ITER Forum website Update 8/16

B.J.Green (30/8/16)

1.
Major JT-60SA magnet component arrives in Japan

25 July 2016
http://fusionforenergy.europa.eu/mediacorner/newsview.aspx?content=1032

The first Toroidal Field (TF) coil has arrived from Europe to the JT-60SA site in Naka, Japan, where its assembly will soon begin. After the coil's successful fabrication and testing, even its transportation has been somewhat of an achievement, in consideration of the component size: second only to those currently being fabricated for ITER, they are 8 metres high, 5 metres wide, and 33 tonnes heavy.

The TF Coils are the backbone of the JT-60SA machine, one of the three projects covered in the Broader Approach Agreement between Europe and Japan. They are large "D" shaped superconducting magnets whose main task will be to create the main magnetic field needed to confine the plasma.

In total, an additional 19 voyages are planned to carry the remaining TF coils for the tokamak and their two spares to Japan.

2. Hyundai Heavy clinches additional ITER component deal

Published : 2016-07-19 17:15

Updated : 2016-07-20 09:31

http://www.koreaherald.com/view.php?ud=20160719000940

[**THE INVESTOR**] **Hyundai Heavy Industries** has won an additional contract to supply two vacuum vessel sectors, the key component of the multibillion-dollar project International Thermonuclear Experimental Reactor, the company said on July 19.

Under the US$101.6 million deal, HHI will build two of the

nine vacuum vessel sectors (No.7 and 8) that make up the main body of the ITER, the world's largest nuclear fusion machine being built in Cadarache, southern France. Each vacuum vessel sectors measures 400 tons in weight and 12 meters in height.
The company is scheduled to complete the equipment by the end of 2020 and deliver to the ITER construction site.

In 2010, HHI received the first order to build two vacuum vessel sectors (No.1 and 6) by 2019. With the latest addition, the price of the contract Hyundai won amounts to a whopping US$380 million.

The ITER project, funded and run by seven entities -- including the European Union, India, Japan, China, Russia, South Korea and the US -- was launched in 2007 with an aim to build an experimental nuclear reactor that generates cleaner, safer and more efficient energy sources through atomic fusion.
By Ahn Sung-mi (sahn@heraldcorp.com)

3. Close encounters of the MAST kind | 19/07/2016

http://www.ccfe.ac.uk/news_detail.aspx?id=390

It may look like a UFO, but it's actually the latest big component to go into the new **MAST Upgrade tokamak**, now being assembled at CCFE.
The component is known as the 'upper divertor coil cassette' and is part of the coils that will produce the magnetic field to confine the hot plasma inside MAST Upgrade during experiments.
The cassette is integral to the workings of the Super-X divertor – a novel concept for exhausting waste plasma that will be one of the main innovations of the new device. In the video below you can see the cassette being lowered and attached to MAST Upgrade's outer cylinder, which was **recently moved into place**.
There is still much work needed to complete the assembly of MAST Upgrade – but with each component re-installed it looks more and more like a real tokamak.
Ioannis Katramados, MAST Upgrade's Load Assembly leader, is delighted with such visible progress:
"This has been a long time coming but good preparation, hard work and learning from earlier difficulties has paid off. As more modules come together, the machine takes shape, lifting everyone's spirits and giving us all a push to get the job completed. My thanks to the team for a brilliant performance – again!"

4. Hyundai to Build ITER Vacuum Vessel

By Aiswarya Lakshmi
Tuesday, July 19, 2016
http://www.marinelink.com/news/hyundai-vacuum-vessel412727.aspx

Hyundai Heavy Industries (HHI), the world's largest shipbuilder and a leading industrial plant EPC contractor,won $101.6 million worth of order to supply two vacuum vessel sectors (No.7, 8) for ITER (International Thermonuclear Experimental Reactor).

This is an additional order to the one HHI received from the international body in 2010 to build two vacuum vessel sectors (No.1 and 6) and 35 ports out of 53.

HHI is scheduled to deliver the two vacuum sectors measuring 400 tons in weight and 12 m in height respectively at the Cadarache facility in the south of France where the experimental tokamak nuclear fusion reactor is being built by the year of 2020.

