

In an era where facts no longer matter, consequences still do

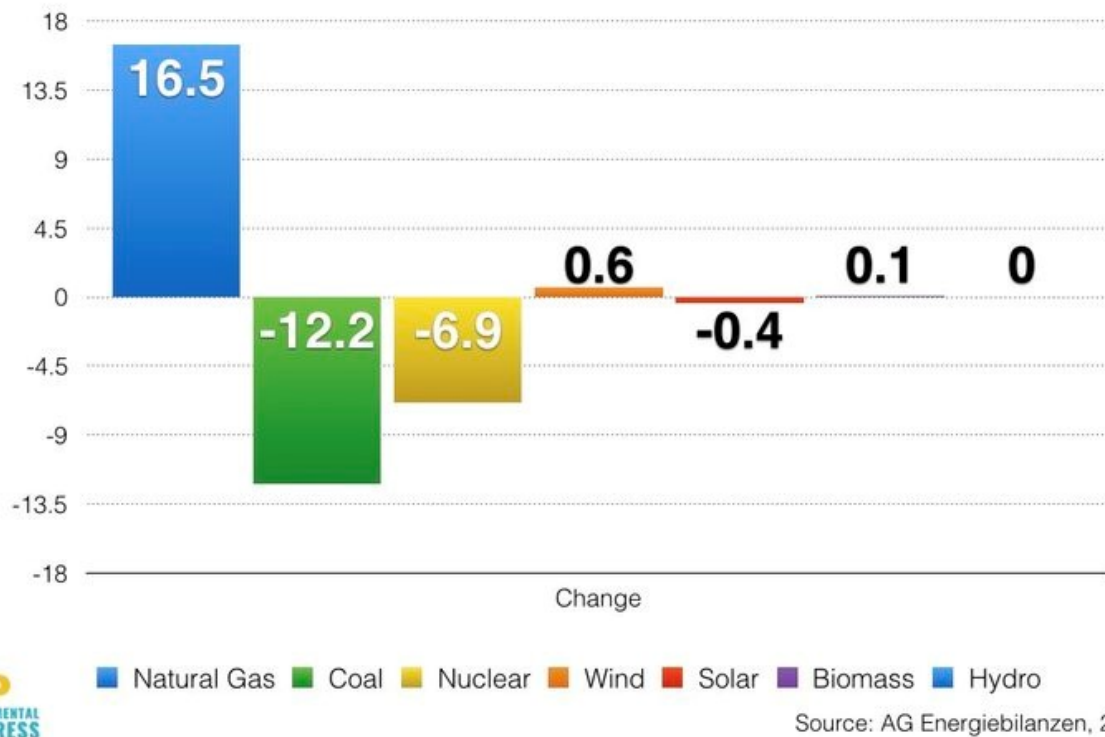
Over the last few years, we have written extensively about the strength of peoples' beliefs and how difficult it is to change them. In spite of this, I thought we were making progress with a push to more evidence-based decision making. For something as polarizing as nuclear power, facts-based decision making is critical to increasing support. (I understand the paradigm of fear of radiation is more emotional than fact based and I agree that we need to appeal to emotions to create the change we need – but let's leave that to a future discussion. In any case it certainly doesn't hurt to have the facts on your side.)

With the populist surge in 2016 we have seen an accompanying rise in complete disregard for facts; all the way to the propagation of absolute lies (or "alternative facts") to support peoples' beliefs. I don't want to get into a political discussion nor take sides on right versus left. What I do want to do in today's post is to discuss something more fundamental – i.e. that although we are free to believe what we want – that beliefs have consequences – and that consequences matter.

So, let's look at what happens when countries believe they can eliminate nuclear power from the mix and replace it with more wind and solar power. Of course, I am talking about Germany. Reducing carbon emissions is a reasonable goal as evidence (alternative facts notwithstanding) shows that climate change is impacting our environment and has long-term implications for our entire society. On the other hand, removing a low-cost low-carbon source of energy like nuclear power because of safety concerns is based on a strong element of fear rather than evidence. In fact, Germany's nuclear plants are likely some of the safest in the world and there is no reason to suspect they will result in a catastrophic accident that means the end of Germany as we know it – yet that is what people fear.

So, what happens in a case like this? The results are in. Fossil fuel use is increasing in Germany, carbon emissions are going up and so is the cost of energy. The German people are paying more money for an outcome that does more damage to the environment and hence, their health. Frankly, it's a high price to pay for the piece of mind that comes from eliminating the perceived risk of nuclear. Or in other words, the extreme fear of nuclear is driving policy more than concern for either energy cost or the environment.

