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B.J.Green (19/4/15)

1. Fossil fuels are not finished, not obsolete, not a bad thing

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http://www.mattridley.co.uk/blog/fossil-fuels-are-not-finished,-not-obsolete-nor-a-bad-thing-(1).aspx

Their energy makes the difference between misery and prosperity
This essay appeared in the Wall Street Journal and later in shorter form in the Sunday Times

The environmental movement has advanced three arguments in recent years for giving up fossil fuels: (1) that we will soon run out of them anyway; (2) that alternative sources of energy will price them out of the marketplace; and (3) that we cannot afford the climate consequences of burning them.

These days, not one of the three arguments is looking very healthy. In fact, a more realistic assessment of our energy and environmental situation suggests that, for decades to come, we will continue to rely overwhelmingly on the fossil fuels that have contributed so dramatically to the world's prosperity and progress.

In 2013, about 87% of the energy that the world consumed came from fossil fuels, a figure that—remarkably—was unchanged from 10 years before. This roughly divides into three categories of fuel and three categories of use: oil used mainly for transport, gas used mainly for heating, and coal used mainly for electricity.

Over this period, the overall volume of fossil-fuel consumption has increased dramatically, but with an encouraging environmental trend: a diminishing amount of carbon-dioxide emissions per unit of energy produced. The biggest contribution to decarbonizing the energy system has been the switch from high-carbon coal to lower-carbon gas in electricity generation.

On a global level, renewable energy sources such as wind and solar have contributed hardly at all to the drop in carbon emissions, and their modest growth has merely made up for a decline in the fortunes of zero-carbon nuclear energy. (The reader should know that I have an indirect interest in coal through the ownership of land in Northern England on which it is mined, but I nonetheless applaud the displacement of coal by gas in

recent years.)
The argument that fossil fuels will soon run out is dead, at least for a while. The collapse of the price of oil over the past six months is the result of abundance: an inevitable consequence of the high oil prices of recent years, which stimulated innovation in hydraulic fracturing, horizontal drilling, seismology and information technology. The U.S.—the country with the oldest and most developed hydrocarbon fields—has found itself once again, surprisingly, at the top of the energy-producing league, rivaling Saudi Arabia in oil and Russia in gas.
The shale genie is now out of the bottle. Even if the current low price drives out some high-cost oil producers—in the North Sea, Canada, Russia, Iran and offshore, as well as in America—shale drillers can step back in whenever the price rebounds. As Mark Hill of Allegro Development Corporation argued last week, the frackers are currently experiencing their own version of Moore's law: a rapid fall in the cost and time it takes to drill a well, along with a rapid rise in the volume of hydrocarbons they are able to extract.
And the shale revolution has yet to go global. When it does, oil and gas in tight rock formations will give the world ample supplies of hydrocarbons for decades, if not centuries. Lurking in the wings for later technological breakthroughs is methane hydrate, a seafloor source of gas that exceeds in quantity all the world's coal, oil and gas put together.
So those who predict the imminent exhaustion of fossil fuels are merely repeating the mistakes of the U.S. presidential commission that opined in 1922 that "already the output of gas has begun to wane. Production of oil cannot long maintain its present rate." Or President Jimmy Carter when he announced on television in 1977 that "we could use up all the proven reserves of oil in the entire world by the end of the next decade."
That fossil fuels are finite is a red herring. The Atlantic Ocean is finite, but that does not mean that you risk bumping into France if you row out of a harbor in Maine. The buffalo of the American West were infinite, in the sense that they could breed, yet they came close to extinction. It is an ironic truth that no nonrenewable resource has ever run dry, while renewable resources—whales, cod, forests, passenger pigeons—have frequently done so.
The second argument for giving up fossil fuels is that new rivals will shortly price them out of the market. But it is not happening. The great hope has long been nuclear energy, but even if there is a rush to build new nuclear power stations over the next few years, most will simply replace old ones due to close. The world's nuclear output is down from 6% of world energy consumption in 2003 to 4% today. It is forecast to inch back up to just 6.7% by 2035, according the Energy Information Administration.

Nuclear's problem is cost. In meeting the safety concerns of environmentalists, politicians and regulators added requirements for extra concrete, steel and pipework, and even more for extra lawyers, paperwork and time. The effect was to make nuclear plants into huge and lengthy boondoggles with no competition or experimentation to drive down costs. Nuclear is now able to compete with fossil fuels only when it is subsidized.

As for renewable energy, hydroelectric is the biggest and cheapest supplier, but it has the least capacity for expansion. Technologies that tap the energy of waves and tides remain unaffordable and impractical, and most experts think that this won't change in a hurry. Geothermal is a minor player for now. And bioenergy—that is, wood, ethanol made from corn or sugar cane, or diesel made from palm oil—is proving an ecological disaster: It encourages deforestation and food-price hikes that cause devastation among the world's poor, and per unit of energy produced, it creates even more carbon dioxide than coal.

Wind power, for all the public money spent on its expansion, has inched up to—wait for it—1% of world energy consumption in 2013. Solar, for all the hype, has not even managed that: If we round to the nearest whole number, it accounts for 0% of world energy consumption.

Both wind and solar are entirely reliant on subsidies for such economic viability as they have. World-wide, the subsidies given to renewable energy currently amount to roughly $10 per gigajoule: These sums are paid by consumers to producers, so they tend to go from the poor to the rich, often to landowners (I am a landowner and can testify that I receive and refuse many offers of risk-free wind and solar subsidies).