The nuclear fusion reactor project that South Korea, USA, EU, Japan, China, Russia, and India are jointly running aims to artificially produce and commercialize nuclear fusion energy by the year of 2025.

The signing ceremony for the order was attended by Mr. Kwon Oh-gap, president and CEO of HHI; Mr. Park Cheul-ho, COO of HHI's Industrial Plant & Engineering Division; Bae Tae-min, director-general for Space,Nuclear and Big Science Policy Bureau, Ministry of Science, ICT & Future Planning of Korea; Mr. Kim Kee-man, president of National Fusion Research Institute of Korea; and Mr. Eisuke Tada, deputy director-general, relations coordinating officer of ITER Organization.

The vacuum vessel sectors ensure the optimal vacuum environment for the plasma produced in the ITER and work as a first tier barrier for neutrons created during the nuclear fusion reaction. Building the vacuum vessel requires the-state-of-the-art 3D modeling and welding technologies for the equipment to be able to withstand ultra-high temperatures (100 million °C) and

ultra-high vacuum conditions.

Park Cheul-ho said, “The 5,000 tons of vacuum vessel that must be built within a 10 mm allowable error requires an ultra-high level of precision in engineering and manufacturing process.We see the two orders we won is the fruit of our world’s top class technology. However, we won’t stop here but continue to pursue our goal of leading the world’s nuclear fusion power generation sector.”

5. Local benefits from Idaho SMR

15 August 2016
http://www.world-nuclear-news.org/NN-Local-benefits-from-Idaho-SMR-1508168.html

The proposed construction and operation of NuScale's small modular reactor (SMR) near Idaho Falls will have a significant impact on the local economy, an economic impact analysis commissioned by the city's mayor has found.

Mayor Rebecca Casper commissioned the preliminary economic impact analysis through the Idaho Department of Labor to examine the potential economic impact of a project to build the first commercial NuScale SMR on a site at the US Department of Energy's Idaho National Laboratory (INL). More in-depth economic impact studies will be conducted as the project progresses.

According to the study, preliminary estimates indicate that the first phase - construction - of the project will cost $2.8 billion and directly support up to 1000 jobs, while creating or sustaining an additional 11,808 jobs in the local economy through indirect and induced economic activity. The operations phase would support 360 jobs annually, with indirect and induced economic activity creating or sustaining a further 1147 jobs.

City of Idaho Falls economic development coordinator Dana Briggs said the SMR project would spur growth, development and career opportunities in eastern Idaho. "As shown by the data gathered in this economic impact analysis, realizing the location of a Small Modular Reactor at the INL site will have a tremendous impact on our local and regional economy," she said.

Briggs noted that the study had not included the impact of the SMR supply chain. "Regional companies are well positioned to provide supplies, technology, and expertise for SMR technology to be deployed throughout the nation and world. The economic possibilities are mutually beneficial for our businesses, citizens, and community. This is an excellent opportunity for our region," she said.

Last week, public power consortium Utah Associated Municipal Power Systems announced the selection of a preferred site for the construction of the plant within the INL boundary. NuScale is

preparing to submit a reactor design certification application to the US Nuclear Regulatory Commission, with plans for a construction and operating licence application referencing the design in late 2017 or early 2018.

Researched and written
by World Nuclear News

6. EPA approval for Mulga Rock

15 August 2016

http://www.world-nuclear-news.org/UF-EPA-approval-for-Mulga-Rock-1508167.html

Western Australia's Environmental Protection Authority (EPA) has today recommended Vimy Resources' Mulga Rock uranium project for approval by the state's environment minister.

The EPA's endorsement of Vimy's plans to mine up to 1360 t U3O8 (1153 tU) per year at the project, 240 km east-northeast of Kalgoorlie in Western Australia's Great Victoria Desert, follows an environmental impact assessment process which included a 12-week public review period. The EPA board examined the proposal and tested it against six key environmental factors including potential impacts to flora, vegetation, terrestrial fauna, human health and the environmental quality of inland waters. The EPA's process also included a site visit, discussions with Vimy and the consideration of public and government agency submissions.

