1. Birmingham brings early change to bureau review

THE AUSTRALIAN
SEPTEMBER 16, 2014 12:00AM
http://www.theaustralian.com.au/national-affairs/climate/birmingham-brings-early-change-to-bureau-review/story-e6frg6xf-1227059509503

THE Bureau of Meteorology has been ordered to bring forward the creation of a panel of external -experts to oversee the national homogenised temperature record, ACORN-SAT.

The federal government will monitor the technical advisory group to ensure it includes -respected external scientists and statisticians as recommended by the peer review panel that originally approved the ACORN-SAT methodology.

Simon Birmingham, the parliamentary secretary with responsibility for the weather bureau, said yesterday it had advised that establishment of the oversight panel was “in progress” and due to be completed by next year.

“However, the parliamentary secretary in reviewing the recommendations has brought the completion date forward to the end of 2014,” a spokesman said.

Senator Birmingham would be briefed on the proposed composition of the panel and would

“ensure” it had the independence envisaged in the original recommendation, he said.

The bureau has been under pressure to meet the recommendations of its independent peer review panel, which praised the ACORN-SAT program two years ago but said greater transparency was needed.

Last week, the bureau published a full list of adjustments after criticisms that homogenisation had changed cooling trends at some regional weather stations to warming trends.

The bureau has said adjustments are necessary to compensate for changes in equipment or location or after comparisons are made with nearby stations.

The bureau says while homogenisation had changed temperature trends at some stations, the overall national trend for warming has not been affected.

Independent scientists had for two years been calling for the -publication of the adjustments, as recommended by the peer review panel.

Following their release, scientist Jennifer Marohasy said the bureau had at last acknowledged that it had changed the temperatures at most, if not all, the weather stations making up the network from which national temperature trends were calculated.

“Scrutinise the detail in this document of adjustments and not only is the rationale and methodology indefensible, but it contradicts information published

in the official station which is meant to be the go-to document for understanding this official network known as ACORN-SAT," Dr -Marohasy said.

In addition to the publication of reasons for adjustments, the peer review panel recommended two years ago a technical advisory group meet annually to review progress on the development and operation of ACORN-SAT.

2. Nuclear power 'needed' to keep cheap energy alive

THE AUSTRALIAN
SEPTEMBER 18, 2014 12:00AM

http://www.theaustralian.com.au/national-affairs/nuclear-power-needed-to-keep-cheap-energy-alive/story-fn59niix-1227062009642#

AUSTRALIA should consider nuclear energy when it builds its next generation of power stations in about 2030 and faces the doubling or tripling of electricity prices. Australian Industry Group chief executive Innes Willox will tell an energy conference today Australia faces "the definitive loss'' of its former advantage in low-cost energy.

To view the remainder of the article requires a subscription.

3. **Fusion power**

Iterative processes

A big nuclear-fusion project attempts to move from design to construction

Sep 20th 2014 | From the print edition

http://www.economist.com/news/science-and-technology/21618675-big-nuclear-fusion-project-attempts-move-design

HERE is one way to squeeze energy from nuclear fusion: create and contain a roiling soup of ionised hydrogen atoms known as a plasma, and heat it to ten times the temperature of the sun's core. Some of the fast-moving atomic nuclei will bash together with enough oomph to fuse. Gather the energy from fast-moving particles created in these collisions and you have a limitless (for hydrogen is abundant), comparatively clean energy source. It is an idea conceived in the 1950s, but yet to be born in a laboratory.

Here is one way that might make it happen: gather an international consortium of the fusion-minded, including the European Union, America, China, India, Japan, Russia and South Korea. Conspire to build a 23,000-tonne doughnut-shaped vessel called a tokamak, that is wrapped with 80,000km of superconducting wire, all to contain the plasma magnetically and, for the first time, produce fusion energy continuously. Call it the International Thermonuclear Experimental Reactor; shorten the name to ITER for better PR. And farm out the design to the seven "domestic agency" partners, each completely in charge of the procurement and production of their bit (they will all have to agree to any changes, though, as the design of this technological beast inevitably evolves).

It sounds wonderfully egalitarian, in a technocratic sort of way. Timelines are slippery things, though, so delays will occur and costs will go up. That makes for more delays. Partners may drop out and come back as the political will to pay for the project comes and goes.

The story of ITER has become a tale of these shortcomings. The first of its components arrived at the reactor's site in Cadarache, in the south of France, earlier this month, just as

the foundations were finished. In the next week or so construction should start on the walls that will house its core: the doughnut-shaped vacuum vessel. Perhaps tellingly, no one can say exactly when even that will happen. There has already been a 30-month delay in the manufacture of the vacuum vessel. The most recently published schedule says the first plasma will be created in the vacuum vessel in 2020. That will now have to slip to 2023 or 2024, but the revised official schedule will not be published until mid-2015. The overall cost? Also unknown, but it is sure to surpass by a considerable sum the current official estimate of $20 billion.

The factors that have hobbled ITER from the start have not been concerns of nuclear physics or large-scale engineering. They have been problems of leadership and project management. Few would now argue that the initial design was adequate, or that the seven domestic agencies should have been allowed to have the absolute control they got over the bits of it they worked on. As delays and dissent cropped up within the domestic agencies, ITER's management kept the other agencies in the dark, and stuck too long to timelines that were never feasible.

Most embarrassingly, a management assessment from last October that was leaked earlier this year derided the organisation along all these lines, and added that the project lacked a "nuclear safety culture". America withheld 12% of its ITER funding this year, pending the implementation of every one of the assessment's recommendations. A dissenting subcommittee of the Senate has proposed a budget that would see America pull out altogether next year, as it did in 1999 (it came back into the fold in 2003).

ITER's core philosophy is to share between countries the risks, efforts and rewards of trying to crack the fusion-power problem—costs and delays be damned. The idea is that if the project proves successful, any of the domestic agencies involved should then be able to build its own version with the knowledge collaboratively gained.

Consensus among the ITER faithful is that it will accomplish

its stated goal of extracting 500 megawatts of power from a continuously fusing plasma—about ten times as much power as is put in. Scientifically, nothing seems to stand in the way of this. But consider the National Ignition Facility, a star-crossed American effort to use lasers rather than magnetic fields to create fusion. It looked certain, on paper, that if engineers built a laser of a given size (the world's largest, by some margin) and fired it at a target of a prescribed shape and composition, the result would be a net gain of energy. The laser and the targets were made; fusion "break-even", however, was not. The facility has now switched its focus to "nuclear-stockpile stewardship" (modelling the behaviour of atom bombs).

What looks good according to the equations is thus not always—or even often—what works best in reality. But if ITER wants even the chance to test the science, it will first have to solve, in a comprehensive fashion, its human problems.

4. Confusing climate of change ahead of New York summit

THE AUSTRALIAN
SEPTEMBER 20, 2014 12:00AM

http://www.theaustralian.com.au/news/features/confusing-climate-of-change-ahead-of-new-york-summit/story-e6frg6z6-1227064560762

THE record-breaking expansion of Antarctic sea ice is symbolic of the confusion and contradictions that have gathered to cloud the politics and scientific message on man-made climate change.

