1. Lockheed says makes breakthrough on fusion energy project

BY **ANDREA SHALAL**
WASHINGTON Wed Oct 15, 2014 1:09pm EDT
http://www.reuters.com/article/2014/10/15/us-lockheed-fusion-idUSKCN0I41EM20141015

(Reuters) - Lockheed Martin Corp said on Wednesday it had made a technological breakthrough in developing a power source based on nuclear fusion, and the first reactors, small enough to fit on the back of a truck, could be ready for use in a decade.

Tom McGuire, who heads the project, said he and a small team had been working on fusion energy at Lockheed's secretive Skunk Works for about four years, but were now going public to find potential partners in industry and government for their work.

Initial work demonstrated the feasibility of building a 100-megawatt reactor measuring seven feet by 10 feet, which could fit on the back of a large truck, and is about 10 times smaller than current reactors, McGuire told reporters.

In a statement, the company, the Pentagon's largest supplier, said it would build and test a compact fusion reactor in less than a year, and build a prototype in five years.

In recent years, Lockheed has gotten increasingly involved in a variety of alternate energy projects, including several ocean energy projects, as it looks to offset a decline in U.S. and European military spending.

Lockheed's work on fusion energy could help in developing new power sources amid increasing global conflicts over energy, and as projections show there will be a 40 percent to 50 percent increase in energy use over the next generation, McGuire said.

If it proves feasible, Lockheed's work would mark a key breakthrough in a field that scientists have long eyed as promising, but which has not yet yielded viable power

systems. The effort seeks to harness the energy released during nuclear fusion, when atoms combine into more stable forms.

"We can make a big difference on the energy front," McGuire said, noting Lockheed's 60 years of research on nuclear fusion as a potential energy source that is safer and more efficient than current reactors based on nuclear fission.

Lockheed sees the project as part of a comprehensive approach to solving global energy and climate change problems.

Compact nuclear fusion would produce far less waste than coal-powered plants since it would use deuterium-tritium fuel, which can generate nearly 10 million times more energy than the same amount of fossil fuels, the company said.

Ultra-dense deuterium, an isotope of hydrogen, is found in the earth's oceans, and tritium is made from natural lithium deposits.

It said future reactors could use a different fuel and eliminate radioactive waste completely.

McGuire said the company had several patents pending for the work and was looking for partners in academia, industry and among government laboratories to advance the work.

Lockheed said it had shown it could complete a design, build and test it in as little as a year, which should produce an operational reactor in 10 years, McGuire said. A small reactor could power a U.S. Navy warship, and eliminate the need for other fuel sources that pose logistical challenges.

U.S. submarines and aircraft carriers run on nuclear power, but they have large fission reactors on board that have to be replaced on a regular cycle.

"What makes our project really interesting and feasible is that timeline as a potential solution," McGuire said.

2.

Studies find plants warming to effect of carbon emissions

• THE AUSTRALIAN
OCTOBER 15, 2014 12:00AM
http://www.theaustralian.com.au/national-affairs/climate/studies-find-plants-warming-to-effect-of-carbon-emissions/story-e6frg6xf-1227090572243?nk=afb187a323c8492224a8946e6503df04

RESEARCHERS have found upsides to global warming, with two US-led studies suggesting climate scientists are underestimating the ability of plant communities to limit climate change — or even benefit from it.

The studies, published in the -interdisciplinary journal *PNAS*, show how far scientists are from understanding the complex interplay between vegetation and CO2. And both underline the importance of maintaining vegetation as a buffer against warming.

One team, led by the University of Texas at Austin, discovered that plants are more effective carbon sinks than previously thought. The researchers found that current models underestimated an effect known as "CO2 fertilisation" — the mechanism by which plants absorb CO2 from the atmosphere.

This "inherent structural -deficiency" in the models has led to a 16 per cent underestimate of the contribution of increasing CO2 to plant growth, potentially explaining why climate models consistently overestimate growth in atmospheric CO2.

The second study, led by the University of Wyoming, found prairie grasslands can benefit from elevated CO2 because it encourages certain species.

Researchers pumped CO2 into five plots and studied the response over eight years. They found the additional CO2 helped shield the grassland from rainfall and temperature fluctuations.

Co-author Elise Pendall, a botanist at the University of Western Sydney, stressed that elevated CO2 caused other problems in the climate, but said her team had been “somewhat surprised” to -discover it actively benefited biodiversity.

“People who graze cattle and raise livestock (face) a lot of uncertainty in terms of extreme heatwave and droughts, but elevated CO2 seems to be dampening extreme effects on the ecosystem.”

She said there had been good research on photosynthesis, but climate change models had a long way to go. “It’s really hard to estimate how much CO2 is being taken out of the air by vegetation.

“You can put a leaf into a little chamber and measure it directly, but when it’s the whole earth or even a small ecosystem, it’s pretty hard,” Professor Pendall said.

Melbourne University energy systems analyst Roger Dargaville said the Texans had provided “important research into a complex field”, but the findings did not -remove the need to reduce emissions. “Plant uptake may be larger than expected, but a larger carbon turnover does not necessarily mean higher net (carbon) storage, in the same way that larger cash turnover in a business does not necessarily result in larger profits.”

An Australian study has found ultraviolet B radiation, which has increased due to ozone thinning, has boosted the ability of marine organisms to sequester CO2.

Lead author Susana Agusti, from the University of

Western Australia, said the results were -unexpected.

3. Plant growth, ocean studies show climate science far from settled

THE AUSTRALIAN
OCTOBER 15, 2014 12:00AM
http://www.theaustralian.com.au/national-affairs/opinion/plant-growth-ocean-studies-show-climate-science-far-from-settled/story-e6frgd0x-1227090572250

Graham Lloyd

Environment Editor
Sydney
Subscriber only article

4. NATURE **| NEWS: EXPLAINER**

Lockheed Martin's fusion goals meet scepticism

Company claims it will have a working reactor in a decade.

Jeff Tollefson

17 October 2014
http://www.nature.com/news/lockheed-martin-s-fusion-goals-meet-scepticism-1.16169

Lockheed Martin formally entered the nuclear-fusion arena on 15 October, laying out a 10-year roadmap to commercialize a reactor that would fit on the back of a lorry. Research has been under way for several years at the defence contractor's Skunk Works division in Palmdale, California, but the firm has been very secretive about its results. Now, it has revealed a grandiose plan for harnessing nuclear energy, although outside experts are reserving judgement over the chances of success.

What is Lockheed Martin proposing to do?