EPA chairman Tom Hatton said each proposal received by the EPA scrutinised on a case-by-case basis. "In this instance, the EPA has recommended the Mulga Rock Uranium Project be approved subject to a suite of stringent conditions," he said. The authority recently recommended that another proposed uranium mining project, Cameco's Yeelirrie, should not go ahead on the grounds that it failed to adequately protect underground fauna.

The 14 conditions recommended by the EPA include the preparation of environmental management plans to ensure that impacts on the conservation of significant flora, vegetation and terrestrial fauna are minimised. Vimy will also be required to prepare plans to ensure impacts on Aboriginal heritage sites are minimised and to monitor and manage the quality of soil and groundwater. The EPA has also recommended conditions on aspects related to the eventual rehabilitation and decommissioning of the mine. It concluded that radiation exposure to mine-site workers and the public would be within acceptable limits for human health.

The project will require final approval from both the state and Australian federal environment ministers before it can proceed. It is being assessed under a bilateral agreement under which the federal environment minister relies on the environmental impact assessment processes carried out at the state level, so the Western

Australian assessment report will help to form the basis of the final assessment and decision at the federal level.
Vimy CEO Mike Young said the EPA had undertaken a very efficient and thorough assessment, describing the EPA's approval as a "fantastic" outcome. He said the company could see no reason why the state and federal ministers would not agree with the EPA's assessment.
The EPA's report to the Western Australian minister for the environment is now open to public appeal for 14 days, ending 29 August. Vimy said that it "expects that there will be appeals" but anticipates a final decision by the end of the year.
"We can see the end of the approvals process," Young said. "This de-risks perceptions and is a very significant step towards achieving the conditions required for the final investment decision."
Mulga Rock is described by Vimy as the third largest undeveloped uranium deposit in Australia. The project has a total of 76.2 million pounds (29,310 tU) of indicated and inferred uranium resources in four deposits, which Vimy intends to mine by shallow open-pit methods, with a central processing plant. Cobalt, copper, nickel and zinc metal concentrates will be extracted after the uranium has been removed, and sold separately. The project has an expected mine life of 16 years.
Researched and written
by World Nuclear News

7. Changjiang 2 enters commercial operation

15 August 2016
http://www.world-nuclear-news.org/NN-Changjiang-2-enters-commercial-operation-1508164.html
Unit 2 of the Changjiang nuclear power plant on China's southern island province of Hainan has entered commercial operation, China National Nuclear Corporation (CNNC) announced today.
The company said the 650 MWe CNP-600 pressurized water reactor met all the conditions for entering commercial operation at 5.00pm on 12 August, having completed a 168-hour continuous demonstration run.
The reactor achieved first criticality on 9 June following the completion of loading 121 fuel assemblies into its core on 12 May. It was connected to the grid on 20 June.
Initial approval for construction of the Changjiang plant was granted by the National Developmental and Reform Commission in July 2008. Early site works began in December 2008. Construction of unit 1 began with the pouring of first concrete on 25 April 2010, while that for unit 2 was poured on 21 November 2010. Changjiang

1 achieved first criticality on 12 October 2015 and entered commercial operation in December.
The plant, near Hoi Mei Tong village in China's Hainan province, is being built as a joint venture between CNNC and China Huaneng Group, with shares split 51% and 49%, respectively. The plant will eventually comprise four units, with units 3 and 4 housing either CNP-650 or ACP-600 reactors. Construction of both those units is scheduled to begin by 2018.
CNNC has said that the first two Changjiang units will together provide almost one-third of the electricity needs of Hainan. By using nuclear power instead of coal-fired generation, the units will avoid the burning of some 300 million tonnes of coal and the resulting emission of about 7.5 million tonnes of carbon dioxide and 5.8 tonnes of sulfur dioxide, it claims.
Changjiang 2 becomes CNNC's 15th power reactor in commercial operation. It now has 12,162 MWe of generating capacity online. CNNC also has another nine units under construction and several more planned.
Researched and written
by World Nuclear News

