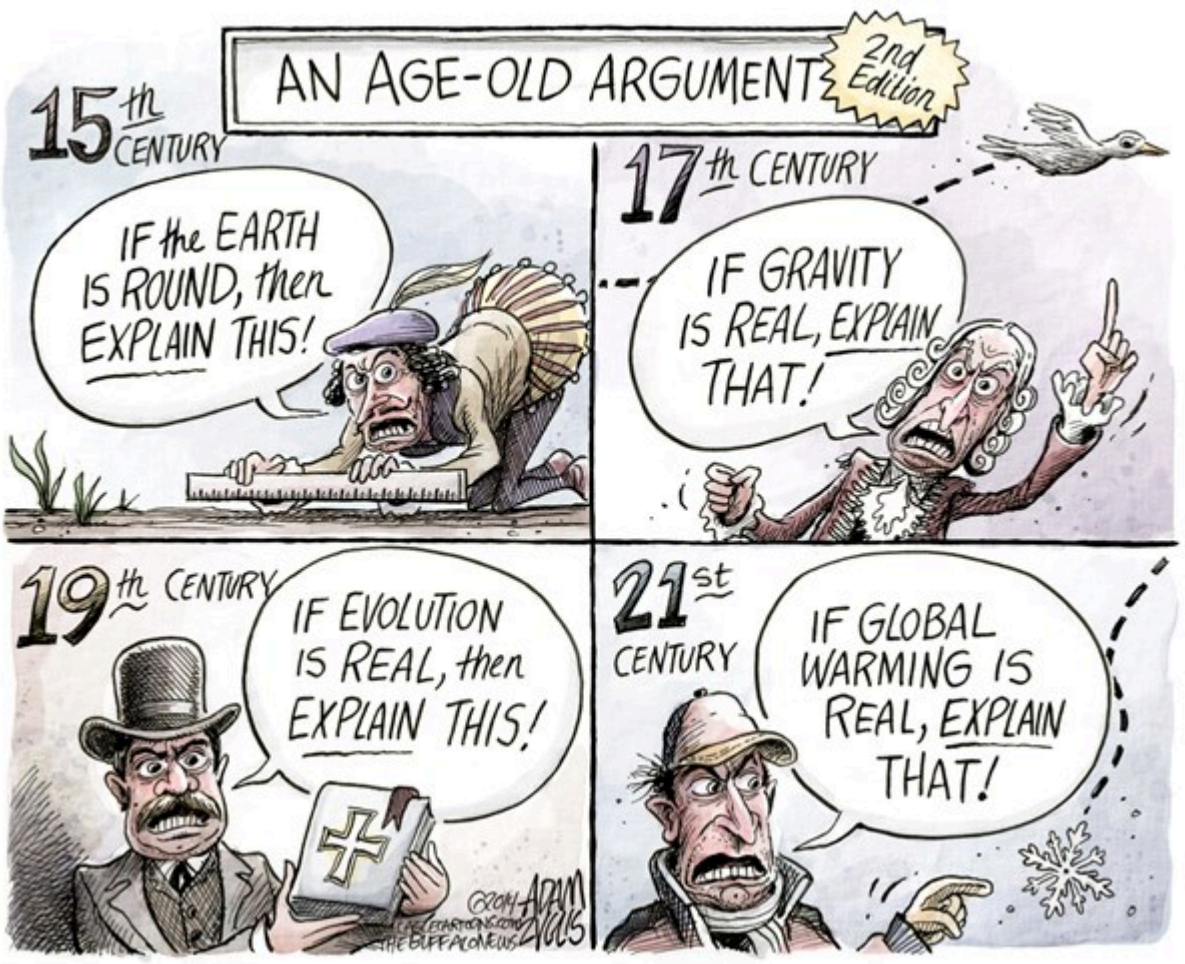
I am confident that nuclear plants will expand their already important role in the future electricity mix of the world and, as such, the industry needs to find new and innovative ways to make taking a nuclear decision easier. This includes ways to gain a higher level of public support, ensure that project risks are manageable and that costs can be kept under control. In some future posts, we will talk about some of these ideas and how we can unlock the global nuclear potential.

How can Nuclear Power Build Trust in a time when denying science is rampant?

Recent public outcry as a measles outbreak has managed to impact much of North America has once again showed the nature of public deniers of science. In this case it is concerns about vaccinations that have led to numerous children falling sick with measles. While not considered a highly risky disease, some children get very sick and some may actually

die. The main concern is that it is very contagious so that without vaccinations it moves quickly within a community to infect large numbers of people, greatly increasing the public risk.