The company currently has a roughly half-scale experimental device, and says that it is now gearing up to produce a compact 100-megawatt reactor. The small scale means that the team can design, build and test reactors in annual cycles, says project leader Tom McGuire. The goal is to have a prototype in five years that can sustain short-term reactions — lasting perhaps 10 seconds — and a commercially viable product that can compete with coal-fired power plants in 10 years.

What would it mean if the company succeeds?

By mimicking the stars and harnessing the energy that is released when hydrogen isotopes fuse into helium at high temperatures, the reactor could provide a virtually limitless supply of clean, climate-friendly power.

Simply developing a reactor that can sustain a reaction and generate significant quantities of energy would invite a Nobel prize. Developing a reliable 100-megawatt fusion reactor that can be built at or below the price of coal-fired power plants would fundamentally transform the global energy sector, and with it the global economy.

How does the technology differ?

The minimal information that has been released so far makes that difficult to determine. The bulk of the work on fusion today, including the international ITER project in southern France, focuses on the tokamak design, which uses multiple sets of electromagnets wound around a toroidal chamber to confine the hot plasma. McGuire says that his team has taken the best ideas from several designs and mashed them into a new compact design that uses electromagnets to confine the plasma within a more compact oval-shaped chamber.

What do the experts think?

Although nearly everybody is pleased to see an industrial giant such as Lockheed Martin jump into the fusion fray, academics remain sceptical. Lockheed has yet to release any data from its initial experiments. And without more details, nobody can work out how this design differs from predecessors that have been tried and abandoned in decades past.

“It’s hard to tell the man on the street anything from a scientific point of view,” says Stewart Prager, director of the Department of Energy’s Princeton Plasma Physics Laboratory in New Jersey. “It’s not clear what their science claims are.”

Why announce the plans now?

Lockheed Martin has applied for a number of patents, and McGuire says that this week's announcement was intended to get out in front of that process and ensure that people have the right context when those patents come through. Moving forward, he says that the team will be publishing its results in peer-reviewed journals.
"This is going to be conducted in the open," he says.

What challenges lie ahead?
The first challenge is to show that the reactor can contain the plasma at high enough temperatures and densities to generate a sustained fusion reaction that generates more energy than it consumes. McGuire calls this "the big Nobel-prize moment". According to Lockheed's schedule, that moment should arrive in five years' time.
Then it will be time to shift into materials and operations. These fusion reactions generate powerful neutrons, and the reactor must be able to not only withstand the damage they cause but also harness the heat that is released in the process to drive a generator. McGuire acknowledges that the team has a long way to go, but says that there is a clear stepwise path forward.
Having watched numerous breakthrough concepts tank during development, others are less sanguine.
"There are just so many questions in going from a small experiment to a power plant," says Stephen Dean, president of Fusion Power Associates, an advocacy group based in Gaithersburg, Maryland. "One has to be extremely sceptical about whether the whole thing is going to hold up once all of the details come out."
Nature doi:10.1038/nature.2014.16169

5. A pause for this message: climate change numbers aren't adding up

THE AUSTRALIAN
OCTOBER 18, 2014 12:00AM
http://www.theaustralian.com.au/opinion/a-pause-for-this-message-climate-change-numbers-arent-adding-up/story-e6frg6zo-1227094300232

SCIENCE, like climate, can take a long time to

change direction.

When Intergovernmental Panel on Climate Change chairman Rajendra Pachauri first acknowledged to this newspaper in February last year the existence of a pause in global surface temperatures of more than a decade, his comments were met with incredulity.

But as the political and diplomatic world strives to deliver meaningful action on climate change, momentum is building behind the controversial view that the numbers don't add up.

A rising chorus of literature in the world's best scientific journals and most prestigious opinion pages has argued the climate change math is flawed. Like a freight train that has left the station, questions about an 18-year "hiatus" in global average surface temperatures and the location of "missing" heat from the climate system are building a head of steam.

For climate scientists, irritating questions from "sceptics" about the "pause" have now become peer-reviewed papers that suggest the Earth's climate may be much less sensitive to higher levels of carbon dioxide than predicted.

Michael Asten, from the school of earth atmosphere and environment at Monash University, says there have been 15 articles commenting on and analysing the pause, or hiatus, published by the top journal group Nature in the past two years.

"While opinions on causes differ, existence of the pause is settled; only activists dare claim the pause in global temperature does not exist," Asten says.

For scientists such as Matthew England, from

University of NSW Climate Change Research Centre, the “missing heat” will reappear with a vengeance. But it is unclear when this will happen.

There is no dispute that the level of carbon dioxide in the atmosphere is rising, that human actions are contributing to the rise and, all things being equal, this will have an impact on the Earth’s climate.

But while the IPCC says it is more certain than ever that humans are causing climate change, the gap between what climate models have predicted should happen and what is being observed is growing. Clearly, in nature, all things are not equal and the uncertainties of scientific understanding continue to be great. This week, fresh science has shed new light on how plants use more CO2 than previously thought. We now know plankton growth in the Arctic Ocean accelerates with increasing UV light, locking up more carbon. Complex processes are layered over complex systems that occur across timeframes longer than scientists have been able to physically measure them. Key questions remain about the impact of clouds and ocean cycles and the true level of climate sensitivity to CO2.

It is a crucial time for science.

Garth Paltridge, former chief research scientist with the CSIRO Division of Atmospheric Research and chief executive of the Antarctic Co-operative Research Centre, fears the rise of “postmodern” science. In the world of postmodern science, he says, results are valid only in the context of society’s beliefs, and where the very existence of scientific

truth can be denied.
“Postmodern science envisages a sort of political nirvana in which scientific theory and results can be consciously and legitimately man-ipulated to suit either the dictates of political correctness or the politics of the government of the day,” Paltridge says.
At this point, Australian -governments and their climate agencies are standing firmly behind the IPCC.
But respected US climate scientist Judith Curry agrees with Paltridge. Curry is a professor and former chairwoman of the school of earth and atmospheric -Sciences at the Georgia Institute of Technology. She has served on the NASA Advisory Council Earth Science Subcommittee, National Academies Climate Research Committee and the Space Studies Board, and the National Oceanic and Atmospheric Administration Climate Working Group.
Curry has been a strong voice in the climate change debate internationally and is at the centre of new research that questions -climate sensitivity. She argues the sensitivity of the climate to increasing concentrations of carbon dioxide is a central question in the debate on the appropriate policy response to -increasing carbon dioxide in the atmosphere.
In the US, she says, a climate policy dialogue is starting to open up, with discussion of the 2C threshold, lower sensitivity and the hiatus.
Climate sensitivity is defined as the global surface warming that occurs when the concentration of carbon dioxide in the atmosphere doubles. High sensitivity will lead to substantial warming as atmospheric CO2

continues to increase. If climate sensitivity is low, Curry says, future warming will be substantially lower and it may be several generations before average temperatures move past the 2C limit set for dangerous warming.

