Australian ITER Forum Website News Update 12/17

B.J.Green (21/12/17)

1. A fusion future

November 20, 2017

Laban Coblentz, Head of Communication, ITER gives an absorbing insight into all things fusion and the future of fusion energy

https://www.openaccessgovernment.org/a-fusion-future/39955/

From its earliest history, the human animal, among all species, has been the most ambitious to dominate its environment: to conquer the earth, the seas, the skies, and – more than half a century ago – making its first forays into space. If Elon Musk and other visionaries have their way, humans will soon become an interplanetary species.

Harnessing nuclear fusion is an equally **ambitious goal**, but in reverse: bringing a star to Earth. Fusion accounts for more than 99% of the energy of the universe. The fusion reaction powering our Sun at its core – 600 tons of hydrogen converted every second – is our engine of sustained light and heat: the source of all life on our planet. But the Sun accomplishes this feat using gravitation – 300,000 times that of Earth – and a temperature of 15 million degrees. The puzzle of how to replicate this phenomenon, how to “create a star on Earth” as a controlled energy source, has been a science and engineering quest for more than six decades. Many methods have been tried.

The front-runner, by a good measure, is the Tokamak: a toroidal or doughnut-shaped vacuum chamber encasing a second, invisible cage formed by magnetic fields. A gaseous soup made of two forms of hydrogen – deuterium and tritium – is injected into the chamber and heated until it becomes plasma: the **fourth state of matter,** with the electrons stripped away from their nuclei.

At a temperature of 150 million degrees, 10 times hotter than the core of the sun, the speed of these hydrogen nuclei overcomes their natural repulsion, allowing them to collide and fuse. Two new products result in helium and a neutron so energised that, in free space, it would reach the moon in less than 9 seconds.

In a commercial Tokamak, these intense bursts of energy will heat water and drive a turbine to generate electricity.

Fusion energy is desirable because of its near-perfect characteristics. Fusion releases no carbon or other greenhouse gases. The fusion reaction, while difficult to create, is inherently safe; unlike nuclear fission, there is no possibility of a Chernobyl or Fukushima-style meltdown. Nor does a fusion reactor produce any high-activity, **long-lived radioactive waste.**

And fusion energy is incredibly concentrated. Consider this: if the world were entirely powered by coal, at current consumption rates, it would require 24 billion tonnes per year; if powered by fusion, the same output would take a mere 867 tonnes of hydrogen.

Best of all, fusion **fuel is abundant.** Deuterium is easily extracted from seawater, and lithium, used in the Tokamak to breed tritium, is similarly plentiful. This translates to millions of years of supply. With this fuel accessible to every region and country, fusion visionaries foresee a transformed geopolitical landscape, an energy-rich global community unscarred by conflicts over access to petroleum resources.

Since the Russian invention of the Tokamak in the 1950s, hundreds of successively larger Tokamaks have been built and operated. The science and engineering challenges have largely been overcome, their solutions proven. What remains is to demonstrate and study a "burning plasma," meaning a plasma that is largely self-heated by fusion.

In fusion physics, the critical parameter is referred to as "Q": the ratio of thermal output from fusion power versus the thermal input power used to start up the plasma. With all other factors equal, Q is directly proportional to the size of the Tokamak vacuum chamber.

Which brings us to ITER: the first full-scale Tokamak, a project of 35 countries now taking shape in the picturesque heart of Provence in southern France. ITER will have a Q of 10 or greater: 50 megawatts of thermal power heating the plasma to produce, via fusion, a thermal output power of 500 megawatts or more. The ITER mission is to demonstrate the feasibility of fusion on a commercial scale through the production and study of this burning plasma.

Arguably, ITER is the most challenging science and engineering project humans have ever attempted. ITER's superconducting magnets, some as large as 24 metres in diameter, will be supercooled with liquid helium to -269°C, the temperature of interstellar space. A few metres away, the resulting magnetic cage will keep the superheated plasma – the hottest point in the universe – away from the walls.

"ITER," in Latin, means "the way"; and the complicated multinational collaboration at the heart of the ITER Agreement is seen by many as foreshadowing "the way" that future 'big science' must adapt to be successful. Each ITER Member supplies most of its financial support in the form of components: massive, delicate pieces of the Tokamak and support systems that must be shipped to Provence and assembled into this intricate, supersized fusion platform.

ITER's complexity demands extraordinary managerial and systems engineering performance; but the resulting benefits – new industrial expertise, spin-offs, and groundbreaking innovation in fields as diverse as materials science, robotics, electromagnetics, cryogenics, vacuum systems, and power electronics – accrue mutually to each of ITER's partners.

The ITER worksite is abuzz. Massive structures are emerging from the ground. Giant components are arriving weekly. **Fast-paced construction** has been proceeding for several years, and the assembly phase begins in 2019, with the operational machine – "First Plasma" – on schedule for December 2025. Stay tuned.

Laban Coblentz

Head of Communication

2. Channeling helium: Researchers take next step toward fusion energy

HTTP://ENGINEERING.TAMU.EDU/NEWS/2017/11/10/CHANNELING-HELIUM-RESEARCHERS-TAKE-NEXT-STEP-TOWARD-FUSION-ENERGY

Fusion is the process that powers the sun, harnessing it on Earth would provide unlimited clean energy. However, researchers say that constructing a fusion power plant has proven to be a daunting task, in no small part because there have been no materials that could survive the grueling conditions found in the core of a fusion reactor. Now, researchers at Texas A&M University have discovered a way to make materials that may be suitable for use in future fusion reactors.

The sun makes energy by fusing hydrogen atoms, each with one proton, into helium atoms, which contain two protons. Helium is the byproduct of this reaction. Although it does not threaten the environment, it wreaks havoc upon the materials needed to make a fusion reactor.

“Helium is an element that we don't usually think of as being harmful,” said Dr. Michael Demkowicz, associate professor in the Department of Materials Science and Engineering. “It is not toxic and not a greenhouse gas, which is one reason why fusion power is so attractive.”

However, if you force helium inside of a solid material, it bubbles out, much like carbon dioxide bubbles in carbonated water.

“Literally, you get these helium bubbles inside of the metal that stay there forever because the metal is solid,” Demkowicz said. “As you accumulate more and more helium, the bubbles start to link up and destroy the entire material.”

Working with a team of researchers at Los Alamos National Laboratory in New Mexico, Demkowicz investigated how helium behaves in nanocomposite solids, materials made of stacks of thick metal layers. Their findings, recently published in ***Science Advances***, were a surprise. Rather than making bubbles, the helium in these materials formed long channels, resembling veins in living tissues.

“We were blown away by what we saw,” Demkowicz said. “As you put more and more helium inside these nanocomposites, rather than destroying the material, the veins actually start to interconnect, resulting in kind of a vascular system.”

This discovery paves the way to helium-resistant materials needed to make fusion energy a reality. Demkowicz and his collaborators believe that helium may move through the networks of veins that form in their nanocomposites, eventually exiting the material without causing any further damage.

Demkowicz collaborated with Di Chen, Nan Li, Kevin Baldwin and Yongqiang Wang from Los Alamos National Laboratory, as well as former student Dina Yuryev from the Massachusetts Institute of Technology. The project was supported by the Laboratory Directed Research and Development program at Los Alamos National Laboratory.