This is only the most recent large scale public outcry where science is ignored. It is the same as those who deny climate change and those who deny the safety and benefits of nuclear power.



The role of nuclear power in combating climate change has once again been demonstrated in the most recent update of the IEA Nuclear Power Roadmap.

- Based on the 2 degrees Celsius (°C) scenario (2DS) – nuclear power would continue to play a major role in lowering emissions from the power sector, while improving security of energy supply, supporting fuel diversity and providing large-scale electricity at

stable production costs.

- Global installed capacity would need to more than double from current levels of 396 gigawatts (GW) to reach 930 GW in 2050, with nuclear power representing 17% of global electricity production and a formidable growth for the nuclear industry.
- Governments have a role to play in ensuring a stable, long-term investment framework that allows capital-intensive projects to be developed and provides adequate electricity prices over the long term for all low-carbon technologies. Governments should also continue to support nuclear research and development (R&D), especially in the area of nuclear safety, advanced fuel cycles, waste management and innovative designs.

This means that a larger commitment to nuclear power is an important element of any strategy that has a chance of getting climate change under control.

The report also notes that public acceptance continues to be one of the major impediments to a stronger commitment to nuclear power in many markets. Concerns about safety, costs and waste disposal continue today; the same issues as they were back when I started work in this industry more than 30 years ago. While science can clearly demonstrate that nuclear power has benefited the environment, by avoiding significant amounts of pollutants and carbon emissions; is very safe; and that waste management is more of a social issue than a technical one: public attitudes remain very hard to change.

Generally the public has very different views on key issues than scientists. In this year’s annual meeting of the American Association for the Advancement of Science (AAAS) a significant number of discussions were about how the public thinks about science issues and how scientists communicate about their work. On key issues the difference in opinion according to PEW research is striking. While 57% of the public believe that eating GMO food is unsafe, 88% of scientists

believe the opposite. Only 68% of adults believe vaccinations should be mandatory while scientists are at 86%. And finally only 50% of the public believe that climate change is man-made while 87% of scientists believe in man-made climate change. Clearly there is a huge gap between science and public beliefs. We in the nuclear industry are not the only ones to suffer from this lack of effective communication.

I have long noted when told the industry must better educate the public that in reality, the public does not want an industry science lesson which tends to be the approach most used in the past. In fact, when this approach fails, experts just shake their heads and try again. In reality what the public want to know is that the industry is safe, and that this safety is in the hands of experts that they trust to deliver upon this promise. We see that one of the largest impacts of the Fukushima accident in Japan is the loss of trust in both the utility and government by the population. The impact to the public of this is significant – the health impacts of the fear of radiation and the accident is far larger than the actual health impacts of any radiation to the public.

Trust is not something that is built overnight. It takes years, even decades to develop trust with the public – and only a moment to destroy it. People are skeptical (as they should be) and unfortunately are always ready to believe stories that discredit those they don't trust.

So why do I bring up the measles outbreak? Because we finally have an incident where the public seems outraged at deniers and supportive of science. Measles vaccinations are safe. Millions of doses have been safely given to children over decades. They save lives. And those that disagree have been putting not only their children at risk but also the children of their neighbours and colleagues. One has to ask, how can any educated, concerned adult put his or her own children at risk? Clearly they believe that the risk of vaccination is

higher than the risk of the disease. In the midst of all of this, recent news surveys are showing that significant numbers of people still believe the vaccination can put their children at risk. This is just not the case given the science.

It was said best by a mother in Pickering Ontario who has already lost a young child to illness and who now has her baby at risk, "*If you have chosen to not vaccinate yourself or your child, I blame you," she writes. "You have stood on the shoulders of our collective protection for too long. From that high height, we have given you the PRIVILEGE of our protection, for free. And in return, you gave me this week. A week from hell. Wherein I don't know if my BABY will develop something that has DEATH as a potential outcome*."

It is essential to understand these words. It is easy to oppose something when you are already benefiting from it. Yes, don't vaccinate your child because you know the risk of disease is low since all others are vaccinated, oppose GMO foods when you have ample safe food to eat while others are starving, and oppose climate change while you have reliable electricity and relatively clean air while others can't breathe and are the first to suffer the consequences.

