

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.



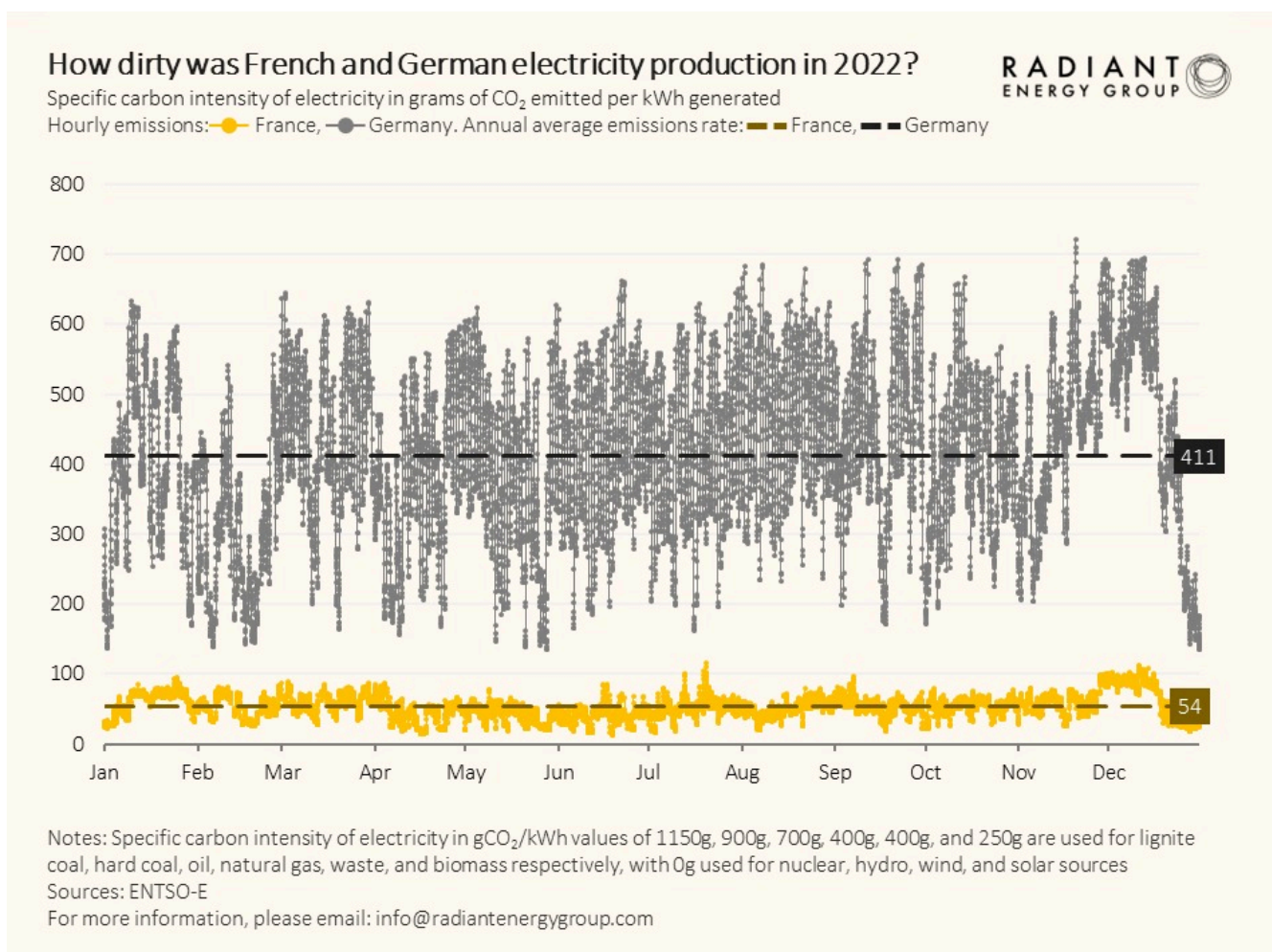
Source: [istockphoto.com](https://www.istockphoto.com)

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!