8. Fifth Japanese power reactor restarted

12 August 2016
http://www.world-nuclear-news.org/C-Fifth-Japanese-power-reactor-restarted-1208164.html
Shikoku Electric Power Company announced today that it had initiated the process to restart unit 3 of its Ikata nuclear power plant in Japan's Ehime prefecture. It becomes the fifth Japanese reactor to resume operation under new safety standards introduced following the March 2011 accident at the Fukushima Daiichi plant.
The company said that at 9.00am today it began the operation to extract the control rods from the reactor's core, allowing the fission process to begin.
Shikoku announced on 5 August that it planned to restart the unit today and that power generation would resume on 15 August. Output from the 846 MWe pressurized water reactor will then gradually be increased and full capacity should be reached on 22 August. The unit is set to re-enter commercial operation in early September.
Ikata 3 has been idle since being taken offline for a periodic in April 2011.
Under Japan's reactor restart process, plant operators are required to apply to the Nuclear Regulation Authority (NRA) for: permission to make changes to the reactor installation; approval of their

construction plan to strengthen the plant; and, approval of the plant's operational safety programs. Operators are required to add certain safety-enhancing equipment within five years of receiving the NRA's approval of a reactor engineering work program.
Shikoku submitted its engineering work program for Ikata 3 to the NRA in July 2013. This was approved by the NRA in July last year. That approval - which means the NRA considered the reactor, and the plant as a whole, to be safe for operation - represented by far the major part of the licensing process. Shikoku's 'construction plan' for Ikata 3 - what it plans to do to strengthen the unit - was approved on 23 March this year. The utility received approval for its operational safety programs - the third and final approval - on 19 April. The NRA has since carried out final pre-operational safety inspections of the unit. The loading of fuel into Ikata 3 was then carried out 24-27 June.
Unit 1 of Kyushu Electric Power Company's Sendai plant in Kagoshima prefecture was the first to be restarted last August, followed by Sendai 2 in October. Unit 3 of Kansai Electric Power Company's Takahama nuclear power plant in Fukui prefecture resumed operation on 29 January. Takahama 4 was restarted on 26 February, but has remained offline since 29 February following an automatic shutdown of the reactor due to a "main transformer/generator internal failure". However, an injunction imposed by a district court on 9 March led to unit 3 being taken offline as well and both units have since remained idle.
Another 20 reactors are moving through the restart process, which has been prioritised to bring on the most-needed reactors first, in the localities and prefectures more supportive of restart.
Researched and written
by World Nuclear News

9. Final super modules in place at Summer 2

11 August 2016

The final "super modules" have been lifted into place in the containment vessel of VC Summer unit 2, marking a milestone in the construction of the AP1000 reactor.

http://www.world-nuclear-news.org/NN-Final-super-modules-in-place-at-Summer-2-1208167.html

The CA02 and CA03 modules make up the in-containment refuelling water storage tank. The tank, which holds up to 500,000 gallons - nearly 2 million litres - of borated water, is positioned above the reactor, and relies on gravity as the only driving force needed to release water to keep the reactor core cool should the reactor experience an unexpected shutdown.
Safety features relying on the laws of nature, including gravity,

natural circulation and condensation, are known as "passive" systems because they do not require operator actions, mechanical equipment or AC power to be deployed.
The CA02 and CA03 structural steel modules are known as super modules because they are too large to transport and require on-site assembly. The CA03 module - assembled from 17 sub-modules - is over 35 metres long, 12 metres tall and weighs about 228 tonnes. The CA02 is about 12 metres tall and weighs over 50 tonnes.
Scana Corporation subsidiary South Carolina Electricity & Gas (SCE&G) and co-owner Santee Cooper are building two Westinghouse-designed AP1000 units at the VC Summer site in South Carolina, where SCE&G already operates an existing PWR unit. Construction began on both units in 2013, with unit 2 expected to enter operations in 2019 and unit 3 in 2020. Westinghouse is the contractor for the construction project, and Fluor is the construction manager.
Two AP1000 units are also under construction at Vogtle in Waynesboro, Georgia and two each at Sanmen and Haiyang in China.
Researched and written
by World Nuclear News

10. Preferred site chosen for NuScale SMR

11 August 2016

A preferred site has been identified for the construction of a small modular reactor (SMR) at the US Department of Energy's Idaho National Laboratory (INL), near Idaho Falls.

http://www.world-nuclear-news.org/NN-Preferred-site-chosen-for-NuScale-SMR-1108167.html

