

Closing perfectly good nuclear plants before their end of life – it's a sin!

In March, Kuosheng Unit 2 became the latest nuclear unit to be retired following the expiry of its 40-year operating licence in accordance with Taiwan's nuclear phase-out policy. This is the fourth unit to be shut down in Taiwan leaving just two more operating units at Maanshan. When their licences expire in 2024 and 2025, the island's phase out will be complete, taking its once 20% nuclear share down to zero. And as has been the case with most other nuclear plant closures around the world, its output will be replaced with fossil fuels, adding carbon emissions at a time when we are all trying to reduce them. Taipower has reassured its customers there are numerous new gas-fired power generation projects and even new coal-powered units being brought online this year to make up for the energy lost as a result of its unnecessary nuclear phase out.

Of course, Taiwan is not the first to go down this path. Over the last few years, there have been a number of plants that were closed before their time. In the US, it was primarily due to competition from low-cost gas in deregulated markets. In Europe and Asia, it was simply a result of government anti nuclear policies. Today as we pass the 12th anniversary of the Great Tohoku earthquake and tsunami in Japan, that also triggered the Fukushima nuclear plant accident, things are changing rapidly.



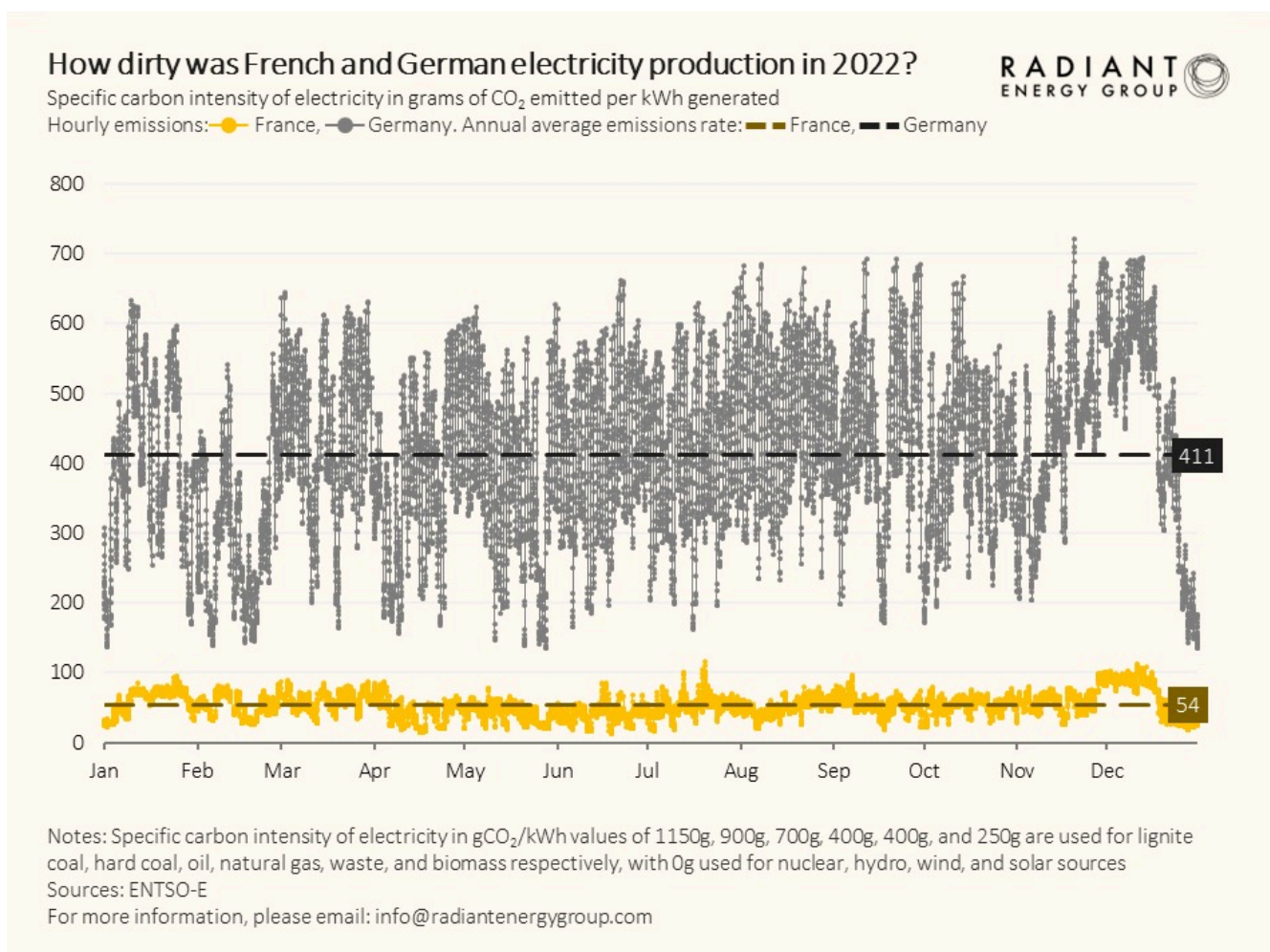
Source: [istockphoto.com](https://www.istockphoto.com)

Why? There are two urgent drivers to the revisiting of nuclear power. First and foremost, is the energy crisis in place in Europe due to the war in Ukraine. When energy security is at risk, people respond, and respond quickly. And then there is climate change. With more and more countries setting net zero goals, it has become crystal clear that nuclear must be part of the mix. We have never been more optimistic about the future of nuclear power playing an essential role in a decarbonizing world.

As we have said many times before, deciding not to continue to use nuclear power is the right of every sovereign nation. However, if you believe you have better options, build them, then shut down the old plants. What we have seen is the opposite. Closing nuclear plants in Germany, emissions go up, close Indian Point in New York, emissions go up, close San Onofre in California, emissions go up. Belgium plans to close its nuclear fleet and replace it with gas, emissions will go up. And so on and so on and so on.

It took an energy crisis in Europe for the penny to drop. Closing perfectly good plants that emit zero carbon without having something better to replace them is folly.

Progress has been made. After seeing about 10% of its operating units close, the US started saving units through state legislated support, and now is ensuring nuclear remains an essential part of its carbon reduction strategy with provisions in the recent federal Inflation Reduction Act (IRA). Even when it was generally thought to be too late to save Diablo Canyon in California, common sense prevailed. Belgium has agreed to run its two newest plants another decade and is considering minor extensions for its older units. Korea has recovered from its period of anti nuclear policies and is once again moving full steam ahead. Japan, a decade after the Fukushima accident is recommitting to nuclear power. Even Germany is contemplating extending its final units' lifetimes, even if only by a very little bit.



We now have enough experience with the early movers who have hoped to decarbonize with renewables alone. Germany has spent two decades and over \$500 Billion dollars and made little

progress on its emissions reduction goals. Its huge investment in renewables has not been sufficient to overcome the impact of shutting down most of its nuclear fleet. The chart above shows that in 2022, France, with its mostly nuclear fleet emitted about 8 times less carbon than Germany. The evidence is in. Trying to decarbonize with renewables alone is simply not feasible.