According to the IPCC's latest report, the actual change in 70 years if the level of CO2 in the -atmosphere doubles — known as the transient climate response — is likely to be in the range of 1C to 2.5C. Curry says most climate models have transient climate -response values exceeding 1.8C. The IPCC report notes, however, there is a substantial discrepancy between recent observation-based estimates of climate sensitivity and estimates from -climate -models.

In Curry's calculation, the best estimate for transient climate response is 1.33C with a likely range of 1.05C to 1.80C. Her observation-based energy-balance approach calculations use the same data as the IPCC's latest report for the -effects on the Earth's energy balance of changes in greenhouse gases, aerosols and other drivers of climate change.

The Curry paper also estimates what the long-term warming from a doubling of carbon dioxide -concentrations will be, once the deep ocean has warmed up.

"Our estimates of sensitivity, both over a 70-year timeframe and long term, are far lower than the average values of sensitivity determined from global climate models that are used for warming projections," Curry says.

“Also, our ranges are narrower, with far lower upper limits than reported by the IPCC’s latest report. Even our upper limits lie below the average values of climate models.”

Curry says more than a dozen other observation-based studies havde found climate -sensitivity values lower than those determined using global climate models, including recent papers in prestigious climate journals.

She says the new climate sensitivity estimates add to the growing evidence that climate models are running “too hot”.

“Moreover, the estimates in these empirical studies are being borne out by the much-discussed ‘pause’ or ‘hiatus’ in global warming — the period since 1998 during which global average surface temperatures have not significantly increased,” she says.

The pause in warming is at odds with the 2007 IPCC report, which expected warming to increase at a rate of 0.2C per decade in the early 21st century.

Curry says the warming -hiatus, combined with assessments that the climate-model -sensitivities are too high, raises -serious questions as to whether the climate-model projections of 21st-century temperatures are fit for making public policy decisions.

Inquirer put a series of questions to Australia’s high-profile -climate change bodies asking them to comment on Curry’s research on climate sensitivity, the hiatus in global surface temperatures and model predictions.

Former climate commissioners Will Steffen and Tim Flannery were unavailable to answer but Climate Council chief executive Amanda McKenzie says "vested interests have been using the 'so-called pause' to spread doubt and misinformation".

"The Earth continues to warm strongly," she says. "Since 1998 human activities have introduced two billion Hiroshima bombs' worth of heat into the -atmosphere."

David Karoly, from the school of earth sciences at the University of Melbourne, says "the 18-year period 1996 to 2013 has a warming trend in global average surface temperature that is not significantly different than the long-term warming trend 1950 to 2012".

"It is slightly smaller in magnitude than the long-term warming trend, but that difference is not statistically significant," Karoly says. He says the reduction in the rate of surface warming for the recent 15 years demonstrates that natural internal variability of the climate system is very important and that exchanges of heat between the surface and the deeper ocean are very important.

Karoly says he -believes "some climate models underestimate … and some models overestimate the global climate sensitivity".

"The most plausible explan-ation is natural decadal variability of the climate system."

Responses from Australia's key science organisations show they remain in lock-step with the IPCC and their advice is accepted by Environment Minister, Greg Hunt.

Helen Cleugh, science director at CSIRO Oceans and Atmosphere Flagship, says measurements do show that the rate at which global mean surface temperature has warmed in the past decade is less than the previous decade. However, while the rate of increase is lower, the temperatures are not lower, she says. Measurements across the oceans and Earth system as a whole show that warming has continued unabated.

“A reduction in the rate of warming (not a pause) is a result of short-term natural variability, ocean absorption of heat from the atmosphere, volcanic eruptions, a downward phase of the 11-year solar cycle, and other impacts over a short time period,” Cleugh says.

After taking advice from the Bureau of Meteorology, Hunt tells Inquirer the warming of the climate system is “unequivocal”.

“The climate system, which -includes the atmosphere, oceans, land and ice has continued to -accumulate heat over the last 18 years,” Hunt says. Although there has been a slower rate of atmospheric warming during the past 18 years, this does not undermine the fundamental physics of global warming, the scientific basis of climate models or the estimates of climate sensitivity.

However, he says he is “exceptionally interested” in the latest reports that there may be even greater capacity for plants and soil to absorb carbon. “While this will be the subject of significant global research over coming years, it underscores the importance of protecting the great rainforests of the world and

helping to revegetate our landscapes," he says.
Greens leader Christine Milne says she does not accept the pause.
"There has been a slowdown in the speed of the rise but global surface temperatures have still continued to climb," Milne says. "There are strong indications through observations and models that the ocean is absorbing more of the heat than it has in the recent past."
In Britain, the Met Office has acknowledged the pause and debate about its significance.
"Global mean surface temperatures rose rapidly from the 1970s but have been relatively flat over the most recent 15 years to 2013," the Met says. "This has prompted speculation that human induced global warming is no longer happening, or at least will be much smaller than predicted.
"Others maintain that this is a temporary pause and that temperatures will again rise at rates seen previously," the Met says.
But the Met Office says research shows the recent pause in global surface temperature rise does not materially alter the risks of substantial warming of the Earth by the end of this century.
"Nor does it invalidate the fundamental physics of global warming, the scientific bases of climate models and their estimates of climate sensitivity," the Met says.
Australia's Bureau of Meteorology says the rate of warming in global surface temperature during the past century has not been uniform, with some decades

warming more rapidly than others.
“This is a consequence of variations in heat exchange between the atmosphere and the oceans, and other decade-to-decade changes like variations in solar forcing and the solar dimming -effects of pollution and volcanic eruptions,” BoM says.
“The pattern that results is one of steady warming of the oceans, accompanied by alternating periods of fast and slow rises in air temperature.”
There is dispute over whether increased ocean heat can fully explain the absence of surface warming during the past 18 years. Recent papers have claimed greater deep ocean heat in the north Pacific, Atlantic and -Southern Ocean to explain the “missing” heat.
According to Curry, the bottom line is that uncertainties in ocean heat content are very large, and “there is no particularly convincing evidence that the “missing heat” is hiding in the ocean.
Asten, at Monash, says the -hiatus demonstrates a disconnect between climate models up to 2013 (the IPCC Fifth Assessment Report) and physical measurements on our “laboratory Earth”.
There are multiple possible -explanations for the disconnect, he says.
UNSW’s England and co-workers have proposed a mechanism of transport of heat on a warming Earth from the ocean surface into the deep ocean via changes in the interaction of trade winds and ocean currents.
Gerald Meehl and colleagues at the National Centre for Atmospheric Research in Colorado have shown