“Applications to fusion reactors are just the tip of the iceberg,” Demkowicz said. “I think the bigger picture here is in vascularized solids, ones that are kind of like tissues with vascular networks. What else could be transported through such networks? Perhaps heat or electricity or even chemicals that could help the material self-heal.”

3. Optimism in Bonn about fusion reactor, despite Brexit

HTTPS://EUOBSERVER.COM/SCIENCE/139890

As climate negotiators were discussing words and commas in preparation for implementing the Paris agreement at one area of the Bonn climate conference in Germany, another zone is reminiscent of a trade fair - with countries and companies offering green solutions.
But while many propose reducing carbon emissions in the coming years, one exhibition offers a solution for a longer timeframe.
"We are trying to replicate the energy of the sun," engineer Shakeib Ali Arshad told this website earlier this week.
Arshad works for Fusion for Energy (F4E), an EU organisation that contributes to a complicated, ambitious international project to create fusion power.
Fusion is the process of colliding the nuclei of hydrogen atoms, a reaction that occurs naturally in the sun – hence the comparison.
"It's safe, clean, and long-term," said Arshad.
The fuel for the fusion reactor, hydrogen, can last millions of years, he said.
The physics has proven possible but at small scale fusion requires large amounts of energy. The current challenge is to prove that a fusion reactor can be built which produces more power than it
Consumes.

It is called the International Thermonuclear Experimental Reactor (ITER) and it is being built in Europe, in southern France.
The European Union is paying for 45 percent of the material, with the rest being provided by China, India, Japan, South Korea, Russia, and the United States.

"ITER is a very big project, beyond the capacity of any one player to build this on their own," said Arshad.
"This machine is perhaps the most complex machine that humans have tried to build," the British scientist noted.
"In the centre of this device you've got the highest temperatures in the universe and two metres out you've got superconducting magnets with the coldest temperatures in the universe."
Only the international space station and the Large Hadron Collider at the European Organization for Nuclear Research (CERN) are perhaps comparable in their intricacies, he added.
It has been marred with some delays and revised budgets: earlier this year the EU and its six global partners agreed that the budget will be some €20 billion.
On Monday (13 November), the European Court of Auditors said in a report about 2016 accounts that the money spent on the European team, F4E, was all "legal and regular".
However, the auditors noted that the UK decision to leave the EU and Euratom means that the contribution of the UK to the project will have to be part of the Brexit negotiations.
"This may have a significant effect on the future activities of the F4E Joint Undertaking and the ITER project," they said.
But according to Arshad, the point of no return has passed.
"We've placed big contracts for big equipment. This machine will get built."
"This machine will demonstrate the scientific viability, and I think in the fusion community you will find there is a fair amount of confidence that we will succeed on that."
But a commercially viable power plant running on fusion, that is another story.
It will likely have to be even larger than the ITER machine, which will be 30 metres tall and 30 metres wide, and have a weight of around 23,000 tonnes.
"Right now we are moving from physics to engineering problems. Then we have to move from engineering to commercial problems in that last stage," said Arshad.
The ITER machine is expected to be completed by 2025, when experiments can begin, lasting perhaps two decades.
The first reactor that will demonstrate commerical viability will probably not be built before 2050, said Arshad.
But he added that it is not a question of "if", but of "when".
"I think fusion is such a big fuel resource, it is obviously going to be the biggest part of the solution for mankind. Even though this is on a time horizon that most people don't consider."
Does Arshad think he will be living in a retirement home that has power provided by a fusion reactor, this website asked?
"Probably not at that stage. I'm older than you might imagine. I'm 51," he said, laughing.
"Hopefully our children will get to see some fusion power and then it will increase from there."

4. ITER PREPARES THE REPLACEMENT OF FOSSIL FUELS

HTTPS://WWW.THEAGILITYEFFECT.COM/EN/ARTICLE/ITER-PREPARES-REPLACEMENT-FOSSIL-FUELS-2/

The ITER project is designed to demonstrate that the hydrogen fusion process that powers our sun and the stars can be controlled. The Bernard Bigot, Director-General of the international megaproject based in Cadarache in southern France, explains the principle on which it is based, how it works and the purpose of the programme: to prepare the replacement of the fossil fuels that are exhausting and damaging the earth with energy that will have no impact on the environment and the climate. ITER builds on expertise and innovation accumulated over decades and constitutes a major milestone in the effort to achieve the energy transition.

Learn more:
www.iter.org

5. **Picture perfect! | 02/11/2017**

http://www.ccfe.ac.uk/news_detail.aspx?id=434

With JET's 2017 engineering break nearing its end, what better time to take a new interior photo of the world's largest tokamak?

It's the latest in a series of pictures of JET charting the evolution of the machine over time, stretching right back to the original 1983 model. Not only is this a fascinating visual record of the project, the new hi-res images also give researchers and engineers a very detailed view of JET's present-day condition as they prepare to go back into plasma operations.

As the remote handling team concluded its work inside the JET vessel earlier this month, there was a small window of opportunity for a quick photographic survey. The team attached a Nikon SLR camera encased in protective plastic to one of the remote handling booms, which was then steered through one of the ports into position.
Photographers Shauna Ward and Kate Hardie Baker worked in tandem with the team, using software in the Remote Handling Control Room to manoeuvre the camera and shoot the images.

Justin Thomas of the Remote Handling Operations Group said:
“Taking these pictures signifies the end of the remote in-vessel operations for us. It is done when all of the components are installed, and the tools removed. In addition to this interior photo we have taken another 4,000 images covering the whole internal surface of JET.
“The use of digital photography has had a big impact on the way we inspect and record the condition of the JET vessel at the start and end of each shutdown. Twenty years ago, we used a ‘high resolution' video camera, with about 400,000 pixels. Now we use a digital SLR with 36,000,000 pixels.
“During the shutdown we have been working hard to replace many JET components. Diagnostic calibrations have featured strongly. This has seen us deploy a range of delicate test equipment used to calibrate them. The tasks, at times, has been challenging but overall uneventful, which is the best way.”

6. Max-Planck-Princeton partnership in fusion research confirmed

Investigation of plasmas in astrophysics and fusion research / funding for another two to five years

November 23, 2017

http://www.ipp.mpg.de/4237337/10_17

Investigation of plasmas in astrophysics and fusion research / funding for another two to five years

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The scientific performance of Max-Planck-Princeton Center for Plasma Physics, established in 2012 by the Max Planck Society and Princeton University, USA, has been evaluated and awarded top grade. The Max Planck Society has now decided to continue its support for another two to maximum five years with 250,000 euros annually. The center’s objective is to link up the hitherto less coordinated research on fusion, laboratory and space plasmas and utilise synergies.

The center’s partners in fusion research are Max Planck Institute for Plasma Physics (IPP) at Garching and Greifswald and Princeton Plasma Physics Laboratory (PPPL) in the USA. Plasmas in astrophysics are being investigated at Max Planck Institute for Solar System Research in Göttingen and of Astrophysics in Garching and at the Faculty of Astrophysics of Princeton University. Primarily through exchange of scientists, particularly junior scientists, computer codes have been jointly developed in the past five years and experimentation has been pursued on the devices MRX at Princeton, Vineta at Greifswald and ASDEX Upgrade at Garching. “For the evaluation the center presented a total of 150 publications, accounting for significant progress in central areas of plasma physics and astrophysics”, states Professor Per Helander, head of IPP’s Stellarator Theory division and, alongside Professor Amitava Bhattacharjee from PPPL, Deputy Director of Max-Planck-Princeton Center since 2017.