Closure of Nuclear Plant Wiped out Emissions Reductions from Less Coal Power



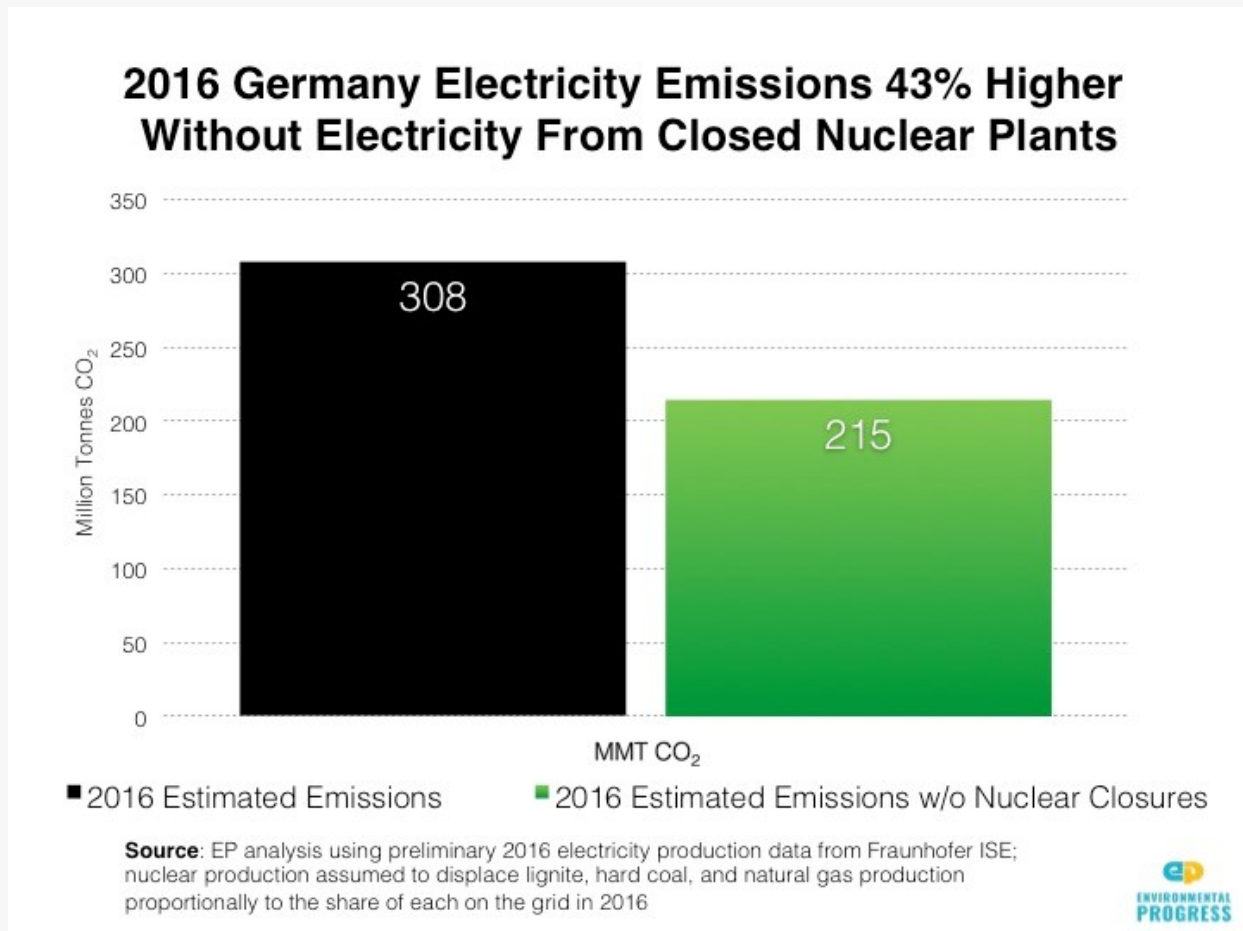
As shown above, closure of another nuclear plant in 2015 resulted in increased emissions in 2016 (the first full year it was out of service) even though there was a substantial substitution of gas to replace coal.

And after adding 10 percent more wind turbine capacity and 2.5 percent more solar panel capacity between 2015 and 2016, less than one percent more electricity from wind and one percent less electricity from solar was generated in 2016. So, not only did new solar and wind not make up for the lost nuclear, the percentage of time during 2016 that solar and wind produced electricity declined dramatically. And why was this the case? Very simply because Germany had significantly less sunshine and wind in 2016 than 2015.

This analysis was done by [Environmental Progress](#) and shows that the intermittency of these renewable sources of electricity both throughout the day and from year to year mean that even huge increases in capacity of these forms of generation will continue to require fossil backup in the absence of nuclear power making 100% renewables an unachievable goal. [Another study](#) shows that to achieve a 100% renewable system in Germany would require a back-up system capable of providing power at a level of 89% of peak load to address the intermittency.

Comparing Germany to France, France has more than double the share of low carbon energy sources and Germany has more than twice the cost of energy as France.

So, trying to decarbonize by also removing nuclear from the mix at the same time is simply too high a mountain to climb. The following shows that German emissions were 43% higher in 2016 without the nuclear plants that have been already shut down. Keep in mind that they still do have operating nuclear and with more plants to shut down, the future trend is not likely to change.