from climate models that a -mechanism may exist whereby in El Nino conditions a greater proportion of global heat is stored in oceans below 300m, whereas in La Nina conditions that greater proportion is stored in the upper ocean, although tuning climate models to replicate this process has had only limited success.
William Llovel and co-workers at the California Institute of Technology, in a study published two weeks ago, shows with quantitative observations on global ocean mass and temperature profiles that the deep ocean has cooled slightly, not warmed, in the past decade, and thus the explanation of heat transfer from a warming Earth surface into deep oceans becomes less credible.
“The three studies represent careful studies using conventional assumptions relating to climate sensitivity, addressing the question ‘where has the heat in a warming earth gone?’ ” Asten says.
“An alternative approach which I predict will come, although not without opposition from ‘consensus scientists’, is to postulate that the ‘missing heat’ was never here; that is, a reduced climate sensitivity will be estim-ated for the Earth, at or below the low end of the range currently published by the IPCC.”
Asten says the trend of climate sensitivity estimates made across the past six years from meteorological, satellite and ocean sediment records has been, with very few exceptions, to produce estimates at or below the low end of the range published by the IPCC.
He says low values of climate sensitivity will still affect global temperatures as CO2 concentrations in

the atmosphere rise, but increases in temperature may be of similar magnitude to naturally driven temperature cycles, a scenario that has strong implications for how we manage causes and consequences of climate change.

Paltridge says that the prospect of "missing heat" being located in the oceans is a double-edged sword.

"We are being told that some internal oceanic fluctuation may have reduced the upward trend in global temperature," he says.

"It is therefore more than a little strange that we are not hearing from the IPCC that some natural internal fluctuation of the system may have given rise to most of the earlier upward trend.

"In light of all this, we have at least to consider the possibility that the scientific establishment behind the global warming issue has been drawn into the trap of seri-ously overstating the climate problem in its effort to promote the cause.

"It is a particularly nasty trap in the context of science because it risks destroying, perhaps for centuries to come, the unique and hard-won reputation for honesty which is the basis of society's respect for scientific endeavour."

6. 15-year warming pause is 'settled' THE AUSTRALIAN

OCTOBER 18, 2014 12:00AM

http://www.theaustralian.com.au/national-affairs/climate/year-warming-pause-is-settled/story-e6frg6xf-1227094416570

Graham Lloyd

Environment Editor
Sydney

THE existence of a more than 15-year “pause” in average global surface temperatures has been “settled” but scientists remain split on what it means for the future.

While the level of carbon dioxide in the atmosphere has continued to rise, global surface temperatures have not increased at the same pace, causing speculation over what has happened to the “missing heat”.

Some leading climate scientists claim the missing heat has been absorbed by the world’s oceans and will return with rapid future warming. But new research has found the Earth’s climate is much less sensitive to carbon dioxide than previously thought.

Michael Asten from Monash University’s School of Earth -Atmosphere and Environment said that, while opinions on causes differed, the existence of the pause was settled.

“Only activists dare claim the pause in global temperature does not exist,” Professor Asten said.

Australia’s leading public science organisation, CSIRO, has -acknowledged the “hiatus” but says its existence does not detract from the urgency of addressing human carbon dioxide emissions.

CSIRO Oceans and Atmosphere Flagship director Helen -Cleugh said measurements did show that the

rate at which global mean surface temperature had warmed in the past decade was less than in the previous decade. But she said actual temperatures had remained at historic highs. She said that when the entire climate system was considered, the Earth had continued to warm.

“Measurements across the oceans and Earth system as a whole show that warming has continued unabated throughout this period,” Dr Cleugh said.

Climate Council chief executive Amanda McKenzie said her organisation, which includes Will Steffen and Tim Flannery, did not accept there had been a pause.

“No, 2013 marked the 37th year in a row that the yearly global temperature was hotter than the average,” Ms McKenzie said.

“Vested interests have been using the so-called pause to spread doubt and misinformation.”

Federal Environment Minister Greg Hunt said warming of the climate system was “unequivocal”.

“The climate system, which includes the atmosphere, oceans, land and ice, has continued to accumulate heat over the last 18 years,” he said. “The government fully accepts the science.”

Most research has focused on finding the extra heat elsewhere in the climate system. NASA has ruled out an early theory that it was hiding in the deep oceans below 2000m. Other papers have claimed it could be located in the north Pacific and Atlantic oceans. Another paper says warming of the Southern Ocean has been underestimated in the past.

Dr Asten said he believed the pause in surface

temperatures would force scientists to re-examine fundamental assumptions in climate science. “The hiatus demonstrates a disconnect between climate models up to 2013 and physical measurements on our ‘laboratory Earth’,” he said.
Dr Asten said research was showing climate sensitivity was lower than thought.
A recent peer-reviewed paper by US-based climate scientist Judith Curry estimated the Earth’s climate had a much lower climate sensitivity to CO2 than predicted by the IPCC reports. As a result, Dr Curry said there were serious questions about whether the climate model projections of 21st-century temperatures were fit for making public policy decisions.

7. ENERGY & ENVIRONMENT

Generating Power From Tidal Lagoons

By BETH GARDINEROCT. 28, 2014
http://www.nytimes.com/2014/10/29/business/energy-environment/swansea-bay-generating-power-from-tidal-lagoons.html?_r=1

LONDON — Harvesting energy from the tides is hard to do, and the development of a new generation of sea-based power arrays lags far behind more widely used renewable technologies like wind and solar.
But the company pushing a new project on the coast of Wales thinks its twist — a 21st-century update of traditional dam-based hydropower — will be much easier to bring to fruition. If it wins government permission to go forward, Tidal Lagoon Power Limited says the approach, known as tidal lagoon generation, could provide as much as 10 percent of Britain’s power from six of its projects

within a decade.
That is an optimistic assessment. Still, those hoping the seas will become a big contributor to the world's future energy needs will be watching to see what happens in Swansea Bay, Wales.