It is true that some countries subsidize the use of fossil fuels, but they do so at a much lower rate—the world average is about $1.20 per gigajoule—and these are mostly subsidies for consumers (not producers), so they tend to help the poor, for whom energy costs are a disproportionate share of spending.

The costs of renewable energy are coming down, especially in the case of solar. But even if solar panels were free, the power they produce would still struggle to compete with fossil fuel—except in some very sunny locations—because of all the capital equipment required to concentrate and deliver the energy. This is to say nothing of the great expanses of land on which solar facilities must be built and the cost of retaining sufficient conventional generator capacity to guarantee supply on a dark, cold, windless evening.

The two fundamental problems that renewables face are that they take up too much space and produce too little energy. Consider Solar Impulse, the solar-powered airplane now flying around the world. Despite its huge wingspan (similar to a 747), slow speed and frequent stops, the only cargo that it can carry is the pilots themselves. That is a good metaphor for the limitations of renewables.

To run the U.S. economy entirely on wind would require a wind farm the size of Texas, California and New Mexico combined—backed up by gas on windless days. To power it on wood would require a forest covering two-thirds of the U.S., heavily and continually harvested.

John Constable, who will head a new Energy Institute at the University of Buckingham in Britain, points out that the trickle of energy that human beings managed to extract from wind, water and wood before the Industrial Revolution placed a great limit on development and progress. The incessant toil of farm laborers generated so little surplus energy in the form of food for men and draft animals that the accumulation of capital, such as machinery, was painfully slow. Even as late as the 18th century, this energy-deprived economy was sufficient to enrich daily life for only a fraction of the population.

Our old enemy, the second law of thermodynamics, is the problem here. As a teenager's bedroom generally illustrates, left to its own devices, everything in the world becomes less ordered, more chaotic, tending toward "entropy," or thermodynamic equilibrium. To reverse this tendency and make something complex, ordered and functional requires work. It requires energy.

The more energy you have, the more intricate, powerful and complex you can make a system. Just as human bodies need energy to be ordered and functional, so do societies. In that sense, fossil fuels were a unique advance because they allowed human beings to create extraordinary patterns of order and complexity—machines and buildings—with which to improve their lives.

The result of this great boost in energy is what the economic historian and philosopher Deirdre McCloskey calls the Great Enrichment. In the case of the U.S., there has been a roughly 9,000% increase in the value of goods and services available to the average American since 1800, almost all of which are made with, made of, powered by or propelled by fossil fuels.

Still, more than a billion people on the planet have yet to get access to electricity and to experience the leap in living standards that abundant energy brings. This is not just an inconvenience for them: Indoor air pollution from wood fires kills four million people a year. The next time that somebody at a rally against fossil fuels lectures you about her concern for the fate of her grandchildren, show her a picture of an African child dying today from inhaling the dense muck of a smoky fire.

Notice, too, the ways in which fossil fuels have contributed to preserving the planet. As the American author and fossil-fuels advocate Alex Epstein points out in a bravely unfashionable book, "The Moral Case for Fossil

Fuels," the use of coal halted and then reversed the deforestation of Europe and North America. The turn to oil halted the slaughter of the world's whales and seals for their blubber. Fertilizer manufactured with gas halved the amount of land needed to produce a given amount of food, thus feeding a growing population while sparing land for wild nature.
To throw away these immense economic, environmental and moral benefits, you would have to have a very good reason. The one most often invoked today is that we are wrecking the planet's climate. But are we?
Although the world has certainly warmed since the 19th century, the rate of warming has been slow and erratic. There has been no increase in the frequency or severity of storms or droughts, no acceleration of sea-level rise. Arctic sea ice has decreased, but Antarctic sea ice has increased. At the same time, scientists are agreed that the extra carbon dioxide in the air has contributed to an improvement in crop yields and a roughly 14% increase in the amount of all types of green vegetation on the planet since 1980.
That carbon-dioxide emissions should cause warming is not a new idea. In 1938, the British scientist Guy Callender thought that he could already detect warming as a result of carbon-dioxide emissions. He reckoned, however, that this was "likely to prove beneficial to mankind" by shifting northward the climate where cultivation was possible.
Only in the 1970s and 1980s did scientists begin to say that the mild warming expected as a direct result of burning fossil fuels—roughly a degree Celsius per doubling of carbon-dioxide concentrations in the atmosphere—might be greatly amplified by water vapor and result in dangerous warming of two to four degrees a century or more. That "feedback" assumption of high "sensitivity" remains in virtually all of the mathematical models used to this day by the U.N. Intergovernmental Panel on Climate Change, or IPCC.
And yet it is increasingly possible that it is wrong. As Patrick Michaels of the libertarian Cato Institute has written, since 2000, 14 peer-reviewed papers, published by 42 authors, many of whom are key contributors to the reports of the IPCC, have concluded that climate sensitivity is low because net feedbacks are modest. They arrive at this conclusion based on observed temperature changes, ocean-heat uptake and the balance between warming and cooling emissions (mainly sulfate aerosols). On average, they find sensitivity to be 40% lower than the models on which the IPCC relies.
If these conclusions are right, they would explain the failure of the Earth's surface to warm nearly as fast as predicted over the past 35 years, a time when—despite carbon-dioxide levels rising faster than expected—the warming rate has never reached even two-tenths of a degree per decade and has slowed down to virtually nothing in the past 15 to 20