But the worst offences remain shutting down perfectly good operating plants before their time. There are 437 nuclear units in operation around the world producing about 10% of the world's electricity. Yet they also represent the second largest source of global low carbon generation after hydro. Add to that, as stated in the IEA/NEA Projected Cost of Electricity 2020, life extending nuclear plants is the single lowest cost option of any type of electricity generation. No surprise. If something is capital intensive, as nuclear power is, then it makes sense to maximize use of the asset once you have the capital behind you.

So, for all those countries thinking about closing well operating zero emissions nuclear plants before their time, remember what the Pet Shop Boys have said many years ago – It's a Sin!

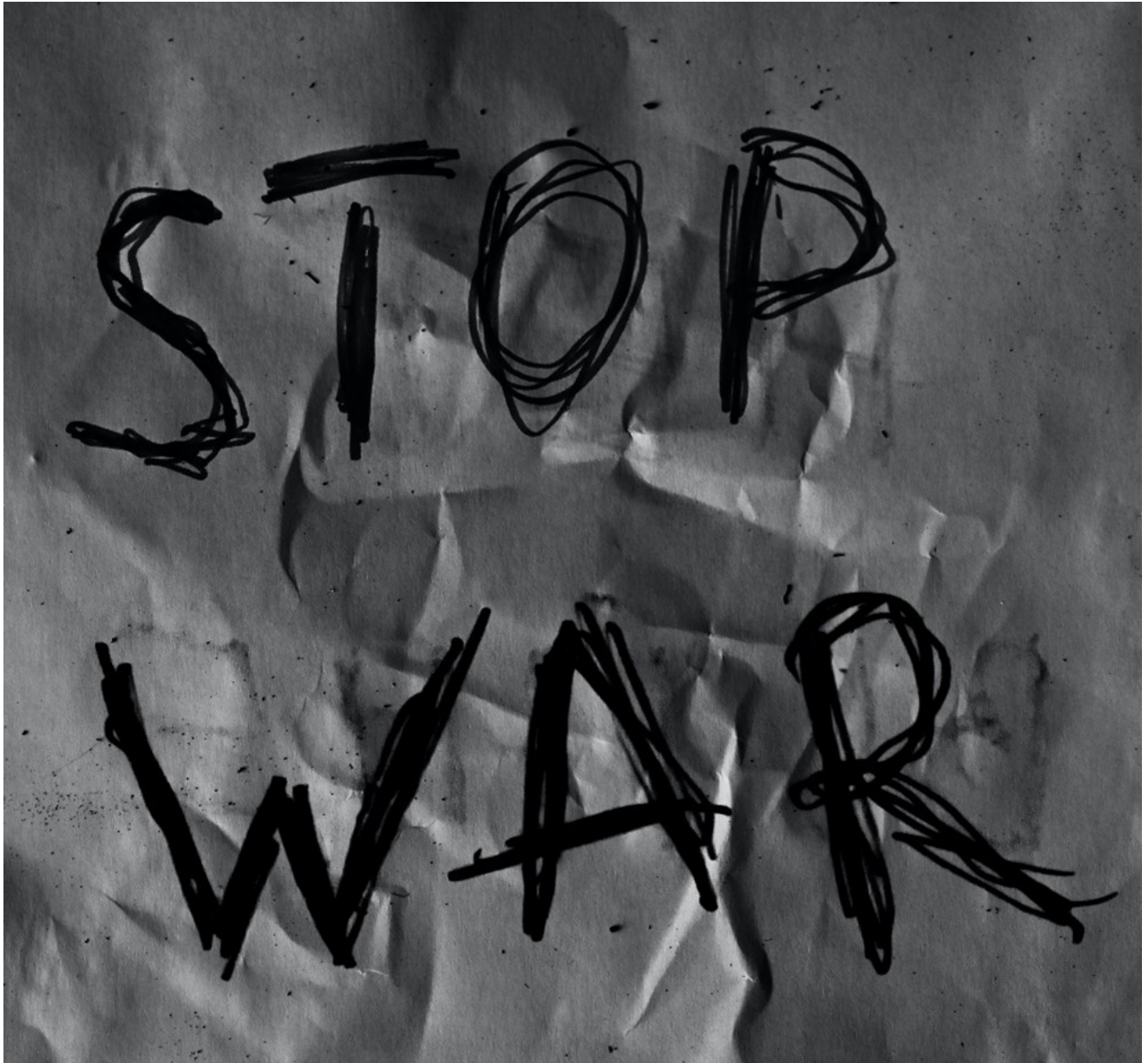
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A war raises fears about nuclear plant safety

As the 11th anniversary of the Fukushima accident passed in March, there were none of the regular articles that we see in the press every year to remind us how scary that event was. Often these articles have focused more on the nuclear accident and barely mentioned the catastrophic impact to Japan of the Great Tohoku earthquake, the cause of both the nuclear accident and more than 20,000 deaths.

This year the news was all about the shocking events in Ukraine, where it was reported that Russia occupied and attacked two nuclear sites; the Chernobyl site, home to the worst civil nuclear accident in history (1986), and the Zaporizhzhya plant – which is Europe's largest operating nuclear power station. This created a new level of fear for what may happen in the event these plants are damaged due to a planned attack.



Source: Pexels.com

The war in Ukraine is causing untold horror and suffering to its people. However, excessive worry about an event at a nuclear plant greatly increasing the devastation is misplaced. There could be military reasons to occupy a power plant such as the desire to control critical infrastructure. There is also the view that setting up a base at a nuclear plant would deter defensive attacks to avoid damaging the plant. Whatever the reason, the likelihood of actually trying to damage the plant and release large amounts of radiation to the environment is small. There have been many articles on why these nuclear plants are safe. Here is one to provide some context.

First of all, nuclear plants are extremely hardened against attack. The fire power needed to do damage that would result in large releases is substantial. It would be far easier to damage the switch-yard or transmission lines to stop energy from flowing. And when it comes to dramatic consequences, there are many easier industrial targets that would inflict more damage.

As of the most recent report from the IAEA on April 28, *"Regarding the country's 15 operational reactors at four nuclear power plants, Ukraine said seven are currently connected to the grid, including two at the Russian-controlled Zaporizhzhya NPP, two at the Rivne NPP, two at the South Ukraine NPP, and one at the Khmelnytsky NPP. The eight other reactors are shut down for regular maintenance or held in reserve. Safety systems remain operational at the four NPPs, and they also continue to have off-site power available, Ukraine said."*

There is also little to gain and much to lose from damaging a nuclear plant. Russia is on the border with Ukraine and would be at risk of radiation affecting its own territory. Prior to the war, Russia was the most prolific exporter of nuclear plants around the world with a reported project backlog in excess of \$100 Billion. This export market will certainly be impacted by this war. Russia would not want to demonstrate their plants are not safe and that they are readily subject to catastrophe.

This is not the first time fear of what may happen at a nuclear plant has exceeded the fear of the initiating event. In each case, the nuclear industry responded by making improvements at nuclear plants to reduce the risk. Following 9/11 in 2001, fear of a terrorist attack on nuclear plants resulted in much hardening of plants to withstand such an attack. Following Fukushima, all the plants in the world made changes to better withstand the impact of natural disasters such as earthquakes and tsunamis. And now, the fear of what

may happen at a nuclear plant seems to be even greater than other consequences of war.