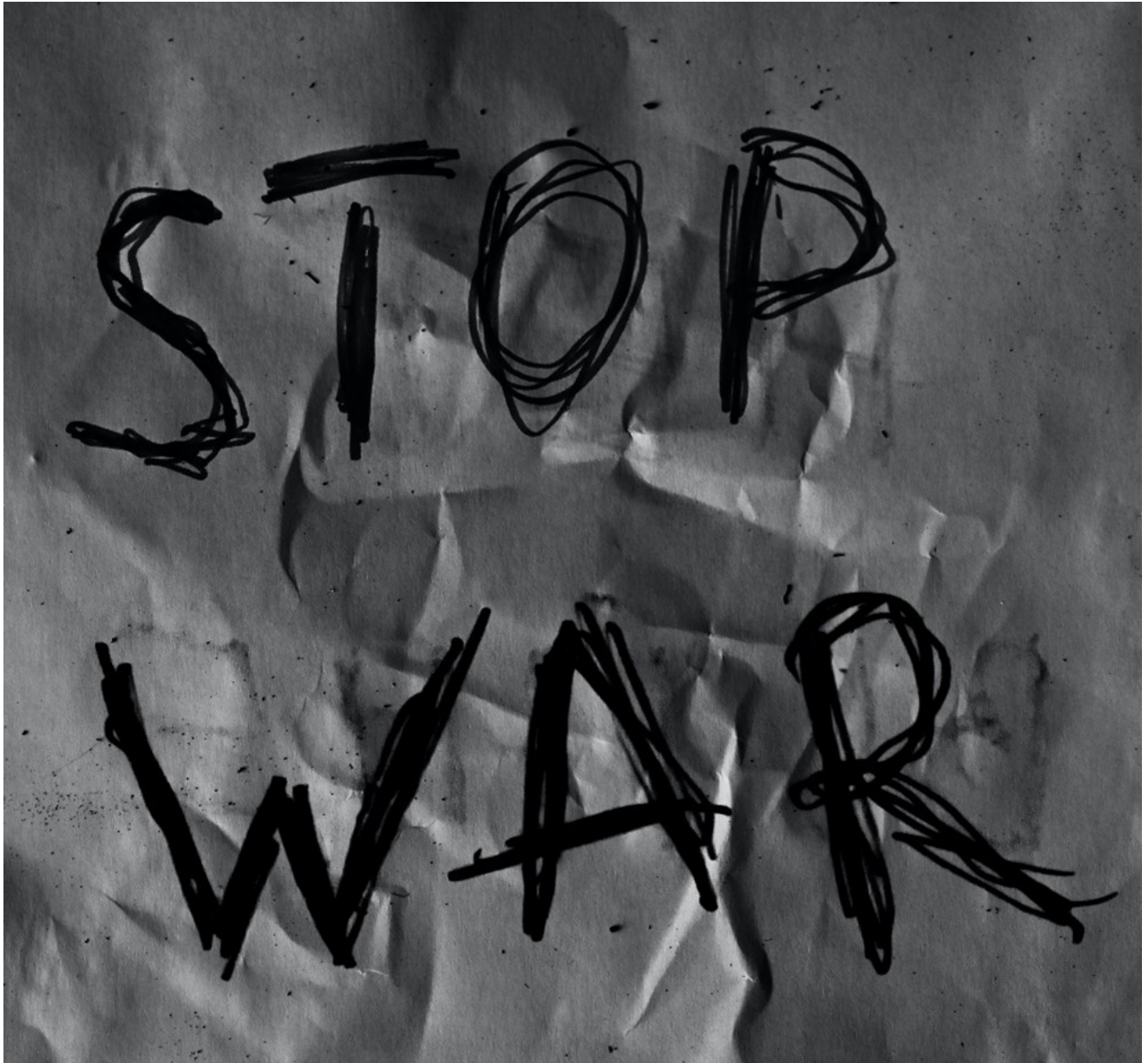
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A war raises fears about nuclear plant safety

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.

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.

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.

If we don't make decisions based on science.....what else is there?

I have written much about the strength of our beliefs and how they influence important decisions. A case in point is the decision to close nuclear stations early in Germany. As we in the rest of the western world try and understand the German approach to eliminating nuclear power on the road to their *Energiewende* (energy transition), we must remember that this plan started in 2010, a year before the Fukushima accident. This energy transformation is a monumental task and a source of pride to most Germans. It has a very aggressive target of reducing emissions by 80 per cent and providing for 80 per cent of the country's electricity consumption from renewable sources by 2050 all while *"aiming for a market-oriented energy*

policy that is free of ideology and open to all technologies, embracing all paths of use for power, heat and transport."