It's not just about Germany. As Japan struggles to get its nuclear plants back on line after the 2011 Fukushima accident, its use of coal has skyrocketed. In 2015 its use of fossil fuels for electricity generation was [82% compared to 62%](#) in 2010 when the nuclear plants were in operation. And now Japan plans to build 45 new coal plants (20 GW) over the next decade to meet its energy needs.

Finally, we can also look at [South Australia](#), a nuclear free zone. Recent blackouts due in part to lower wind availability and the inability of thermal plants to make up the shortfall are also leading to questions on 'how much renewables is too much'.

So, we can all continue to hold our beliefs very dearly and only listen to those that support them, while vilifying those that do not. However, please keep in mind that in a world where the farcical becomes reality, results still matter. And for now, the results are clear, taking nuclear power out of the mix in Germany is not achieving its political-planners' goals. Yet these results are also not likely to change any

German minds when it comes to nuclear power. But hey, why worry about the outcome when you know you are right or as said by comedian Chico Marx in the famous Marx brothers movie Duck Soup “Who you gonna believe – me or your own eyes?”?

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 overwhelmingly 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.

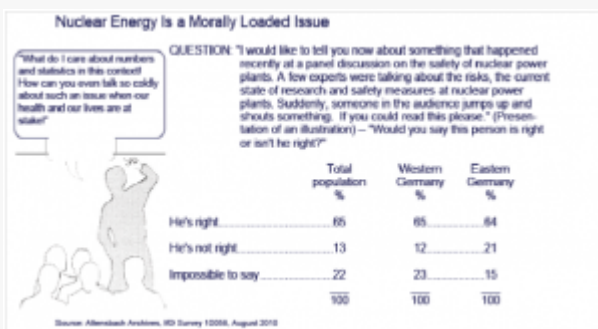
But as interesting as this all is, this post is not about a group of environmentalists who have decided to put their faith in science as search for the truth. Rather it is about why so many others don't do the same. It seems as science is always appreciated when it supports your side of an issue. i.e. 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.

Learning the right lessons – a new paradigm to build a brighter future

Last month we talked about [Fukushima two years on](#) and focused our discussion on making sure we remember the real people whose lives continue to be severely impacted by this accident. This month, as we also remember Chernobyl on its 27th anniversary, I wanted to talk about the legacy of these events and focus on learning the lessons that are necessary to make the industry stronger and, most of all, improving its support amongst the public.

There have been a number of important positive reports recently that can

lead to a better understanding of the consequences to the public of nuclear power.

The **first** being [a study by Japanese researchers](#) who found that internal radiation levels in the population around Fukushima are very low. *“Some 99% of residents of Fukushima prefecture and neighbouring Ibaraki have barely detectable levels of internal exposure to cesium 137, a group of Japanese researchers has found. Of the remaining 1%, all showed levels well below the government-set limit.”* Of interest, the levels are much lower than following the Chernobyl accident and indicate low levels of contamination in the food. This builds on the recent WHO study I reported on last month that says the risk of adverse health impacts from radiation to the Japanese population is very low.

Second, a [study was 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. This study is important because it quantifies the benefits of nuclear power being clean compared to burning fossil fuels. Its author, James Hansen is considered an environmental activist who has taken hard positions on a number of environmental issues.

And **finally** a new [draft document by the US Environmental Protection Agency](#) that *“would change its long-standing advice to state and local governments about how to limit long-term exposure to radiation after a reactor accident or a “dirty bomb” attack. By reducing the projections for how much radiation exposure is likely in the years after such an episode, the proposal could also reduce the amount of contaminated land that would have to be abandoned.”* This is critically important because finally there is starting to be a discussion on how to best respond in the event of an accident in addition to how to prevent accidents in the first place.

So why talk about reports such as these? Because I think they are a critical step to ensuring we learn the right lessons following Fukushima. This will lead to improving the response following accidents, and then ultimately starting a meaningful dialogue to reduce the public fear of nuclear power.

In the industry we often see the focus continuing to be on how to both reduce the risk of accidents in the first place and then ensure that even when there is an event there are no releases of radiation to the environment. These post-Fukushima lessons learned fall into three broad categories:

- Reducing the risk of an accident by building better protection against such hazards as earthquakes and tsunamis

- Ensuring continued cooling of the reactors following an event through the use of portable accessible temporary power to replace safety systems that may have been damaged or destroyed on site; and
- Better Severe Accident Management Guidance (SAMG) so that even after a severe accident there would be no releases. This includes such protections as hardened vents and recombiners to lower the risk of hydrogen explosions and various sorts of strategies for in-containment retention of any melted core.