This all comes down to the narrative that nuclear plants are just a whole different level of risk compared to the many other things that can cause serious consequences. Nothing can be further from the truth. In reality, people don't die from nuclear plant accidents. They do die from plane crashes, bombings, exploding gas from leaks and natural disasters. To date, many thousands have perished during this terrible war. Yet fear is greatest when thinking about what may happen should a nuclear plant have an accident. That being said, of course there can be consequences from attacking a nuclear plant and it is important that the plants in Ukraine are maintained and operated safely. But one thing is for sure, we need not be afraid of nuclear plants. We do need to be concerned about terrorism, natural disasters and of course, the horrific consequences of war.

Fukushima 10 years later – its time to focus on the social science

Ten years have passed since Japan suffered the great Tohoku earthquake and tsunami that killed 20,000 people, caused US\$300 billion of damage and initiated the accident at the Fukushima Daichi nuclear power plant.

Reviewing the media reporting last month, the nature of the stories has changed. There were of course many articles that continued to talk about the dangers of nuclear power but there were also numerous articles noting the real lesson to be

learned from the accident is that nuclear power is safe. And when news outlets associated the deaths in Japan with the nuclear accident, complaints resulted in many of them accepting their articles were wrong and issuing corrections to state the deaths were all due to the earthquake and tsunami.

When it comes to the actual impact of the accident on human health, the science is absolutely clear. No one died from radiation from this event (the Japanese have associated one death of a nuclear worker with radiation, but the science does not support it). A recently (2020 edition) updated United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) report on the levels and effects of radiation exposure due to the accident said that future health effects, e.g. cancer directly related to atomic (nuclear plant) radiation exposure are unlikely to be discernible. But that doesn't mean there was not a large impact on people and Japanese society as a whole. People are suffering consequences related to the fear of radiation and its potential impact to them and their families, rather than from the radiation itself. As stated in the earlier 2013 UNSCEAR report, *"The most important health effect is on mental and social well-being, related to the enormous impact of the earthquake, tsunami and nuclear accident, and the fear and stigma related to the perceived risk of exposure to ionizing radiation."* Addressing this impact is essential for both the Japanese people that continue to suffer and to minimize these kinds of impacts in the future.

How society feels about different technologies and their dangers vary dramatically resulting in a broad range of public views when accidents happen. Let's look at some of the tragic events that have happened around the world in recent years and how society reacted.

In 2018 and 2019 two Boeing 737 MAX aircraft crashed (in Indonesia and in Ethiopia) killing 300 people. After the

second accident the world reacted (two accidents so close together for a new design has never been seen in the history of modern aviation), and these planes were grounded for over two years as serious safety culture issues were identified at Boeing. Changes have been implemented to correct the deficiencies with the planes now declared safe and returned to service. Why did it take so long for the industry to react and why did the public not become more concerned about flying? Flying is important to the world as we all want to travel. We accept flying as safe and are willing to overlook an accident as a rare event even though the consequences are tragic. (Since the pandemic we miss travelling more than ever.) Reporting was more related to how the issue can be resolved to get the planes flying again than in creating fear of flying.

Last summer, a large amount of ammonium nitrate stored at the port of the city of Beirut, the capital of Lebanon, exploded, causing at least 215 deaths, 7,500 injuries, and US\$15 billion in property damage, and leaving an estimated 300,000 people homeless. This was a huge tragedy, with the blame focused on the corruption of the Lebanese government. There was no reporting talking about this dangerous substance and its risks. No one was asking how it should be safely stored and transported and whether there are shortcomings in the regulations on how to keep people safe. In fact, the industry that creates the chemical was nowhere to be seen in the discussion.

Finally, as we all continue to feel the impact of this global pandemic that to date has infected more than 145 million and killed more than 3 million, we still have many who are fighting against public health directives focused on keeping us safe and some who simply choose to not accept the danger posed by this disease. With the end of the pandemic now in sight because of the amazing success of vaccines developed in record time, the biggest risk remains vaccine hesitancy.

Somehow there are many people who are more afraid of the vaccine than the disease.

Looking at these examples, we see that:

- It takes two crashes to convince authorities to look for problems with a new aircraft design. The public, although concerned, does not become afraid to fly as long as it is on a different aircraft model (easily compartmentalizing the risk to a specific model) and most are likely to feel comfortable flying on the 737 MAX now that it has been approved to fly again;
- A devastating explosion of a dangerous chemical raises no questions at all about the chemical itself. The public are comfortable allocating the blame to government incompetence without any thought to whether or not others are unsafe who are using this substance;
- A global pandemic that to date has killed more than 3 million people and completely disrupted all of our lives for over a year is not enough for some to follow the science while erroneously worrying that the cure may be more dangerous than the disease risking a delay to the end of the pandemic; and
- An accident at a nuclear plant resulting from an extreme once in a hundred-year natural disaster disrupts the lives of many and kills no one. The conclusion for some is the technology is so dangerous that there are calls to completely shut down the industry, with some countries like Germany who have no plant models that are similar to Fukushima nor the conditions for a similar event deciding the risks are too great.

Our purpose here is not to go into detail but to contrast how we as a global population choose to see threats and risks and respond to them. Each one of these examples demonstrates a vastly different response as the public has varying degrees of

concern when evaluating risk. Often many of us try and discuss why we think this is the case. However, truly understanding these differences in perception and reaction is a task for the social scientists. The issues are complex. Studies are needed to learn how to better address public concerns and develop strategies to ensure that risks are contextualized, and science better explained to ensure the best possible response when tragic events occur.

It is a good thing the nuclear industry learns lessons from its experience to make nuclear better, but we also seem to define ourselves by our accidents rather than by our successes. Perhaps its time for that to stop. It may have taken a decade, but the world is realizing the benefits of nuclear power far outweigh the risks (a phrase we hear every day about vaccines) and that climate change is the greater threat to humanity that needs to be addressed now, with nuclear power being an important part of the solution.

10 years of blogging... Nuclear power is making progress, but it hasn't been easy

It's hard to believe, but this month it is 10 years since our first blog post in May of 2009. 10 years! And what a decade it has been for the nuclear power industry. There were highs and lows, and most of all change....

In 2009, there was still optimism about the nuclear

renaissance, until the effects of a world financial crisis and the first downturn in global energy demand since World War 2 made it a difficult time to support large energy projects. Nevertheless, the first next generation EPR design in Finland was under construction, and the UAE would soon select the Koreans to build their new nuclear plant (based on their next generation APR1400), to become the first nuclear newcomer-country in many years.

This was also the time the environmental movement started to consider the merits of nuclear power. It was 2009 when Stuart Brand published his book "Whole Earth Discipline: An Ecopragmatist Manifesto" in which he took on the environmental establishment with this statement that ***"Cities are green. Nuclear energy is green. Genetic engineering is green."*** This was a turning point for some environmentalists as they started to question their life-long opposition to nuclear power.