For example, the old question in astrophysics why solar wind is much hotter than the sun’s surface can now be treated with a computer code developed to describe turbulence in fusion plasmas. This enabled plasma theoreticians from IPP along with US colleagues to investigate in detail the heating mechanism in solar wind plasma – with hitherto unattained accuracy – and compare their results with space probe measurements.

Another puzzle whose solution has been approached at Max-Planck-Princeton Center: Why is it that in outer space and in the laboratory magnetic reconnection, i.e. rupture and relinking of magnetic field lines, is much faster than theory predicts? Whether solar corona or fusion plasma, the rearrangement of the field lines is always accompanied by fast conversion of magnetic energy to thermal and kinetic energy of plasma particles. Physicists from Max Planck Institute for Solar System Research and from the University of Princeton have described a fast mechanism that could describe the observations in the solar corona: formation of unstable plasmoids. Also the sawtooth instability in fusion plasmas, i.e. continual ejection of particles from the plasma core, derives from instantaneous reconnection of magnetic field lines. In the framework of the Max-Planck-Princeton cooperation IPP scientists have now come up with the first realistic simulation that can explain the superfast velocity.

Last but not least, a new theory ansatz for calculating magnetic equilibria, first developed at Princeton, led to a very fast computer code. With the new algorithm, equilibrium calculations for the complex magnetic fields of future stellarator fusion devices no longer take months, but just a few minutes.

“As hoped, the center has created new cooperations and built sturdy bridges, on the one hand between research on plasmas in fusion devices, in the laboratory and in outer space, and on the other hand between US and German plasma physicists”, as IPP’s Scientific Director Professor Sibylle Günter sums up the past five years of Max-Planck-Princeton Center. Along with Professor Stewart Prager of PPPL she is one of the two Co-directors of the center. The successful cooperation has meanwhile attracted further partners. In July 2017, a Memorandum of Understanding for admission of Japan’s National Institutes of Natural Sciences was signed: “We look forward to the next years of joint research”, states Sibylle Günter, “made possible by the present confirmation by the Max Planck Society”.

Isabella Milch

7. 30 November 2017

Planning for the manufacturing of ITER’s first wall panels

http://fusionforenergy.europa.eu/mediacorner/newsview.aspx?content=1185

In the core of the ITER machine the temperature of the fusion reaction will reach 150 million ° C. To protect the surface of the vacuum vessel, which will be exposed to the super-hot gas, a layer made of 440 first wall panels, resembling to heavy metallic tiles, will “dress” it from top to bottom. Each of these panels measure 1 x 1.5m and weigh up to 1.5 T. Together with shield blocks installed behind the panels they form the “blanket” as it is known in the ITER jargon.

Europe is responsible for the production of 215 of these panels. During the last three years, F4E has been laying the manufacturing foundations of these critical components through its collaboration with: i) AREVA N.P, ii) ATMOSTAT (group ALCEN); and iii) a consortium consisting of IBERDROLA, Wood (formerly AMEC Foster Wheeler) and LEADING Enterprises. All of them have completed the testing of materials and bonding techniques, and produced semi-scale prototypes which have successfully undergone high heat flux tests. Since then, they have taken a step forward and are in the process of producing full-scale prototypes.

F4E took the initiative to organise a workshop to help them network with companies specialised in automation. Following a market survey, conducted by F4E, six companies from all over Europe were invited to present their skills and expertise. Through presentations and bilateral meetings, automation companies and manufacturers were invited to explore how the manufacturing costs could be decreased and quality could be improved the moment Europe starts producing its share of first wall panels.

“This first workshop gave us the opportunity to introduce the ITER project to new companies, explain in more detail the technical requirements of the first wall panels, one of the In-Vessel components, and move from the stage of prototypes to an industrial phase” explains Stefano Banetta, F4E’s Technical Responsible Officer following this component.

8. LITHIUM LOOPS MAY LEAD TO FUSION TECHNOLOGY

Khai Trung Le
Materials World magazine
,
1 Dec 2017
http://www.iom3.org/materials-world-magazine/news/2017/dec/01/lithium-loops-may-lead-fusion-technology

Khai Trung Le talks to researcher Dr Masa Ono about a liquid metal system designed to improve the reliability of fusion power plants.

Fusion technology moves closer to readiness with the use of liquid lithium loops to help recycle tritium, the radioactive isotope that fuels fusion reactors, and protect the tokamak magnetic fusion system from the intense heat generated.

Fusion generators are expected to operate for 12 months before needing costly maintenance, putting additional strain on internal parts including plasma facing components (PFCs) in the divertor – the region that exhausts waste heat coming from the plasma. Dr Masayuki Ono, Project Leader of the National Spherical Torus Experiment-Upgrade at Prince Plasma Physics Laboratory (PPPL), USA, told *Materials World*, 'Even high temperature materials like tungsten could not withstand such intense power. Therefore, instead of developing solid-based PFCs, we investigated a system based on liquid metal.'

Cool the plasma

The liquid lithium protects the divertor by evaporating on the metal surface, analogous to making a metal surface resistant to torch heat by covering it with water. Ono said, 'Lithium protects the material wall in two ways – as a sacrificial coating on the surface and cooling the plasma and incoming heat. Once the lithium evaporates and enters the plasma, it causes radiation, cooling the plasma.' The lightness of lithium makes it compatible with fusion plasma, unlike high-Z materials such as tungsten that would reduce the primary fusion reaction.

The lithium loop system will also protect against dust buildup, produced by the interaction between the plasma and divertor walls. Ono added that, 'the plasma will weaken the metal surfaces and eventually turn them into dust,' as well as other impurities such as nitrogen and oxygen. 'Since these impurities are expected to be of a relatively low level, they could be handled after separation through specialised cleaning loops attached to the main lithium loop.'

Ono's team said the lithium loop's design has shown to enhance plasma performance on numerous fusion devices, including Princeton's National Spherical Torus Experiment and Lithium Tokamak Experiment and the Chinese Academy of Science's Experimental Advanced Superconducting Tokamak, as well as keep the reactor clean by transporting impurities and dust particles out of the fusion chamber.

Additionally, the lithium loops can recycle tritium, which fuses with deuterium to production fusion reactions. Ono said, 'Only 1% of tritium, which is a very expensive fuel, is burned in fusion reaction. The lithium system is able to extract the remaining 99%, bounding the tritium as a form of lithium hydride, the combination of lithium and hydrogen-tritium. The liquid lithium would crystalise in a cold trap operating at 200˚C – like heating sugar water and cooling it to make rock candy. The tritium is regenerated by heating it up and releasing it as a gas.' Extracting and collecting the recycled tritium also involves no moving parts – 'the cold trap is just a stainless steel box with plates,' said Ono – reducing the likelihood of mechanical failure and improving the reliability of the tokamak.

Research on the lithium loop system has been focused on the tokamak system. However, Ono expects it to be compatible with any steady state fusion system, including the stellarator.