"If it's put together and it's a success, people will look for other similar areas where there's some development opportunity," said Douglas J. Arent, executive director of the Joint Institute for Strategic Energy Analysis at the National Renewable Energy Laboratory in Colorado. Similarly, if the Swansea Bay project disappoints, that could quash hopes of similar efforts elsewhere, he said.
Even if the project succeeds, tidal lagoon power is unlikely to become more than a niche source of energy. Because it requires an unusually large difference between the levels of high and low tides, known as the tidal range, it is likely to be workable in only a few places, like Cook Inlet in Alaska and parts of South Korea.
"You have to find just the right site," Mr. Arent said. Still, tidal lagoon could be a useful contributor, he said, because, unlike the wind and sun, tides are predictable. "This is one aspect of a broadening view of 'How do we think about the use of energy from our water resources?"'
Tidal Lagoon Power's plan, estimated to cost 1 billion pounds, or $1.6 billion, to build an 11.5-square-kilometer, or 4.4-square-mile, lagoon along Britain's west coast emerged after proposals for a much larger project, stretching across the mouth of the nearby Severn river, foundered last year after decades of wrangling.
Critics said that £25 billion proposal made little economic sense and would have damaged the estuary's rich ecosystem. The area has been a focus of attention in renewable energy circles because its tidal range is among the biggest in the world.
The lagoon project would be far smaller than the old estuary-spanning idea, but proponents hope it would be the first of six that eventually contribute a significant

chunk of Britain's power. The country is pushing to meet its goal, made binding in 2009 by the European Union, of getting 15 percent of its electricity from renewable sources by 2020.

The idea behind tidal lagoon generation is straightforward. Engineers would build a large holding pool along the shore, contained by a U-shaped seawall. When the tide rises, water levels become higher outside the pool than in. Sluice gates open to let water enter, turning turbines as it flows. When the tide recedes, the levels are higher inside than outside, and the water, when released, turns the turbines in the other direction.

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"Technically, each component part has been proven in the field," said Andy Field, the chief spokesman for Tidal Lagoon Power. "It's just pulling it all together that represents the innovation."

In principle, it is not so different from projects like the 48-year-old barrage, or dam-like structure, which harnesses flows at the mouth of the Rance river in Brittany, France, or the newer Sihwa Lake station in South Korea. Because they often block estuaries, though, such plants raise worries about damage to local environments.

The lagoon approach seeks to minimize such impact. Swansea Bay, if approved, would be the first tidal lagoon to be built.

Worldwide, plants in the broader category of tidal range now have about 500 megawatts of energy-generating capacity, and that could rise to 800 megawatts by 2020, including lagoon proposals, said Angus McCrone, chief editor at the market research firm Bloomberg New Energy Finance. That is tiny compared, for example, to global solar panel capacity, which grew by 100 megawatts every day in 2013, according to International Energy Agency estimates.

More barrage-type projects are under consideration in South Korea and elsewhere, and a few other lagoons, in the early stages of planning, have been proposed in

addition to Swansea Bay. Halcyon Tidal Power, for example, hopes to build its own lagoon near the Swansea site and is proposing another in Nova Scotia's Scots Bay. Because the technologies involved are familiar, analysts say the lagoon idea seems more ready for commercial-scale application than tidal stream generation, in which turbines are driven by fast-flowing currents, an underwater version of a wind farm. Tidal stream has yet to come into wide use, as engineers seek a design and the materials best suited to withstand the powerful forces of the sea.

The biggest concern for the Swansea Bay project, energy experts say, is its high cost, and the fear of budget overruns, in part because of the need for a 10-kilometer, or 6.2-mile, seawall.

Like nuclear power and other renewables, tidal lagoon would require a government-guaranteed rate for its power. A report that Tidal Lagoon Power commissioned from the consulting firm Poyry in Finland estimated that the Swansea lagoon would require a price of £168 per megawatt hour, just above the guarantee provided to offshore wind farms, considered a very expensive form of energy.

The five projects the company hopes to build subsequently, elsewhere in Britain, would be much larger, bringing the cost down to £92 per megawatt hour, Poyry estimates. That is the same price as that guaranteed to the planned Hinkley Point C nuclear plant in England, which drew concern about costs when it was announced.

Ali Lloyd, one of the authors of the Poyry report, said price might not be an insurmountable barrier.

In order to meet their challenging renewables target, the British authorities are prepared to offer high initial subsidies to technologies whose costs look likely to fall in the longer term, Mr. Lloyd said. "The same logic will have to apply for tidal lagoons," he said.

But Cédric Philibert, senior renewable energy analyst at

the Paris-based International Energy Agency, said that the cost of the proposed project was worrying. “It’s not the principle I’m objecting to, but the level, which is very high,” he said.

He believes there is a better way to design the lagoon, using turbines like those being developed for tidal stream projects, and placing them in series, rather than in parallel, an idea he referred to as “tidal gardens.” That would allow the turbines to run more efficiently, and with a lower differential in tides, meaning the expensive walls required could be smaller, and the number of potential sites much larger, he said.

The planning authorities are now evaluating the company’s proposal. The British secretary for energy and climate change, Edward Davey, who has the final say, is expected to announce a decision in the spring.

Mr. McCrone, the market research editor, said investors appeared interested. He believes the lagoon has about a one-in-three chance of being built, better odds than he had given to the big Severn barrage proposals.

Mr. Field, of Tidal Lagoon Power, called that estimate conservative. The company hopes to begin construction next year and generate electricity by 2018. Mr. Field said the plant would run for 120 years, while subsidies would last 35, meaning that in the long term, its electricity would be considered cheap.

Mr. Lloyd said tidal lagoons could ultimately be a small but meaningful contributor to the global energy mix.

“If you are serious about decarbonizing your electricity supply, frankly you need all the technologies available, whether that’s wind, solar, nuclear,” or anything else, he said. “There’s a role for all of them.”

8. Carbon Capture and Storage has arrived, get

over it, Global CCS Institute boss tells deniers

THE AUSTRALIAN
NOVEMBER 05, 2014 12:00AM
Sid Maher
National Affairs Editor
Canberra
http://www.theaustralian.com.au/national-affairs/climate/carbon-capture-and-storage-has-arrived-get-over-it-global-ccs-institute-boss-tells-deniers/story-e6frg6xf-1227112731077

CARBON Capture and Storage, which promises to dramatically cut carbon dioxide emissions, is on the cusp of widespread deployment and is delivering abatement for as low as $50 a tonne.