Utah Associated Municipal Power Systems (UAMPS) CEO Doug Hunter announced that the organization had identified its preferred site from four possible locations within INL's boundaries. Speaking at the Intermountain Energy Summit, he said the 35 acre (14 hectare) plot lies about six miles (10 km) southeast of the Lost River Rest Stop near the junction of US Highways 20 and 26.
The UAMPS Carbon Free Power Project (CFPP) was formally launched in 2015, bringing together UAMPS, NuScale, Energy NorthWest and Enercon Services in a project to build the first-of-a-kind of NuScale's reactor design. Earlier this year the US Department of Energy granted a permit to UAMPS allowing it to perform site selection and characterization activities within the INL site. Hunter said the preferred site would not interfere with any existing INL facilities or research.
The SMR design for the CFPP is being provided by NuScale Power of Portland, Oregon. Engineered with passive safety features, the 50

MWe NuScale Power Module could see up to 12 individual modules installed in a single facility. The first-of-a-kind commercial plant would include a reactor building, turbine building, used fuel storage area, administration and other buildings.

NuScale chief commercial officer Mike McGough told the conference the company is "nearly ready" to submit a reactor design certification application to the US Nuclear Regulatory Commission. The company has previously said that it plans to submit a construction and operating licence (COL) application referencing the design in late 2017 or early 2018.

Regional agency UAMPS - a political subdivision of the State of Utah that provides wholesale electricity to community-owned power systems in Arizona, California, Idaho, Nevada, New Mexico, Oregon, Utah and Wyoming - established the CFPP to provide for additional mid-sized baseload electrical generating capacity to meet the expected future needs of its members. The move followed the formation of the Western Initiative for Nuclear (WIN) collaboration, set up by NuScale in 2013 to study the demonstration and deployment of a multi-module NuScale SMR plant in the mid-western USA by 2024.

Earlier this year NuScale confirmed it intends to participate in a UK government competition to identify the most suitable SMR design for possible future deployment.

Researched and written
by World Nuclear News

11. Exelon reaffirms long-term commitment

12 August 2016

Exelon will continue to advocate for public policy that recognises the clean energy attributes of nuclear plants but has warned it will have no choice but to close plants that remain unprofitable.

http://www.world-nuclear-news.org/NP-Exelon-reaffirms-long-term-commitment-1208168.html

In a presentation to analysts on Wednesday, CEO Chris Crane and senior Exelon leaders outlined plans to invest $25 billion in critical infrastructure, smart grid technology and other reliability and customer service improvements at its utilities over the next five years. Cash flow from the company's generation activities will be used to fund the investments.

Crane described 2016 as a "pivotal year" for nuclear power plants which have faced financial challenges driven by cheap gas prices and the "unintended consequences" of government mandates which had tended to prefer renewables over other low-carbon or carbon-free alternatives and failed to compensate properly for carbon-free

generation.
He praised the recent approval by the New York Public Service Commission of a Clean Energy Standard (CES) explicitly recognising the zero-carbon contribution of nuclear power plants via credits based solely on the social cost of carbon. Approval of the CES has helped to assure the continued operation of Exelon's Nine Mile Point and RE Ginna nuclear power plants in upstate New York, and furthermore enabled Exelon to move to acquire the Fitzpatrick plant from Entergy, which otherwise would have faced closure in early 2017.
The failure of Illinois to enact legislation that would have preserved the Clinton and Quad Cities plants, however, meant that the company had "no choice" but to proceed with preparations for the closure of the units. Exelon announced in June that Clinton would close in 2017 and Quad Cities the following year following seven years of losses despite being two of the utility's best-performing plants.
"We will continue to work for solutions in our states to preserve these generation fleets, but we do need the states to step up and recognise the value of these assets and what they contribute to communities and the environment," Crane said. He warned that nuclear plants must still perform economically. "Where we can't see a path to sustained profitability, we have no choice but to shut down plants," he said.
In answer to questions, Exelon Generation CEO Ken Cornew confirmed that the "drop dead" date after which the company would be unable to reverse its decision on Quad Cities and Clinton plants would be December 2016. Further decisions on the Illinois legislation could be made in state meetings scheduled for late November and early December, but Cornew cautioned that there was "no certainty" of the outcome of those meetings.
Researched and written
by World Nuclear News

12. July 2016 was Earth's hottest month in recorded history, says Nasa

http://www.telegraph.co.uk/science/2016/08/16/july-2016-was-earths-hottest-month-in-recorded-history-says-nasa/

Associated Press

16 AUGUST 2016 • 3:16AM

Earth just broiled to its hottest month in recorded history, according to Nasa.