The Antarctic was supposed to melt but has expanded this winter to its largest extent on the satellite record. Good science and sound physics says global temperatures will rise in response to higher levels of

carbon dioxide in the atmosphere. However, the level of CO2 has continued to climb to record levels, but for many the debate is stuck on whether the “hiatus” in global average surface temperature rise has now lasted 15 years or 19 years.

A slew of explanations have been offered both for expanding Antarctic sea ice and the inconvenient “pause”. Increased ice growth in Antarctica could be due to shifting wind patterns caused by climate change, even through climate models did not see it coming. Concerned scientists correctly say Arctic ice cover, the more pressing concern, although bigger this year than the two previous years, is still below the long-term average.

At least part of the explanation for the pause, scientists say, is natural cycles that mask the real impact of rising levels of atmospheric CO2.

Another reason for the more than decade-long flat line in average global surface temperature, which the Intergovernmental Panel on Climate Change now concedes is real, is increased heat in the oceans.

A widely publicised peer-reviewed paper that includes lead scientists from the University of NSW Centre of Excellence for Climate System Science said the increased heat was in the Pacific Ocean. A subsequent peer-reviewed paper said it was in the Atlantic.

There is a long list of other “peer-reviewed” explanations for the pause that may or may not stand

the test of time.

To make things worse — or better, depending on your point of view — the global temperature trend has fallen below the least-worst scenario forecast by all the climate change models relied on by the IPCC.

The confusion does not mean climate change is not real or that increased CO2 in the atmosphere is not a problem. But the mixed signals are certainly making a tough job tougher for world leaders, who are under pressure to cooperate on what to do about man-made global warming.

For those most concerned about climate change, in a perfect world, global heads of state would be queuing in New York next week to meet UN Secretary--General Ban Ki-moon to pledge ambitious programs to help the world put the brakes on CO2 emissions and stop the global temperature rising by more than 2C by the end of the century.

When the New York summit was conceived, the expectation was that the IPCC's increased certainty on the human contribution to climate change, as outlined in the Fifth Assessment Report, would have provided the momentum for world leaders to enter a public auction of good intent. IPCC chairman Rajendra Pachauri will make a statement about the report's findings

Next week's meeting is a scene-setter for next year's UN climate summit in Paris, which is another attempt

following the disastrous Copenhagen summit in 2009 to broker a legally binding global treaty on carbon emissions, to take effect from 2020.

Ban has asked leaders to bring bold announcements and actions to the New York summit that will reduce emissions, strengthen climate resilience, and mobilise political will for a meaningful legal agreement next year.

“I expect each country to put forth a clear vision of placing the world on a trajectory to keep temperature rise within 2C and to confirm support for a meeting in Paris next year intended to reach an agreement on how to achieve that vision,” Ban said.

The reality is while Barack Obama will attend the New York summit, the heads of state from the other top carbon-emissions nations will not.

Chinese President Xi Jinping and Indian Prime Minister Narendra Modi will not attend. German Chancellor Angela Merkel has pulled out. Japan is not going. Canada will be represented by its environment minister while Russia, Australia, Ukraine and Pakistan will be represented by their foreign ministers. Saudi Arabia is sending its petroleum minister.

Australia’s Climate Institute was putting on a brave face, saying “we look forward to the substance of comments made, rather than who makes them”.

To galvanise action, there has been a series of reports

including a fresh exploration of the potential of the new climate economy by Britain's Nicholas Stern and Australia's Ross Garnaut setting out "a 10-point global action plan for governments and businesses to secure better growth in a low-carbon economy".

In Australia, now independent climate-change adviser Will Steffen has released a document repeating alarming claims about the possible economic impact of future sea-level rises.

High-profile weather presenters have been co-opted by the World Meteorological Organisation to present scary scenarios about future weather events.

Actor Leonardo DiCaprio has been co-opted as the celebrity face of climate change action, and global rallies have been organised for cities around the world tomorrow, led by a New York street parade.

The New York parade, which starts at Central Park West, provides a snapshot into the hierarchy of community groups for climate change action.

At the front of the parade will be "indigenous, environmental justice and other frontline communities". Second will be labour, families, students and elders ahead of renewable energy and environment organisations.

Anti-corporate campaigns, peace and justice have been put together in the middle, followed by science and religion with a rainbow coalition of lesbian, gay, bisexual, transgender and queer bringing up the rear.

Similar displays of people power are planned for New Delhi, Berlin, Paris, Lagos, Tanzania and other major centres.

In Australia, GetUp! says the headline march will be in Melbourne where speakers include Tim Flannery, Christine Milne and Mark Butler.

GetUp! is directing its anger at Tony Abbott's decision not to attend the New York summit, but there are clearly more substantial issues at play.

The absence of China and India from the summit is a clear signal of how far away global agreement still is. Modi, in particular, remains an unknown quantity. He has made widely publicised recent comments that cast doubts on whether he believes climate change is real and if his country is prepared to act.

According to *The Economic Times* of India, Modi's decision not to participate in New York reflects the environment ministry's advice to the Prime Minister's -office that attendance would put pressure on India to make some new announcement on its efforts to deal with climate change.

China can highlight new rules on coal imports as a sign of good faith on climate mitigation.

In reality, however, the crackdown on coal imports has been driven by the desire to help domestic coal producers and the need to address air quality issues in China's major cities. China has been reluctant to set out a peak or "cap" for CO2 emissions, or say when

this may be reached.

Obama has received worldwide headlines for his initiative to use Environmental Protection Agency sanctions to reduce the level of CO2 emissions from power generation.

There was a hitch this week, however, when the EPA pushed back until December the public comment period on the new rules for power plants.

The delay followed heavy lobbying by Republicans and industry groups, and could push the hope for any meaningful action beyond the next presidential -election.

The EPA's proposed rule, announced in June, would cut carbon pollution from the country's power plants by an average of 30 per cent over 2005 levels.

It is the cornerstone of Obama's climate change offensive and the fear is, as with Ban's New York talkfest, it now could be over before it begins.

5. The Wall Street Journal

THE SATURDAY ESSAY

Climate Science Is Not Settled

We are very far from the knowledge needed to make good climate policy, writes leading scientist Steven E. Koonin

By STEVEN E. KOONIN
Sept. 19, 2014 12:19 p.m. ET

he crucial scientific question for policy isn't whether the climate is changing.

That is a settled matter: The climate has always changed and always will.
Mitch Dobrowner

The idea that "Climate science is settled" runs through today's popular and policy discussions. Unfortunately, that claim is misguided. It has not only distorted our public and policy debates on issues related to energy, greenhouse-gas emissions and the environment. But it also has inhibited the scientific and policy discussions that we need to have about our climate future.

My training as a computational physicist—together with a 40-year career of scientific research, advising and management in academia, government and the private sector—has afforded me an extended, up-close perspective on climate science. Detailed technical discussions during the past year with leading climate scientists have given me an even better sense of what we know, and don't know, about climate. I have come to appreciate the daunting scientific challenge of answering the questions that policy makers and the public are asking.

The crucial scientific question for policy isn't whether the climate is changing. That is a settled matter: The climate has always changed and always will. Geological and historical records show the occurrence of major climate shifts, sometimes over only a few decades. We know, for instance, that during the 20th century the Earth's global average surface temperature rose 1.4 degrees Fahrenheit.