To read *Liquid lithium loop system to solve challenging technology issues for fusion power plant*, visit bit.ly/2yZKL4y

9. Potential new tech innovations can combat climate change

*By ALYSSA WOODEN on December 2, 2017*No Comment

http://www.jhunewsletter.com/2017/12/02/potential-new-tech-innovations-can-combat-climate-change/

Over the past hundred years, human activity has brought about a rise in global temperatures, more extreme weather patterns and a drastically changing ecosystem. The effects of climate change and environmental degradation can be harmful to human health, with consequences such as water and food shortages, rising sea levels and pollution.

The good news is that researchers develop new technologies everyday to combat climate change and mitigate its effects. Policies like the Paris Agreement prioritize the issue of climate change for many countries, and organizations like the Intergovernmental Panel on Climate Change provide access to a wide range of data detailing the extent of the damage. Although it is unlikely that the environment will ever revert to its original state, technological advancements can help reduce greenhouse gas emissions and keep temperatures down.

One of the foremost ways we can mitigate climate change is by developing large-scale sources of clean energy. Solar panels and wind turbines have been around for decades, but in order to meet the growing need for emission-free power, scientists and engineers are turning their attention to nuclear fusion.

Nuclear fusion in the sun, which occurs when high-energy atoms collide and fuse together, is the primary source of energy for all life on earth. Fusion produces no greenhouse gases or harmful waste and is far more energy efficient than fossil fuels. The fuel that powers nuclear reactors, hydrogen isotope nuclei, is virtually inexhaustible.

However, fusion reactions require conditions which are extremely difficult — and expensive — to recreate. The fuel must be heated to 180 million degrees Fahrenheit, and the reactions must occur in a controlled manner that does not damage the container in which they take place.

There are several experiments underway that seek to make nuclear fusion a viable energy source within the next few decades. The International Thermonuclear Experimental Reactor (ITER), currently under construction in France, is a fusion reactor called a tokamak, a machine consisting of a doughnut-shaped magnetic chamber. Inside the chamber, hydrogen gas is subjected to intense heat and pressure, causing it to transform into plasma and allowing fusion reactions to take place. Heat energy produced by the reactions is contained by the tokamak's magnetic field and eventually harnessed.

Halfway across the world from ITER, a Canadian company called General Fusion is developing a magnetized target fusion system, a machine in which plasma is compressed by steam-powered pistons to produce the conditions for the fusion reaction. The generated heat is absorbed by a wall of molten lead-lithium, which is used to heat water that powers an electricity-generating steam turbine.

The electric vehicle industry is also trying to reduce carbon emissions from transportation. However, a major contributor to air pollution in many U.S. cities are hauler trucks — the 18-wheeled giants used to transport goods thousands of miles across the country — which are often too big to run on the same batteries as electric cars.

The German company Siemens is working to solve this problem by attaching specially designed trucks to metal wires that run the length of highways and supply electricity to the trucks.

Siemens is currently testing out these systems, called eHighways, in Stockholm and Los Angeles. In the U.S., installing the electric wire across a one-mile stretch of highway would cost $13.5 million, although the potential benefits to human and environmental health may make this an economically viable option in the future.

There is a host of technology available that seeks to prevent carbon emissions, but what if it were possible to extract the carbon dioxide already in the atmosphere? The Canadian company Carbon Engineering (CE) is trying to answer that question by developing direct air capture technology, which they hope will be ready for deployment within the next few years.

As air containing CO2 enters CE's air contractors, it is absorbed by a solution and converted into solid pellets of calcium carbonate. The pellets are heated with natural gas and broken down into pure CO2, which can be captured and used. CE hopes to combine this captured CO2 with hydrogen to create a synthetic fuel.

This fuel, which can be used to power planes, trucks and other vehicles, is carbon-neutral, as the carbon it emits could be recaptured by the air-capturing system which created it. Theoretically, it could be recycled indefinitely. Moreover, the carbon emitted by the natural gas which heats the pellets can be captured by the system and converted to fuel as well.

CE has demonstrated that each facility of air contractors can purify one ton of CO2 and produce one barrel of fuel per day.

Although these massive-scale projects are years away from reaching the general public, scientists — as well as ordinary people — are making progress every day to reduce CO2 emissions and lessen the environmental impacts caused by human activity. Although the technological revolution may have been what led to climate change in the first place, we can use these technologies to reverse the damage and recover our planet.

10. Vice Foreign Minister Li Baodong Attends Opening Ceremony of 10th Anniversary of ITER-Retrospect and Prospect

2017/11/29

http://www.fmprc.gov.cn/mfa_eng/wjbxw/t1515694.shtml

On November 28, 2017, Vice Foreign Minister Li Baodong attended the opening ceremony of the 10th Anniversary of ITER-Retrospect and Prospect and delivered a speech.

Li Baodong congratulated on the important progress made in the "International Thermonuclear Experimental Reactor" program (ITER program) and presented a high tribute to leaders, experts and scientific and technological workers who participated in this major project. Li Baodong said that the ITER program is a project of the century for the world's major scientific and technological countries to work together to solve the energy and environmental problems facing mankind. It is also the first major international science program for China to participate in as a full member. In the past ten years, China has made important contributions to promoting the ITER program, which also promotes the development of its own nuclear fusion cause and sets an example for international cooperation in science and technology. It is an important practice for China to promote the building of a community with a shared future for mankind.

Li Baodong said that the 19th National Congress of the Communist Party of China has started a new journey of building a modern socialist country in an all-round way. China is now in a new era in which the country is increasingly entering the world stage and making greater and continuous contributions to humankind. We should take a more positive attitude to participate in and lead the ITER program, promote the sustainable development of China's energy strategy, accelerate the construction of an innovative country, make contributions to building China into a great modern socialist country that is prosperous, strong, democratic, culturally advanced, harmonious, and beautiful by the middle of the century, and create a bright future for mankind with all countries across the world.

The ITER program is one of the largest multilateral and international scientific and technological cooperation projects in the world today. It aims to validate the scientific and engineering feasibility of the peaceful use of nuclear fusion through the construction of reactor-scale nuclear fusion devices. The ITER program is carried out by China, the European Union, Russia, the United States, Japan, the Republic of Korea and India. The conference was held by China International Nuclear Fusion Energy Program Execution Center. Vice Chairman of the Chinese People's Political Consultative Conference and Minister of Science and Technology Wan Gang attended and addressed the conference. More than 300 representatives from the Ministry of Science and Technology, the Ministry of Education, the Ministry of Finance, the State Administration of Science, Technology and Industry for National Defense, the Chinese Academy of Sciences, the China National Nuclear Corporation, and the research institutes, universities and enterprises related to nuclear fusion were present.

11. Fusion for Energy's 10th Anniversary: 10 years o0f EU Support for ITER's Success
https://ec.europa.eu/info/news/fusion-energys-10th-anniversary-10-years-eu-support-iters-success-2017-nov-30_en

Fusion for Energy (F4E), the European Joint Undertaking for ITER and the Development of Fusion Energy, celebrates its 10th anniversary this week. F4E was established to provide the European contribution to the ITER project by an international partnership composed of Euratom, US, Russia, China, India, Korea and Japan that is looking for an abundant low carbon energy source. The project partners jointly represent two-thirds of the world's population and over 80% of global GDP. The ITER project aims to build the largest fusion machine in the world in order to verify the feasibility of fusion as a sustainable energy source. The construction of the project has significantly accelerated after major changes in its management in 2015, and has by now crossed the half-point towards physical completion. Agreements for nearly 90% of all deliveries have been concluded between the ITER project management and ITER members.