But while this is all good, it is not going to get us to the solutions we need as it only goes part of the way there. We also need to demonstrate that we have clear and effective strategies so that even if there are releases we can protect people and keep them safe. This means a better understanding of the real health risks of radiation exposure so there can be clear guidelines on when to evacuate and of even more importance when to allow people to return. And there also needs to be clear guidelines for remediation of land following any amount of contamination and how to go about it.

The latter is absolutely necessary because when it comes to public safety and hence public support, the real issue with nuclear power continues to be fear. While most people would probably accept that nuclear power provides safe and clean electricity under normal operating conditions; the real fear comes from the belief that even if the risk is small, the consequences of a nuclear accident are too severe to be tolerated by society. And as long as this belief holds, no matter what the industry does to reduce the risk of an accident, the fear will never change. The more emphasis we put on trying to make it almost impossible for there to be an accident with releases, the stronger the belief that we must do this because the consequences of releases are just too severe to even contemplate.

This makes nuclear a hard sell to the public because the consequence is seen as real while the risk is less relevant. People evaluate risk by focusing on the severity of consequences and considering their perceived control over them. Some people are afraid of flying and not driving even though we all know the risk of dying in an auto accident is significantly higher than in a plane crash. Why? In part because we all believe that we are good drivers (control) and even if we have an accident we can survive because not all individual car accidents kill people (severity). Therefore we can convince ourselves that we likely won't have an accident and even if we do, it won't be a bad one. On the other hand, we may fear flying even though we know the risk is small because we also know that if we are the unlucky ones to be on the one plane that does go down, then we will surely die. And so it goes for nuclear. While safe most of the time, the public believes that IF there is an accident our communities will be destroyed by contamination and we will either die or even worse our children and grandchildren may also die from cancer in the future.

This is why we need a change of paradigm. What studies such as the ones above actually show is that:

- Safely operated nuclear plants save lives every day by not polluting our environment as does burning fossil fuels. These are real lives saved and the numbers are big.
- Radiation is not as dangerous as most people think especially at low levels of exposure. While it is a carcinogen, it is a far less potent carcinogen than many others we see in our everyday lives from many forms of pollution. In fact we use radiation in medicine to save lives by both diagnosing illness and treating diseases such as cancer.
- Following really bad accidents such as Fukushima; where the entire area was devastated by a huge natural disaster that made it increasingly difficult to manage the nuclear accident at three reactors at the same site; we have still been able to protect people from radiation. The result being that to date not even one person has died from it; and studies show the risk of dying in the future to be too low to measure.

But we also know that through extreme fear people have died being evacuated in haste; that people have had their lives disrupted with extreme fear of not knowing if they will have health impacts or not; and that governments do not have clear and effective guidelines for how to remediate following such an event leading to fear causing irrational decisions that actually further fuel the fear. And that is why we need more effort on managing consequences and improving accident response.

So let's learn the right lessons and start the hard work of changing the paradigm. Let's demonstrate to the public that they don't need to be afraid; that nuclear accidents are very rare; that even when the next accident happens (and it will) that we can effectively keep the public safe from health impacts and protect their homes and their families.

Let's explain to the public that while the risk of a nuclear accident is much lower than being in a plane crash (and air travel is very safe), so are the consequences. Because we also know that if we are in a plane accident we will most likely die. What we need to know is that even after the worst possible nuclear accident we will likely not die – and that our families and children will not suffer serious health impacts.

This is the big change. Understanding that the risk of a nuclear accident is low and the **consequences are indeed manageable** is essential to reducing the fear that is so strong amongst the public. And only without fear can nuclear power fully achieve its potential as the way forward to producing clean abundant energy for a better society. Now this would be a great lesson learned from Fukushima.

Fukushima – Nobody died from radiation and nobody will, but the fear remains

With the second anniversary of the Fukushima accident having just passed, it was with little fanfare outside of Japan. There were the requisite articles in the press about Japan and its quest to reform its energy infrastructure. There was talk about the devastating consequences of the tsunami and the Fukushima nuclear accident. Those who are pro nuclear continue to state how Fukushima shows that nuclear power is indeed safe while those opposed argue that Fukushima clearly demonstrates why all nuclear power should be eliminated.

Let's look at it from a different perspective. I titled this post "Nobody died from radiation and nobody will..." for a reason. The WHO has just released its [report on Fukushima](#) and concluded that there will be an immeasurable increase in cancers in the long term from this event. While still a somewhat-flawed report (uses the too-conservative linear low dose theory) showing some increased risk for a small group; there is a clear conclusion that radiation from this accident has not been harmful to the people of Japan. This is great news. We can draw a conclusion that even after a very bad nuclear accident where there are releases, people can indeed be protected from radiation with no measurable health impact – a very important conclusion for the future of nuclear power and for how we manage possible future events.

There are important lessons the global industry must learn from this event but on this second anniversary I really want to focus on Japan. We tend to talk about how this accident impacts us as an industry arguing the merits of nuclear power – for now let's keep our thoughts with the Japanese people who are living it day in and day out. For these people their suffering is far from over "...but the fear remains".