Much has already been said about the challenges along the way. We now know that raising renewables quickly to as high a level as Germany has done has an impact on the stability of the system; is severely affecting the electricity markets at times when high levels of subsidized wind and solar drive down prices for all other forms of generation risking putting conventional generators out of business; all while increasing fossil generation in the short term at least to make up for lost nuclear with a resultant increase in carbon emissions.

It wasn't supposed to be this way. As stated in the 2010 policy paper, the purpose of the policy is to secure a reliable, economically viable and environmentally sound energy supply for the 21st century. While targeting renewable energy to account for the biggest share in this future energy mix; in 2010 it was also accepted that nuclear energy would be a bridging technology on this road. In fact, the plan made maximum use of the existing nuclear fleet during the transition. Look at the following excerpt of the policy on the continued use of nuclear energy.

"A limited extension of the operating lives of existing nuclear power plants makes a key contribution to achieving the three energy policy goals of climate protection, economic efficiency and supply security in Germany within a transitional period. It paves the way for the age of renewable energy, particularly through price-curbing impacts and a reduction in energy related greenhouse gas emissions.

The operating lives of the 17 nuclear power plants in Germany will be extended by an average of 12 years. In the case of nuclear power plants commissioned up to and including 1980 there will be an extension of 8 years. For plants commissioned after 1980 there will be an extension of 14 years.

Additionally, the regulations on safety requirements for German nuclear power plants will be expanded, with requirements remaining at the highest technical level, in the framework of a 12th amendment to the Atomic Energy Act.

The extension of operating lives also creates the opportunity to increase financing in the fields of renewable energies and energy efficiency. To this end – in addition to the tax on nuclear fuel limited to the end of 2016 – a contractual agreement will be concluded with the operators of Germany's nuclear power plants on absorbing additional profits resulting from the extended operating lives."

In summary they want to get rid of their nuclear plants while also acknowledging they are currently both very economic and safe. Therefore nuclear plant operating lives would be extended to make more money generating more taxes to pay for the energy transformation to enable nuclear to ultimately be eliminated.

And then it happened, the accident at Fukushima. The result; this plan was abandoned and 8 nuclear units were shut down immediately while the remaining 9 will no longer get life extensions. This makes for a much harder transformation with coal use having increased from 2011 to 2012 with most electricity continuing to be generated from fossil fuels followed by nuclear (at about 16% now about half of its pre-Fukushima peak of around 30%). Acknowledging that Fukushima increased the fear of nuclear, is it rational to accelerate the removal of nuclear from the system when a plan was already in place to eliminate it; to the short term detriment of emissions and costs? But what is rational? If it means exhibiting behaviour consistent with your beliefs, then this decision may indeed be rational. But is it reasonable to not challenge one's beliefs to determine if they are valid at times like this?

And hence, the film Pandora's Promise. I was able to attend a

showing where Robert Stone was also there to take questions from the audience. It made for a lively discussion and an overall fun evening.

First and foremost, I found it absolutely riveting to see the transformation of these five environmentalists as they came to understand the facts about nuclear energy. They talk about being a member of the environmental movement and how it went without saying that one would also be strongly opposed to nuclear power. After all, it was an evil technology and radiation kills. Frankly nuclear power can destroy the planet.

For some reason, these folks took the time to listen and see that much of what they believed in the past about nuclear power was simply wrong. I am sure that most of you in the nuclear industry have been providing these facts consistently to all that would listen over the last 30 plus years. So why are they listening now? Why listen when you haven't in the past? The facts are the same. But in this case the driver is different. This group is overwhelming alarmed by the threat of climate change. And as such (and different to many others), they decided to explore ALL the options; even the ones that would have seemed ludicrous to them in the not too distant past. Or in other words, they chose to challenge their strongly held beliefs.

The film was not so much about advocating nuclear power (although it does) but rather of documenting the journey of these five individuals. They visit plants. They visit Chernobyl and Fukushima and they explore the realities about the technology. What I found the most compelling was the hand held dosimeter they carried as they traveled that showed radiation levels no higher at Chernobyl or Fukushima than most of the rest of the world. This kind of evidence is hard to argue with.