years. This is one reason the latest IPCC report did not give a "best estimate" of sensitivity and why it lowered its estimate of near-term warming.
Most climate scientists remain reluctant to abandon the models and take the view that the current "hiatus" has merely delayed rapid warming. A turning point to dangerously rapid warming could be around the corner, even though it should have shown up by now. So it would be wise to do something to cut our emissions, so long as that something does not hurt the poor and those struggling to reach a modern standard of living.
We should encourage the switch from coal to gas in the generation of electricity, provide incentives for energy efficiency, get nuclear power back on track and keep developing solar power and electricity storage.
We should also invest in research on ways to absorb carbon dioxide from the air, by fertilizing the ocean or fixing it through carbon capture and storage. Those measures all make sense. And there is every reason to promote open-ended research to find some unexpected new energy technology.
The one thing that will not work is the one thing that the environmental movement insists upon: subsidizing wealthy crony capitalists to build low-density, low-output, capital-intensive, land-hungry renewable energy schemes, while telling the poor to give up the dream of getting richer through fossil fuels.

By: Matt Ridley | Tagged: rational-optimist, wall-street-journal

2. Work starts on Iter central solenoid

15 April 2015

http://www.world-nuclear-news.org/NN-Work-starts-on-Iter-central-solenoid-1504155.html

Fabrication of the central solenoid of the Iter fusion project has been started by the USA's General Atomics (GA). The solenoid - due for delivery in 2019 - will be one of the largest superconducting electromagnets ever built.
The central solenoid - measuring 18 metres in height, over 4 metres in diameter and weighing some 1000 tonnes - is designed to initiate and drive a hot plasma for fusion energy.
In a 10 April statement, GA said it had started fabrication of the magnet modules at its Magnet Technologies Center in Poway, California. The fabrication hall is equipped with ten manufacturing stations, precision machinery, a 200-tonne capacity air-driven transport cart, a two-storey 600ºC convection oven, and a two-storey insulating machine to apply 200 kilometres of fibreglass tape.

GA will fabricate seven modules - six composing the central solenoid plus a spare one. Some 6.4 kilometres of superconducting niobium-tin conductor will be wound into coiled layers for each of the magnet modules.
The company expects to complete winding of the conductor for the central solenoid modules in 2017. The modules and the solenoid's supporting structure will be delivered to the ITER construction site in Cadarache, France, in 2019. It will then be assembled on site.
GA noted, "Fabrication will require unprecedented engineering and scientific advancements to assemble the technology into a new clean energy source."
US Iter project manager Ned Sauthoff said, "The central solenoid represents the heartbeat of Iter, because it pulses the magnets that drive electric current through the Tokamak plasma."
Director general of the Iter Organization Bernard Bigot said, "Nothing gives us more confidence, here at the Iter Central Team, than witnessing the progress in the manufacturing of Tokamak components."
He added, "The central solenoid is a strong symbol of what the Iter international collaboration is about ... Japan has provided the conductors; the USA will be transforming the conductors into the finished coil; the coil will then be shipped to the Iter site and assembled into the machine."
The Iter project is meant to take nuclear fusion research to a new level with the largest ever Tokamak unit, which should be capable of sustaining plasmas that produce 500 MWt for as long as seven minutes. The EU is funding half of the cost while the remainder comes in equal parts from six other partners: China, Japan, India, Russia, South Korea and the USA. The facility is expected to reach full operation in 2027.
Researched and written
by World Nuclear News

3. Could A Giant Magnet Help Power The World?

http://peakoil.com/alternative-energy/could-a-giant-magnet-help-power-the-world

The engineer in charge of the project is John Smith. His experience in nuclear fusion runs deep, going back to the first job he took fresh out of undergrad.
“Almost 22 years I’ve been working in fusion,” Smith said.
In his field, fusion is a kind of holy grail. In theory, it could generate nuclear power anywhere in the world without a constant flow of radioactive waste.
“And there’s no carbon,” Smith said. “It’s a very clean source of energy, and it’s almost completely renewable.”

Engineers at General Atomics have been experimenting with fusion for half a century. But now, Smith and the three dozen employees he oversees are part of a major international effort to prove fusion can actually power the world.
They're building a magnet that will go right into the heart of a giant fusion reactor in the South of France. It's all part of a 35 nation collaboration called ITER, Latin for "the way."
"The big picture goal with fusion is to replicate what happens on the sun," Smith said during a tour through the Poway facility assembling this 1,000-ton piece of machinery.
Existing nuclear power plants produce energy through fission — by splitting atoms. Fusion would do the opposite. Mimicking the reactions that fuel our sun, the process would force atoms to overcome their natural repulsion, ultimately giving off two byproducts: helium and highly energetic particles that could be harnessed to create electricity.
The challenge, Smith said, is "Two atoms don't like to fuse together. You've got to force them together. That's what we're trying to do with the temperature."
The magnet, along with other heating systems within ITER, will help bring two hydrogen isotopes up to extreme temperatures 10 times hotter than the sun. It'll do that by driving current through a plasma magnetically confined within the reactor.
Building a magnet that powerful requires nearly 24 miles of conducting cable manufactured by engineers halfway around the world.
"This is a spool of conductor as it came from Japan," Smith said, pointing to a huge coil of silvery cable that looks a bit like the world's biggest Slinky.
"We've taken it, and on the shipping fixture that it came from, we've lowered it down onto our de-spooling device."