It was looking like the industry would weather the financial storm, but then in 2011, the great Tohoku earthquake and the tsunami that followed devastated the coast of Japan resulting in a serious accident at the Fukushima Daichi nuclear power plant. While no one was killed, an event of this magnitude in an advanced country such as Japan heavily reliant on nuclear power caused a huge amount of global fear. To this day Japan only has 5 of its units in operation with some others permanently out of service as many more are working to meet new higher safety standards to enable them to restart. Some countries took a common-sense approach such as China, who stopped approving new builds until they could satisfy themselves that all was in order. Others such as Germany decided to abandon the technology altogether.

There were some positives in this immediate post Fukushima

accident period. In the US, two AP1000 projects were approved in 2012 at Vogtle and VC Summer. The UK continued to march forward with its commitment to new build although it took another year for the UK government to agree to a price of energy for the Hinkley Pt C project which is now under construction.

In 2015 Canada made a big re-commitment to nuclear power approving the refurbishment and life extension of 10 units at Bruce and Darlington, a commitment of \$25 Billion over 15 years. This clearly showed a strong commitment to nuclear as these plants will continue to be the backbone of the Ontario electricity system into the 2060s.

PERCEPTION



REALITY



And there were many challenges. The world's two largest nuclear vendors, Westinghouse and Areva, struggled financially as a result of difficult projects that impacted their financial viability. After taking a huge financial hit, the VC Summer project was cancelled, and Toshiba sold the bankrupt Westinghouse to Brookfield. Meanwhile In the US, hydraulic fracking produced very cheap natural gas causing financial mayhem in those states with de-regulated electricity markets resulting in some early nuclear plant closures and more being considered for economic reasons.

In France, Areva was restructured into Framatome and Orano as the Olkiluoto project in Finland and the Flamanville project in France continued to be delayed. French government support for nuclear weakened as it set out a policy to reduce its reliance on nuclear from 75% to 50% by 2025.

However, in the US today many states are pushing back and providing support to keep their plants operating as they acknowledge the benefits of nuclear power to grid reliability and their near zero carbon emissions. And in France, the current government has accepted the importance of nuclear power delaying the roll back to 50% to at least 2035 as they consider their future strategy.

While many countries in the west continued to experience challenges, the east is charging ahead. China has the world's most ambitious nuclear program having reached 45 units in operation and targeting to triple this by 2030. They are also starting to work their way into the export market with success in Pakistan and discussions ongoing with many countries. And Russia is having a big impact on the global industry as Rosatom has become a leading exporter of nuclear plants.

Concern about climate change has increased with the most recent agreement to reduce green house gases made in Paris in 2015. Following in the steps of Stuart Brand, more environmentalists now believe that nuclear power must be a part of the solution. The evidence from Germany and California demonstrate that a 100% renewable future is not in the cards as the challenges of managing a system based on an energy-diffuse, intermittent energy source becomes clear. To really decarbonize the world must use all the tools available to reduce emissions. This includes nuclear power. Many governments agree and at the Clean Energy Ministerial (CEM) meeting in Vancouver (just getting underway as we write this post), discussion will continue about the NICE initiative (Nuclear Innovation – Clean Energy future (NICE)) advocating for all clean energy options to be on the table – and this includes nuclear power.

During this meeting, the IEA is expected to release a report that supports the need for nuclear energy to meet climate goals.

There is also an active movement to develop the next generation of nuclear plants, so called SMRs (small modular reactors), that are to be smaller, more versatile and easier to build. The thought is to replace the economics of scale with the economics of numbers. The UK, Canada and the US are all promoting these options with a plethora of companies working on these novel designs.

While there have been challenges over the years, we have

seen much progress. Every time negative emotions knock us down, facts and logic raise us up. Today we have the first AP1000s, EPRs, VVER1200s and APR1400s in operation, governments are talking about the role of nuclear power to decarbonize the world to combat climate change, a new generation of SMRs is under development, and environmentalists are seeing the possibility of using these plants going forward. This provides us with hope, but we always recognize that while hope is nice, it is not a strategy. There is much work to do in the next decade and the outcome is far from certain. But there is one thing we are certain of – the world needs lots of energy, clean, reliable and economic to power mankind – and nuclear power has what it takes to deliver.

As for our blog, over the last decade we have written about nuclear power's ups and downs, focused on various countries from China to Korea to Canada and the UK, talked about economics and how to make projects successful and the impact of the Fukushima accident on the psychology of the world.

What about the future?

While our audience has increased dramatically over the last 10 years, we are still talking mostly to ourselves – the nuclear industry – and while that may make us all feel good, it does not change minds. We plan to work hard to expand our reach and start a dialogue with those who are more skeptical of nuclear power and see where

that takes us. And of course, we want to continue to talk about those things that are happening and what they mean for both the industry and the world at large. Your thoughts and recommendations on future direction are welcome.

We thank you for reading our blog and hope you will continue.

It's fear, not facts, that influence our attitudes and beliefs

"We are the healthiest, wealthiest, and longest-lived people in history. And we are increasingly afraid. This is one of the great paradoxes of our time." As said by Daniel Gardner in his book "The Science of Fear: How the Culture of Fear Manipulates Your Brain" more than a decade ago; fear can be all consuming and it is often hard to understand how we choose what to be afraid of and why.

8 years ago this month, Japan suffered the great Tohoku earthquake and tsunami that killed more than 20,000 people and caused US\$300 billion of damage. Entire towns were wiped out when the wave hit on March 11, 2011. Farms, factories, roads, railways and electricity lines were destroyed, while almost half a million people were made homeless. Yet when you research this tragic event, the focus is more than likely to be on the resulting accident at the Fukushima Daichi nuclear power plant than on the natural disaster. The reality is that **no one died from the nuclear accident**, although some died

indirectly as a result of the evacuation. No one was exposed to enough radiation to cause future concern for their health, but there are health impacts, all as a direct result of a tremendous fear of radiation and what people believe may be its potential impact on the population and their families. It is this same fear that is delaying the recovery of the nearby towns even though radiation levels are as low as other safe cities in the world like Hong Kong and London while the area's fruits and vegetables are fine to eat and so is the catch from the Fukushima fishing boats. When this tragedy is discussed, it is not fear of earthquakes and tsunamis that are talked about, it is an overwhelming fear of radiation.



Japan plans to lift the evacuation order for part of Okuma town on April 10

But it is not just radiation that we fear. For years, there has been a portion of the population that has feared vaccinations and as a result, have refused to immunize their children against preventable childhood diseases. Currently, we have an outbreak of measles in North America, a disease that should no longer exist given there is a very effective vaccine to prevent it. But over the past decades there has

been a huge fear campaign by so called anti-vaxxers, causing many people to be wary of vaccinating their children and allowing the disease to flourish once again. The science clearly shows the risk is essentially zero for those getting the vaccine while the risk of complications from the disease are indeed real. Prior to the availability of a measles vaccine, 2.6 million children annually died of the childhood disease. Today, that number is 109,000 but it should be zero. The WHO (World Health Organization) has now declared “vaccine hesitancy” as one of the top ten health threats to the world in 2019. So why is it, when the science is clear, so many are so afraid of vaccines to the point that they are willing to put their children’s health at risk (although they believe they are protecting them)?