To deliver on Europe's commitments to the project, F4E has so far concluded contracts with over 400 European companies and 60 scientific and research entities for a total of some EUR 4 billion. F4E's direct contractors are located in more than 20 EU countries. While about 50% of the value of the planned European contribution to ITER has already been contracted, the project offers many further opportunities for European companies in the coming years in various high-tech areas and high added value industry sectors.

European Commissioner for Climate and Energy Miguel Arias Cañete will give a speech at a celebration event organised on Thursday 30 November in Barcelona, the seat of F4E. Some 500 participants are expected to join the celebrations, including the Spanish Minister of State Carmen Vella and the Mayor of Barcelona Ada Colau, as well as representatives of companies working closely with F4E on the ITER project.

12. Episode 4 – The Sun

November 29, 2017 Jen

http://10thingstoknowabout.ie/episode-4-the-sun/

10 Things to Know About… The Sun

The energy from 1.5 hours of sunlight on the earth's surface is sufficient to meet annual global energy consumption – so how here in Ireland can we fully reap the benefits of such an amazing, renewable resource?

Aoibhinn meets solar expert **Prof Peter Gallagher** who discusses the basic physics of how the sun generates and releases energy, and explains how our understanding of those processes can help predict how solar events could affect the earth. Peter has made studying the sun his life's work and is the driving force behind the **LOFAR** project, an exciting new radio telescope at Birr Castle.

Solar is currently the fastest growing power generation technology worldwide and though it may come as a surprise to some, Ireland is in a fantastic position to take advantage of the solar energy sector. Aoibhinn visits the first ‘solar farm’ on the island, a 30-acre solar farm beside Belfast International Airport which will supply a quarter of the airport’s annual electricity and meets **SEAI’s solar energy expert Brian Denvir** to find out about the exciting opportunities for Irish researchers in the solar energy sector.

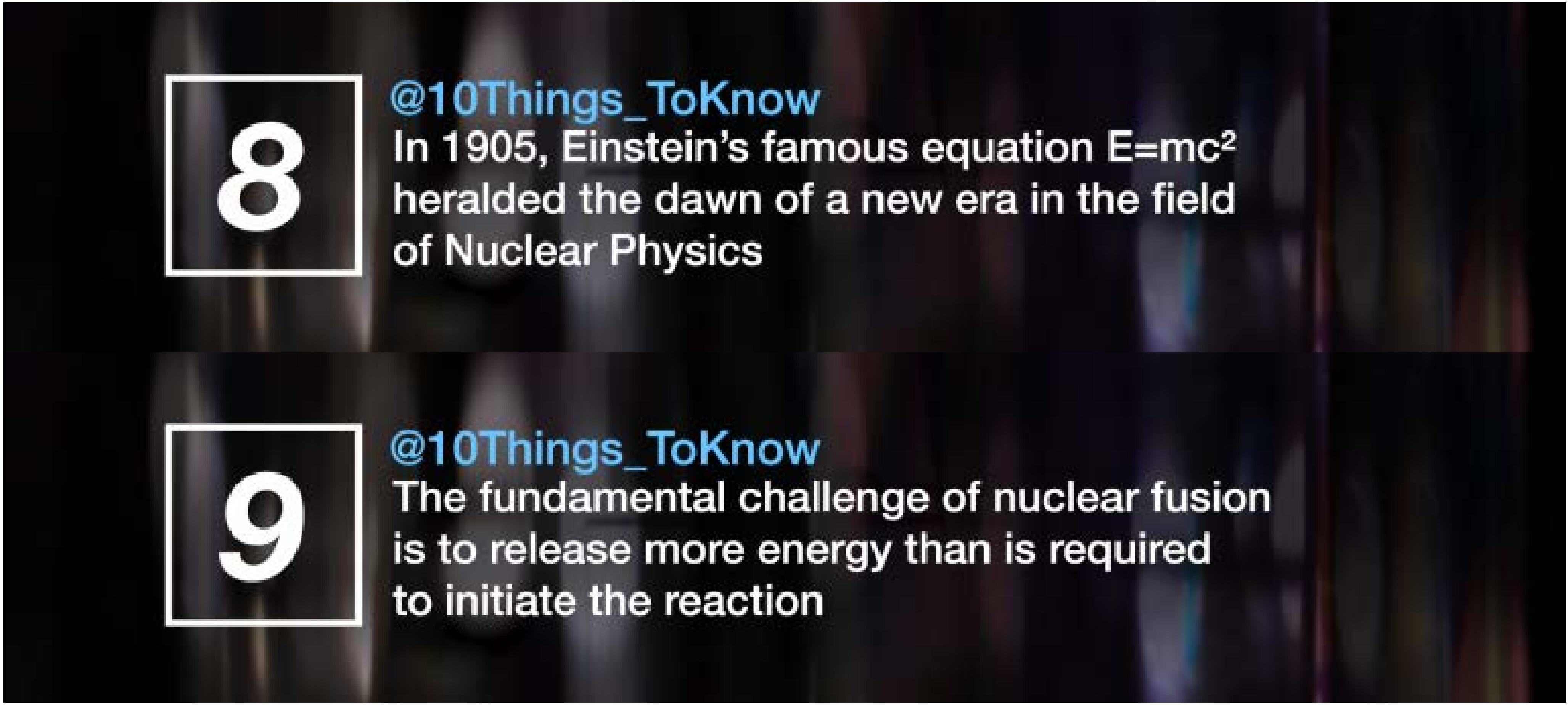
Capturing that market will rely on innovation from the tech sector, and we meet Ed Duffy from **NinesPV** in Tallaght IT, who has developed a new etching technology for silicon wafers to increases the amount of light absorbed in solar cells and increase the overall efficiency of the solarPV manufacturing process.
Of course battery storage is the holy grail for solar and indeed all forms of renewable energy, and Irish company **Solo Energy** are utilizing cutting edge battery technology to install a 'virtual power plant' across Ireland. By installing batteries at multiple locations around the country, their "Flexigrid" software allows the software in each battery to 'talk' to the grid and remotely control when it charges (through the existing solar PV) or discharges (to storage heaters for example) according to the current cost and availability of renewable energy on the grid. We see exactly how the technology works when a new system is installed at Ballyvolane Fire Station in Cork.

The Sun's impact on Earth has been recognized since prehistoric times, but in **Weird Science**, Fergus ask if our stellar neighbour could be responsible for whale strandings??

And finally, what if we could replicate the sun's power here on earth? **Jonathan** travels to Marseille, to meet the **Irish researchers who are working at ITER**, the world's most complex engineering project aiming to recreate the awesome power of sun through nuclear fusion.

And finally, instead of just harnessing and storing it, what if we could actually replicate the sun's power here on earth? Based on how our own sun produces energy, **Nuclear Fusion** has the potential to supply humanity with energy for as long as we need it – if only we can figure out how to harness the reaction!