The finished magnet will consist of six of coils.
Once the cable is straightened out, a machine winds it into precise concentric spirals. Those spirals form layers. Forty of those layers will make up one cylindrical module, called a coil.
The finished magnet will consist of six of these coils.
Once each coil is tightly wound and perfectly welded, it'll weigh 250,000 pounds. By then, the only way to move it through the facility is on a cushion of air created by a heavy-duty cart.
"The simplest way to explain it is an air-hockey table, turned upside down," Smith said. "Instead of blowing air up to levitate a puck, we're actually blowing air down, and levitating the coil."
These coils will eventually be chilled to nearly absolute zero once they're inside the French reactor. But first, they need to bake inside a furnace for five weeks at 1,300 degrees Fahrenheit. All that heat forges a superconducting material capable of circulating electricity

with no energy loss.
Many steps in the magnet’s production are done by machine. However, some tasks are so delicate, they still need to be done by hand. For instance, insulating the pipes that pump liquid helium into the magnet.
Smith watches the engineer tasked with this job.
“It’s amazing to think you have something this big that weighs this much, and here he is putting little pieces together with tweezers,” he said.
It’ll be 2019 before General Atomics ships the final piece of this magnet off to France. And it’ll be at least 2040 before ITER paves the way for a demonstration plant aiming to actually pump fusion energy into the grid. Some experts believe even that timeline is optimistic.
ITER has been known for cost overruns, delays and management problems. Congress is even threatening to pull U.S. funding without certain reforms. But Smith said, for scientists who’ve dedicated so much to fusion, it’s rewarding just to see these parts finally getting made.
“For physicists this is their life looking at magnetic fusion and ITER and the promise of that,” Smith said.
He recently gave a tour to a fusion researcher with years of experience working on ITER.
“And he said in all that 15 years, ‘this is the first component I’ve seen that will actually go to ITER.'”
kbps

4. General Atomics Unveiling Giant Magnet for Fusion Reactor

POSTED BY DEBBIE L. SKLAR ON APRIL 2, 2015 IN TECH
http://timesofsandiego.com/tech/2015/04/02/general-atomics-unveiling-giant-magnet-for-fusion-reactor/
General Atomics Thursday announced plans to unveil a 1,000- ton superconducting electromagnet to be used in a 35-nation fusion energy study.
According to General Atomics, the Poway-built device that’s powerful enough to lift an aircraft carrier out of the water will be showcased at an April 10 news conference in Poway.
The electromagnet will be used in the International Thermonuclear Experimental Reactor experiments in France, in which scientists will try to create a burning plasma that demonstrates the feasibility of fusion energy.
Clean fusion energy has been a holy grail for researchers looking for alternatives to standard nuclear energy and carbon-based fuels. Scientists

say fusion energy does not create long-term waste products or meltdown risks.
On its website, the ITER project is described as a “large-scale scientific experiment intended to prove the viability of fusion as an energy source, and to collect the data necessary for the design and subsequent operation of the first electricity-producing fusion power plant.”
The U.S., China, India, Japan, Korea, Russia and nations in the European Union are involved in the ITER project. Preparation on a site in southern France began seven years ago, and operations are scheduled to begin in 2019, according to an ITER timeline.
The unveiling by General Atomics will come on the heels of news last month that scientists at the San Diego-based company and the U.S. Department of Energy’s Princeton Plasma Physics Laboratory discovered how magnets can control damaging heat bursts in a fusion reactor.
The research built on prior studies showing that tiny magnetic fields can suppress the heat bursts — and now they know how the process works.
—*City News Service*

5. India to set up its own mini N-fusion reactor

Prashant Rupera, TNN | Apr 1, 2015, 01.07AM IST
http://timesofindia.indiatimes.com/india/India-to-set-up-its-own-mini-N-fusion-reactor/articleshow/46763586.cms

VADODARA: Nuclear energy production in India is set to get a major boost with the department of atomic energy (DAE) giving nod to set up the country's own thermo-nuclear fusion reactor.

India is presently one of the seven partner countries in world's biggest energy research project - the ITER - that is coming up in Cadarche, France.

"Presently, our contribution as one of the seven partners in the International Thermonuclear Experimental Reactor (ITER) project in France is 10%. The knowledge that we gain will be used to set up our own demonstrator reactors at home. We will begin by setting up an experimental version of the Cadarche ITER reactor in France here," ITER-India's project director Shishir Deshpande said here on Monday night. Deshpande along with ITER's top brass - Dr Sergio Orlandi (director - central engineering and plant) and deputy director general Dr Remmelt Haange — is touring India to review progress made by Indian companies involved in the fusion reactor project.

Sources said that the central government has sanctioned Rs 2,500 crore to seed research in nuclear fusion.

All nuclear plants in India at present are fission-based. Generating electricity through fusion is comparatively economical and safer. ITER-India, a division of the Gandhinagar-based Institute of Plasma Research, is the nodal agency under DAE, responsible for delivery of ITER contributions from India.

To be executed over 10 years, European Union, China, Japan, Korea, Russia and the US apart from India are the seven nation partners in France project which is expected to be commissioned by 2024.

Four Indian companies including two based in Gujarat have been awarded contracts to prepare large components which will be fabricated and sourced from India for ITER.

Hazira-based L&T Heavy Engineering is manufacturing the cryostat (a 30 metre height x 30 metre diameter large vacuum vessel made of stainless steel) which will house the entire ITER reactor in France. "Manufacturing of the cryostat is progressing well and the first consignment is getting ready for shipment later this year," said Orlandi.