A new report by the Global CCS Institute says there are now 22 CCS projects in construction or operation worldwide, a 50 per cent increase since 2011.
Global CCS Institute chief executive Brad Page said CCS in the power sector was a reality, the world's first large-scale CCS project now operating at Boundary Dam in Canada.
Some projects were expected to deliver abatement in the range of $50-$100-a-tonne of carbon.
"With eight major CCS projects anticipated to go live in a range of industries worldwide by 2016, this low-carbon technology is reaching the critical mass necessary for widespread deployment," he said. "It's time for the deniers to stop it. We've now got it on power stations ... it works.''
The report found there were 14 CCS projects in

advanced planning stage, including nine in the power sector expected to make a final investment decision next year. CCS was poised to extend across a diverse range of sectors such as iron and steel, natural gas and power.

“We need to be clear that CCS is the only technology that can achieve large reductions in carbon dioxide from industries such as iron and steel, chemicals and cement which together emit 20 per cent of the world’s CO2,’’ Mr Page said. “In fact, it is just as important to use CCS on industrial processes as in the electricity sector, currently the world’s largest CO2 emitter, accounting for up to 40 per cent of emissions.”

The Gorgon LNG project in Western Australia will be the biggest CCS project of its kind in the world when it -begins operating in 2016.

A project in Victoria’s Otway Basin has sequestered 65,000 tonnes of carbon, and while the ZeroGen project in Queensland did not proceed it provided valuable information on CCS used in subsequent projects. The Callide coal-fired power plant in Queensland also uses CCS technology.

9.

The nuclear option must be high on agenda of energy green paper

GARY JOHNS
• THE AUSTRALIAN
NOVEMBER 04, 2014 12:00AM

http://www.theaustralian.com.au/opinion/columnists/the-nuclear-option-must-be-high-on-agenda-of-energy-green-paper/story-fn8v83qk-1227111366128

THE Abbott government is finalising an energy green paper (not to be confused with a green energy paper). Submissions are due today. Every group is in there pitching, including nuclear engineers.

China has under construction, planned or proposed 207 new nuclear reactors, tripling nuclear cap-acity by 2020. Our little green friends love to tout China as huge in windmills and solar panels, but China is really powered by coal, hydro and nuclear power. Stick that in your windmill and twist it!

Australia has an overcapacity in electricity generation, which is not forecast to disappear until 2023-24. Unless we cut the renewable energy target, it will force -expensive renewables into an oversupplied market and strand existing assets. Following the abolition of the carbon tax and touted adjustments to the RET, it should be clear there is no certainty in government support for future generators that are reliant on subsidies.

In this context, small modular nuclear reactors, which can deliver up to 100 megawatts base load, low-emission power, are ready now. They are most likely to be deployed in remote areas where other sources of power are expensive or where steam is required in addition to electricity.

If SMRs can make it in this market, without the level of subsidies that applies to renewables, then good luck to them. Last year, the Bureau of Resources and Energy Economics found that, across the projection period to 2050, nuclear would

remain cost-competitive with renewable and non-renewable technologies on a level cost of electricity generated basis (capacity of a plant divided by its energy output and cost).

A recent paper by Charles Frank of the Brookings Institution uses a methodology based on avoided emissions and avoided costs, rather than comparing levelised costs. The key finding was that nuclear, hydro and combined cycle natural gas have far greater net benefits than wind and solar, which suffer from a very high- -capacity cost per megawatt, very low-capacity factors and low reliability, resulting in low avoided emissions and low avoided energy cost per dollar invested. Avoided emission calculations may become less relevant, however, as political support for climate abatement strategies wane.

The main safety concern regarding nuclear power is the possibility of an uncontrolled release of radioactive material, leading to contamination and radiation exposure off-site. In fact, the Three Mile Island (1979) and Chernobyl (1986) “disasters” were not only less disastrous than imagined, but comparing these reactors to current models is to compare the Model T to any recent car. Even the reactors involved in the Fukushima (2011) disaster were 1960s design and no one died from -nuclear exposure at Fukushima.

Advanced reactors are inherently safer. Generation IV full-scale reactors, and SMRs under development, incorporate passive safety features that require no -active controls or operational intervention to avoid accidents in the event of malfunction.

The major impediments to building SMRs in Australia are not safety or science, environment or economics but the law.

The Environment Protection and Biodiversity Conservation Act 1999, for example, states that the minister must not approve the construction or operation of a -nuclear power plant. Such prohibition is unwarranted. In its green paper, the Abbott government has promised to “review the current regulatory framework that governs nuclear and waste facilities to remove any duplication and streamline regulations”. This is not good enough. The ban on nuclear power must be lifted. These laws are based on old politics and old science. It is time that prohibition was repealed so all sources of power are on the table and assessed according to commercial and environmental risks.

Nuclear politics is hard. The commonwealth has still not secured a site for Australia’s low-level radioactive waste, following the failure to secure Muckaty Station, north of Alice Springs. Nevertheless, community attitudes are changing to one aspect of the nuclear cycle, the export of uranium. In 2012, the Queensland government repealed a ban on uranium mining and the NSW government repealed a ban on uranium exploration. In South Australia — the main source of uranium exports — 48 per cent of the community support nuclear power while 33 per cent oppose it.

The white paper on energy should be neutral; any source of energy should be allowed to compete in the marketplace on its -merits. Nuclear should be subject to the same stringent regulations as apply to coal and gas — no more, no less.

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10.

Inconvenient truths ignored by the climate propaganda machine

MAURICE NEWMAN
• THE AUSTRALIAN
NOVEMBER 07, 2014 12:00AM

http://www.theaustralian.com.au/opinion/inconvenient-truths-ignored-by-the-climate-propaganda-machine/story-e6frg6zo-1227115176694

“LEAVE fossil fuels in the ground,” Greens leader Christine Milne says. “Renewable energy is the future.” “Coal is a stranded asset.” “It’s driving global warming.” “It’s a huge risk to the planet,” she adds, lest we miss the point.

Milne’s prescription for a vibrant Australian economy includes “keeping the renewable energy target at 41,000 gigawatt-hours”, “stopping new coalmines”, “no coal-seam gas’’ and “no new ports”. “Jobs will come from green energy,” Milne assures us.

She could have added, there are fairies at the bottom of her garden.

Clearly Milne is unaware of the cost to California, Europe and Britain of their ultra green -embrace.

The Golden State’s energy -prices are 40 per cent above the US national average, plunging its manufacturing and agricultural regions into depression, with one in five living in poverty.

Researchers at Spain’s King Juan Carlos University

have found renewable energy programs destroyed 2.2 jobs for every green one created.