Nor is the crucial question whether humans are influencing the climate. That is no hoax: There is little doubt in the scientific community that continually growing amounts of greenhouse gases in the atmosphere, due largely to carbon-dioxide emissions from the conventional use of fossil fuels, are influencing the climate. There is also little doubt that the carbon dioxide will persist in the atmosphere for several centuries. The impact today of human activity appears to be comparable to the intrinsic, natural variability of the climate system itself.

Rather, the crucial, unsettled scientific question for policy is,

"How will the climate change over the next century under both natural and human influences?" Answers to that question at the global and regional levels, as well as to equally complex questions of how ecosystems and human activities will be affected, should inform our choices about energy and infrastructure.

But—here's the catch—those questions are the hardest ones to answer. They challenge, in a fundamental way, what science can tell us about future climates.

Even though human influences could have serious consequences for the climate, they are physically small in relation to the climate system as a whole. For example, human additions to carbon dioxide in the atmosphere by the middle of the 21st century are expected to directly shift the atmosphere's natural greenhouse effect by only 1% to 2%. Since the climate system is highly variable on its own, that smallness sets a very high bar for confidently projecting the consequences of human influences.

A second challenge to "knowing" future climate is today's poor understanding of the oceans. The oceans, which change over decades and centuries, hold most of the climate's heat and strongly influence the atmosphere. Unfortunately, precise, comprehensive observations of the oceans are available only for the past few decades; the reliable record is still far too short to adequately understand how the oceans will change and how that will affect climate.

A third fundamental challenge arises from feedbacks that can dramatically amplify or mute the climate's response to human and natural influences. One important feedback, which is thought to approximately double the direct heating effect of carbon dioxide, involves water vapor, clouds and temperature.

But feedbacks are uncertain. They depend on the details of processes such as evaporation and the flow of radiation through clouds. They cannot be determined confidently from the basic laws of physics and chemistry, so they must be verified by precise, detailed observations that are, in many

cases, not yet available.

Beyond these observational challenges are those posed by the complex computer models used to project future climate. These massive programs attempt to describe the dynamics and interactions of the various components of the Earth system—the atmosphere, the oceans, the land, the ice and the biosphere of living things. While some parts of the models rely on well-tested physical laws, other parts involve technically informed estimation. Computer modeling of complex systems is as much an art as a science.

For instance, global climate models describe the Earth on a grid that is currently limited by computer capabilities to a resolution of no finer than 60 miles. (The distance from New York City to Washington, D.C., is thus covered by only four grid cells.) But processes such as cloud formation, turbulence and rain all happen on much smaller scales. These critical processes then appear in the model only through adjustable assumptions that specify, for example, how the average cloud cover depends on a grid box's average temperature and humidity. In a given model, dozens of such assumptions must be adjusted ("tuned," in the jargon of modelers) to reproduce both current observations and imperfectly known historical records.

We often hear that there is a "scientific consensus" about climate change. But as far as the computer models go, there isn't a useful consensus at the level of detail relevant to assessing human influences. Since 1990, the United Nations Intergovernmental Panel on Climate Change, or IPCC, has periodically surveyed the state of climate science. Each successive report from that endeavor, with contributions from thousands of scientists around the world, has come to be seen as the definitive assessment of climate science at the time of its issue.

For the latest IPCC report (September 2013), its Working Group I, which focuses on physical science, uses an ensemble of some 55 different models. Although most of these models are tuned to reproduce the gross features of the

Earth's climate, the marked differences in their details and projections reflect all of the limitations that I have described. For example:

• The models differ in their descriptions of the past century's global average surface temperature by more than three times the entire warming recorded during that time. Such mismatches are also present in many other basic climate factors, including rainfall, which is fundamental to the atmosphere's energy balance. As a result, the models give widely varying descriptions of the climate's inner workings. Since they disagree so markedly, no more than one of them can be right.

• Although the Earth's average surface temperature rose sharply by 0.9 degree Fahrenheit during the last quarter of the 20th century, it has increased much more slowly for the past 16 years, even as the human contribution to atmospheric carbon dioxide has risen by some 25%. This surprising fact demonstrates directly that natural influences and variability are powerful enough to counteract the present warming influence exerted by human activity.

Yet the models famously fail to capture this slowing in the temperature rise. Several dozen different explanations for this failure have been offered, with ocean variability most likely playing a major role. But the whole episode continues to highlight the limits of our modeling.

• The models roughly describe the shrinking extent of Arctic sea ice observed over the past two decades, but they fail to describe the comparable growth of Antarctic sea ice, which is now at a record high.

• The models predict that the lower atmosphere in the tropics will absorb much of the heat of the warming atmosphere. But that "hot spot" has not been confidently observed, casting doubt on our understanding of the crucial feedback of water vapor on temperature.

• Even though the human influence on climate was much

smaller in the past, the models do not account for the fact that the rate of global sea-level rise 70 years ago was as large as what we observe today—about one foot per century.

• A crucial measure of our knowledge of feedbacks is climate sensitivity—that is, the warming induced by a hypothetical doubling of carbon-dioxide concentration. Today's best estimate of the sensitivity (between 2.7 degrees Fahrenheit and 8.1 degrees Fahrenheit) is no different, and no more certain, than it was 30 years ago. And this is despite an heroic research effort costing billions of dollars.

These and many other open questions are in fact described in the IPCC research reports, although a detailed and knowledgeable reading is sometimes required to discern them. They are not "minor" issues to be "cleaned up" by further research. Rather, they are deficiencies that erode confidence in the computer projections. Work to resolve these shortcomings in climate models should be among the top priorities for climate research.

Yet a public official reading only the IPCC's "Summary for Policy Makers" would gain little sense of the extent or implications of these deficiencies. These are fundamental challenges to our understanding of human impacts on the climate, and they should not be dismissed with the mantra that "climate science is settled."

While the past two decades have seen progress in climate science, the field is not yet mature enough to usefully answer the difficult and important questions being asked of it. This decidedly unsettled state highlights what should be obvious: Understanding climate, at the level of detail relevant to human influences, is a very, very difficult problem.

We can and should take steps to make climate projections more useful over time. An international commitment to a sustained global climate observation system would generate an ever-lengthening record of more precise observations. And increasingly powerful computers can allow a better understanding of the uncertainties in our models, finer model

grids and more sophisticated descriptions of the processes that occur within them. The science is urgent, since we could be caught flat-footed if our understanding does not improve more rapidly than the climate itself changes.

A transparent rigor would also be a welcome development, especially given the momentous political and policy decisions at stake. That could be supported by regular, independent, "red team" reviews to stress-test and challenge the projections by focusing on their deficiencies and uncertainties; that would certainly be the best practice of the scientific method. But because the natural climate changes over decades, it will take many years to get the data needed to confidently isolate and quantify the effects of human influences.

Policy makers and the public may wish for the comfort of certainty in their climate science. But I fear that rigidly promulgating the idea that climate science is "settled" (or is a "hoax") demeans and chills the scientific enterprise, retarding its progress in these important matters. Uncertainty is a prime mover and motivator of science and must be faced head-on. It should not be confined to hushed sidebar conversations at academic conferences.

Society's choices in the years ahead will necessarily be based on uncertain knowledge of future climates. That uncertainty need not be an excuse for inaction. There is well-justified prudence in accelerating the development of low-emissions technologies and in cost-effective energy-efficiency measures.