INOXCVA, a subsidiary of Vadodara-based Inox India Limited, has already set up a manufacturing facility at Halol to manufacture cryolines which will carry cryogens (liquid helium and nitrogen) from cryoplant to the ITER magnets and other components for the fusion project.

6. Spectroscopic studies on ITER fusion reactor walls use

Andor ICCD camera

googleon: all
03/25/2015
By John Wallace
Senior Editor
http://www.laserfocusworld.com/articles/2015/03/spectroscopic-studies-on-iter-fusion-reactor-walls-use-andor-iccd-camera.html

An ICCD camera made by Andor is used in a laser-induced-breakdown spectroscopy (LIBS) test to be used on ITER's reactor walls. Here, it res the hydrogen and deuterium lines, helping to show the deuterium conte the coatings on the walls. (Image: Andor)

To be completed by 2020, the ITER tokomak nuclear-fusion reactor being built in Saint-Paul-lès-Durance, France is the first fusion reactor expected to produce more energy than needed to run it. However, the fusion process will indirectly lead to the build-up of thick deposits of material layers on the reactor walls; the ITER engineers need to know how fast the deposits are growing, as well as their chemical composition, so that the maintenance of the reactor can be better planned and made more efficient with minimum impact on operation time.

A research team from the VTT Technical Research Centre of Finland (Espoo, Finland), the University of Tartu (Tartu, Estonia), INFLPR (Bucharest, Romania), and the Max-Planck-Institut für Plasmaphysik (Garching, Germany) has developed and tested a laser-induced-breakdown spectroscopy (LIBS) method for noninvasively measuring the composition of the layers, including specific beryllium-tungsten mixtures, for the first time. The technique uses an iStar ICCD camera made by Andor (Belfast, Ireland).

Noninvasive testing

"Shutting down any nuclear reactor is an expensive exercise, so a noninvasive diagnostics technique that maximizes service intervals has the potential for massive savings," says Antti Hakola, senior scientist at the VTT Technical Research Centre. "Our LIBS experiments are

important as they show that the composition of the deposits as well as their thickness can be determined without taking any components out of the reactor. In addition, this is the first time that beryllium samples, which are very significant for fusion applications, have been analyzed and we now know their ablation characteristics."
Studying the depth profiles of the coatings revealed that coating removal rates depended on deuterium content as well as the thickness and makeup of the coatings.
"We compared products from a number of manufacturers before choosing the Andor SR-750 spectrograph and Andor iStar 340T intensified CCD (ICCD) camera," adds Hakola. "The key for us was the very fast (nanosecond) and precise (picosecond) temporal resolution as our main criteria were to ensure fast triggering, that the width and delay of the recording gate can be flexibly changed, even to a subnanosecond regime, and that the spectral resolution would be high (less than 0.05 nm). The spectrometer has proved an utterly reliable tool and the Andor software has also been helpful, particularly in obtaining kinetic series of how spectral lines evolve as the number of laser pulses increases."
For more info on Andor's ICCD cameras, see http://www.andor.com/scientific-cameras/istar-iccd-camera-series

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1. J. Karhunen *et al.*, *Physica Scripta* (2014); 2014(T159):014067. doi: 10.1088/0031-8949/2014/T159/014067

7. Tough Questions for ITER's New Director General, Bernard Bigot

By Alexander Hellemans

Posted 20 Mar 2015 | 21:00 GMT

http://spectrum.ieee.org/energywise/energy/nuclear/iter-appoints-bernard-bigot-new-director-general?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+IeeeSpectrumFullText+%28IEEE+Spectrum+Full+Text%29

When ITER, the International Thermonuclear Experimental Reactor project, was launched in 1985, the plans called for a huge reactor that would demonstrate that the fusion of hydrogen atoms into helium atoms would be a source of unlimited energy. Its founding nations (Russia, the United States, Japan, and the EU (China and Korea subsequently joined the project in 2003, and India in 2005)) also hoped it would reduce drastically the problem of nuclear waste that plagues fission reactor projects.
The design approved in 1988 featured a tokamak in which huge superconducting magnets would trap an extremely hot plasma made of hydrogen atoms inside a toroidal steel vessel. Because of the vessel's size, scientists would be able to induce a fusion reaction that would yield up to 10 times as much energy as is injected in order to heat the plasma.
But that early promise quickly hit the cold reality that large-scale projects frequently encounter large-scale problems. The ITER project never enjoyed an easy life, especially when the United States withdrew its support in 1998, hopped in again in 2005, then drastically reduced its outlays for the project in 2008.
An external report in 2013 blamed a series of missed deadlines and cost overruns on the ITER

organization’s weak management of a decentralized organization. The total estimated cost for the project is now at €15 billion (about $16.5 billion), which is almost double the cost of CERN's Large Hadron Collider. Despite that level of government largesse, recent plans to achieve “first plasma” by 2020, and the first demonstration of energy production by 2027, are now being revised. A new schedule should be finalized by the end of the year. So, what happens if the sponsors of the reactor, located in Cadarache in Southern France, decide to pull the plug? Contracts totaling €6.5 billion (about $7 billion)— €3.5 billion of which are for completing construction on the site—would be in limbo. The 500 contractors who now work on the building site would be out of work. So might the 600 staffers employed directly by ITER organization with its €275 million annual budget. According to ITER, 72 percent of these employees are engineers and scientists.
nextpage
On 5 March, the ITER Council, in an extraordinary session, confirmed the appointment of Bernard Bigot as the Director General of ITER. Bigot, a physicist and chemist by training, has had a long career in research, but also as Chairman and CEO of the French Alternative Energies and Atomic Energy Commission (CEA). He takes over from Osamu Motojima, who started his term as head of ITER in July 2010. Bigot spoke to *IEEE Spectrum* last week; his comments have been abridged.
Spectrum: **On 5 March, you presented an action plan, proposing changes to the management of ITER. What are the specific**