We travel to **ITER** in the south of France, which is the most ambitious and complex engineering project in history that aims to prove the feasibility of nuclear fusion, to meet Castlebar native and DCU graduate **Deirdre Boilson**, and **Mike Walsh** from Co Cork who are heading up two of the key divisions!


8
@10Things_ToKnow
In 1905, Einstein's famous equation E=mc²
heralded the dawn of a new era in the field
of Nuclear Physics
9
@10Things_ToKnow
The fundamental challenge of nuclear fusion
is to release more energy than is required
to initiate the reaction

13.

the japan times

NEWS

https://www.japantimes.co.jp/news/2017/12/07/world/science-health-world/iter-nuclear-fusion-project-hails-halfway-construction-milestone-eyes-first-plasma-2025/#.Wjs3N62B1Yh

WORLD / SCIENCE & HEALTH

ITER nuclear fusion project hails halfway construction milestone, eyes 'first plasma' in 2025

AP

BERLIN – A vast international experiment designed to demonstrate that nuclear fusion can be a viable source of energy is halfway toward completion, the organization behind the project said Wednesday.
Construction of the International Thermonuclear Experimental Reactor, or ITER, in southern France has been dogged by delays and a surge in costs to about €20 billion ($23.7 billion).

ITER's director-general, Bernard Bigot, said the project is on track to begin superheating hydrogen atoms in 2025, a milestone known as "first plasma."

"We have no contingency plan," he told The Associated Press in a phone interview from Paris.

Scientists have long sought to mimic the process of nuclear fusion that occurs inside the sun, arguing that it could provide an almost limitless source of cheap, safe and clean electricity. Unlike in existing fission reactors, which split plutonium or uranium atoms, there's no risk of an uncontrolled chain reaction with fusion and it doesn't produce long-lived radioactive waste.

A joint project to explore the technology was first proposed at a summit between U.S. President Ronald Reagan and Soviet leader Mikhail Gorbachev in 1985, with the aim of "utilizing controlled thermonuclear fusion for peaceful purposes ... for the benefit for all mankind."

It took more than two decades for work to begin at the site in Saint-Paul-les-Durance, about 50 km (30 miles) northeast of Marseille. The project's members — China, the European Union, India, Japan, South Korea, Russia and the United States — settled on a design that uses a doughnut-shaped device called a tokamak to trap hydrogen that's been heated to 150 million degrees Celsius (270 million Fahrenheit) for long enough to allow atoms to fuse together.

The process results in the release of large amounts of heat. While ITER won't generate electricity, scientists hope it will demonstrate that such a fusion reactor can produce more energy than it consumes.

There are other fusion experiments, but ITER's design is widely considered the most advanced and practical. Scientists won't know until 2035, following a decade of testing and upgrades, whether the device actually works as intended.

Still, fusion experts said Wednesday's milestone was noteworthy.

“The glass is half full, rather than half empty,” said Tony Donne of EUROfusion, a consortium of European research organizations and universities that provide scientific advice for ITER.

Donne said the appointment of Bigot had helped the project overcome what he called a “very difficult period” during which political considerations had hampered construction of what some consider the most complicated machine ever built.

Cost remains an issue, though, and Bigot was visiting Washington on Wednesday to drum up support from the United States, which contributes about 9 percent of the budget. Much of the funding goes to suppliers in the member states — in the case of the U.S. that includes General Atomics, which is building the central solenoid, an 18-meter (59-foot) electromagnet that’s powerful enough to lift an aircraft carrier.

Bigot said most other members, including the European Union, which pays 45 percent of the budget, had pledged their financial support for years to come and he was hopeful the Trump administration would see the benefits of staying on board.

“All countries including the United States know that their energy supply is not sustainable beyond this century,” said Bigot, who was previously France’s nuclear energy chief.

Should Washington cut its funding, the project won’t collapse, he said. “It’s too important for the other members. But there would be some delay.”

Gerald Navratil, a professor of applied physics at Columbia University, said fusion could help solve the problem of how to reliably produce large amounts of electricity without emitting greenhouse gases, noting ITER’s current cost is comparable to that of developing a large passenger aircraft.

“Energy is such an important part of our technological society that expenditure of 20 billion to develop a new energy source is really not out of line,” he said.

14. Part of the world’s most advanced nuclear fusion project to be located in Croatia?

https://www.total-croatia-news.com/lifestyle/23836-world-s-most-advanced-nuclear-fusion-device-to-be-located-in-croatia

15. $20 billion ITER fusion facility reaches halfway point for construction in France

BY ALAN BOYLE on December 6, 2017 at 4:45 pm

https://www.geekwire.com/2017/20-billion-iter-fusion-reactor-reaches-halfway-point-construction-france/

The world's biggest and most expensive nuclear fusion research project, known as ITER, says it's halfway done with the construction effort leading to the startup of its seven-story-high reactor in 2025.

ITER's ambition to demonstrate a sustained fusion reaction that produces a net gain in energy is matched by the estimated cost, which exceeds $20 billion.

The 35-nation consortium began construction a decade ago, under an unusual arrangement that calls for the various countries to contribute components for the reactor taking shape at Cadarache in southern France. The United States is responsible for 9 percent of the total cost.

"ITER" originally stood for International Thermonuclear Experimental Reactor, but now project leaders prefer to characterize the name as a Latin word meaning "The Way" — that is, the way to the world's energy future.

Today, ITER Director-General Bernard Bigot declared that the construction work has passed the halfway point on the timeline leading to "first plasma," when deuterium and tritium are to be heated to high temperature in the reactor's giant tokamak chamber.

During a visit to Washington, D.C., Bigot expressed concern that the United States was cutting back on its budgeted contributions to ITER. He noted that the amount went from a planned $105 million in 2017 to $50 million, and that the budget for 2018 anticipated a cut from $120 million to $63 million.

"If the U.S. does not provide the necessary funds in 2018, then there will be an impact on the entire project," he told Reuters.

Bigot said the Trump administration was reconsidering the funding issue, with a decision coming as early as this week.

Fusion is the reaction that powers the sun, involving the combination of hydrogen nuclei under conditions of high pressure and high temperature. When the nuclei combine, that creates one helium nucleus and converts a smidgen of extra mass directly into energy.

ITER is pursuing a path to fusion power that's relatively low-risk but high-cost, known as magnetic confinement fusion. Atoms of deuterium and tritium, two isotopes of hydrogen, will be heated into a plasma while being squeezed by super-strong magnetic fields in a doughnut-shaped chamber.

"First plasma" is scheduled for 2025, but ITER says it could take 10 more years to reach full-power operation. Even then, the reactor isn't likely to produce power for commercial use. Instead, the insights gained during ITER's experiments are expected to help engineers design and build commercially viable fusion power plants.

In parallel with ITER, several privately funded ventures are pursuing lower-cost, higher-risk avenues to controlled fusion, with a potentially quicker reward (or failure).

A Canadian company called General Fusion has won backing from Amazon billionaire Jeff Bezos. California-based TAE Technologies, meanwhile, counts Microsoft co-founder Paul Allen as an investor. Another fusion company, Helion Energy, is headquartered in Redmond, Wash., and has attracted funding from PayPal co-founder Peter Thiel.