There seems to be a large scale shift from public good to individual good in society these days. Trust in government, scientists and other institutions is very low. The public is not willing to accept that these institutions have their back so they quickly rush to beliefs that are not supported by science with the resulting ultimate negative impacts on society. To be fair these beliefs come because many of these institutions that were trusted in the past have let the public down. And in this day of instant news and social media, it is easy to attack, but then interest is lost by the time the truth comes out and only a small subset of those who read the original story of concern remain interested enough to see the truth when it comes out.

Trust – it is essential for the future of nuclear power. The public must trust the industry to deliver on its promise of developing and operating safe, reliable and economic nuclear plants. They must trust the government to provide a strong regulator to oversee the industry and ensure public safety. This industry is dependent upon this trust if it is to flourish.

Building trust in science is a task that goes well beyond the nuclear industry. Yes, scientists have much work to do to build that trust with the public and government, but governments must then ensure that they use science as a basis for policy. While it remains reasonable to question the results of science, it is not reasonable to base policy on the assumption that science is wrong. Government in all countries need science advisers in key positions to ensure that real science is heard when policy is being made.

The media is also part of the solution. Poor reporting looking for the sensationalist point of view is not helpful. Science journalists must be the ones to cover science issues and they must take the time to report on them correctly. Just this week there was a fascinating editorial in the Canadian newspaper, the Globe and Mail when a reader complained about the lack of "balance" on the vaccination issue. The response by the Globe is important reading," *The reader is correct that news stories should be fair and balanced, but if The Globe were to include someone "credible" from the anti-vaxxer community, that would be false balance….False balance is when journalists twist themselves into a knot to try to balance scientific and expert views with someone whose views are not fact-based, expert or scientific….. False balance is not only poor journalism, it can harm the readers' understanding because it suggests there is a balance between the views. In politics, for example, it is important and responsible to offer fair weight to different parties' views. It is not responsible to offer equal weight to science versus flimsy beliefs*."

The issue is that most people today listen to those they are familiar with and trust and discount those they don't know. Therefore nothing is more important than the scientific community listening to and speaking with the public in a way that earns their trust. Getting this done is essential to all of our futures. The work ahead of us all to build trust in science is huge and it will take a long time but we must be relentless in our efforts to make this happen.

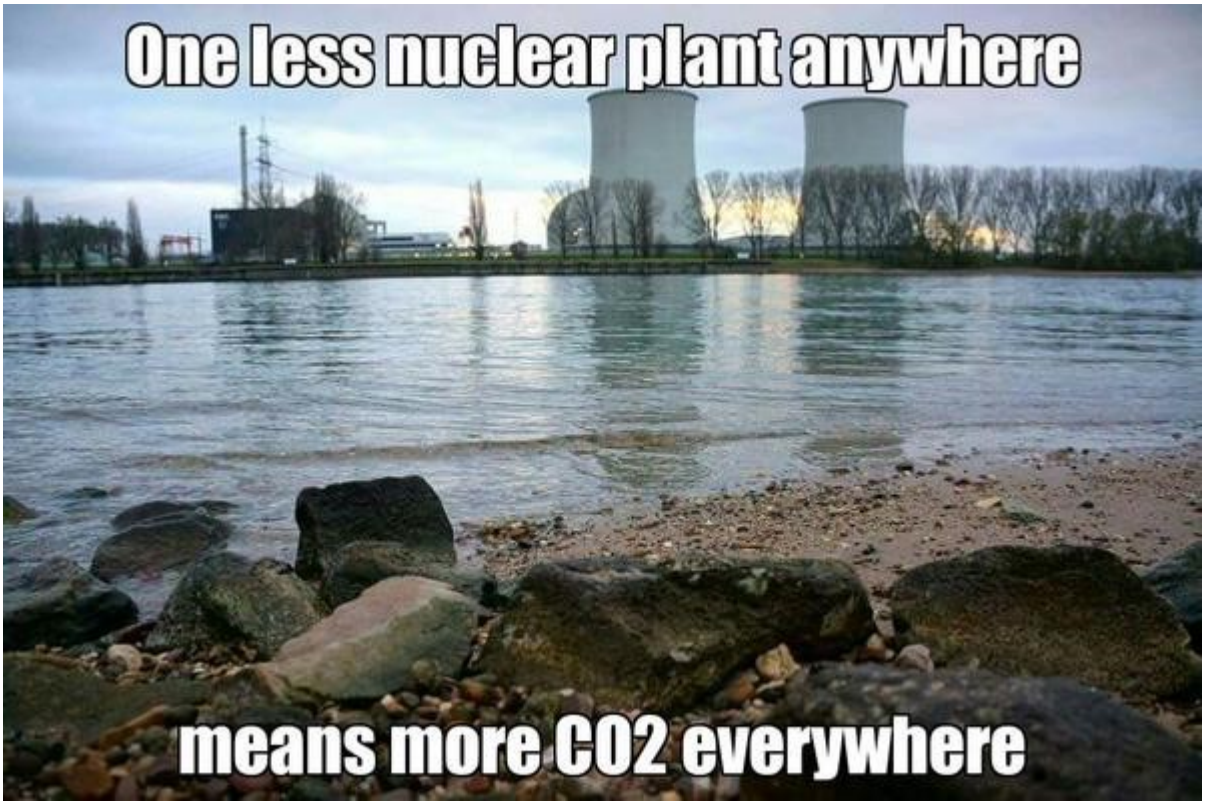
Given the public push back in this measles outbreak, we can ask – is this the beginning of a new opportunity for dialogue on issues that are supported by science? Is the public starting to understand that their beliefs may be hurting them more than helping? If so, then we need to ensure that the nuclear industry is continuing to deliver open, honest and transparent information in support of its benefits while clearly explaining the magnitude of the risks. Science is on our side. Now it's time to make a strong case to the public.