Even after the fading of a strong El Nino, which spikes global temperatures on top of man-made climate change, July burst global temperature records.

Nasa calculated that July 2016 was 1.51 degrees Fahrenheit (0.84 degrees Celsius) warmer than the 1950-1980 global average. That's clearly hotter than the previous hotter months, about 0.18 degrees warmer than the previous record of July 2011 and July 2015, which were so close they were said to be in a tie for the hottest month on record, said Nasa chief climate scientist Gavin Schmidt.

Scientists blame mostly man-made climate change from the burning of fossil fuel with an extra jump from the now-gone El Nino, which every few years is a natural warming of parts of the Pacific Ocean that changes weather worldwide.

Georgia Tech climate scientist Kim Cobb said this is significant "because global temperatures continue to warm even as a record-breaking El Nino event has finally released its grip."

Nasa's five hottest months on record are July 2016, July 2011, July 2015, July 2009 and August 2014. Only July 2015 was during an El Nino. Records go back to 1880.

This is the 10th record hot month in a row, according to Nasa. The National Oceanic and Atmospheric

Administration, which calculates temperatures slightly differently, will come out with its July figures on Wednesday. NOAA has figured there have been 14 monthly heat records broken in a row, before July.
"The scary thing is that we are moving into an era where it will be a surprise when each new month or year isn't one of the hottest on record," said Chris Field, a climate scientist at the Carnegie Institution and Stanford University.
This new record and all the records that have been broken recently years tell one cohesive story, said Schmidt, director of Nasa's Goddard Institute for Space Studies: "The planet is getting warmer. It's important for what it tells us about the future."

13. NIF Experiment Challenges Standard Ionization Models

When hydrogen fuel is compressed to extreme densities and temperatures in NIF inertial confinement fusion (ICF) implosions, a very dense plasma—a chaotic mixture of freely moving ions and unbound, or free, electrons—is created. Researchers need to understand the properties of this material in order to design successful ignition experiments, as well as to model the state and evolution of planets and dwarf stars.
https://lasers.llnl.gov/news/papers-presentations
A recent Discovery Science experiment on NIF, however, indicates that widely used models describing the ionization balance in a hot dense plasma—the number of bound compared to unbound electrons—underestimate the amount of ionization that occurs when material is subjected to the kinds of pressures and temperatures created by converging shocks driven by NIF's laser beams.
The experiment, reported in a *Physical Review E* paper published

online on July 21, used 176 laser beams to create pressures exceeding 100 megabars (100 million atmospheres) in a solid polystyrene (plastic, or CH) sphere. The sample ionization state was measured by NIF's new x-ray Thomson scattering (XRTS) platform (see "Measuring Ionization at Extreme Densities") using ~9-keV (about 9,000-electron-volt) x rays produced by a zinc backlighter foil located 7.5 millimeters from the center of the CH sphere and irradiated by an additional 16 laser beams. The experiment approached the conditions needed to dislodge the electrons closest to the nucleus, known as *K*-shell electrons, from their orbits.

"We can see from these results that the current ionization model is off at high pressures," said LLNL physicist Tilo Döppner, a member of the experimental team. "The experiment shows higher ionization in CH than the common model would predict. This is important, because many thermodynamic quantities depend on the ionization state of the material."

The findings are of special significance for ICF experiments, Döppner said, because knocking electrons from the innermost atomic shells reduces the absorption of the plastic ablator, and that can cause errors in radiographic measurements of the remaining mass of imploding ICF capsules.

The experiment was performed as part of the GigaBar Equation of State (EOS) campaign of the NIF Discovery Science program. Döppner said the development of the XRTS platform, including the construction of a new high-efficiency gated spectrometer, required "a lot of hard and dedicated work by a large number of people. X-ray Thomson scattering is a challenging diagnostic technique," he said, "but this new NIF data point (for ionization balance measurements) has already triggered new theoretical work in dense plasma physics."