problems that you are addressing?
Bigot: What has plagued the ITER project so far is that we had no efficient decision process, caused by the fact that the ITER Organization and the seven domestic agencies did not operate as an integrated team. We have to make decisions every day, take financial decisions; we need to learn to work together. The question is not to 'control,' but the capacity to work together.
***Spectrum:* What are the changes you proposed?**
Bigot: There are three important points. The first one is that the members, represented by the domestic agencies they have established, must consider it fully legitimate that the Director General is fully empowered to take any decision with eventual implications to the main interest of the project. The domestic agencies and the Central Team, here in France, worked quite independently, and I strongly believe that they should work closely together and be placed on an equal footing, and that we need someone who can arbitrate.
Secondly, we need to set up an organization in such a way that people feel associated with the decisions taken. We will set up an Executive Project Board that will be chaired by the DG, and in which the seven domestic agencies will be represented by their heads. In this way we can discuss issues and take decisions. Previously, representatives of the domestic agencies had also the rank of Deputy-Director General, confusing the technical role they had in the ITER Central Team and their responsibility in representing their own country. Now the Central team consists only of

technical people, that way we simplify the process of diffusion and discussion.

My last point is that I will ask the ITER Council to provide the DG with a reserve fund that will be fully available to implement the technical decisions taken by the Executive Project Board. We are now in a new phase, starting with the assembly of the test reactor, and we have to operate as a single organization, despite the fact that the domestic agencies will continue as legally separate organizations.

***Spectrum:* Past delays and mistrust of the technology have sometimes resulted in funding problems. Is outreach sufficient?**

Bigot: The questions are legitimate, and that is why we have to communicate. We have to answer these questions, and not only from the general public. A large part of my duties will be to keep in close touch with the members, with political leaders, congressmen, in such a way that they feel fully associated, fully understanding how we work, and what the possibilities of this technology are.

We have to demonstrate that we can deliver. ITER is not just a nice research project, it has to fulfill the expectation that in the long term fusion will be a reliable, sustainable, and environmentally friendly way to supply energy.

***Spectrum:* What makes you optimistic that the ITER project will succeed in demonstrating this?**

Bigot: I have now visited several of the members, and I realize there are many issues to be addressed. So far we are moving in the right direction. The more we advance with the project, the more we see what the difficulties are and we address them, and we find solutions. For example, a few years ago we did not master the technology for producing superconducting coils required for the large magnets. We are now proceeding with the manufacture, and we're satisfied with the results. And it is encouraging that some members are considering the next step, after ITER. China, with its large population, expects that fusion technology will be able to provide a share of their energy supplies some time this century. We view their own plans for fusion energy as an endorsement of ITER.

8. Canada-India contract strengthens nuclear ties

16 April 2015

http://www.world-nuclear-news.org/NP-Canada-India-contract-strengthens-nuclear-ties-1604157.html

A long-term uranium supply contract signed by Cameco and India's Department of Atomic Energy (DAE) has been welcomed by the two countries' prime ministers as they look to further cooperation and collaboration between their nations.

The contract was signed yesterday in the presence of Canadian Prime Minister Stephen Harper and Indian Prime Minister Narendra Modi during the first official visit by an Indian prime minister to Canada in 42 years. It is Cameco's first contract with India, and was made possible by a nuclear cooperation agreement between the two countries that came into force in September 2013.

Under the contract, which covers the period to 2020, Cameco will supply the DAE with 7.1 million pounds of uranium concentrate (about 2730 tU). All of the uranium is to be sourced from Cameco's Canadian operations. The contract is worth around CAD 350 million ($286 million) at current uranium prices, according to the Canadian government.

A joint statement issued by the two leaders highlighted the importance of the supply agreement, saying it imparted a "new significance" to civil nuclear cooperation between the countries. Prime Minister Modi said the uranium procurement agreement

launched a "new era of bilateral nuclear cooperation" and reflected a "new level of mutual trust and confidence".
Cameco president and CEO Tim Gitzel said the contract opened the door to a "dynamic and expanding" market. "Much of the long-term growth we see coming in our industry will happen in India and this emerging market is key to our strategy," he said.
Beyond uranium supplies, Harper and Modi also agreed to encourage a collaborative program to "leverage their industries' respective strengths" in pressurized heavy water reactor (PHWR) technology. Sixteen of India's 21 currently operating nuclear power plants are indigenously designed PHWRs that can trace their ancestry to two Canadian-designed Candu plants, Rajasthan 1 and 2, which started up in 1973 and 1980.
The leaders also encouraged closer civil nuclear energy cooperation between Indian and Canadian companies, and welcomed the setting up of the India Nuclear Insurance Pool earlier this year as a positive step towards that. A Canadian civil nuclear trade mission to India is scheduled for October, and the leaders also agreed to "explore mutually beneficial partnerships in the application of radioisotopes for societal benefits".
The joint statement also encourages Canadian and Indian atomic energy establishments and research institutions to establish mechanisms for long-term collaboration in nuclear energy R&D, and includes an agreement to exchange nuclear safety and regulatory experiences and developments. The two countries' nuclear regulators, the Atomic Energy Regulatory Board of India and the Canadian Nuclear Safety Commission, have finalized an arrangement for regulatory cooperation in the field of nuclear and radiation safety regulation.
Researched and written
by World Nuclear News

9.