This month we had a second tragic accident with the new Boeing 737 MAX as an Ethiopian Airlines plane crashed soon after take-off causing 157 deaths. This is the second crash of this new version of the popular airplane in 6 months; the first being a crash of a Lion Air flight in Indonesia last October, killing 189. Never before in the modern air travel age have we seen a new version of a plane come out and have two fatal crashes within 6 months of each other – and so soon after the plane first entered commercial operations. Yet it took days until the US and Canada grounded the plane for safety reasons as it became apparent there were similarities in the accidents. With more than 300 dead, all within the first few minutes of their flights, we just don’t seem very worried about flying. Don’t get me wrong, air travel is very safe – but this particular situation is troubling and there is a need to ensure the root cause of this failure is identified and addressed. Early reports state that a new system that may be implicated in the accidents was not properly rolled out to pilots in order to save airlines money. I travel a lot and I am very concerned about flying on this type of aircraft until a solution is identified that ensures this particular issue will never happen again. But somehow, when fears can in fact

be justified, we find a way to manage them. In this case it is essential for Boeing and the industry to act decisively to not squander this very important public trust.

So, what is the point of this discussion? We know that fear can be a powerful driver in our behaviours. What is not always clear is why we choose to fear things to the point of trauma when they are proven safe, yet don't get too worried about things that should actually be of concern. As a result, it is not enough to fight fear with facts. Fear is a strong emotion. The facts may be clear but all you need is just a bit of doubt and the fear remains. And it is easy for those opposed to something to cause doubt.

As asked in this interesting article on the measles issue, should we hijack the fear monger's method and use fear to push back on untrue claims? Clearly what is driving the strong push to finally silence anti-vaxxers is the resurgence of this disease and the potential impact to children and young adults who may get it. In other words, once we see the disease touching those close to us, a mostly forgotten childhood disease becomes real again and the option of vaccinating becomes less scary than the fear of getting sick. We see young adults getting vaccinated because they are worried about getting measles overcoming their parents' earlier concerns that caused them to withhold vaccination when they were children. Is it time to use frightening imagery to push the factual side of the argument? As stated in this article, *"A baby in the midst of a whooping cough (pertussis) fit will appear to cry without making a sound. Her mouth will be open as she tries to cough to clear the mucus from her narrowed airway, but if she's really struggling, nothing will happen. Her lips and tongue might turn blue. She could seize. When the*

fit is finally over, she'll vomit. It's absolutely terrifying to watch (and no doubt, to experience), and precisely the type of picture public health organizations need to paint to counter anti-vaccination propaganda."

Getting back to the nuclear industry, it is time to accept that taking the high ground and fighting fear with facts alone is just not enough. We are in an industry where fear abounds. An article this week, on the 40th anniversary of the Three Mile Island accident looks at just how frightened we were at the time. While this may be historically interesting, the real question is why we think about this 40 years on when the accident turned out to have **no impact on public health**. 40 years is a long time to focus on a non event. A new poll in the US shows the public evenly split on the issue of support for nuclear power (49% in favour, 49% opposed), but of more interest, is the fact that 49% are also concerned with nuclear safety, or in other words, it is fear that continues to drive opposition to the technology.

Even more so, the people in Germany today are investing hundreds of billions of dollars in decarbonizing the German economy through its Energiewende; yet they seem to be comfortable replacing low carbon nuclear plants with new coal plants greatly impacting their ability to achieve their climate goals. So, what does this say? Clearly Germans believe nuclear power is far more frightening than climate change. Again, this is not consistent with the facts, but the public remains supportive.

The reality is, if we are afraid of something, we need a strong reason to change our views. Just telling someone there is no need to be afraid by explaining the facts is going

to fall on deaf ears. What is needed to revisit one's fear is understanding that there is a greater issue at hand, a bigger problem to solve. Only then may we be willing to reconsider our long-held beliefs. Not because we suddenly believe the facts, but rather because we finally feel a need to actually listen to them to solve a greater concern. It is easy to worry about vaccines when you've never heard of anyone getting measles, and for sure never dying of it. But when you see your neighbour's child seriously ill, it may be time to reconsider.

<https://www.youtube.com/watch?v=Z-MZjeBWilQ&feature=youtu.be>
The wind blows and the lights come on
Over the last 40 years the nuclear industry has been worn down and tends to respond to criticism defensively. Well, maybe it is time to do something different and go on the offensive. Of course, as opposed to those on the other side, we should always tell the truth (although those against scientifically supported truths always have an easier time as they see no need to tell the truth, only to frighten). For example, it is not enough to say nuclear can help in the fight against climate change because the public already believes a viable solution is available with renewables. We also need to show that 100% renewables is simply not feasible. Only then can we get the attention required to consider alternatives. Here is a recent ad by citi bank about its support for clean energy – look at the last part where the lights all go on as a result of this new off shore wind farm.

Should we be making ads that show the lights going out when the wind stops blowing as it does two thirds of the time, showing the need for reliable 24/7 clean energy?

How do we decide what we are afraid of and what we are not? The time has come to divert some of the research money going into the continued improvement in nuclear safety to better understand the psychology of fear and how it impacts views on this clean safe energy source. Then we need to better address these concerns by showing how this technology can reduce societal fears making all our lives better. One thing is for sure, the facts are on our side, but we need to understand that this is simply not enough. Only then can we really try and change attitudes.

Addendum (added April 7): See this video by BP that shows that gas is there to meet the need in the *"off chance the wind ever stops blowing here"* making it seem that wind is the primary source of energy. Of course we know that it is actually in the **absolute certainty** the wind doesn't blow more than half the time, gas will fill in the gaps.

<https://youtu.be/C5Jj2wD3GjE>

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

Nuclear Power Plant

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.

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.

As a solution for climate change – nuclear power is falling behind

Recently, the 2014 edition of the International Energy Agency's (IEA) Energy Technology Perspectives (ETP) was issued. The ETP is issued on a two year cycle; the current edition takes the World Energy Outlook 2013 forecasts and

looks to the longer term out to 2050. With climate change now becoming even more pressing I thought it would be interesting to see the progress over the last two years (I wrote about the 2012 edition back in June of that year). According to the report, as an important contributor to meeting climate requirements going forward, nuclear power is falling behind.

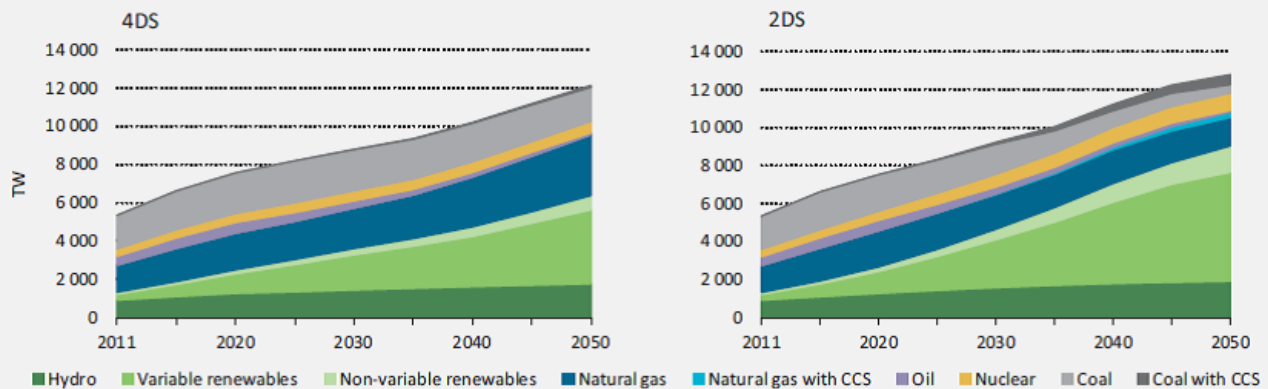
On the positive side, the IEA sees the opportunity by which *"policy and technology together become driving forces – rather than reactionary tools – in transforming the energy sector over the next 40 years."* The report looks to balance energy security, costs and energy-related environmental impacts. But in the end it concludes that *"Radical action is needed to actively transform energy supply and end use. "*