As 2014 comes to a close, nuclear power is at a crossroads – again!

The world needs nuclear power – so says the latest edition of the World Energy Outlook (WEO) issued in November. "*Nuclear power is one of the few options available at scale to reduce carbon-dioxide emissions while providing or displacing other forms of baseload generation. It has avoided the release of an estimated 56 gigatonnes of C02 since 1971, or almost two years of total global emissions at current rates*."

Yet looking back at 2014, the industry has had its ups and

downs. There were setbacks as France formalized its intention to reduce its reliance on nuclear going forward, Sweden pulled back after its most recent election, and in Finland the Olkiluoto 3 project was delayed once again. In the US, the most recent plant to be shutdown is the Vermont Yankee plant; shutdown after 42 years of operation as not being economic, yet its shutdown will definitely raise electricity costs for its consumers and impact the local economy as a result of its closure-related job losses.



Vermont Yankee shuts down

There was good news in Japan as the first units were approved for restart since the 2011 Fukushima accident, although the actual restarts are taking longer than expected. The re-election of the Abe government also bodes well for Japan's nuclear future. In the UK, there was a big win as Europe approved the project at Hinkley Point as not contravening state-aid rules; but once again progress is slower than most would like.

And then there are places where nuclear power is booming.

China brought new units into operations and approved numerous new units with a larger-than-life target for its nuclear share in 2020 and beyond. The Chinese also approved its first Hualong One reactor, the evolution and combining of designs from both CGNPC and CNNC, as they plan for future exports. Korea approved new units and its first new site in decades. Russia continues to grow both domestically and continues to be very aggressive in the export market.

Given the importance of nuclear power, it is the first time since 2006 the WEO includes a special chapter on nuclear – in fact this time 3 full chapters performing a detailed in-depth analysis of the nuclear option. It clearly demonstrates the benefits of nuclear power in addition to being one of the only generation options at scale available to reduce carbon emissions; it also plays an important role as a reliable source of baseload electricity that enhances energy security. Clearly the benefits and the need for more nuclear is becoming clearer than ever. So why is there this continuing imbalance as we look around the world at various counties' policies for nuclear power?

The WEO notes two significant issues holding back a large-scale nuclear renaissance. These are public concern and economics. Both are valid and need to be better addressed by the industry. We have written much over the past year or so on the importance of improving public attitudes and, in fact, in many countries we now see improvement. But we also acknowledge there is a long way to go to reduce public fear about nuclear power. For example, even though the main objective of Germany's Energiewende is to reduce carbon emissions; their even stronger emotional response against nuclear is causing a short term increase in carbon emissions .i.e. their fear of nuclear is stronger than their desire for a cleaner environment.

On the cost side, concerns about high capital costs and completing projects to cost and schedule are valid. The

industry has more work to do on this issue as evidenced by some recent projects. At the same time we see that countries such as Korea and China, who are building series of plants in sequence and are achieving the benefits of replication and standardization resulting in lower costs and improved certainty, are completing projects to cost and schedule. Yes, it can be done. But even these countries are not immune to public concerns.