First of all, I want to continue to express my sorrow to the Japanese people whose lives have been impacted by this horrific natural disaster. With over 19,000 dead and hundreds of thousands without their homes (either because it was destroyed or if they were evacuated due to the threat of radiation from the Fukushima accident) these peoples' lives have been radically altered and to this day many have very uncertain futures. In addition to families, the economy of the region has been destroyed.

While we in the industry tend to focus on the accident from a technical point of view in most of our analyses, the focus is somewhat different in Japan (I was privileged to visit Japan this past year, but unfortunately not Fukushima). The following paragraphs come from the official report of the [National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission \(NAIIC\)](#)– from the Chairman's

message.

“THE EARTHQUAKE AND TSUNAMI of March 11, 2011 were natural disasters of a magnitude that shocked the entire world. Although triggered by these cataclysmic events, the subsequent accident at the Fukushima Daiichi Nuclear Power Plant cannot be regarded as a natural disaster. It was a profoundly manmade disaster – that could and should have been foreseen and prevented. And its effects could have been mitigated by a more effective human response.

What must be admitted – very painfully – is that this was a disaster “Made in Japan.” Its fundamental causes are to be found in the ingrained conventions of Japanese culture: our reflexive obedience; our reluctance to question authority; our devotion to ‘sticking with the program’; our groupism; and our insularity.

Had other Japanese been in the shoes of those who bear responsibility for this accident, the result may well have been the same.

Many of the lessons relate to policies and procedures, but the most important is one upon which each and every Japanese citizen should reflect very deeply. The consequences of negligence at Fukushima stand out as catastrophic, but the mindset that supported it can be found across Japan. In recognizing that fact, each of us should reflect on our responsibility as individuals in a democratic society.”

Read the above carefully – and I invite you to read the entire report if you have not had a chance. So while we focus on the technical, the Japanese people are looking at this accident as a proxy for examining what is wrong with Japan and its culture. This is a defining event in the country’s history that is making the average Japanese citizen question key aspects of their culture.

Beliefs are powerful – so to note that some of what happened and its severity are due to a set of beliefs must be very difficult. And as we all know, there is nothing like a crisis to start people thinking about things differently. Of course it’s not my role to comment on someone else’s culture but only to note how culture can impact us all so profoundly. If ultimately there is change in Japan, we should applaud the Japanese people as I cannot see anything more difficult than changing the way a society thinks.

I recently read [“Strong in the Rain”](#), one of the first books to chronicle the disaster (the tsunami, not just the nuclear accident). It tends to look at real families and the impact to them. It is an interesting read and does help you feel what the people were feeling.

Now let’s go back to the accident itself. From a technical point of view, the Fukushima plant is now in a safe state. There is lots of news about how long it will take to complete the cleanup and decommissioning of the site and its cost, but the reality is that the plant is safe. The concerns going forward are with the contamination of the areas

nearby and the ability for people to return to their homes and resume their lives.

We have also seen that the radiation levels in the nearby communities are dropping. A [recent report](#) has shown that levels are down by 40% and a number of people have been allowed to return to their homes. And, as stated in the WHO report, it is now very clear that none of the Japanese public will suffer direct health effects from exposure to radiation.

But that doesn't mean there are no health effects. Similar to those who experienced the accident at Chernobyl, the main impact to health is psychological. And this comes from the very basic issue of fear. People are afraid of the impact of radiation to them and their families. People are afraid of not having a future as their homes have been destroyed. And in the case of Japan, people are stigmatized – they are ashamed to be from Fukushima. The result: depression, chronic anxiety, panic attacks, lack of understanding of what to do, PTSD, insomnia, headaches, excessive smoking and alcohol, anger, irritation, anguish and loss of hope. And of most importance in a society like Japan, there has been a complete loss of trust in authority – people no longer trust the government. With trust gone, people don't know where to turn for credible information and, most of all, support as they do their best to recover from this disaster.

It is interesting that recently I have heard the term “social license” being used more and more in conferences and discussions. Plant owners around the world clearly understand they operate with the permission of the local community, and that sets how the relationship with the community must work. A loss of trust is a very difficult thing to overcome and rebuilding trust is a long term undertaking.

The fear associated with an accident of this magnitude has broader effects as well. With no clear standards for decontamination after an accident, the Japanese government set goals of bringing the levels down to pre-accident conditions. This target is very ambitious and also not likely necessary. Our extraordinary fears of radiation have resulted in poor decisions being made both during the event and after. It is now too late to try and convince evacuated people that they can go back to homes with higher levels of radiation than before even if the risk of health consequences is minute. The damage is done – trust is gone.