16. Nuclear fusion research centre gets £86m from government

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7 December 2017
http://www.bbc.com/news/uk-england-oxfordshire-42269929

An £86m investment in new facilities for nuclear fusion research in the UK has been announced by the government.
Two new "centres of excellence" will be created for the UK Atomic Energy Authority's (UKAEA) fusion research programme at Culham Science Centre in Oxfordshire.
It is hoped they will enable the authority to develop technology for the first nuclear fusion power plants.
The centres are expected to create about 100 jobs when they open in 2020.
One will research how to process and store tritium, one of the fuels which could power commercial fusion reactors.
The other will test prototype components under the conditions they would experience during a fusion reaction.

Prof Ian Chapman, the UKAEA's chief executive, said there was an increasing focus on the technologies needed for the first power stations, as fusion entered the "delivery era".
Culham Science Centre is currently home to the world's largest fusion reactor, but a larger tokamak - a magnetic fusion device - is being built in southern France.
That development is part of **an international project called ITER** that is trying to prove fusion can be a viable power source

The UKAEA said the new facilities at Culham will help British industry to secure contracts from ITER and other schemes around the world.

What is nuclear fusion?

- Nuclear fusion uses the same process which powers the sun
- **It involves using extreme temperatures to create high energy collisions between charged particles**
- It has the potential to produce large amounts of electricity without any carbon dioxide emissions
- No fusion project has yet succeeded in maintaining fusion for long periods of time

Source: ITER

17. Thermonuclear Fusion: How Scientists Hope to Extract Energy of Stars on Earth

https://sputniknews.com/science/201712131059962395-thermonuclear-fusion-project-on-schedule/

The International Thermonuclear Experimental Reactor (ITER) project has reached an important milestone, passing the 50% completion mark this month. Nuclear physicist Anatoly Krasilnikov, director of Russia's ITER Project Center, told the RIA Novosti news agency about Russia's key role in the project.

ITER project general director Bernard Bigot announced last week that the ambitious $23.7 billion nuclear fusion research and engineering megaproject in Saint-Paul-les-Durance, southern France is now over 50% finished. The project, whose participants include Russia, the EU, the US, China, India, Japan, South Korea and Switzerland, envisions completing the assembly of its doughnut-shaped tokamak reactor by 2021, and starting the process of superheating hydrogen atoms to 150 million degrees Celsius – ten times the temperature of the Sun's core, by 2025.

The idea of a reactor capable of controlled thermonuclear fusion for the creation of electrical energy is a dream stretching back decades. The problem, until now, has centered on the fact that thermonuclear fusion requires very significant energy resources to be achieved, together with highly exacting operating conditions, in order to avoid the reaction from being snuffed out.

In the 20th century, Soviet physicists achieved a theoretical breakthrough on how to control the thermonuclear fusion process, coming up with the idea of the tokamak, a device made from magnetic coils and generating a powerful magnetic field to confine plasma fuel in a torus ring-like reactor.

Under the tokamak principle, deuterium and tritium isotopes of hydrogen are introduced into the chamber in gaseous form, enabling operators to separate electrons from them. The ionized plasma mixture is then heated to 150 million degrees Celsius, with the nuclei of the deuterium and tritium giving rise to helium nuclei. The process results in the release of fast neutrons, whose energy, transferred to a carrier of heat energy such as water, can then serve to create electricity, including via a conventional thermal power station.

Thinking about the creation of an international project for the use of controlled thermonuclear fusion started in 1985, when the USSR and the US proposed a joint effort in the field as a step toward ending the Cold War. However, it took nearly two decades for construction of the ITER experimental thermonuclear fusion reactor, which currently involves nearly three dozen other nations, to begin in southern France. Deuterium and tritium-based fuel will be used to fuel the fusion reaction. The reaction will then heat the reactor blankets – special modules inside the tokamak. From there, water will be collected into pools, where it will be cooled. Since it is experimental, the ITER reactor itself will not supply power to the French energy grid.

Russia Playing Crucial Role in Project

Russia, as heir to the pioneering work carried out by Soviet scientists, has played an integral role in the ITER project from the beginning, providing technology, know-how and funding for the experimental facility.

Anatoly Krasilnikov, director of ITER Center, the Russian branch of the ITER project, explained that in addition to those parts, Russia has provided the ITER facility with coil superconductors and switching equipment. Supplies of these and other components will continue into 2018.

"ITER is a very complex design. All of its systems are unique, because they are being created for the first time," Krasilnikov said, speaking to RIA Novosti.

This year, Russia supplied the first of the 23 metric ton branch pipe components for ITER's vacuum chamber. In the meantime, the St. Peterburg-based Sredne-Nevsky Shipyard is tasked with providing the reactor's toroidal coil magnetic field generator parts, recently finishing the fifth of the eight doughnut-shaped components necessary. When delivered, these will be used to assemble the three-hundred-ton reactor ring module.

According to the physicist, there are no major obstacles to the project, and any outstanding technological and scientific issues are being successfully resolved by researchers. For instance, he said, Russian scientists are currently working on the issue of plasma disruption, a phenomenon in which the reactor's fuel cools sharply, splashing onto the reactor walls and resulting in significant damage or even the melting of components, thus requiring costly and time-consuming repairs.

"There are signs according to which physicists can discern that a plasma disruption is coming. A technique for predicting breakdowns and preventing their occurrence is under development. Scientists from the [Moscow-based] Kurchatov Institute are creating models of the disruptions and how they can be impacted to mitigate them," Krasilnikov said.

ITER project scientists calculate that their working experimental generator will generate about 500 megawatts of energy, five times the amount it consumes through its operation. If successful, the experiment will give rise to the DEMOnstration Power Station project, a commercial project whose engineering design is expected to be completed by the mid-2020s on the basis of the experimentation carried out by ITER.

Proponents of thermonuclear power laud it as a clean source of energy compared to traditional sources, and point out that it is not as dangerous as nuclear power. Skeptics suggest however that the technology will remain an expensive alternative to traditional fuels, so long as the latter remain available in significant quantities.

18. Iter fusion project passes construction milestone

11 December 2017
http://www.world-nuclear-news.org/NN-Iter-fusion-project-passes-construction-milestone-1112175.html

Construction of the Iter fusion reactor, being built at Cadarache in the south of France, is now 50% complete, the Iter Organisation has announced. The reactor - construction of which began in 2010 - is scheduled to achieve first plasma in 2025.

The organisation said: "According to the stringent metrics that measure project performance, 50% of the 'total construction work scope through First Plasma' is now complete."

It said that almost 53% of construction activities (on the Iter site at Cadarache) and manufacturing activities for components and systems needed for first plasma have been completed. "The performance metrics used in Iter assign a relative weight to every activity category within the project," the organisation said. "Design, for instance, accounts for 24%; buildings construction and manufacturing for 48%; assembly and installation for 20%."
"After having compounded the percentage of completion of each category, the metrics produce a figure for the totality of the work scope through the launch of operations ('first plasma')." Design, which accounts for approximately 25% of the scope, is now close to 95% complete; manufacturing and building, which represents almost half of the total activities is close to 53% complete.
Iter Director-General Bernard Bigot said the passing of the 50% milestone reflects "the collective contribution and commitment of Iter's seven members".
Iter, which stands for International Thermonuclear Experimental Reactor, is a major international project to build a 500MW tokamak fusion device (requiring an input of 50MW) designed to prove the feasibility of fusion as a large-scale and carbon-free source of energy.
The European Union is contributing almost half of the cost of its construction, while the other six members (China, India, Japan, South Korea, Russia and the USA) are contributing equally to the rest. Under a revised schedule established by the Iter organisation last year, first plasma is planned for 2025, with deuterium-tritium fusion experiments commencing in 2035. Construction costs are expected to be around €20 billion ($22 billion), with components contributed by the Iter members on an 'in-kind' basis.
Iter's specialised components - some 10 million parts in total - are being manufactured in industrial facilities all over the world. They are subsequently shipped to the Iter worksite, where they must be assembled, piece-by-piece, into the final machine.