Put the acid on Great Barrier Reef doomsayers

By Patrick Moore - posted Tuesday, 14 April 2015
http://www.onlineopinion.com.au/view.asp?article=17260

There is nothing more symbolic of the natural beauty of Australia than the Great Barrier Reef.
This makes it a powerful emotional tool to strike fear into the hearts of citizens. The "ocean acidification" hypothesis, that corals and shellfish will die due to higher levels of carbon dioxide dissolved in the sea, is often used to stoke those fears.
Here's why I don't believe there is a shred of evidence to support these claims.
When the slight global warming that occurred between 1970 and 2000 came to a virtual standstill, the doomsayers adopted -"climate change", which apparently means all extreme weather events are caused by human emissions of CO_2.

Cold, hot, wet, dry, wind, snow and large hailstones are attributed to humanity's profligate use of fossil fuels. But the pause in global warming kept on and became embarrassing around 2005.

Something dire was needed to prop up the climate disruption narrative. "Ocean acidification" was invented to provide yet another apocalyptic scenario, only this one required no warming or severe weather, just more CO_2 in the atmosphere.

The story goes that as CO_2 -increases in the atmosphere the oceans will absorb more of it and this will cause them to become acidic - well, not exactly, but at least to become less basic. This in turn is predicted to dissolve the coral reefs and kill the oysters, clams, mussels and algae that have calcareous shells. It was named "global warming's evil twin".

Seawater in the open ocean is typically at a pH of 8.0-8.5 on a scale of 0-14, where 0 is the most acidic, 14 is most basic and 7 is neutral. Ocean acidification from increased CO_2 is predicted to make the ocean less basic, perhaps to pH 7.5 under so-called worst-case projections.

How do I know that increased CO_2 will not kill the coral reefs and shellfish? Let me count the ways.

First, contrary to popular -belief, at 400 parts per million (0.04 per cent), CO_2 is lower now in the atmosphere than it has been during most of the 550 million years since modern life forms emerged during the Cambrian period. CO_2 was about 10 times higher then than it is today.

Corals and shellfish evolved early and have obviously managed to survive through eras of much higher CO_2 than present levels. This alone should negate the "predictions" of species extinction from CO_2 levels nowhere near the historical maximum.

Second, due to its high concentration of basic elements such as calcium and magnesium, sea-water has a powerful buffering capacity to prevent large swings in pH due to the addition of CO_2.This self-correcting capacity of seawater will ensure the pH will remain well within levels conducive to calcification, the process whereby shells and coral structures are formed. Marine shells are largely made of calcium carbonate, the carbon of which is derived from the CO_2 dissolved in the seawater.

Third, and most interesting, there are freshwater species of clams and mussels that manage to produce calcareous shells at pH 4-5, well into the acidic range. They are able to do this because a mucous layer on their shell allows them to control the pH near the surface and to make calcification possible beneath the mucous layer.

The "ocean acidification" story depends only on a chemical hypothesis whereas biological factors can overcome this and create conditions that allow calcification to continue. This is corroborated by the historical record of millions of years of success in much higher CO_2 environments.

Fourth, ocean acidification proponents invariably argue that increased CO_2 will also cause the oceans to warm due to a warming climate. Yet they conveniently ignore the fact that when water warms the gases dissolved in it tend to "outgas".

It's the same phenomenon that happens in a glass of cold water taken from the fridge and placed on a counter at room temperature. The bubbles that form on the inside of the glass as it warms are the gases that were dissolved in the colder water. So in theory a warmer sea will have less

CO_2 dissolved in it than a cooler one.
Finally, it is a fact that people who have saltwater aquariums sometimes add CO_2 to the water in order to increase coral growth and to increase plant growth. The truth is CO_2 is the most important food for all life on Earth, including marine life. It is the main food for photosynthetic plankton (algae), which in turn is the food for the entire food chain in the sea.
For some reason, the proponents of catastrophic global warming ignore this fact. They talk of "carbon pollution" as if CO_2 is a poison. If there were no CO_2 in the global atmosphere there would be no life on this planet. Surely, that should be enough to permit questioning the certainty of those who demonize this essential molecule.
Many climate activists are telling us ocean acidification is decimating coral reefs and shellfish. Have they read the story of remote Scott Reef off Western Australia? The ARC Centre of Excellence for Coral Reef Studies reports that in a brief 15 years this huge reef recovered completely from massive bleaching in 1998. Reefs go through cycles of death and recovery like all ecosystems.
We are told CO_2 is too high and we will suffer for it. Nothing could be further from the truth.
We should celebrate CO_2 as the giver of life it is.