But climate strategies beyond such "no regrets" efforts carry costs, risks and questions of effectiveness, so nonscientific factors inevitably enter the decision. These include our tolerance for risk and the priorities that we assign to economic development, poverty reduction, environmental quality, and intergenerational and geographical equity.

Individuals and countries can legitimately disagree about these matters, so the discussion should not be about "believing" or "denying" the science. Despite the statements of numerous scientific societies, the scientific community cannot

claim any special expertise in addressing issues related to humanity's deepest goals and values. The political and diplomatic spheres are best suited to debating and resolving such questions, and misrepresenting the current state of climate science does nothing to advance that effort.

Any serious discussion of the changing climate must begin by acknowledging not only the scientific certainties but also the uncertainties, especially in projecting the future. Recognizing those limits, rather than ignoring them, will lead to a more sober and ultimately more productive discussion of climate change and climate policies. To do otherwise is a great disservice to climate science itself.

Dr. Koonin was undersecretary for science in the Energy Department during President Barack Obama's first term and is currently director of the Center for Urban Science and Progress at New York University. His previous positions include professor of theoretical physics and provost at Caltech, as well as chief scientist of BP where his work focused on renewable and low-carbon energy technologies.

6. Climate not as sensitive to carbon dioxide

THE AUSTRALIAN
SEPTEMBER 27, 2014 12:00AM

http://www.theaustralian.com.au/national-affairs/climate/climate-not-as-sensitive-to-carbon-dioxide/story-e6frg6xf-1227072070917

Graham Lloyd
Environment Editor
Sydney

A NEW peer-reviewed paper using observations rather than computer models has found the Earth’s climate was l ess sensitive to increasing

levels of carbon -dioxide in the atmosphere than predicted by the Intergovernmental Panel on Climate Change.

The findings have generated vigorous international debate about an issue that remains a key area of uncertainty in climate -science.

The paper, published in the journal *Climate Dynamics*, was prepared by US climate scientist Judith Curry and climate -researcher Nic Lewis.

Dr Curry said the sensitivity of climate to increasing concentrations of CO2 was at the heart of the scientific debate on anthropogenic climate change, and also the public debate on the appropriate policy response to increasing -carbon dioxide in the atmosphere.

She said climate sensitivity and estimates of its uncertainty were important to establishing the cost benefit of taking action to limit greenhouse gas emissions.

The Lewis and Curry paper does not claim to be the last word on the subject and said the major area of uncertainty was the role played by aerosols.

But the paper contains a much higher level of comfort than does the IPCC that the world will not exceed the two -degrees warming threshold set by the UN.

The Lewis and Curry paper said the best estimate for equilibrium climate sensitivity — the change in global

mean surface temperature at equilibrium that is caused by a doubling of the -atmospheric CO2 concentration — was 1.64 degrees.

The temperature range given with a confidence level of 17 to 83 per cent was 1.25 to 2.45.

This range compares with a range of 1.5 to 4.5 given in the IPCC's fifth assessment report for the same level of confidence.

Unlike the fourth assessment report, the IPCC's most recent synthesis document did not give a best estimate for climate sensitivity. The Curry and Lewis paper's best estimate for transient climate response — the temperature change at the time of CO2 doubling — was 1.33C with a range of 1.05C to 1.8C.

The IPCC range was 1.0C to 2.5C with no best estimate given.

The IPCC report acknowledges the scientific debate that continues over the issue of climate sensitivity and the different -results between models and analysis based on observations.

To arrive at their lower climate sensitivity range than the IPCC, Lewis and Curry analysed the Earth's observed temperature change, ocean heat uptake and the level of human greenhouse gas emissions and natural -variability.

By contrasting the period 1859-82 with the period 1995- 2011 they estimated how much the Earth had

warmed in association with human greenhouse gas emissions. Neither the Australian -Science Media Centre nor the University of NSW Centre of -Excellence Climate System Science commented on the Curry and Lewis paper yesterday.

Dr Curry said the paper was not the last word of climate sensitivity because it related only to the uncertainty in external forcing, surface temperature and ocean heat uptake.

It did not take account of solar influence or -internal variability.

In an essay published this week, President Barack Obama's former climate advisor Steven Koonin said today's best estimate of the sensitivity was no different, and no more certain, than it was 30 years ago despite billions of dollars having been spent.

7. Climate is right for a probe into the Bureau of Meteorology

MAURICE NEWMAN
THE AUSTRALIAN
OCTOBER 01, 2014 12:00AM

http://www.theaustralian.com.au/opinion/climate-is-right-for-a-probe-into-the-bureau-of-meteorology/story-e6frg6zo-1227075659378

WEATHER bureaus are a protected species. Often criticised, their workings remain a mystery to most of us. They continue to -escape close scrutiny.

In an op-ed in Britain's *The Telegraph* (December 19, 2010), the mayor of London, Boris Johnson, blamed much of the city's pre-Christmas transport chaos on the Met Office. The Met had predicted 1C to 1.5C warmer temperatures. The reality was the coldest December in 100 years. "Is it really true no one saw this coming?" Johnson asked. Well no. He identified Piers Corbyn of Weather Action, a private weather forecaster, and went on: "He has no telescope or supercomputer. Using a laptop, huge quantities of publicly available data and a first-class degree in astrophysics, he gets it right, again and again."

Perhaps a predisposition to man-made global warming accounts for the Met Office's failure to predict abnormally harsh winters in Britain? After all, its chairman for two full terms was Robert Napier, a global warming activist and former head of WWF UK. The Met's leaning came to light in leaked emails and revelations from Russian scientists. It and the Climatic Research Unit of the University of East Anglia were shown to have systematically contorted data past and present to achieve the desired warming dir-ection. The frustrated CRU climatologist-programmer, Ian "Harry" Harris, admitted to struggling with the complex computer programs and conceded he would do what the CRU usually did, "allow bad databases to pass -unnoticed and good databases to become bad".

The leaked emails also informed us of Australia's collusion in the warming hype. There was an email

from Phil Jones referring to Australia “inventing” the Dec-ember 1995 monthly value, and there was reference to Australian scientists who “would like to see the section on variability and extreme events beefed up if possible”. The head of climate monitoring and prediction ser-vices at the Bureau of Meteorology boasted about a policy that “snows” sceptics.

Doctoring data or throwing inquirers off the track to deliver an outcome is unscientific and unacceptable at any time. Yet in climate science there seems to be a culture of toleration. In 2009 John Theon, retired chief of NASA’s Climate Processes Research Program, testified to a US Senate inquiry that “scientists have manipulated the observed data to justify their model results”.

Fast forward to today. This newspaper’s environment editor, Graham Lloyd, published information that raises questions about the quality of Australia’s temperature records. In a series of articles, Lloyd published details about the Bureau of Meteorology’s data “homogenisation”, the practice that involves the mixing, matching and deletion of temperature records and that seemed to create its own discontinuities. The bureau claims to observe world best practice. Perhaps. But homogenisation practices globally are under challenge, so conformity provides little comfort. If temperature manipulation can happen somewhere, why not elsewhere?