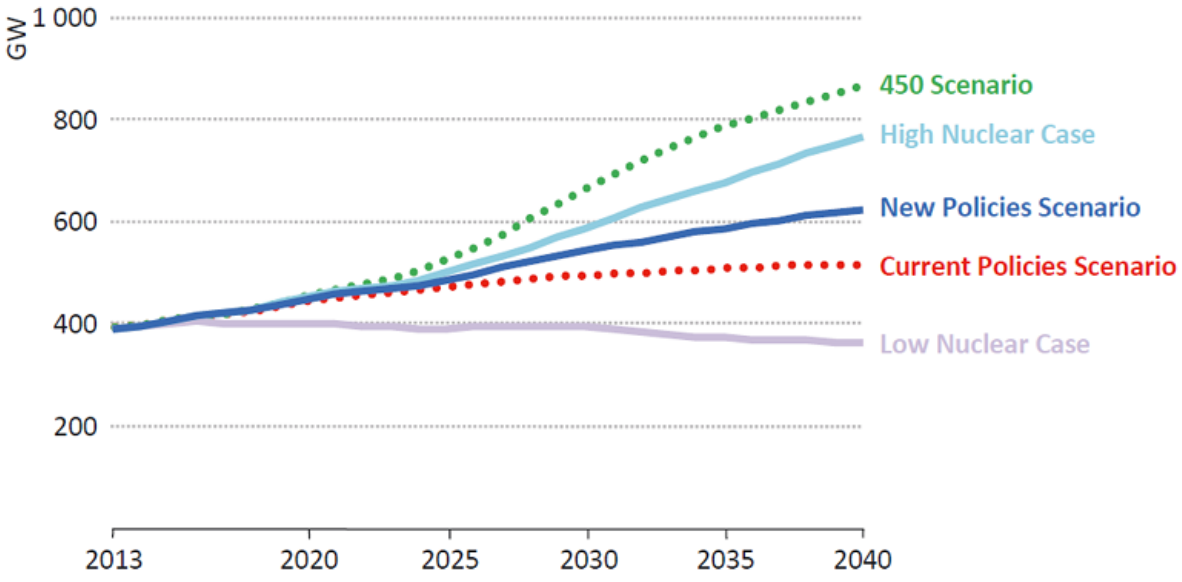
The real problem is that these concerns tend to overwhelm the discussion even amongst energy professionals. For example the summary in Chapter 12 of the WEO, "The Implications of Nuclear Power", starts "*Provided waste disposal and safety issues can be satisfactorily addressed, nuclear power's limited exposure to disruptions in international fuel markets and its role as a reliable source of baseload electricity can enhance energy security…..* ". Renewables are always addressed with hope and little concern for their very real issues while discussions about nuclear are most often focused on its challenges.

Yet even at Google, engineers have come to a conclusion that the challenges to achieving climate goals with renewables are very large. Two Google engineers assigned by the company to show how renewable energy can tackle climate change each came to a blunt conclusion: It can't be done. As stated, "*Trying to combat climate change exclusively with today's renewable energy technologies simply won't work; we need a fundamentally different approach*."

The following figure sums it up very clearly. In the case that doom and gloom overwhelms good policy and decision making, we may end up with the Low Nuclear Scenario. But this scenario has real implications – "*taken at the global level, a substantial shift away from nuclear power, as depicted in the Low Nuclear Case, has adverse implications for energy security, and economic and climate trends, with more severe consequences for import-dependent countries that had been planning to rely relatively heavily on nuclear power*." Of more

importance, at the other end of the spectrum is the 450 Scenario which the IEA believes we need to achieve to truly have an impact on climate change. And in this case, even more nuclear power than the so called “High Nuclear Case” Is needed.

Figure 11.12 ▷ Global nuclear power capacity by scenario and case



So there it is, the best way to economically and efficiently address climate change is with a substantial contribution by nuclear power. This year’s WEO lays out the challenge very clearly – once gain nuclear power is at a crossroads. The options range from a slow decline to a more than doubling of nuclear power in the next 25 years. Nuclear power must be an important part of any future low carbon energy system but there are beliefs that are very well entrenched in the minds of both the public and even many global energy professionals that must be addressed once and for all. It is our responsibility to take on these challenges for a brighter future. It’s time to go big and work together to build a strong base of global support for nuclear power. Beliefs are hard to change, but change them we must if we are to have a sustainable, abundant and economic energy future for us all.

And as 2014 comes to a close, I want to thank all of you for continuing to read our blog and contribute to the discussion.