Researched and written
by World Nuclear News

19. Russia completes reactor assembly of Rostov 4

20 December 2017

The assembly of the reactor of Rostov 4 has been completed, Russian state nuclear corporation Rosatom said yesterday.

http://www.world-nuclear-news.org/NN-Russia-completes-reactor-assembly-of-Rostov-4-20121702.html

Hydraulic tests of the VVER-1000/V-320 reactor have started and, once completed, permission will be sought from regulator Rostekhnadzor to bring the unit to the minimum controlled power level, Oleg Vysotsky, head of the reactor department of Rostov Nuclear Power Plant Phase 2, said in the company statement.

Start-up of the unit and its connection the grid are planned for next year, Rosatom said, without elaborating.

The Rostov plant is located on the banks of the Tsimlyansk reservoir, nearly 14 km (8 miles) from the city of Volgodonsk. Four 1000 MWe VVER pressurized water reactors have been planned at the Rostov site since the early 1980s. Construction of units 1 and 2 began promptly, but progress faltered. Units 1 and 2 eventually entered commercial operation in March 2001 and October 2010, respectively. Unit 3 was connected to the grid in December 2014, while the reactor pressure vessel was installed at unit 4 in December 2015.

The start-up of another new Russian unit – a VVER-1200 reactor - is also scheduled for next year. The process of loading 163 fuel assemblies into the core of unit 1 of the Leningrad Phase II nuclear power plant in western Russia began on 8 December.

Researched and written
by World Nuclear News

20. Finnish cities consider SMRs for district heating

15 December 2017

http://www.world-nuclear-news.org/NN-Finnish-cities-consider-SMRs-for-district-heating-1512175.html

A number of Finnish cities have begun studies to evaluate the feasibility of using small modular reactors (SMRs) instead of fossil fuels to provide district heating, according to Energy for Humanity. A recent study looked at completely decarbonising electricity, transport and heating in Helsinki through the use of small, advanced reactors.

Most of the district heating in Finland is produced by burning coal, natural gas, wood fuels and peat, said the non-profit organisation, which is funded by philanthropic donations and advocates for climate action and energy access. It noted that while many Finnish cities have progressive climate policies and goals, they have struggled to decarbonise heating and liquid fuels.

"More than half of the greenhouse emissions of all of Helsinki come from district heating, mainly run by fossil fuels," said Petrus Pennanen, Helsinki city council member and vice chair of the Finnish Pirate Party. "If we are serious about decarbonising Helsinki, we need to at least take an honest look at these upcoming reactors."

Atte Harjanne, a climate change researcher at the Finnish meteorological institute and a Green Party representative at the Helsinki city council, agrees. "Nuclear has proven – despite the early fears the environmental movement grew up with – to be a safe, fast and cost-effective way to decarbonise the energy sector. It deserves a look at a level playing field."

Pennanen and Harjanne worked with the Ecomodernist Society of Finland - an environmental NGO - to draft the initiative and bring advanced, small reactors into the public decarbonisation discussion and media. The Ecomodernist Society has been fostering the dialogue for two years in Finland, organising seminars and publishing reports on heat decarbonisation with advanced and small nuclear reactors.

The Society and Energy for Humanity published a report in September this year that evaluated completely decarbonising the Helsinki metropolitan area energy sector through the use of advanced nuclear reactors. "With the large seasonal variations in heat and electricity demand, the Helsinki area presents a challenging environment for any decarbonisation effort," the report notes.

The model used in the Helsinki case study anticipates future annual energy use in district heating at 8 TWh, electricity at 12 TWh and 4 TWh of hydrogen for transportation fuels.

Although several advanced SMRs are in development and coming to market by 2030 that could meet the specifications, the study selected models to consider: the HTR-PM pebble-bed reactor currently being constructed in China and Terrestrial Energy's Integral Molten Salt Reactor.

"Small nuclear reactors are one of the few options we have in supplying reliable low-carbon heat for industrial process, district heating networks and other uses in a practical manner," the study found. "If nuclear reactors are used for combined heat and power, their overall efficiency and economics can improve enormously compared with producing just electricity," it added.

"It makes sense to explore further these technologies and the possibilities they hold. We need to take nuclear and advanced nuclear seriously. If we do not, we will never find out what they could have offered us, and might suffer a climate catastrophe instead," the study concludes.

Rauli Partanen - vice-chair of the Ecomodernist Society of Finland and author of the report - said: "Nuclear is great for baseload needs, but with advanced technologies such as high temperature reactors and high temperature electrolysis, we can use nuclear to decarbonise not just electricity, heat but also transportation fuels and many industries."

"Most of the district heating networks in the area are interconnected, so it makes sense to include the whole area in the study," said Pennanen. He noted that Espoo and Kirkkonummi have also expressed interest in studying the use of advanced reactors.

Researched and written by World Nuclear News

21. Kansai applies for key restart checks at Mihama unit

15 December 2017

Kansai Electric Power Company has applied to the Japanese regulator for pre-service inspections of unit 3 of its Mihama nuclear power plant in Fukui Prefecture. These inspections mark the final regulatory stage in the restart procedure for the country's reactors.

http://www.world-nuclear-news.org/RS-Kansai-applies-for-key-restart-checks-at-Mihama-unit-1512174.html

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 its construction plan to strengthen the plant; and, final safety inspections to ensure the unit meets new safety requirements. Operators are required to add certain safety-enhancing equipment within five years of receiving the NRA's approval of a reactor engineering work programme.

Kansai submitted its restart application for Mihama 3 in March 2015. The NRA approved the utility's basic design and detailed design for the unit in October 2016. It approved Kansai's safety program for Mihama 3 the following month.

The company announced today it has applied for pre-service inspections of the unit. These inspections are to confirm that the safety countermeasure equipment complies with the approved construction plan at the plant. Kansai expects all these inspections to be completed by late March 2020, after which the reactor can resume commercial operation.

The company said it will pay careful attention to the pre-use inspection and make every effort to confirm the safety of the unit.
Mihama 3 - a 780 MWe pressurised water reactor - entered commercial operation in 1976. In November 2016, the NRA approved an extension to the operating period for the unit until 2036. Mihama 3 is the third Japanese unit to be granted a licence extension enabling it to operate beyond 40 years under revised regulations which came into force in July 2013, following Kansai's Takahama 1 and 2, which received NRA approval in June last year.
In June this year, Kansai released a schedule for safety improvement work it will carry out at the unit to enable it operate for an additional 20 years. Most of the work is related to improving the unit's seismic resistance and carrying out preventative maintenance. The company aims to complete the work by the end of January 2020.
Researched and written
by World Nuclear News