In response to *The Australian*’s report, the BoM

quietly released a “nothing to see here” summary of the impact of temperature adjustments at 112 locations around Australia with the list of reference stations used for comparison. The stated reasons for homogenisation seem arbitrary. Words like “merge”, “move” and “statistical”, provide little understanding of the thinking behind each decision or the reason stations were chosen. Colonial records are dismissed, notwithstanding the existence of Stevenson screens and the undoubted diligence of record keepers pre-1910. To the layman, the list of so-called “nearby” stations used to homogenise data raise questions of suitability. Is Bathurst jail really an appropriate site to include for homogenising Bourke’s records?

As a member of the World Meteorological Organisation, the BoM is inevitably caught up in global warming politics. After all it was the WMO that part established the Intergovernmental Panel on Climate Change and it remains an anthropogenic warming propagandist.

The BoM is a large and expensive agency, employing 1700 people and costing more than $300 million a year to run. The importance of its database and the reliability of its forecasts go well beyond direct operating costs and daily bulletins. As the bureau says, 10 per cent of Australia’s GDP is weather sensitive. This makes its input to public policy potentially valuable. But it must first dispel suspicions of a warming bias. The memory of Climategate and its casual approach to celsius conversion, lingers. It

should explain why homogenisation consistently turns cooling trends to warming and why pre-1910 records were dropped and, with them, the extreme heatwaves of the Federation drought.

The record is error-ridden. Even to an amateur, the latest information dump prompts more questions than answers. The concerns about Rutherglen raised by Lloyd as to why a 0.35C cooling became a 1.73C warming still have no satisfactory explanation. No supporting documentary evidence, algorithms or methodology have been produced, leaving the unfortunate impression that temperature records were falsified.

As Einstein warned, “Whoever is careless with the truth in small matters cannot be trusted with important matters.” Indeed, those who doubted the reliability of the “high quality” records that were abandoned for the 2011 ACORN-Sat data are unlikely to find much comfort in the latest release. But it’s not only temperatures where doubts exist.

In 2008, David Stockwell, a niche ecological modelling expert, found: “The most worrying failure was that simulations (CSIRO/BoM models) showed increases in droughted area over the last century in all regions, while the observed trends in drought decreased in five of the seven regions identified.”

Lending its name to clearly partial scholarship only increases concerns that the bureau puts -climate change advocacy ahead of scientific rigour and

transparency. Trust in our national climate records is critical. Yet the more we see, the more we question. Now is not the time for a tame review.For the sake of public -policy and the BoM's reputation, the air must be cleared.

Nothing short of a thorough government-funded review and audit, conducted by independent professionals, will do.

Maurice Newman chairs the Prime Minister's Business Advisory Council. These views are his own.

8. Canada switches on world's first carbon capture power plant

Boundary Dam held up as first commercial-scale CCS plant and proof that coal-burning is compatible with cutting emissions

Suzanne Goldenberg

http://www.theguardian.com/environment/2014/oct/01/canada-switches-on-worlds-first-carbon-capture-power-plant

Canada has switched on the first large-scale coal-fired power plant fitted with a technology that proponents say enables the burning of fossil fuels without tipping the world into a climate catastrophe.

The project, the first commercial-scale plant equipped with carbon capture and storage technology, was held up by the coal industry as a real life example that it is possible to go on burning the dirtiest of fossil fuels while avoiding dangerous global warming.

Saskatchewan's state-owned electricity provider is due to cut the ribbon on the $1.3 billion Canadian project on Thursday. But officials from SaskPower International Inc told guests invited to the ceremony the 110 megawatt plant went live on Tuesday night.

The Boundary Dam power plant promises to cut carbon dioxide emissions by 90% by trapping C02 underground before the gas

reaches the atmosphere – making its opening a milestone in the coal industry's efforts to remain viable in a low-carbon economy.

The company said the project would reduce greenhouse gas emissions by about 1 million tons a year, or the equivalent of taking 250,000 cars off the road, in one of the more fossil fuel-dependent regions of Canada.

Captured CO2 from the Boundary Dam project will be pumped underground and sold to the Cenovus oil company for use in priming nearby oil fields, or buried in geological formations.

"Saskatchewan is number one in the world," said Brad Page, the chief executive of the Global CCS Institute, said. "This is an incredibly important event from our perspective."

Scientists from the United Nations climate panel said last year that without broad deployment of CCS technology most of the world's fossil fuel will have to stay in the ground to avoid dangerous climate change.

Page was cautious however in predicting CCS technology deployed at Boundary Dam would soon be replicated on a large-scale.

He noted the Saskatchewan plant relies on a local source of coal – and on selling on the CO2 to the oil industry – to keep it in the black. Coal also faces intense competition from historically low prices for natural gas, which makes it prohibitively expensive to build new coal plants with CCS.

Even so, the opening of Boundary Dam represents a rare success story for the CCS industry.

The technology has not been fully embraced by the big US coal companies – which are still focused on opposing incoming power plant rules from the Environmental Protection Agency.

CCS is also viewed with deep suspicion by environmental campaigners because its economic viability - so far - depends on using the CO2 to increase oil production, and because it is more expensive than renewable sources of energs.

The technology of carbon capture and storage has been around for years. "This is not a moonshot," Ian Yeates, the SaskPower

executive in charge of CCS, told the Guardian earlier this year.

But projects combining power generation and CCS have faced long delays and cost overruns, and run into criticism for receiving government subsidies. A number have been scuttled altogether because of competition from historically low prices for natural gas.

In Mississippi, Southern Company has spent more than $5.5 bn over the last six years trying to bring a new-built CCS project, the Kemper County Energy Facility, into operation. The opening is now delayed until mid-2015.

Only one other CCS project involving power generation is currently on the boards in the US, in Texas.

Boundary Dam claimed its cost over-runs had nothing to do with the CCS technology, but in other construction issues involved in overhauling a 50-year-old power plant. Officials also said they were confident they could bring in the next such CCS project 25% cheaper.

The plant received some CAD$240m in subsidies.

But Yeates acknowledged that at this point the viability of the technology depended on having a nearby source of coal and an additional revenue stream from the enhanced oil recovery. “I think at this stage of the game, because the concept is so new, having a revenue stream from the CO2 is critical to help the economics. But I think eventually that will not be required,” he said.

He said the company had seen a lot of interest in the CCS plant from China, India and other places which have large quantities of similar lignite coal.

“There are 7,000 coal-fired turbines on the planet right now and they are not going to be turned off any time soon because people need the energy they produce,” Yeates said. “Is there going to be enough gas to replace all those units? We are going to be burning fossil fuels as a world economy for many many decades if not a century or two as energy demands grow...something like carbon capture and sequestration will be of value to deal with that.”

Prof Stuart Haszeldine, director of Scottish Carbon Capture & Storage, said: “Boundary Dam is working proof for naysayers, including the Intergovernmental Panel on Climate Change, that

full-scale CCS on power generation now exists and works commercially to deliver electricity, with no subsidy." He claimed the plant's opening would "create ripples worldwide."

9. NASA rules out deep ocean for hidden heat

THE AUSTRALIAN
OCTOBER 08, 2014 12:00AM

Graham Lloyd
Environment Editor
Sydney

http://www.theaustralian.com.au/national-affairs/climate/nasa-rules-out-deep-ocean-for-hidden-heat/story-e6frg6xf-1227083031830

THE "missing heat" that would explain the more than decade-long pause in global average surface temperatures could not be found in the deep ocean, a NASA study has found.