Wishing you all a very happy, healthy and prosperous 2015!

If we are serious about carbon free electricity – there must be more nuclear power

Last month, we wrote about the ongoing push by the United Nations to combat climate change and its underwhelming support for nuclear power as an important part of the solution. To no one's surprise, the final volume of the current IPCC report on climate change issued November 1 is no different. Yet this report is very clear in its conclusion that limiting the impact of climate change may require reducing greenhouse gases emissions to zero this century. So while the world is focused on developing a range of new technologies to meet this challenge, fossil fuel use continues to grow. In reality, the answer is right in front of our eyes. What the world needs is a massive increase in nuclear power.

While many will write about this most recent IPCC report, we want to bring some new perspective and once again discuss the role of nuclear power as an essential tool to reduce carbon emissions. There are a few new studies and announcements this past month that show the paradox of current policies.

First there was a study released in Nature that suggests that even though natural gas emits about half the carbon of coal, abundant natural gas alone will do little to slow climate change. The study's lead author Haewon McJeon, an economist at the US Department of Energy's Pacific Northwest National

Laboratory said, "*Global deployment of advanced natural gas production technology could double or triple the global natural gas production by 2050, but greenhouse gas emissions will continue to grow in the absence of climate policies that promote lower carbon energy sources*." This is in contrast to many who believe that gas is an important part of the solution. We have no issue with gas and believe it can be an important part of a diversified electricity system; but according to this study, it is not a great tool in the fight against climate change.

Of even more relevance to the discussion, a recent report issued by Hatch Ltd. in Canada,"*Lifecycle Assessment Literature Review of Nuclear, Wind and Natural Gas Power Generation*", demonstrates the challenges of relying too much on wind to drive down emissions. This report notes that wind as an intermittent resource is usually backed up by gas. So if wind generally operates about 20% of the time, the gas backup would be operating the other 80% continuing to emit carbon. Therefore nuclear emits some 20 times less carbon than a wind/gas combination (see figure below). Most of us in the energy industry know this is why gas producers are often strong supporters of wind and solar. While the public believe wind is good for the environment; it's even better for the gas industry.

Even the wind industry acknowledges these results. They note this is only one scenario and that there are more plausible scenarios where wind would be supported by demand side management, storage and other means of clean generation. This is indeed a laudable goal for the future, but the reality remains, today most renewables are backed up by gas.

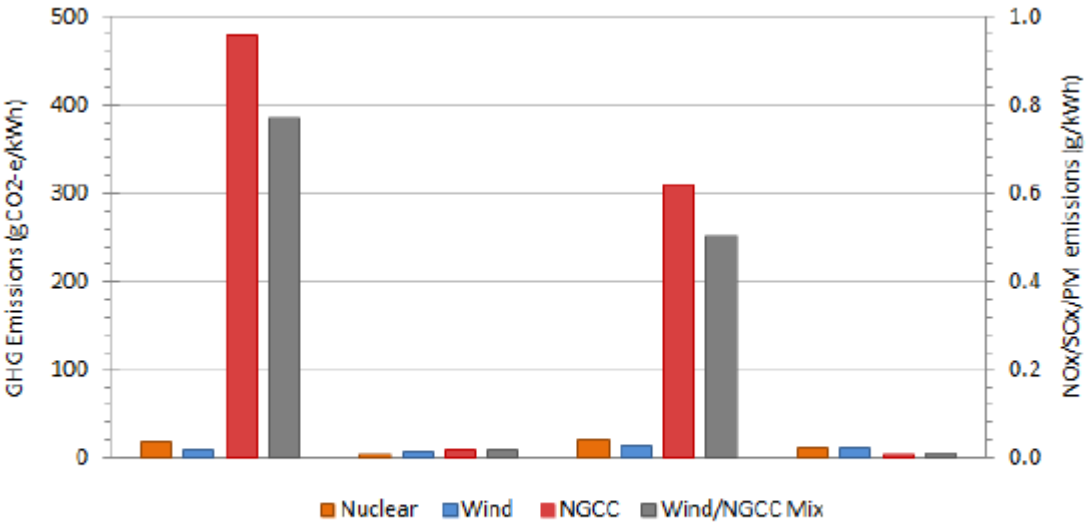


Figure 18. Summary of Total Lifecycle Emissions

All of the above would suggest that there should be more support for nuclear as a very important element for a solution to climate change. It is effective and available today and most of all can provide large amounts of clean reliable electricity.