Future experiments will drive hollow CH capsules to even higher compression, pressures approaching one gigabar (one billion

atmospheres), and electron densities of 10^{25} per cubic centimeter. "This is a very interesting plasma state because of its high degree of degeneracy and correlations," Döppner said, "potentially with sufficient energy density to fully ionize carbon—and it's only possible at NIF."

Former UC Berkeley postdoc Dominik Kraus, who worked on the experiment at NIF, was lead author of the paper. He and Döppner were joined by LLNL researchers Annie Kritcher, Benjamin Bachmann, Rip Collins, Dan Kalantar, Nino Landen, Tammy Ma, Sebastien Le Pape, Joe Nilsen, and Damien Swift and by collaborators from the University of Warwick and the Atomic Weapons Establishment in the UK, SLAC National Accelerator Laboratory, Washington State University, and the GSI Helmholtz Center for Heavy Ion Research in Darmstadt, Germany.

14. Britain's energy dilemma: if not nuclear power, then what?

The delay to the construction of the controversial Hinkley point plant raises a question: what else can provide baseload power without polluting?

https://www.theguardian.com/uk-news/2016/jul/30/hinkley-point-c-if-not-nuclear-then-what-renewables-ccs

Britain faces a problem in coping with its complex energy demands. It needs to provide extra energy to meet rising demands for power in coming decades but at a reasonable cost – while also reducing carbon emissions by considerable levels in order to meet its climate change commitments. This is not an easy combination to achieve. However, Hinkley

Point was considered by many experts to be a crucial aid in reaching these goals.
With its massive 3.2bn watt capacity, Hinkley Point C would provide 7% of the nation's electricity when completed. Night and day, it would help to generate the power that would keep the nation working while renewable energy sources, mainly wind plants, would provide the rest of the electricity needed by homes and offices. "You have to have some baseload source to provide power when it is utterly calm and renewables are not providing energy," explains Bob Ward, of the Grantham Research Institute. "Gas and coal plants – which can also supply that baseload – will no longer be viable in future because of their carbon emissions, which cause global warming. You are then left with nuclear."
This dilemma reveals a major drawback that affects renewable energy. Wind and solar plants are intermittent power suppliers. They often provide power when it is not needed but fail to supply it when it is required. And until a method of storing energy on an industrial scale is developed, this drawback will continue to bedevil its deployment across the country. Research into ways to store energy on a large scale is now being pursued across the globe but may take decades. Similarly, other game-changing energy projects are being worked on.
One of the most important of these is fusion power. This aims to recreate the process that provides the Sun with its energy. Nuclei of hydrogen atoms are fused together at colossal temperatures inside huge reactors to create helium nuclei – and a great deal of excess energy, but little pollution or radioactive contamination. However, current devices – in particular the international Iter fusion reactor being built in France with British involvement – are currently years behind schedule and vastly over budget. Few experts believe fusion will get us out of our current energy problem.

Alternatively, we could continue to use fossil fuel plants

but take their carbon dioxide emissions, liquefy them and then pump into the ground, a procedure known as carbon capture and storage. Britain has huge, empty North Sea oil fields which many geologists and energy experts believe would be ideal for storing liquefied carbon dioxide. Several test projects were set up in recent years, with the government pledging to provide funding of up to £1bn until, in November last year, it abruptly cancelled the programme, halting work on all major British CCS projects.

As Luke Warren, chief executive of the Carbon Capture and Storage Association, said at the time: “This is devastating. This technology is critical for the UK’s economic, industrial and climate policies.” These may prove to be prophetic words.

15. The Industrial Revolution kick-started global warming much earlier than we realised

August 25, 2016 6.27am AEST

https://theconversation.com/the-industrial-revolution-kick-started-global-warming-much-earlier-than-we-realised-64301

In the early days of the Industrial Revolution, no one would have thought that their burning of fossil fuels would have an almost immediate effect on the climate. But our new study, published today in Nature, reveals that warming in some regions actually began as early as the 1830s.

That is much earlier than previously thought, so our discovery redefines our understanding of when human activity began to influence our climate.