The report in journal *Nature Climate Change* said the absence of warming below 1995 metres left "unresolved the mystery of why global warming appears to have slowed in recent years".

NASA's analysis had shown deep ocean warming had contributed "virtually nothing" to sea level rise for the past 20 years.

Study co-author Josh Willis said the findings did not throw suspicion on climate change itself because "the sea level is still rising".

And other research by the US Department of Energy, also published in *Nature Climate Change*, said earlier warming in the upper Southern Ocean had been underestimated by up to 58 per cent.

The NASA research said the temperature increase in the upper oceans was not enough to explain the "pause".

"In the 21st century, greenhouse gases have continued to -accumulate in the atmosphere, just as they did in the 20th century, but global average surface air temperatures have stopped rising in tandem with the gases," NASA said.

"The temperature of the top half of the world's oceans — above the 1995m mark — is still climbing, but not fast enough to account for the stalled air temperatures."

Many processes on land, air and sea have been invoked to explain what is happening to the "missing" heat.

This NASA study was the first to test the idea using satellite -observations, as well as direct temperature measurements of the upper ocean.

Scientists have been taking the temperature of the top half of the ocean directly since 2005, using a network of 3000 floating temperature probes called the Argo array.

"The deep parts of the ocean are harder to measure,"

said NASA Jet Propulsion Laboratory's William Llovel, lead author of the study.

"The combination of satellite and direct temperature data gives us a glimpse of how much sea level rise is due to deep warming. The answer is — not much", he said.

Study co-author Dr Willis said the findings did not throw suspicion on climate change and his colleague, Felix Landerer, said warming in the top half of the ocean continued, a clear sign that our planet is heating up.

10.

IPCC calculations show global warming won't be harmful if it resumes

ALAN MORAN
THE AUSTRALIAN
OCTOBER 08, 2014 12:00AM

http://www.theaustralian.com.au/opinion/ipcc-calculations-show-global-warming-wont-be-harmful-if-it-resumes/story-e6frg6zo-1227083037892

OCTOBER 1 marked an important anniversary: 18 years during which the earth average temperature has remained unchanged.

Satellite data available from 1988 has allowed very precise measurements of global temperatures. These at first confirmed a warming trend.

But the satellite recordings, greeted with such

enthusiastic fanfare by the warmist fraternity, have, for the past 18 years, bitten the hand that fed them.

A number of hypotheses have been advanced to explain the inconvenient truth of this data. But NASA has just reported that there is no evidence that the increased heat is hiding in the deep oceans.

This invites the question: how much damage does a doubling of carbon dioxide levels bring and what is the cost of measures to prevent this doubling?

Significantly, the costs the Inter-governmental Panel on Climate Change attributes to warming are quite small. The IPCC draws from three studies that attempt to estimate the net losses in world GDP from global warming under business-as-usual conditions. One of these (Nordhaus 2008) estimates a loss across the next 50 years of 2.5 per cent, with a 3C warming. The second (Bosello et al) has a 0.5 per cent loss resulting from a 1.9C warming. And the third, (Rosen and van der Mensbrugghe) estimates a 1.8 per cent loss as a result of a 2.3C warming.

The IPCC's summary for policymakers glosses over the numbers and concentrates on scary rhetoric, an outcome that led to the resignation of Richard Tol, co-chairman of a key working group.

Yet the efforts to restrain global warming are to prevent a loss over 50 to 100 years of about half to one year's annual growth in world income levels. Even this overstates the losses from warming because

it magnifies ocean rises, the need for new infrastructure, losses from tourism and new security scares.

Having been forced to acknowledge that global warming has a relatively trivial effect on real levels of human welfare, the IPCC seeks to ensure that its estimates of the costs of pursuing serious carbon dioxide reductions are not too great. It does this by assuming massive new low-cost breakthroughs in solar, and in decarbonising coal emissions as well as by foreshadowing technologies not yet on the drawing boards.

Of course, if these technologies are really about to emerge there is no point in investing in current generation renewable energy. Indeed, whether we are on the cusp of technological breakthrough or not, there is no point investing in renewables that will always rely on expensive subsidies.

The IPCC puts the costs of its interventions from forcing the world off fossil fuels at just 2.7 per cent in 2050. This is increased to over 8 per cent if the carbon capture and storage does not work, nuclear is phased out and renewables cannot provide more than 20 per cent of world energy.

Even this higher figure is clearly understated as we can see with Australia's experience. Many of those who support the retention of Australia's mandatory renewable energy target now want to let aluminium smelting off the hook. The exclusion of aluminium

smelting would still maintain the cost of the MRET for all other businesses and for consumers. This would exacerbate the hardship of many of Australia's most vulnerable, including the disabled and the elderly already living in energy poverty.

The emerging world superpowers, China and India, consider the costs of abatement to be exorbitant and refuse to impose such measures on their economies. Without them no world agreement would be meaningful. For the moment, the evidence for global warming is lacking but, even if warming resumes, the IPPC's calculations show that it will not be very harmful. Attempts to prevent it, even if politically feasible, will cost more than the damage emissions may be causing.

The only certainty is the -immense costs of Australia maintaining its renewable energy requirements will offer no benefits except to the rentseekers calling so loudly for its retention.

Alan Moran is with Regulation Economics.

11. **Posted:** Oct 10, 2014 | **By:** Lauren Davis
Topics: Lab equipment > Heating/hotplates/autoclaves

Powering the future with plasma fusion

http://www.labonline.com.au/articles/69893-Powering-the-future-with-plasma-fusion

When it comes to finding new sources of energy, the Australian Plasma Fusion Research Facility (APFRF) is looking onwards and upwards - quite literally, in fact. The Sun and the stars are powered by fusion energy - fuel formed from the fusion of hydrogen into helium - in a

process which the facility hopes to help reproduce here on Earth.

Plasma fusion is considered a clean form of nuclear technology by which hydrogen isotopes are heated to many millions of degrees, causing them to fuse together and release vast amounts of energy. It has several advantages over nuclear fission: the raw materials can be extracted from seawater; the end product is helium, not a long-lived radioactive isotope; and the reaction cannot get out of control. The Australian Plasma Fusion Research Facility represents Australia's involvement in the international fusion effort.

Located in The Australian National University's (ANU) Plasma Research Laboratory, the $35 million APFRF was originally known as the National Plasma Fusion Research Facility, opened in 1997 and based around Australia's largest fusion experiment: the H-1 Heliac stellarator. The device confines hot plasma within a magnetic field 10,000 times stronger than the Earth's and is the only stellarator in the Southern Hemisphere.

Now the facility has been significantly upgraded thanks to a Commonwealth investment of $7 million under the Education Investment Fund's Super Science Initiative. Dr Boyd Blackwell, a senior fellow in the Plasma Research Laboratory, said the four-year upgrade has improved the APFRF in a number of ways.

"The radiofrequency heating system is the biggest single cost in this upgrade," said Dr Blackwell, referring to the system which heats the plasma to millions of degrees - hotter than the core of the Sun. "You need a lot of power - 400 kW - to do that and, as a research facility, we needed flexibility in that power."