In fact, the public is quite aware of this. A just released study in the USA is showing eighty-two percent of those surveyed agree with the statement, “We should take advantage of all low-carbon energy sources, including nuclear, hydro and renewable energy, to produce the electricity we need while limiting greenhouse gas emissions.” Further 75 percent of those polled said nuclear energy will be “very important” or “somewhat important” in meeting America’s future electricity needs. Seventy-three percent of those surveyed associate nuclear energy with clean air. Clearly a very important step in securing the support required to increase the use of nuclear energy.

On the other hand, we have also seen more negative political views. In Sweden, after reconfirming the need for more nuclear power in 2009; the outcome of the most recent election had the new government stepping back in order to gain support from the Greens. Social Democrat leader Stefan Lofven said “*Sweden*

has very good potential to expand renewable energy through our good access to water, wind and forests. In time, Sweden will have an energy system with 100% renewable energy." Reality clearly has no place in politics.

And of even more concern is the recent vote by the French parliament to reduce the use of nuclear energy from 75% to no more than 50% by 2025. They must remove a plant from service when Flamanville comes into service in the next year or so as the amount of nuclear power cannot increase. And it looks like the French president himself will take the decision on which plant to shut down. Taking safe clean reliable power out of service prior to its end of life purely as policy seems foolish at best. The Hatch study shows this strategy will most likely lead to increased use of fossil fuels and thus higher carbon emissions at least in the short to medium term. This is exactly what we have seen in Germany. Taking a large amount of nuclear out of service is requiring the construction of new coal generation even though Germany is expanding renewable generation at a very high rate.

So what does this all mean? As we have said many times before, removing and / or reducing nuclear strictly for policy reasons, especially in the case of successfully operating units means only one thing – that there remains an overriding societal belief that nuclear is not safe – and therefore less is always better than more. While some environmentalists now realize this is not the case; this truth has not yet caught up with the public at large and hence is not always supported by their politicians.

The IPCC report is clear that the world must take action to combat climate change. Nuclear power is the only large scale source of clean abundant reliable electricity generation available and that should make it an essential part of the solution. Trying to generate all electricity with zero carbon emissions without making extensive use of nuclear power is simply making what is already very difficult, pretty much

impossible.

Attention to climate change is on the rise… nuclear power is an essential part of the solution

September 2014 was a most interesting month in the fight against climate change. As world leaders prepared to meet at the United Nations Climate Summit on September 23, there was a large global march in New York on September 21 to bring public concern for climate change to their attention. As stated by the UN meeting chair, "*The purpose of the 2014 Climate Summit was to raise political momentum for a meaningful universal climate agreement in Paris in 2015 and to galvanize transformative action in all countries to reduce emissions and build resilience to the adverse impacts of climate change*."

The New York march had some 300,000 participants, well above the 100,000 people expected. Has the tide turned and is climate change finally getting the international attention it deserves? Is public concern finally pushing governments to act? The climate summit had a large attendance, including 100 Heads of State and Government and more than 800 business and other leaders.

The summit did appear to make progress. A summary of the outcome can be read here. Of importance,

- World leaders agreed that climate change is a defining issue of our time and that bold action is needed today to reduce emissions and build resilience and that they would lead this effort.
- Leaders committed to limit global temperature rise to less than 2 degrees Celsius from pre-industrial levels.
- Leaders committed to finalize a meaningful, universal new agreement under the United Nations Framework Convention on Climate Change (UNFCCC) at COP-21, in Paris in 2015, and to arrive at the first draft of such an agreement at COP-20 in Lima, in December 2014.

Another important gesture of the new global commitment to reducing carbon was the fact that the Rockefeller Brothers Fund, which has $860 million in assets and was founded in 1940 by the sons of oil tycoon John D. Rockefeller, decided to divest its fossil fuel holdings in response to climate change and announced this just prior to the UN meeting. While this fund is not huge in size, the statement is important given the Rockefellers made their fortune in oil. This announcement makes their fund join the approximately 800 other global investors representing $50 billion in assets who have decided to move away from fossil fuels to support a solution to climate change.

So what about the role of nuclear power in this fight to reduce carbon emissions? The Economist published a very interesting figure demonstrating that, when it comes to energy production, the worldwide use of nuclear power is second only to hydro (and not by much) in having reduced global emissions to date. And while renewables are a growing source of emissions-free energy, all other efforts to reduce emissions have been one or two orders of magnitude less effective in reducing global carbon so far.