A study by Verso Economics commissioned by the Scottish government concluded that for every job in the wind industry, 3.7 jobs were lost elsewhere.

For the average person, this is what is so confusing about the climate change debate.

Conformists tell us one thing, but the reality is different. In 2009, when chief scientist Penny Sackett threatened we had only five years to avoid “disastrous global warming”, we were alarmed. Now we realise she was being emotional.

When climate commissioner Tim Flannery said that “even the rain that falls isn’t actually going to fill our dams and river systems”, it was sobering, but soon we were donating to flood victims and -suspected he’d dreamt it up to scare us.

Climate scientists have been telling us for decades with “95 per cent certainty” that temperatures would move in lock step with CO2 concentrations in the atmosphere. We have been force-fed on climate change being “extremely likely” (is that a scientific term?) to be the product of human activity.

Yet, with the highest human emissions of greenhouse gases in history, temperatures have gone nowhere for 18 years.

We were warned the heat was stored in the deep oceans and would return with a vengeance. Now, 3500 Argo buoys and NASA can’t find it.

Repeatedly proved wrong, the voice of authority demands silence from rational doubters.

The Intergovernmental Panel on Climate Change, singing from the green song sheet, wants governments to turn their backs on coal, the cheapest, most efficient energy source on the planet. We are warned of tipping points and catastrophe but offered no scientific proof, just speculation.

Governments are falling meekly into line, with the Europeans boasting they will embrace an RET of 40 per cent by 2030. Sitting at 17 per cent, the EU is unlikely to meet even its 20 per cent target by 2020, let alone 80 per cent to 95 per cent by 2050.

If talk could reduce emissions, plants would be gasping. But rhetoric is different from reality. Some of Europe's dirtiest coal-fired power stations are receiving subsidies to extend their lifespan. Germany is building 10 coal-fired plants to generate cheaper power. Whatever the dreamers say, economics will drive this debate, not climate theory.

The recent IPCC Synthesis Report is primarily a political document designed to push governments into signing a tougher global emissions abatement agreement in Paris next year. In the bizarre world of climate change, the plan is to legally oblige countries to put forward their proposals and report on progress. However, no penalty will be imposed if countries miss targets or renege on commitments. It's -appearances that count.

In painting the bleakest picture they can, IPCC authors have projected CO2 levels reaching 1000 parts per million in 2100, largely through coal combustion, despite BP in its Energy Outlook 2035

stating, “Coal is expected to be the slowest growing major fuel, with demand rising 1.1 per cent a year by 2035”, because production costs rise as extraction goes deeper.

The IPCC case smacks of desperation. With improved energy efficiency and the growing use of nuclear power, the scenario it paints is highly improbable. Typically, it ignores the growing gap between climate models and observations. It overlooks the slowing of sea-level rises or that sea temperatures are within natural variability. It fails to mention that the extent of Antarctic sea ice is the highest since records began. Nowhere are we told of glacier studies that confirm the Roman and Medieval Warm Periods were as warm as today. The pause is discounted, with the IPCC relying on a longer-term upward trend. Inconvenient truths are not permitted in this alarmist report. The endorsement by UN Secretary-General Ban Ki-moon will make it harder for Australia to hold on to its comparative advantage of cheap coal, but our economic and business self-interest must come before international popularity, particularly given the case to do otherwise is so shaky.

While the debate over the RET and Direct Action shows all sides of politics remain hostage to the climate change cartel, an ABC radio poll asked: “Is the IPCC right that on current fossil use ‘projec-tories’, we are heading for a global warming of four or five degrees by century’s end?” The result? Of 3101 votes counted, 91 per cent voted no, only 9 per cent yes.

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

11. UV light shed on carbon storage

THE AUSTRALIAN
NOVEMBER 01, 2014 12:00AM
http://www.theaustralian.com.au/news/health-science/uv-light-shed-on-carbon-storage/story-e6frg8y6-1227108939330

John Ross
Higher Education Reporter
Sydney

SCIENTISTS may have under-estimated the carbon storage -capacity of plants by overlooking photosynthesis caused by ultraviolet light.

Plants fuel themselves by using sunlight to synthesise carbo-hydrates from carbon dioxide and water. Scientists generally accept that this process is triggered only by visible light, despite evidence since the 1970s that ultraviolet light can also play a role. Now Australian researchers studying a common alpine shrub have recorded a "photosynthetic" capability of ultraviolet A light that is more than 10 times stronger than that found in any other plant. The University of Sydney team believes many other flora may share this trait after a screening of 55 subalpine plant species revealed that 26 use UVA light to photo-synthesise.
The researchers say the omission of UVA from the

definition of “photosynthetically active radiation” means biological models may be underestimating rates of photosynthesis, resulting in a “miscalculation of potential for carbon sequestration”.
“Carbon gain for alpine environs across the globe could be underestimated given that UVA radiation increases with altitude,” the team reports in the journal -*Oecologia*.
The researchers believe the range of light wavelengths that -instigate photosynthesis — at least for some plant species — is 10 per cent higher than is currently being modelled.
It is the latest research to suggest that the natural ability of plants to absorb CO2 is being under-estimated.
Last month, a US team reported that models did not adequately account for the impacts of “CO2 fertilisation”, the mechanism by which plants absorb CO2 from the atmosphere.
The new study, the first of its type in the world, was based on a woody shrub called Pimelea ligustrina or “tall rice-flower”. It grows above the tree line in NSW, the ACT, Victoria and Tasmania.
Measurement under full sunlight in the field revealed that the UVA content of sunlight -increased its photosynthetic rate by 12 per cent.

12. G20 can cold-front climate lobby

MICHAEL ASTEN
• THE AUSTRALIAN

NOVEMBER 13, 2014 12:00AM

http://www.theaustralian.com.au/opinion/g20-can-coldfront-climate-lobby/story-e6frg6zo-1227121009652

THE climate lobby will be working the corridors of the G20 -meeting in Brisbane this weekend, using the recent Intergovernmental Panel on Climate Change Synthesis Report and Climate Council -commentary.

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Curiously, neither has updated the underlying observational -science relating to climate change; the figures are subsets from the IPCC Fifth Assessment Report, where data and literature review stops at 2012. Observational data and climate model predictions are presented separately, concealing the uncomfortable truth of the global temperature -hiatus, which challenges the fundamental -assumptions of the models. It is a challenge that gets stronger every year as increasing atmospheric CO2 content is unmatched by predicted temperature increase.