But as interesting as this all is, this post is not about a

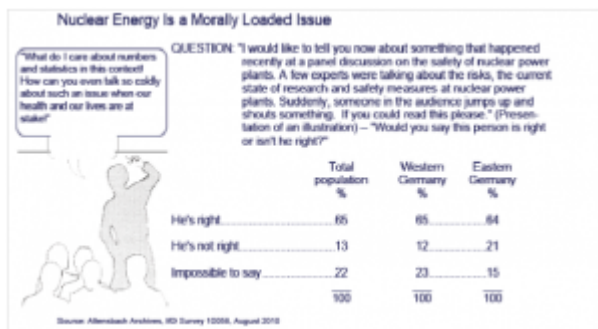
group of environmentalists who have decided to put their faith in science as search for the truth. Rather it is about why so many others don't do the same. It seems as science is always appreciated when it supports your side of an issue. i.e. science is proving climate change which is pro-environment so science is right. Science shows that nuclear power is good but that disagrees with environmental dogma so sweep it aside. It's good news when those who use science to make their climate case are realizing they should do the same when they evaluate nuclear power. We should applaud anyone who takes the time to challenge a long held belief.

So, while Germany is aiming for a market-oriented energy policy that is free of ideology, why are they so dogmatic that nuclear needs to go and the quicker the better? I recently was provided with a copy of a very interesting presentation made by Dr. Thomas Petersen at the Jahrestagung Kerntechnik 2013 in Berlin this past spring that explores "Nuclear energy and the perception of risk in Germany". While presented at a conference the presentation has not been available on line to date. I want to thank Dr. Petersen for giving me permission to post it so you can see what I think is a remarkable set of data.

Most of us outside of Germany probably believe that Germany is a world leading innovator when it comes to technology. Yet in this presentation it would appear that most Germans do not have faith (or trust) in experts when it comes to science. They overestimate risk and consequences and are extremely averse to taking any risk they perceive can cause harm. The slides note that a majority believe life is becoming more dangerous with time; are concerned that technological progress is risky and that research into certain technologies should be stopped; and that in politics, decisions are too often made on the basis of facts rather than how people feel.

When it comes to nuclear power, it is high on the list of

technologies that carry too much risk. Consider the following slide:



Pulling all of these thoughts together is saying something along the lines of "I believe what I believe – I know that nuclear power is dangerous so please don't try and deter me with facts or truth". The really scary part is that in today's western democracies this is indeed how we make decisions. And while we may want to laugh, or cry; it is always important to remember these decisions have very real consequences. Less nuclear, more carbon. Fact. Less nuclear, more fossil fuels. Fact. Less nuclear, more coal – and more illness and fatalities from pollution. Fact.

So what is happening in Germany? The great transformation. Yes, they are doing great things with renewables. There is no doubt. But at what cost in the short term? The subsidies are destroying European energy markets, new coal plants are being built and carbon emissions are going up. All to replace perfectly safe well run nuclear plants before they reach their end of life. Nuclear plants have never hurt a single individual in Germany and likely never will. So what exactly are these people being protected from?

The answer is clear as I close with this final quote from a pro-transition blog that disputes the negative impact on coal use of the policy by arguing it is a short term blip. When talking about the reduction in nuclear generation over the last two years, the author concludes, *"This reduction is a long-hoped for goal and the inspiration for the nation's energy transition. Germans don't want nuclear reactors. They*

haven't since the 1970's and they really don't want them after Fukushima."

We can see that five environmentalists have taken on their beliefs due to a larger concern – climate change. I wonder what issue it will take, if anything, for Germans to do the same?

Note:

In addition to the film, Pandora's Promise, Mark Lynas has released a short book called Nuclear 2.0 available on Amazon in electronic format only. I have read it and frankly it is extremely well done. It meticulously addresses the concerns with nuclear one by one by one with clear and effective information to make the reader see the facts. I recommend it if you haven't had a chance to read it.

The only thing more powerful than the truth is fear

As I was thinking about what to write this month, I was invited by my dry cleaner to attend a protest in a nearby park against genetically modified food. This somewhat infuriated me as I know without doubt that GMO has helped millions around the world and had never killed anyone (although denial of these foods has), yet, as with nuclear power, opposition remains strong, especially in Europe.