To slash or to trim

1

Emission reductions by policies/actions, bn tonnes CO_2 equivalent

Policy/Action	Cumulative emissions	Period	Annual emissions*
Montreal protocol[1]	135.0bn	1989-2013	5.6bn
Hydropower worldwide[2]	2.8bn	2010	2.8bn
Nuclear power worldwide[2]	2.2bn	2010	2.2bn
China one-child policy[3]	1.3bn	2005	1.3bn
Other renewables worldwide[2]	600m	2010	600m
US vehicle emissions & fuel economy standards†[4]	6.0bn	2012-25	460m
Brazil forest preservation[5]	3.2bn	2005-13	400m
India land-use change[6]	177m	2007	177m
Clean Development Mechanism[7]	1.5bn	2004-14	150m
US building & appliances codes[4]	3.0bn	2008-30	136m
China SOE efficiency targets[8]	1.9bn	2005-20	126m
Collapse of USSR[9]	709m	1992-98	118m
Global Environment Facility[10]	2.3bn	1991-2014	100m
EU energy efficiency[11]	230m	2008-12	58m
US vehicle emissions & fuel economy standards‡[4]	270m	2014-18	54m
EU renewables[11]	117m	2008-12	29m
US building codes (2013)[12]	230m	2014-30	10m
US appliances (2013)[12]	158m	2014-30	10m
Clean technology fund[13]	1.7bn	*project lifetime*	*na*
EU vehicle emission standards[14]	140m	2020	*na*

CATEGORIES:
Energy production
Transport
Other regulations
Global treaties
Land & forests
Other

See following panel for sources and explanations

*Annual emissions are cumulative emissions divided by the relevant period. The estimate for the current emissions avoided under the Montreal protocol is eight billion tonnes of CO_2e. The annual figure for the collapse of the USSR refers to the years 1992-98. †Cars and light trucks ‡Heavy trucks

Nuclear power's critical role in the fight against climate change has been confirmed by US Energy Secretary Montiz who has said "*that nuclear energy, as an important low carbon energy source, must play a major part in meeting the most pressing challenge of climate change*."

Yet there continues to be a disconnect. Looking deeper into the outcome of the UN Climate Summit, their statement on energy says "*A shift toward renewable sources of energy such as solar, wind and geothermal – along with greater energy efficiency in appliances, buildings, lighting and vehicles – is essential to use the world's resources sustainably, diversify economies and successfully address the challenge of*

climate changes. Sustainable Energy for All, an initiative led by the United Nations and World Bank, has set 2030 as a goal for doubling the global rate of energy efficiency improvement, doubling renewable energy's share in the global energy mix, and ensuring universal access to modern energy services."

The same goes for the Rockefeller Brothers Fund. Stephen Heintz, president of the fund, said in their statement, *"We are quite convinced that if he were alive today (John D. Rockefeller), as an astute businessman looking out to the future, he would be moving out of fossil fuels and investing in clean, renewable energy*."

As I see it, there has to be a more explicit understanding by the UN and others that nuclear power has and continues to be a leading source of low- carbon energy. The implication of their words seems to be the future belongs to renewables (solar, wind and geothermal). Nuclear is not explicitly mentioned yet, as illustrated by the Economist, it is a very clean technology playing an essential role in reducing carbon emissions. In fact, the word nuclear seems to be purposely avoided. Why is this? As an industry, we have allowed these beliefs to be perpetrated. Somehow we have tolerated nuclear power being seen as yesterday's technology while solar and wind are tomorrow's. Or is the issue that we have allowed the fear of nuclear to persist and continue to outweigh the potential benefits to many?

This is a major concern and a disservice to the fight against climate change. As one of the outcomes of the UN Climate Summit is a commitment to increase the amount of funds available to support clean energy technologies, it is essential that nuclear power be specifically included. Yet in their statement on financing, we see "*the goal of reaching a "Clean Trillion" in annual energy investments has been a widely cited target, with a minimum of 5% of a portfolio invested in renewables and clean technology as a benchmark for investors*." It's time for nuclear to be included as the clean

energy technology leader that it is.

The time to act is now. There is work to do to ensure that, as climate change concerns continue to build, government policies around the world recognize an essential part of the solution is a significant new nuclear build program using both technology already available today as well as continuing to invest in the more fuel efficient nuclear technologies of future. And that means funds being allocated to a cleaner tomorrow be directed to new nuclear as well as all the other initiatives to reduce the global carbon footprint.