Determining when global warming began, and how quickly the planet has warmed since then, is essential for understanding how much we have altered the climate in different parts of the world. Our study helps to answer the question of whether our climate is already operating outside thresholds that are considered safe for human society and functional ecosystems.

Our findings show that warming did not develop at the same time across the planet. The tropical oceans and the Arctic were the first regions to begin warming, in the 1830s. Europe, North America and Asia followed roughly two decades later.

Surprisingly, the results show that the southern hemisphere began warming much later, with Australasia and South America starting to warm from the early 20th century. This continental-scale time lag is still evident today: while some parts of Antarctica have begun to warm, a clear warming signal over the entire continent is still not detectable.

The warming in most regions reversed what would otherwise have been a cooling trend related to high volcanic activity during the preceding centuries.

By pinpointing the date when human-induced climate change started, we can then begin to work out when the warming trend broke through the boundaries of the climate's natural fluctuations, because it takes some decades for the global warming signal to "emerge" above the natural climate variability.

According to our evidence, in all regions except for Antarctica, we are now well and truly operating in a greenhouse-influenced world. We know this because the only climate models that can reproduce the results seen in our records of past climate are those models that factor in the effect of the carbon dioxide released into the atmosphere by humans.

These remarkable findings were pieced together from the most unusual of sources – not thermometers or satellites, but rather from natural climate archives. These include coral skeletons, ice cores, tree rings, cave deposits and ocean and lake sediment layers, all of which record the climate as they grow or accumulate.

These archives provide long records that extend back 500 years – well before the Industrial Revolution – and provide a critical baseline for the planet's past climate, one that is impossible to obtain otherwise.

But why is there no clear warming fingerprint yet seen across Antarctica? The answer most likely lies in the vast Southern Ocean, which isolates the frozen continent from the warming happening elsewhere.

The westerly winds that circulate through the Southern Ocean around Antarctica keep warm air masses from lower latitudes at bay. Ozone depletion and rising greenhouse gas concentrations during the 20th century have also caused this wind barrier to get stronger.

The Southern Ocean currents that flow around Antarctica also tend to move warmer surface waters away from the continent, to be replaced with cold deeper water that hasn't yet been affected by surface greenhouse warming. This process could potentially delay Antarctica's warming by centuries.

Ocean insulation

The delay in warming observed in the rest of the southern hemisphere is something we do not yet fully understand. It could simply be because fewer records are available from the southern hemisphere, meaning that we still don't have a full picture of what is happening.

Alternatively, like Antarctica, the southern hemisphere's oceans could be holding back warming – partly through winds and currents, but perhaps also because of "thermal inertia", whereby the ocean can absorb far more heat energy than the atmosphere or the land before its temperature

markedly increases. Bear in mind that the southern half of the globe has much more ocean than the north.

Essentially, then, the coolness of the southern hemisphere's vast oceans could be "insulating" Australasia and South America from the impact of global warming. The question is, for how long?

If our evidence of delayed warming in the southern hemisphere holds true, it could mean we are in in for more climate surprises as global warming begins to overcome the thermal inertia of our surrounding oceans. Could the recent record warming of Australian waters, and the subsequent damage to the Great Barrier Reef, be an early sign that this is already occurring?

Recent research suggest that the mass bleaching event of the reef was made 175 times more likely by climate change. Following the recent severity of such extremes, a better understanding of how anthropogenic greenhouse warming is already impacting the southern hemisphere is critical.

What to do about it

Leading scientists from around the world met in Geneva last week to discuss the goal of limiting average global warming to 1.5℃ – the more ambitious of the two targets enshrined in the Paris climate agreement.

Last year, global temperatures crossed the 1℃ threshold, and 2016 is on track to be 1.2-1.3℃ above our climate baseline.

But here's the kicker. That baseline is relative to 1850–1900, when most of our thermometer-based temperature records began. What our study shows is that for many parts of the world that estimate isn't good enough, because global warming was already under way, so the real baseline would be lower.

The small increases in greenhouse gases during the 19th century had a small effect on Earth's temperatures, but with the longer perspective we get from our natural climate

records we see that big changes occurred. These fractions of a degree of extra warming might seem insignificant at first, but as we nudge ever closer to the 1.5℃ guardrail (and potentially beyond), the past tells us that small changes matter.