The facility purchased a 2x200 kW RF heating system comprising two RF power amplifiers from Ampegon, based on the company's new Digital Radio Mondiale transmitters, and a cooled antenna with a flexible matching system constructed in the ANU Research School of Physics and Engineering workshops. These sources provide five times more power than the previous devices, consume less power, are fully remotely controlled and can run independently at different frequencies. Dr Blackwell said, "We can change the frequency over a range of 4-20 MHz, and we can program the shape of the pulses that generate the plasma."

He went on to say that the facility used upgrade funding to develop a number of innovative remote plasma measurement systems because, due to the high temperatures involved in plasma fusion, "you have to look at it from a long way away".

"Australia … is renowned for development of remote instrumentation for plasma, and our lab in particular specialises in imaging," Dr Blackwell said. "That means that you don't make just one measurement - you don't even make a bunch of measurements, you make a whole picture worth of measurements.

"A lot of the upgrade funding went into developing a number of those instruments - you could call them ultrafast cameras, if you like, because they

produce images in the end, but they're much more than a camera. For example, they produce images of the radio waves that heat the plasma, or the fluctuations in the plasma."

One of these instruments, developed at the APFRF, has recently provided the first images of the magnetic field inside a tokamak plasma, which will help researchers better understand confinement, said Dr Blackwell. Professor John Howard, the director of the facility, is continuing this research with this instrument on Korea's National Fusion Research Institute (NFRI) flagship experiment 'KSTAR'.

The facility has also developed a plasma device called the Magnetised Plasma Interaction Experiment (MAGPIE), which creates conditions approaching those at the edge of a fusion reactor. Dr Blackwell explained that the materials used to create fusion reactor walls must be able to withstand an extremely high heat load, as well as the atom displacement caused by the bombardment of neutrons that carry the energy.

"MAGPIE can create peak fluxes of one million watts per square metre under the right conditions, so we can put carbon, tungsten, molybdenum and other very high-temperature materials in there, and we can create a plasma nearby and can study the interaction between the plasma and the materials," he said. APFRF's collaborator on the experiment, the Australian Nuclear Science and Technology Organisation (ANSTO), meanwhile creates the atomic displacements to simulate the neutron damage.

In a recent experiment, MAGPIE discovered small bubbles forming on the surface of a tungsten-lathanum alloy after exposure to high-energy helium plasma. As noted by Dr Blackwell, "That is not good, because it means that little pieces will fall off. If the little pieces fall off, they cool the plasma and dampen the reaction. Fortunately, MAGPIE is able to reproduce this on a small scale. Under very well controlled conditions, we can use the excellent tools we have in Australia … to try to probe the cause of these bubbles and hopefully in the end prevent them."

The project is very much a collaborative one, utilising the resources of not only ANU and ANSTO but also the Australian Synchrotron. According to Dr Blackwell, "It wouldn't work without all that [collaboration] happening." This work has in fact led to two new collaborations: one involving the ANU positron facility and another with the Dutch Institute for Fundamental Energy Research.

The facility is powering the future in more ways than one. Although APFRF doesn't have the budget to break any world records, Dr Blackwell described it as "as much as anything, an excellent student and postdoc training platform", enabling students to "get hands-on experience with brand new ideas in remote measuring systems" - more so than if they were under the pressure of handling billion-dollar devices. Many Australian graduates have gone on to do great things around the world, he said, including Dr David Campbell, a University of Sydney graduate, who is Assistant Deputy Director-General and Director of Plasma Operations with ITER - a multibillion-dollar, multinational

experiment currently being built in France by a consortium of 35 nations.

When it commences operation in 2020, ITER aims to demonstrate the technological and scientific feasibility of fusion energy on a large scale, with a volume 10 times larger than any existing magnetic fusion experiment. From 50 MW of input power, the ITER machine is designed to produce 500 MW of fusion power - on par with a small power station - making it the first of all fusion experiments to produce net energy. Dr Blackwell said APFRF hopes to one day contribute to the global project, ideally providing theoretical and data analysis as well as an imaging instrument which takes advantage of ideas developed at the facility. He noted that Australia's participation is not yet secured, but the capabilities provided by the recent upgrades are "all part of 'Powering Ahead', the Australian fusion community's strategic plan to build up momentum and hopefully win increased funding for fusion science Australia-wide".

So how long until we can live in a world powered essentially limitless, safe, greenhouse gas-free fusion energy? Dr Blackwell admitted that the steps of demonstration, commercialisation, production and infrastructure replacement could easily take 100 years, but ultimately concluded, "I think we'll have a very clear answer about whether it can be done with magnetic confinement or not in 10-20 years." It's clearly an exciting time for plasma fusion research and, thanks to the APFRF, Australia can anticipate being part of this new age of clean energy production.

12. Boost for nuclear fusion research

9 October 2014
By Tereza Pultarova
http://eandt.theiet.org/news/2014/oct/eurofusion.cfm

A new €850m programme has been launched by the European Commission to foster development of nuclear fusion as a future energy source.

The EUROfusion programme, funded through the Horizon 2020 Research and Innovation framework, is a joint venture between the EU, Europe's fusion laboratories, Euroatom and Fusion for Energy, Europe's agency responsible for the delivery of ITER, the world's largest experimental tokamak nuclear fusion reactor which is currently being built in southern France.

Covering the period between 2014 and 2018, the EUROfusion programme aims to address key scientific and technological challenges identified in a roadmap outlined by Europe's fusion research laboratories in 2012.

"Fusion has the potential to become a reliable, safe, non-CO2

emitting and sustainable energy source," said Guenther Oettinger, the Vice President of the European Commission and Commissionaire for Energy.

"Today's launching of our European Joint Programme on fusion shows how Europe benefits if we unite our research strength. EUROfusion provides the framework for Europe to maintain its world leading position in fusion research."

The main focus of the five-year programme will be scientific and technical support to the International Thermonuclear Experimental Reactor (ITER) and ensuring Europe is in a position to capitalise on the success of this pioneering project.

The UK-based Joint European Torus (JET) laboratory in Culham, will be at the centre of the research activities funded through EUROfusion.

The programme will also address fundamental issues related to the next generation fusion demonstration reactor DEMO – an experimental nuclear fusion power plant that will be connected to the grid and provide a blueprint for the deployment of fusion reactors across the world, enabling fusion to contribute to meeting the world's growing energy needs after 2050 alongside renewable energy such as wind and solar power.

13. Future of fusion to be discussed at conference September 22, 2014 Mark Cooper, special to RBTH In October, atomic scientists from around the world will gather in St. Petersburg for the I.A.E.A.'s annual conference on the use of fusion for energy.

Source: Russia Beyond the Headlines –

http://rbth.com/business/2014/09/22/future_of_fusion_to_be_discussed_at_conference_40019.html

For the first time, St. Petersburg will host the International Atomic Energy Agency's Fusion Energy Conference, which will be held on Oct. 13-18. This

biannual conference serves as a key platform for international experts to meet and discuss new developments and possibilities for fusion energy. The first such conference was held in Salzburg, Austria, in 1961. Topics on the agenda for the 2014 conference include current prospects for further research in fusion energy. One subject at the top of the agenda is new innovative technological possibilities for using nuclear fusion as a source of energy. This year's conference is expected to be attended by 1,000 delegates from 59 countries.