Why is radical action required? Of all the technologies required to meet the 2D target (this scenario sets a target of only 2 degrees C change as compared to 6 degrees in the status quo scenario), the IEA suggests that only renewables are on track while pretty much every other clean technology is not moving fast enough. Two important technologies not meeting targets are Carbon Capture and Storage (CCS) and Nuclear Power. To no one's surprise, CCS has yet to be proven and become a viable commercial option to de-carbonize fossil fuel emissions. As for nuclear power; after the Fukushima accident, growth has been slower than previously predicted and is expected to be 5 to 25% below the level required by the 2D scenario in 2025.

This leaves much of the burden on renewables to meet the need for lower carbon emissions. Surprisingly, in the hi-renewables scenario, solar becomes the dominant source of electricity reaching 40% penetration by 2050. Realistic or pipe dream? I don't know. One thing is certain, (see chart below), with almost half of future electricity generation coming from variable renewables, compared to almost nothing today, the IEA is demonstrating the need for a huge technology transformation in how the world generates electricity.

Figure 3.4

Global electricity generation capacity by technology

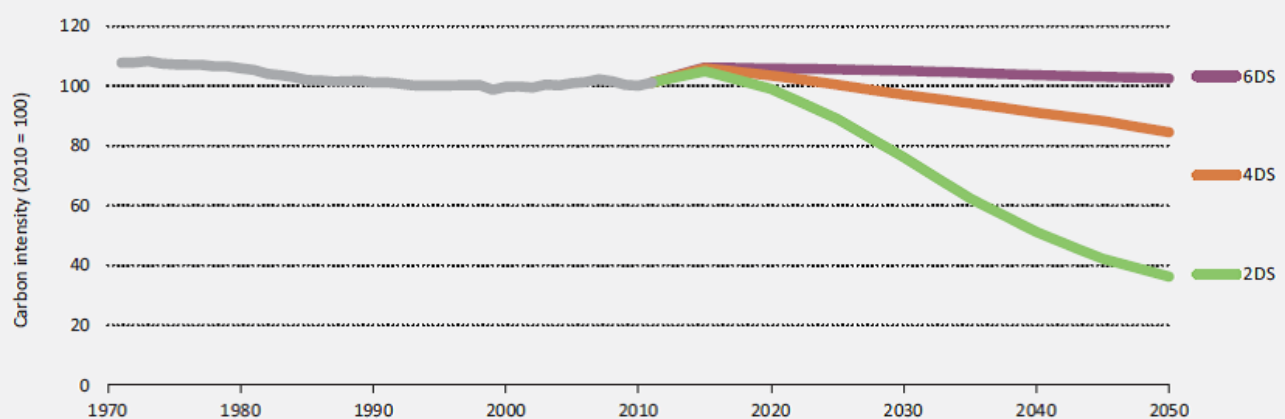


Note: TW = terawatts.

The following chart is the most telling of all. Over the past 40 years carbon intensity (the amount of carbon emitted per unit of energy supplied) has barely budged. Almost no change at all. Yet now we require the carbon intensity to be cut in half in the next 35 years (meaning less than half as much carbon produced per unit of energy supplied). This requires a complete change in how energy is delivered.

Figure 1.1

The Energy Sector Carbon Intensity Index (ESCII)



Notes: the ESCII illustrates the aggregate impact of technology shifts on carbon emissions in the energy sector. It measures how many tonnes of CO₂ are emitted for each unit of energy supplied. Under the ESCII, 100 represents CO₂ intensity in 2010, providing a base to measure progress. Unless otherwise indicated, all tables and figures in this chapter derive from International Energy Agency (IEA) data and analysis.

Key point

The carbon intensity of the global energy supply improved only slightly over the last 40 years, but with growing energy demand, annual emissions have increased by more than 17 gigatonnes (Gt) of CO₂ per year.

The reason is simple. Fossil fuels still represent 80% of

global electricity generation and most of the energy used for transport. To disrupt the curve requires going off fossil fuels to cleaner alternatives. To achieve the 2D scenario, electrification is paramount given the option of generating electricity with clean alternatives. Fossil fuel use must then be cut in half to about 40% of electricity generation and much of the remainder makes use of CCS to reduce its carbon footprint. The report notes that gas must only be a bridging technology to support renewables in the short to medium term as gas still represents a major carbon source. So what's left? Solar and wind to replace fossil fuels and CCS to make them cleaner.

Of course nuclear power is an obvious candidate to make a larger contribution. It is a mature technology and already is an important source of low carbon energy. Given its energy intensity it is certainly feasible to implement more nuclear power on a very large scale. And even with recent set-backs, there are now clear signs of renewal as the industry puts the Fukushima accident behind it.

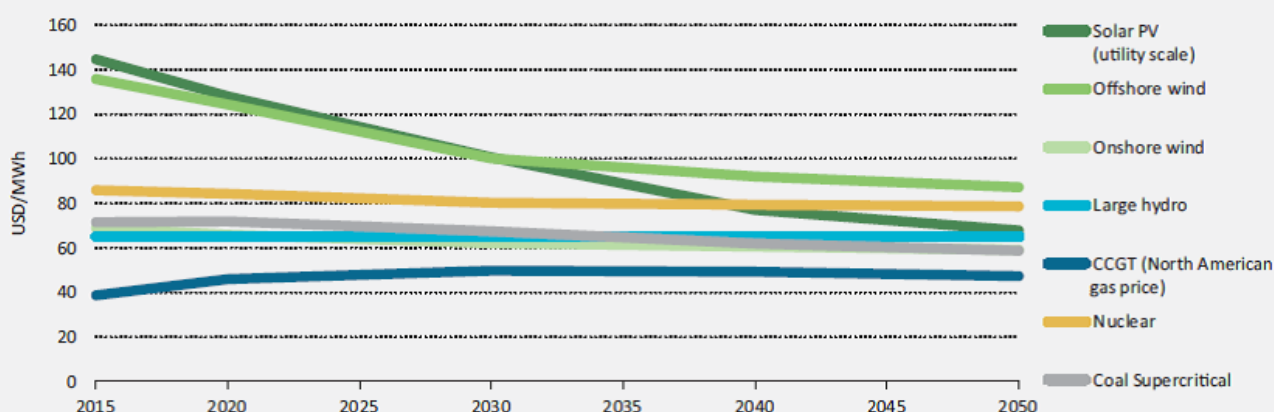
For example, China continues to expand nuclear power at an ever increasing pace. Japan has reconfirmed its commitment to nuclear although restarts are slower than anticipated and the ultimate level of nuclear in post-Fukushima Japan remains unknown. Russia is increasing its commitment to nuclear and, of most interest, is becoming a major exporter offering innovative risk and financing structures that have not been seen in the market to date. Other markets are also starting to move; the latest being Hungary which has just approved a new plant for the PAKS site. However some other important nuclear markets are having challenges. Korea has cut back its long term plans and France is looking to limit the contribution of nuclear power in the future.