10. Nuclear waste: Bury nuclear waste down a very deep hole, say scientists

Date:
April 14, 2015

Source:
University of Sheffield

Summary:
Technologies that will enable nuclear waste to be sealed 5 km below the Earth's surface could provide a safer, cheaper and more viable alternative for disposing of high level nuclear waste.
http://www.sciencedaily.com/releases/2015/04/150414100956.htm

Scientists at the University of Sheffield calculate that all of the UK's high level nuclear waste from spent fuel reprocessing could be disposed of in just six boreholes 5km deep, fitting within a site no larger than a football pitch.
The concept -- called deep borehole disposal -- has been developed primarily in the UK but is likely to see its first field trials in the USA next year. If the trials are successful, the USA hopes to dispose of its 'hottest' and most radioactive waste -- left over from plutonium production and currently stored at Hanford in Washington State -- in a deep borehole.

University of Sheffield researchers are presenting the latest findings relating to these trials and new concepts for sealing the waste into the boreholes at the American Nuclear Society (ANS) conference in Charleston this week (April 13-16).

Professor Fergus Gibb, of the University of Sheffield's Faculty of Engineering, explains: "Deep borehole disposal is particularly suitable for high level nuclear waste, such as spent fuel, where high levels of radioactivity and heat make other alternatives very difficult. Much of the drilling expertise and equipment to create the boreholes already exists in the oil and gas and geothermal industries. A demonstration borehole -- such as is planned in the US -- is what is now needed to move this technology forward."

At the ANS conference next week, Professor Gibb, with co-researcher Dr Karl Travis, will be presenting modelling work carried out by the University of Sheffield team on the Hanford waste, which confirms that around 40 per cent of the waste, in terms of radioactivity, currently stored at the US site could be disposed of in a single borehole.

Fundamental to the success of deep borehole disposal is the ability to seal the hole completely to prevent radionuclides getting back up to the surface. Professor Gibb has designed a method to do this which he will be presenting at the conference next week: to melt a layer of granite over the waste, which will re-solidify to have the same properties as natural rock.

Professor Gibb's colleague at the University of Sheffield, Dr Nick Collier, will propose a method of fixing and surrounding the waste within the borehole using specialist cements able to handle the temperatures and pressures at that depth.

Deep borehole disposal (DBD) has a number of advantages over the current solution envisaged for all UK nuclear waste, which is in a mined repository at 500m depth:

- DBD is effectively 'pay-as-you-go' disposal. A mined repository can cost from hundreds of millions to tens of billions of dollars to construct before any waste can be disposed of; DBD costs a few tens of millions of dollars per borehole.
- There are more geological sites suitable for DBD as the granite layer that is required can be found at appropriate depths under most of the continental crust.
- A borehole could be drilled, filled and sealed in less than five years, compared to the current timescale for a UK mined repository, which is to open in 2040 and take its first waste by 2075 (although a site has not yet been agreed).
- As DBD disposes of nuclear waste at greater depths and with greater safety and because there are more potential sites available, it should be easier to obtain public and political acceptance of the technology.
- DBD has limited environmental impact and does not require a huge

site: the holes are a maximum 0.6m in diameter and can be positioned just a few tens of metres apart. Once a borehole is complete, all physical infrastructure on the surface can be removed.

While seismic activity might damage the containers within the borehole, fracture the surrounding rock and disrupt some of the nearest barriers in the borehole, it would still not destroy the isolation of the waste or make it possible for radioactivity to reach the surface or any ground water.

The demonstration borehole in the USA will be drilled just under half a metre in diameter and trials will be conducted to ensure waste packages can be inserted into the borehole and recovered if required. Initial results are expected in 2016. If these results are positive, disposal of the Hanford waste capsules would then take place in another borehole, just 0.22m in diameter.

11. 02 APR 2015

Turkish Nuclear Power Plant Project near Sinop receives formal approval by Parliament

Download press release - (pdf 230 KB)

http://www.gdfsuez.com/en/journalists/press-releases/turkish-nuclear-power-plant-project-approval-sinop/

GDF SUEZ is pleased to have received the formal approval from the Turkish Parliament for the nuclear power plant project near Sinop in Turkey. This project is being developed within a Japanese-French-Turkish international consortium involving GDF SUEZ. The approval is for the Inter-Governmental Agreement between Turkey and Japan and the Host Government Agreement, which is a commercial agreement between the consortium members and the Government of Turkey.

This proposed 4,400 MW Nuclear Power Plant project consists of four ATMEA1 nuclear power units built on a site in the Sinop district on Turkey’s Black Sea coast. ATMEA1 is a generation III+ pressurized water reactor (PWR) designed to the highest standards of safety, reliability and operating economy by a company co-owned by Mitsubishi Heavy Industries, Ltd. and AREVA.

Following this approval, the consortium will pursue a feasibility study for the Nuclear Power Plant. It will carry out various assessments, including geological surveys, seismic hazard and environmental impact assessments in order to assess the suitability of the proposed construction site. The consortium will also undertake the preparation and assessment of the contractual and financing framework of the project.

Through localized procurement and development of local human resources to build, operate and maintain the new reactors, the project is expected to contribute significantly to the development of Turkey's economy.

GDF SUEZ operates seven nuclear reactors in Belgium at Doel and Tihange with an installed power capacity of around 6,000 MW in Europe. The Group is supporting new developments in third generation pressurized water reactor (PWR) technologies which are the result of advanced engineering incorporating modern safety standards in accordance with extremely demanding requirements.

GDF SUEZ has a long-standing presence in the Turkish market with activities involving power generation, gas distribution, retail and trading. GDF SUEZ has interests in approximately 1,250 MW of power generation capacity in Turkey through the Baymina and Unimar gas-fired power plants. The Group also owns Izgaz, the country's third largest gas distribution company.