My dry cleaner argued trying to tell me that 500,000 were killed in India due to GMO and, as you can imagine, there was

no winning the argument. Mark Lynas, who I have quoted in previous posts has recently taken a hard stand against those who oppose GMO. Mark makes his position clear in his talk at Cornell University this past April where he opens with the following: *"I think the controversy over GMOs represents one of the greatest science communications failures of the past half-century. Millions, possibly billions, of people have come to believe what is essentially a conspiracy theory, generating fear and misunderstanding about a whole class of technologies on an unprecedentedly global scale."*

It is no mistake that environmentalists like Mark have also changed their views on nuclear power and are now vigorously supporting it. The simple reason is that Mark and others like Stewart Brand and George Monbiot, are taking positions that are founded in science rather than a set of beliefs that may feel right, but cannot be supported by scientific evidence.

Most of the opposition to nuclear power is founded in fear – primarily the fear of radiation. However, scientific evidence continues to grow demonstrating the benefits of nuclear power while disproving widely held beliefs of many who oppose it.

For example, this past week (on May 23), a new study was reported on by the Canadian regulator (CNSC) looking at cancer rates near Canadian nuclear plants. Not surprisingly, once again the results were clear. No indication of any increases in cancer near nuclear stations relative to the rest of the province. *"The most important finding of this study is no evidence of childhood leukemia clusters in the communities within 25 km of the Pickering, Darlington and Bruce NPPs."*

Next I return to the study I wrote about last month published in the Journal of Environmental Science and Technology by Pushker A. Kharecha and James E. Hansen of the NASA Goddard Institute for Space Studies and Columbia University Earth Institute. They found that nuclear power has saved an estimated 80,000 lives annually – 1.84 million in all – since

widely introduced in the 1970s and could save another 5 million if construction continues at a decent pace due to a reduction in air pollution. Nuclear power has also reduced carbon emissions by 64 Gt over the same period.

And finally UNSCEAR has now released the results of its latest study on the Fukushima accident. It clearly concluded *"Radiation exposure following the nuclear accident at Fukushima-Daiichi did not cause any immediate health effects. It is unlikely to be able to attribute any health effects in the future among the general public and the vast majority of workers"*. But of even more importance this study also concluded that there are health effects from the Fukushima accident stemming from the stresses of evacuation and unwarranted fear of radiation.

So what does all this tell us? Looking at these three studies we can confirm that

- i) operating nuclear power plants do not cause cancer to the residents of nearby communities from normal operations;
- ii) over the past 40 years nuclear power has in fact saved almost 2 million lives through a real reduction in pollution by not burning fossil fuels and its resultant health impacts; and finally
- iii) that after the biggest nuclear accident in the last 25 years, radiation has not harmed any of the people of Japan and is unlikely to do so in the future.

Considering these kinds of results, why aren't we seeing this reported in the main stream media? With this kind of story there should be universal praise of nuclear power and strong support for its expansion. Frankly, if it were any technology other than nuclear that was reported to have saved millions of lives we likely would have seen it in the headlines at CNN, BBC and other mainstream media. So why are we primarily seeing these nuclear studies reported in trade

magazines and blogs? Why is the world not blown away by this fantastic evidence of the benefits to our lives of nuclear power? As I was pondering these developments I came upon a chapter title in the book I am currently reading by Ben Goldacre called "Bad Science" (Good book by the way). The chapter title is "**Why Clever People Believe Stupid Things**". The chapter then goes on to discuss many of the things we have discussed in this blog before such as confirmation bias, seeing patterns where there are none and a host of other standard reasons why people tend stick to their beliefs in light of strong evidence that they should consider alternatives.

The reality is that some people will never change their view of nuclear power and will oppose it no matter what evidence is brought before them. But for those of us who are frustrated, there is hope. We are starting to see positive change. We have well known environmentalists seeing the benefits of nuclear power. This is now captured in the new documentary "Pandora's Promise" coming in June. Film maker Robert Stone is quoted as saying *"It's no easy thing for me to have come to the conclusion that the rapid deployment of nuclear power is now the greatest hope we have for saving us from an environmental catastrophe,"* Entertainment Weekly says *"the film is built around looking at an issue not with orthodoxy, but with open eyes"*. (I know some of you have already seen it. I haven't seen it yet but I am looking forward to it).

Our story is strong. The message is positive and one of hope for the future. But overcoming fear is no easy task. Fear is a powerful emotion. It will take hard work, commitment – and most of all – time. But if we all persevere, the future is bright. The time has come to get the message out and show how much nuclear power contributes to society, and how necessary it is in a high energy and resource intensive world.