While nuclear power has challenges with public acceptance, this report notes the commercial issues – economics and implementation risk. As can be seen in the following chart,

the IEA estimates nuclear to be the most expensive option after off-shore wind. I have not had time to delve into the details and review the numbers. However, taking this at face value, we know that some projects in the west are not doing as well as they should be. On the other hand, standardized series-build in countries like China and Russia are demonstrating a strong path to lower project costs and risks.

Figure 8.1

ETP's LCOE excluding a carbon price



Notes: unless otherwise noted, material in all figures and graphs in this chapter derive from IEA data and analysis. PV – photovoltaic. CCGT – combined-cycle gas turbine. MWh – megawatt hour. Figures and data that appear in this report can be downloaded from www.iea.org/etp2014.

Key point

Based on LCOE, low-carbon technologies remain more expensive than generation from fossil fuels over the transition period to the 2DS.

There is no hi-nuclear scenario in this edition of the report. That is quite unfortunate as a strong renewed commitment to nuclear power is a very good way to help move this plan to achieve a 2D future become a reality. By stating that nuclear power is not meeting expectations, the report lays out a clear challenge. Now it's time to show the nuclear industry is up to it. If we really want to bend the carbon intensity curve, then more than ever, the world needs more nuclear power as an important part of a low carbon future.

Changing the discussion – It's all about people

*"It's always amazing when a United Nations report that has global ramifications comes out with little fanfare." So starts an article in Forbes talking about the most recent UNSCEAR report on the consequences of the Fukushima accident in Japan. Three years after the accident, UNSCEAR, the United Nations body mandated to assess and report levels and effects of exposure to ionizing radiation has reported and its result could not be more clear. **"The doses to the general public, both those incurred during the first year and estimated for their lifetimes, are generally low or very low. No discernible increased incidence of radiation-related health effects are expected among exposed members of the public or their descendants."***

This result is in stark contrast to a number of more recent accidents in other industries, all with a large number of fatalities. Whether it is a plane lost in Malaysia, a ferry sinking in Korea, an oil explosion in Quebec; the list goes on. Unfortunately there is no shortage of examples of terrible accidents resulting in loss of life. And yet, in comparison to these many tragic events, it continues to be nuclear accidents that many people fear the most.

But the reality is quite different. When it comes to nuclear power, we have now seen that even in the worst of the worst nuclear accidents (Chernobyl and Fukushima), we can protect people and minimize fatalities from radiation. In other words, the decades old belief that nuclear accidents are very low probability but exceptionally high consequence; effectively resulting in the end of the world as we know it (i.e the doomsday scenario), is just not the case.

For those that have been reading my blog for a while, it was

about a year ago that I wrote about the need for a new paradigm to communicating the risks and benefits of nuclear power for the future with an emphasis on refining the message to reflect current reality. The message on safety should be:

- The risk of a nuclear accident is very low and is always getting even lower
- In the event of an accident the risk of releasing radiation to the environment is also very low; and
- Even in the unlikely event that radiation is released, the public's health and safety can be protected.

Of course, this does not mean we should become complacent.

Certainly the industry is doing the right things to make sure a similar accident cannot happen again. Many improvements have been made in plants around the world to both reduce the risk of an accident and in the event of a severe accident, reduce the risk of radioactive releases.

For example, here in Canada, we have broadened our safety objective to ***"Practically eliminate the potential for societal disruption due to a nuclear incident by maintaining multiple and flexible barriers to severe event progression"***. Setting societal disruption as the measure is definitely something new as move forward post Fukushima.

As an industry, we are excellent at learning from every event and making improvements to reduce the risk of a similar event in the future. The global nuclear industry should be proud of its unwavering commitment to safety.

But that being said, while making technical improvements and reducing the risk of future accidents is essential; unfortunately this will be unlikely to result in the public feeling safer. I would argue that in general, the public already believe the risk of an accident is low – the problem is they also believe the consequence of an accident is unacceptably high. So no matter how low we make the

probability, they will remain afraid of the consequences. In other words, as we continue to talk about improving technology to reduce risk; we need to enhance the discussion to talk about people and how to both keep them safe (the easy part); and of even more importance, feel safe (now here is the challenge).

Therefore an important lesson from Fukushima, is that accidents, however unlikely are indeed possible. And it is because of the perceived consequence of an accident that the public continues to be afraid. In fact, fear is an understatement. We know that nuclear accidents cause not only fear but outright panic. And this panic is not limited to people in the immediate area of the plant but is experienced by people all over the world. Not a week goes by when there is not some news item on how radiation from Fukushima is about to land on the North American west coast. While there is little risk of any radiation issue, to the public, it continues to stoke fear.

So now that we know that there is little to no health impact from radiation after Fukushima, does that mean the discussion is over? No, the next step is to address the real health consequence of a nuclear accident – mental and social well-being. Fear of radiation is a complex issue. While people will happily accept significant doses of medical radiation as they believe (quite rightly so) this will improve their health, they remain terrified of radiation from sources such as nuclear power plants.

In their report UNSCEAR noted, *“The most important health effect is on mental and social well-being, related to the enormous impact of the earthquake, tsunami and nuclear accident, and the fear and stigma related to the perceived risk of exposure to ionizing radiation. Effects such as depression and post-traumatic stress symptoms have already been reported. ”*

They continue, *"The evacuations greatly reduced (by up to a factor of 10) the levels of exposure that would otherwise have been received by those living in those areas. However, the evacuations themselves also had repercussions for the people involved, including a number of evacuation-related deaths and the subsequent impact on mental and social well-being (for example, because evacuees were separated from their homes and familiar surroundings, and many lost their livelihoods)."*



And this is where we need to do more. Once we accept that even after implementing our best efforts, there may well be another accident someday, there needs to be increased focus on accident management and recovery. This means clear guidelines on when to evacuate, what is required to remediate a contaminated area and when it is safe to go home again. A huge source of fear is the unknown and after a nuclear accident, people impacted are very worried about their futures. They want to know – will I get sick, how about my children and grandchildren – can I go home again – and if so when? And basically how and when will I be able to resume my normal life?

UNSCEAR noted that *"estimation of the occurrence and severity of such health effects are outside the Committee's remit"*. Given these are important and significant health impacts; it

is time for the industry to take action. As an industry we have long been leaders in industrial safety. Now we have the opportunity to be leaders in post-accident recovery psychological research. We need new research to better understand the impact to people in affected areas following nuclear accidents so we can better plan how to reduce their fear and indeed, have a happy and healthy future. This will lead to better decisions following events based on science rather than short term fear issues. It is important to understand that protecting people means much more than emergency planning to get them out of harm's way when an accident happens. It also means meeting their needs right up until they can resume their normal lives.