Then there is the impact at the national level. Before Fukushima, nuclear power produced about 30% of the Japanese electricity from 54 reactors. Now all are down except for 2 units. With the new regulator in place and their new rules also having been established, more are expected to be brought back this year. But most will take longer as improvements are made to meet the new requirements. At least things are going in the right direction. But in the meanwhile, Japan is being forced to both reduce electricity use (greatly impacting Japanese industry) and pay huge costs for replacement power using fossil fuels, primarily LNG. [Imports were up 25% at a cost of ¥2.5 trillion](#) and about a 4% increase in carbon emissions even though total electricity usage

was down.

Lack of a broader focus is not a uniquely Japanese problem – this is a global problem. We spend all of our energy on preventing accidents and convincing people they won't happen. We don't spend enough time on building a consensus on how to manage after it happens – and if we have learned anything from this at all – accidents will happen. So this is where we need to do better. We need to develop clear methodologies for accident mitigation and we certainly are; but once again we are very focused on how to ensure there are no releases in future events. We also need a consensus on developing safety guides for decontamination or how to manage once radiation has been released. And most of all we need to think about people; not only how we can best protect them, but then how to give them confidence that they are safe and secure.

There are many positives to be learned from this accident but at this time I leave these to another day. So to all the Japanese people we wish you well and hope you are all able to return to your lives as quickly as possible. Our hearts are with you and you are not forgotten.

There is a strength in the people and as [Prime Minister Abe told a memorial service in Tokyo](#) on the anniversary also attended by Emperor Akihito and Empress Michiko, "Our ancestors have overcome many difficulties and each time emerged stronger..... We pledge anew to learn from them and move forward, holding each other's hands."

We need vocal public support for nuclear – this is the industry's most pressing challenge.

I participated in the WNA Annual Symposium in London earlier this month. During the event I had ample opportunity to discuss [my last post](#) on developing a better understanding of the beliefs behind the public's view of nuclear power and what we as an industry need to do going forward.

But in the meanwhile, we have had quite a bit of unsettling news. The push towards reducing the use of nuclear energy in the established nuclear countries has been accelerating. Most of all we see that Japan is moving towards a policy of no nuclear post 2030s. During the symposium the common thought was that the 15% option may win the day but when the 0% option seemed to be the one moving forward, most of the industry were somewhat stunned. To date this policy has not been implemented as Japan's business and industrial sector has finally spoken up. But this is far from a win. The reality is that in [Japan 70% of the public](#) are opposed to nuclear and would like to see it phased out

over time.

Other countries have seen similar outcomes. Belgium has [decided to close its Doel 1&2](#) units in 2015 rather than have their lives extended for 10 more years. In Canada the new [government of Quebec has announced](#) it will not refurbish and life extend the Gentilly-2 station and even in France, the most nuclear country in the world, government has announced that [Fessenheim will be closed in 2016](#) and a long term goal of reducing the reliance on nuclear from its current 75% to about 50%.

We have become somewhat battle weary in the industry so we tend to rationalize the bad news and look to the good news – and there is considerable good news. The UK is supporting new nuclear and moving forward, new build is underway in the US, Canada is committed to refurbishing its Darlington station and new build continues to move forward, albeit slowly. The middle east is embracing nuclear with the UAE having its project well underway and Saudi Arabia committed to a new nuclear program. India and Russia are both growing their programs; and of course, China is going to be booming and building, leading the world in new nuclear.

So why am I so concerned with the recent trends in some countries? It is not simply the act of shutting down plants or reducing the share of nuclear – it is the rationale behind these decisions. The fundamental belief driving these policies is “less nuclear is better than more” – or in other words, if we can do without nuclear then we should. Now why would anyone believe that less is better than more – there is only one reason and that is the real underlying belief – that **nuclear power is dangerous**. That’s it. If we didn’t believe that nuclear is dangerous there is no reason to reduce reliance on what is actually a carbon free and environmentally benign energy source. And this is not a belief that we should let stand.

Look at the recent decision in Canada. The newly elected Premier of Quebec Mme Marois has stated “I want this gesture to become a symbol of Quebec’s commitment to the environment and the welfare of future generations”. Or let’s look at the decision in France to close Fessenheim, France’s oldest station in 2016 when it reaches its 40 year life. (This is even though the French regulator has already approved its suitability to operate for another 10 years). These decisions are purely political – with the belief that this is what the public wants. In the case of France, a national debate will be launched to discuss the impending “energy transition”.

The issue was wonderfully set out by Mark Lynas in his presentation at the WNA Symposium. In his talk, he told a story of a Japanese couple on a train somewhere in the north of England, who pointed out of the window and asked him if a power station in the distance was nuclear. When Mark made it clear that no, it was not a nuclear plant but rather a coal station, the couple were clearly relieved. And this led Mark to ask himself if the world had gone mad. How could a power source that kills more people every day than nuclear has done in 50 years of operation be

the preferred choice for anyone?

Well, looking at what is happening in Germany, in Belgium, in France and in Japan – the question becomes a valid one. Has the world gone mad? Is turning our backs on the world's safest, cleanest and most efficient energy source the way to the future?