Attendees will include scientists, officials and representatives of major energy corporations. The history of fusion In the mid-20th century, the world's leading physicists began looking for new sources of energy in the process of nuclear fusion. They were inspired in their search by the sun. At the sun's core, fusion reactions take place at temperatures of nearly 20 million degrees. These reactions release tremendous amounts of energy. Scientists in the Soviet Union were among the first to use this example to produce a controlled nuclear fusion reaction. Their work creating a reactor known as a tokamak later became the foundation of the International Thermonuclear Experimental Reactor (ITER),

which is currently under construction in Cadarache, France.

The creation of ITER was a long time in the making. In 1985, theoretical physicist Evgeny Velikhov, on behalf of the Soviet Union, invited scientists from Europe, the United States and Japan to jointly build a thermonuclear reactor. In 1986, an agreement was reached in Geneva on designing the facility, which later became known as ITER. In 1992, the partners signed a quadripartite agreement on developing an engineering project for the reactor. Construction began in 2011. The first phase of the construction is scheduled to be completed by 2018, with the first plasma expected to be produced in late 2019. Benefits of a fusion reactor In terms of radiation, a thermonuclear reactor is a far safer option than a nuclear reactor. To begin with, there are relatively few radioactive materials inside it. The energy that may be discharged as a result of an accident or a technical fault is also small and cannot destroy the reactor. Furthermore, the designers of the reactor envisage several natural barriers that would prevent the spread of radioactive materials. A test reactor is being built in France, about 35 miles from Marseille. Originally, the construction was set to be completed in 2016.

However, gradually the the start of experiments was pushed back to 2020. The purpose of the experiment-al reactor is to demonstrate the scientific and technical possibility of producing fusion energy for peaceful purposes. The project is being implemented by China, the E.U., Japan, India, Russia, South Korea, the United States and Japan. Delegates to the St. Petersburg conference will have an opportunity to visit the institutes that conduct controlled nuclear fusion research and manufacture equipment for ITER as part of Russia's obligations under the project.

The conference is also expected to feature an exhibition of the ITER International Organization, with input from all the participating countries. Enterprises of Russia's Rosatomstate nuclear corporation will present information on their participation in the project. Russia's contribution consists of the production and delivery of high-tech equipment, including key units of the reactor. In late July 2014, one of these key reactor components underwent successful testing in Switzerland. The unit is a poloidal field conductor, an essential element of the reactor since it will create a magnetic field for holding the plasma together. The conductor was made jointly by

Russian and European experts. The Russian side made the cable, while the Europeans put it in a steel casing. Under current agreements, Russia will continue to supply the conductors till 2017. In addition, in early June it was announced that Russia will produce and supply diagnostic systems for ITER, which will allow scientists to monitor plasma behavior inside the reactor. Overall, as part of its contribution to the ITER project, Russia is expected to produce nine of the 45 systems necessary to monitor the operation of the thermonuclear reactor.

14. AMEC plc

AMEC JOINT VENTURE WINS CONTRACT FOR ITER NUCLEAR FUSION PROJECT

http://www.twst.com/update/80135-amec-plc-amec-joint-venture-wins-contract-for-iter-nuclear-fusion-project

London, United Kingdom, (19 September 2014) - AMEC, the international engineering and project management company, working in joint venture with Iberdrola Ingeniería y Construcción and Mecánica Industrial Buelna (MIB), announces today the award of a contract to develop and manufacture a prototype First Wall panel for the ITER nuclear fusion reactor.

The First Wall panels are crucial to the success of ITER, a multi-billion pound project in Caderache, Southern France, that aims to demonstrate the technical feasibility of nuclear fusion as a future power source. The panels form part of a barrier that protects the vacuum vessel at the heart of the ITER machine from neutrons and other energetic particles produced in the fusion

process.

The multi-million pound contract awarded by Fusion For Energy (F4E) follows on from the joint venture's success in developing a one-sixth size semi-prototype under a contract awarded in 2013.

"The successful delivery of this contract is an important step along the road to the development of a fusion reactor," said Greg Willetts, Director of AMEC's Consultancy Services business. "Our role will be to verify and provide technical design expertise in the fabrication, manufacturing and testing of a First Wall panel using our unrivalled knowledge of hot isostatic pressing of metals which we have developed during the last decade."

Francesco Zacchia, Blanket Module Responsible Officer at F4E said: "This contract represents an essential step towards our final goal to fabricate the First Wall panels for ITER. We are looking forward to AMEC, Iberdrola and MIB solving the challenging manufacturing issues and to delivering on time with the expected high quality."
Marcos Pérez, Technical Director of Leading Enterprises Group, of which MIB is part, said: "This project is of particular importance for MIB, since it allows us to apply our expertise in advanced precision machining in a new market sector, nuclear fusion."

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Notes to editors: F4E is responsible for the supply of about 50% of the ITER FW panels (Russia contributes 38% and China the remaining 12%), which encompasses 215 panels. Each panel consists of a stainless steel support structure bonded to a heat sink material and beryllium tiles.
The heat sink material is made up of a copper alloy which transfers the heat generated from the plasma to the water coolant, while the beryllium tiles act as an interface for the plasma.
The contract for pre-series and series fabrication for the FW panels is planned to be awarded in 2017.
AMEC (LSE: AMEC) is a focused supplier of consultancy, engineering and project management services to its customers in the world's oil and gas, mining, clean energy, environment and infrastructure markets. With annual revenues of some £4 billion, AMEC designs, delivers and maintains strategic and complex assets and employs around 27,000 people in around 40 countries worldwide. See www. amec.com

Mecánica Industrial Buelna, S.L. (MIB): is a Spanish company of Leading Enterprises Group, specialised in advanced machining and welding processes, focused in a wide range of industrial sectors, including nuclear, oil & gas, renewable energies, automotive, aerospace, railways, etc. With annual revenues of around 25M?, LE Group employs around 250 people. See http://www.leadingenterprises.es and http://www.mecanicabuelna.com

Iberdrola Ingeniería y Construcción S.A.U. (IIC): is 100% owned by Iberdrola Group, created with the main purpose of integrating all of Iberdrola's engineering capabilities in one company. IIC is responsible for the providing Iberdrola and external customers with engineering and construction services across all generation technologies, transmission and control of energy networks and energy efficiency projects. With more than 2.400 people and with a presence in more than 30 countries, IIC has annual revenues of around 700 M?. See www.iberdrolaingenieria.com

Fusion for Energy (F4E) is the European Union's Joint Undertaking for ITER and the Development of Fusion Energy. The organisation was created under the Euratom Treaty by a decision of the Council of the European Union. F4E is responsible for providing Europe's contribution to ITER, the world's largest scientific partnership that aims to demonstrate fusion as a viable and sustainable source of energy. ITER brings together seven parties that represent half of the world's population - the EU, Russia, Japan, China, India, South Korea and the United States. F4E also supports fusion research and development initiatives through the Broader Approach Agreement, signed with Japan - a fusion energy partnership which will last for 10 years. F4E is established for a period of 35 years from 19 April 2007 and is located in Barcelona, Spain. Ultimately, F4E will contribute towards the construction of demonstration fusion reactors.

ITER: the name 'ITER' is derived from the Latin word for 'the way' or 'journey.'