The most important lesson from Fukushima is not technical. Of course we will learn how to avoid similar accidents in the future and make plants safer. But if we really want to change the dialogue and increase public support for the industry, we must also recognize the future is all about people – building confidence and reducing fear.

While the press is reporting doom and gloom in Japan, progress is being made.

Over the summer we talked about Pandora's Promise, where 5 prominent environmentalists had changed their mind from being against to being supportive of nuclear power. They visited Chernobyl and Fukushima, explored the realities of the technology, sought the scientific truth and came away supportive.

That being said, looking at the news over the past few weeks, it would appear that the crisis at the Fukushima nuclear plant in Japan is getting worse, not better. But is this really the case?

In late August, TEPCO reported a contaminated water leak from storage tanks for water used to cool the reactors. Articles with headlines like *"Fukushima operator reveals leak of 300 tonnes of highly contaminated water"* start off with *"Frantic efforts to contain radioactive leaks at the wrecked Fukushima Daiichi nuclear power plant have been dealt another blow after its operator said about 300 tonnes of highly contaminated water had seeped out of a storage tank at the site."* *"With regard to TEPCO's handling of contaminated water, it has been just like whack-a-mole,"* said industry minister Toshimitsu Motegi, in reference to the anarchic fairground game in which players bash creatures that pop up from random holes. And finally Japan raised the severity level of the event from INES 1 to INES 3. The inference is that the situation at the plant remains grave and that we should continue to be afraid of potential consequences to the environment and most of all to the Japanese people.

Then in mid September we saw headlines such as *"Japan to be nuclear free again as last reactor goes offline"* reporting that Ohi 3& 4 the only two reactors to be restarted after the Fukushima accident are now down for routine maintenance. Again, implying that Japan is going down a path to no nuclear for the foreseeable future.

And finally, only a week or so ago, Prime Minister Abe visited the Fukushima site to provide assurance to the world that the situation is under control. To achieve this objective, he said *"I've urged Tokyo Electric Power Company to deal with the contaminated water leakage as its priority. I gave them three demands. These demands include earmarking discretionary funds that managers on site can use to implement necessary safety measures. It also includes a deadline to complete the*

purification of waste water stored in tanks at the plant and decommissioning the idle No 5 and 6 reactors and concentrate efforts to solve problems”.

Looking at the above press stories, it is hard to see a silver lining in what is going on in Japan. But progress is being made.

The new regulator, the NRA, is closely monitoring progress at the site. In a presentation to the IAEA this month, they reported that on August 14, TEPCO's implementation plan for clean up at Fukushima was approved and that Fukushima Daiichi is now under the systematic regulatory system with NRA oversight going forward. With respect to the recent water leaks, yes, there have been issues containing the large amount of contaminated water. As for the 300 tonne leak reported in August, it was stopped and cleaned up. And there is a plan to reduce the risk of new leaks. The volume of water to be managed is large and the issues are not trivial. But while there was a significant reporting of the leak and its apparent radioactivity, there was little reporting that most of all the sampled sea water remains under the detection limits for radiation and where there has been some detection, the levels have not changed following the leak – and that they remain well below allowable limits.

Fukushima is not the only lingering issue following the earthquake and tsunami of March 2011. Remember the tsunami killed more than 19,000 and displaced over 300,000 (about half those displaced were due to Fukushima the rest due to their homes being destroyed by the tsunami). Recovery from such a natural disaster of this magnitude has been slow and painful.

But while the press continues to feed the fear, in reality, nobody died from radiation from the Fukushima accident and no one is likely to die in the future from radiation. It is the fear that is most damaging to people and their health and the continuing dramatic reporting of potential danger without

context is not helping. As a result of such reports a South Korean airline cancelled flights to the area, Tepco's stock price plunged and Tokyo's bid for the Olympic Games in 2020 was put in jeopardy (although they did succeed but only after Prime Minister Abe gave assurances as to the safety of Fukushima). Unfortunately it also leads to governments making decisions not based on the scientific realities but to appease the fear – which usually does the opposite as it confirms the need to be afraid.

Unnecessary fear was addressed recently by a number international radiation protection experts who have written messages to the Japanese people to explain the health impacts of the Fukushima accident. These are posted on the web site of Prime Minister Abe. Of importance, the United Nations body, UNSCEAR, expects that no resident of Fukushima prefecture would be exposed to more than 10 milliSieverts over their entire lifetime. This is far below any possible threshold for potential future cancers. As stated by Gerry Thomas of Imperial College in London, *"Worrying about what might happen can have a very bad effect on quality of life, and can lead to stress-related illnesses. All scientific evidence suggests that no-one is likely to suffer damage from the radiation from Fukushima itself, but concern over what it might do could cause significant psychological problems."*

But in spite of the fear, in spite of the ongoing challenges at the site, Japan continues to move forward. Whereas one year ago, it was reported that the previous Japanese government was looking to eliminate all nuclear power from Japan by 2040, there is now recognition of the importance of nuclear power to Japan and its economy. Plans are now in place to restart most if not all of the remaining nuclear plants over the next two to three years. Japan is doing its best to learn from this event and now plans to have the safest nuclear program in the world. To that end, the new regulator, the NRA, has issued its new safety standards in July of this

year. Already 14 units have applied for restart under these new standards. This includes two of the most advanced BWR units owned by Tepco. It will take months to review these applications but we can expect to see restarts as early as later this year and certainly early in the new year. Back to the gloom and doom news about Ohi 3&4 going down. It should be understood that when their operation was approved following the accident it was under the old rules. Now they will have to show compliance with the new rules before they go back up and this will take some time – but they will return to service.

The Japanese people are still suffering after the great earthquake and tsunami of March 2011 and the subsequent effect of the resultant accident at Fukushima. Most of all the suffering is a result of fear – fear of the unknown – and fear fueled by the fact that people have lost trust in their government. The Japanese people trusted the authorities to safely manage their nuclear program and now feel this is not the case. Not knowing who to trust increases the fear – and the psychological impacts that comes along with it.

Our last blog was mostly about Germany. The contrast with Japan is stark. The Fukushima accident happened in Japan – not Germany. The people are suffering in Japan, not Germany. Prior to the accident both countries had about 30% of their electricity generated by nuclear power. Japan went to zero as it struggles with the aftermath. Germany shut down about half its fleet immediately and still has nuclear providing much needed power as they work to transition. Japan is an island where all other forms of energy have to be imported at high cost to the people and their economy. Germany is part of the European grid and can easily import power and fossil fuels – and in fact are building new coal stations to cope.

But most of all, the German people have decided they don't want nuclear in the future believing it is an unsafe technology although they have had no negative experience in

Germany with their plants. Yet, in spite of ongoing issues at Fukushima the Japanese government is pragmatic and supportive of restarting reactors.

It is certainly not easy for Japan or the nuclear industry to recover from the events of March 2011. A lingering distrust of authorities remains and that is the industry's biggest problem everywhere. I admire Japan and I hope that they can progress to reduce the public fear while rebuilding their nuclear program to have a strong electricity system for the future on a foundation of safety and transparency.