To some extent the answer is yes, the world has gone mad. But I say yes, not for the reasons you would think, but because as the world works to turn away from nuclear for reasons that make no sense in science; as the public believes that nuclear power is inherently dangerous and the issue is whether or not we can safely manage these dangerous machines; and as these decisions have real negative impacts to environments, economies and the health and safety of people in these countries; where are the supporters? Now I don't mean the supporters from the industry, the scientists or the industrialists who all understand the benefits of nuclear; the so called "experts", but are also all seen as biased and prejudiced in their support. I mean those members of the public who should be leading the charge to fight to stop the nonsense. After all, the public are ones to really suffer from a dirtier environment and more expensive electricity.

The industry needs an ever growing group of activists who represent the public, not the industry, to fight for more nuclear. We need those who believe that the world is a better place with nuclear power in it than without it. We do see in France, industry is speaking out. In Japan industry is working hard to keep government from making a decision that will have profound impact on the economy of Japan. And as I have said in earlier posts, we have some key environmentalists who have seen the benefits of nuclear power and how it can contribute to their cause. Those like Mark Lynas, George Monbiot and Stewart Brand and others. These guys are all working hard and speaking out on the side that is less popular with their peers – thus giving even more credibility to them and their arguments. And there is progress. [NEI just reported that public support for nuclear is rising in the US](#), closing in on pre-Fukushima levels.

In his WNA talk, Mark Lynas notes that rebalancing public perceptions of risk more towards what science can tell us objectively is central to any nuclear renaissance and that unbalanced risk perceptions are behind nuclear's major challenges.

This is true. I agree. We also need to note that the way forward is long and hard because decisions are made based on emotion, not scientific fact. What we need are public protests in Germany demanding that nuclear not be shutdown. We need public protests in Japan supporting nuclear restarts. And to get to this point, most of all we need the public not to be afraid. Fear is a powerful emotion that is very difficult to overcome.

The road is a long one. We need to work with experts in public opinion and make the arguments available to opinion leaders in the communities.

For example, we know the benefits of nuclear medicine for our health, yet anecdotally, we also understand that doctors were just as afraid after Fukushima as anyone else. There were cases where they were recommending and then performed abortions for fearful mothers. Yet we also know that these same doctors would not hesitate to prescribe a CT scan or x-ray, even if the benefit is doubtful just to placate a patient who has health worries. And the likelihood is that the dose from these medical tests would be greater than the exposure from Fukushima.

We also argue that we must educate people when they are young. We must bring nuclear energy into the schools so that students understand it more and fear it less. But we also know that teachers as a group tend towards being anti-nuclear.

Hence the problem. Those that are trusted in society like our doctors and teachers are not necessarily on our side. These are the groups that should be more open to scientific proof. These are two groups that we need to work on to move our arguments forward. This is just an example but I think it shows that the climb is a steep one and the work is hard. But now is the time to move. We must all work together to build public support – and that means combating the key issue – that nuclear is inherently dangerous. We must work to help people understand the reality that nuclear power is less dangerous than most alternatives and that the positives are essential for a prosperous, healthy future for us all.

So coming back to Mark Lynas and his thesis. We need to do much more to use science as the source of information to make arguments and formulate public policy. But is that enough? The real question we all need to ask ourselves is what do we need to do so that the Japanese couple Mark met on the train is no longer afraid?

We are all talking to each other but is anybody out there really listening?

Was just in Oxford where I gave a lecture to the WNU Summer institute – a great group of young people who are committed to working in the nuclear industry and doing what they think is best for their and our collective futures. Oxford is a great place to quietly contemplate recent events and consider whether or not we are going in the right direction. (Not to mention I enjoyed having lunch in the “Harry Potter” dining hall).

As were many, I was interested in the recent paper written by Ten Hoeve and Mark Jacobson from Stanford University, [‘Worldwide health effects of](#)

[the Fukushima Daiichi nuclear accident](#)' published in the journal Energy and Environmental Science basically predicting that there will be 130 cancer deaths globally from the Fukushima accident. While it would be easy to simply accept this outcome since the number of deaths is relatively low, especially in the context of the large number of deaths caused by the earthquake and tsunami in Japan, the study has been criticized as poor science – and [very effectively by Mark Lynas](#). It is not the criticism that I find interesting but the comments on Mark's blog by those both supporting and opposing the study, including the authors. Now I don't want to spend my time discussing the study as in my opinion Mark did a fine job – but rather the implications of the two sides debating it.

I recently read "[The Believing Brain](#)" by Dr. Michael Shermer (as well as some other stuff) that helps to create some understanding of the situation that we find ourselves in. What I found fascinating about the debate on the Stanford study is not whether or not it is accurate or nonsense, but the fact that independent of the facts, the chance of either side changing their opinion in any way based on the debate is effectively zero. Or in other words as clearly stated by Michael Shermer – beliefs come first – we then look for information to support these beliefs and the more we investigate the stronger we believe. We have natural filters to dismiss opposing views and carefully collect supporting evidence for our position.

The issue is important because we as scientists and engineers love to believe that if only we can better educate the public then they will come around to see what we so obviously see. Well, unfortunately nothing can be further from the truth. Most peoples' beliefs are so embedded that no matter how much more information is provided, they are most unlikely to change their point of view.

Let's come back to the fundamental issue of concern. The public generally believes that nuclear power is inherently dangerous. So what we really need to do is to try and understand where these beliefs come from and then work to get to the source and see if over time we can change some of these perceptions. And frankly as I have stated before, we are inadvertent contributors to this belief as we in the industry love to explain how difficult it is to manage nuclear power and how seriously we take safety thus reinforcing that it must be very dangerous indeed.

I visited the [Atomic Test Site Museum](#) in Las Vegas a couple of weeks back and it is obvious that the association of nuclear power with nuclear weapons is a powerful one. In the museum there was mention of TMI and Chernobyl as examples of when the peaceful use of this technology went wrong. And this even translates to popular culture. In the recent Batman movie, the core of a new advanced fusion reactor is designed for good to power the world and yet is removed and transformed into a weapon of mass destruction in mere moments by a very smart scientist (although apparently there is only one such smart guy). While only a movie the connection between atomic weapons and power is simple

and clear.

Going back to the debate over the Stanford study, let's consider other examples that [I have used in the past](#). First we recently had the final report released on the cause of the Air France crash out of Brazil a couple of years back. It found root causes, suggested corrective actions and that was that. There is no "anti flying" group that came out and said, "see – look what happened here – clearly air travel is too dangerous and it should be abolished." In fact we laugh at the thought of it. Yet more people died on this one flight than the nuclear industry has killed in its entire history. This is because we fundamentally believe that air travel is safe. That's not to say that at some level of accidents, the public would stop flying – but where is this level? I don't know.

The same with the organic food farming incident in Germany. Killed 50 hospitalized 4000 and there is no anti organic food group writing reports on the dangers of organic farming and calling for an end to it.

Yet every nuclear incident is more proof of why nuclear power shouldn't exist. As told to me by my very talkative taxi driver in Vegas on the way to the airport- we have solar and wind, we don't really need nuclear power. The implication being that we all know nuclear power is dangerous and that if we have alternatives, we should use them first.

Of course the truth is actually the opposite. Nuclear power is economic, clean, efficient, reliable and concentrated using very little land. This makes it a great option for long term power production, not the option of last resort.

So if we can't change people's minds through education alone, what do we do next? Well, an unexpected event or crisis is what will cause some people to revisit their beliefs. In this case the recent crisis is negative for the industry (Fukushima) so many are now questioning nuclear power. Yet somehow in a number of countries support for nuclear power remains strong.

In the UK, support for nuclear power is rising, even following Fukushima and with their close neighbours Germany deciding to abandon their nuclear program. Why is this? Well one thought is that the British understand that they are in dire need of electricity and are very concerned about being overly dependent upon gas from Russia (the crisis). Another contributing factor would be the post Fukushima conversion of George Monbiot to nuclear supporter. He is credible with the public and has taken tough stands on many popular issues. There is no doubt that if he changed his mind on nuclear that is food for thought to the public.

In the US, energy independence is an important issue. Americans do not want to be overly dependent upon middle eastern states for their energy and are looking for ways to be more self sufficient. Nuclear power is one option to help them solve this issue. But of course this support

can be somewhat fragile unless we get to the root of the public's concerns. For example, now in the US, gas prices are low once again allowing another viable option to overtake increasing support for nuclear.

So what am I getting to here? Well let's put in one final quote from Dan Gardner's book "[Future Babble](#)" which is actually a quote from Leon Festinger. *"Suppose an individual believes something with his whole heart. Suppose further that he has a commitment to this belief, that he has taken irrevocable actions because of it; finally, suppose that he is presented with evidence, unequivocal and undeniable evidence, that his belief is wrong; what will happen? The individual will frequently emerge, not only unshaken, but even more convinced of the truth of his beliefs than ever before."* (I really liked this book and will cite it further in a future post.)

So does this mean the situation is hopeless? Not at all but we must fundamentally change how we approach the problem. We need to make use of experts as do other industries to better understand the driving issues behind negative views on nuclear power and then address the root cause. We must accept that the task at hand is large and may take a generation to accomplish and most of all we must acknowledge that there will be setbacks along the way. We must bring credible opinion leaders on side and we must have a global concentrated effort to demonstrate the benefits of nuclear power with simple focused and effective messages; but most of all provide a better understanding of the risks and note that the doomsday scenario is for the comics and not for real life.

I would like to know your thoughts on how we should work together as an industry going forward to really make headway on this important issue of the power of belief. After all, as are those who disagree with us, we are all committed to our beliefs – so how can we make the progress we need to bring more understanding and support for our answer to global energy needs?