How would Joe Hockey fare if he went to the G20 with economic data that was two years out of date? While scientists published in top journals treat the temperature hiatus as fact, activists still deny its existence. Thus the Climate Council (once a proud group of government--funded scientists in the Climate Commission, now a privately funded lobby group) claims, “Myth: The Earth has stopped warming since

1998". Use of the word warming is imprecise, being interpreted as "temperature" or "heat content" dep-ending on the argument of the moment.

The "heat content" approach hypothesised that warming of the deep oceans was compensating for lack of global surface warming. This has been studied in a series of important papers, most recently by William Llovel and co-workers at the California Institute of Technology who used quantitative observations of global ocean mass and temperature profiles to show that the deep ocean has in fact cooled slightly in the past decade.

Failure to include this in updated assessments by the IPCC and Climate Council is inexcusable.

The hiatus in temperature can also be studied using smoothed averages. Both the Synthesis Report and the Climate Council report use old plots that show a steady rise in smoothed temperature to 2010 (the decade of the start of the hiatus).

Yet NASA's Goddard Institute of Space Studies' global temperature graphs are updated monthly, show five-year averages, are publicly available on the internet and show average temperatures peaked in 2004 and show a decline for the following eight years.

Since similar declines in global temperature occurred in 1880-1910 and 1950-75, it is reasonable to ask whether the present apparent decline is historically unusual, and why our government science advisers -persist in the view that steady increases in atmospheric CO2 are the major driver of such changes.

If a downward trend in global temperature is confirmed in the next decade, it will be no surprise — at least three recent peer--reviewed papers predict that — but such views are not even hinted at in the IPCC or Climate Council reviews of possible scenarios.
The dichotomy between observational data and models is similarly marked with sea-level data of the past 120 years. The rate of rise across the past century is 1.7mm a year and has increased to about 3.2mm a year across the past 20 years. The data shows that the fast 3.2mm a year rate of rise has occurred twice in historic times (around 1860-80 and 1930-50). The IPCC modelling studies of sea level rise to 2100 show up to 80cm of total rise by 2100, increasing from the present 3.2 to a predicted huge 15mm a year. These projections have immense economic and community importance, as they have been supplied to government and planning bodies for consideration of restrictions on coastal land development.
Given we have 20 years of over-lapping precise satellite -alti-meter-observed data and the mod-els, we should have been given comparisons between sea-level data and model predictions, and assessment of any evidence for acceleration of the rate of rise in the first sixth of this century. Yet neither the IPCC nor the Climate Council, or the publicly funded CSIRO on its website, even admits the existence of recent data such as that by Anny Cazenave and co-workers at the Geophysical and Oceanography Laboratory, Toulouse, which shows that from 1994 to 2011 the rate of observed rise in global sea level decreased

from 3.5 to 2.5mm a year.
It is of great concern that bodies meant to provide scientific advice are unable to admit that observations show the rate of sea level rise going in the opposite direction to predictions for the first 15 per cent of the model time span.
If Australian politicians get shirt-fronted at the G20 on climate change, they should insist on briefings on recent observational data and its implications for climate model predictions before committing taxpayer dollars to the $100 billion a year UN-led Green Climate Fund.
Michael Asten is a professor of geophysics at Monash University, Melbourne.

13. R&D centre to seek 200 engineers

Research will range from energy to intelligent mobility

By

November 05, 2014

http://www.imeche.org/news/engineering/r-d-centre-to-seek-200-engineers-05111402
A new research centre at the Culham research site in Oxfordshire is set to recruit 200 engineers over the next three years to help develop robotics and remote handling equipment.
The £15 million Remote Applications in Challenging Environments (Race) centre researches robotics for use in fields such as nuclear operation and decommissioning, deep-sea oil and gas extraction and intelligent mobility.
Race is currently using temporary offices at Culham and expects its dedicated building, which will include control systems, hardware

and environmental testing facilities, to be opened during the second half of next year.
The centre employs 80 people and is looking to recruit an extra 200 engineers within the next three years. Race's core business is remote handling systems for the Joint European Torus (Jet) at Culham, the world's largest experimental tokamak nuclear fusion reactor, and research connected to its successor, the Iter fusion reactor being built in the south of France.
The centre also conducts higher-risk, long-term work, and plans to operate a membership scheme that will allow companies access to equipment and expertise when its new building is complete.
Rob Buckingham, director of Race, said: "Everyone is looking for the next, better, set of smart tools. It's about enabling people to work more efficiently, whether that's in a nuclear power plant or a car plant. In manufacturing there are lots of people who want more flexible robotic solutions. In the energy industry, there are applications such as getting people to oil and gas rigs or windfarms.
"Jet is ongoing and there are plans to do more remote handling. Iter is taking off. On the fission side, there are decommissioning liabilities, as well as new build and the operation of existing plants."
The extra engineering positions will initially be sustained through the work supporting fusion research, which builds on several decades of remote handling experience at Culham. Buckingham said a pipeline of work would be established by working with industry on a broad set of potential applications for remote handling technology in areas such as cars, unmanned aerial vehicles, unmanned underwater vehicles, agricultural machinery and hospitals.
According to a study published by consultancy McKinsey last year, the global value of the robotics and autonomous systems market is expected to be between £1.2 trilion and £4 trillion per year by 2025.
Race is part of the government's £250 million Robotics and Autonomous Systems strategy, which was published in July.

14. Massive Stage Awaits Nuclear Giant

Friday, November 7, 2014

http://www.paintsquare.com/news/?fuseaction=view&id=12278

Four years in the making, a colossal concrete floor capable of supporting 400,000 tons now stands ready to support the world's largest nuclear fusion machine.
Located in Saint-Paul-lez-Durance, France, the "seismic pit" is the foundation for an international nuclear fusion research and engineering megaproject: building the world's largest experimental tokamak nuclear fusion reactor.
The floor will be able to support over 400,000 tons of buildings,

infrastructure and equipment, including the 23,000-ton tokamak machine.
The tokamak concept heats a fuel mixture made of deuterium, tritium and two isotopes of hydrogen to temperatures exceeding 150 million°C to form a hot plasma. The plasma is contained in a doughnut-shaped vacuum vessel, and strong magnetic fields are used to keep the plasma away from the walls.

Energy Test Bed

The International Thermonuclear Experimental Reactor (ITER) project was born 29 years ago when then-Soviet leader Mikhail Gorbachev proposed an international project to then-U.S. president Ronald Reagan.
The goal was to develop fusion energy for nuclear purposes.
Now, ITER has seven members: Europe, China, India, Japan, South Korea, Russia and the U.S. Europe will contribute almost half the cost of construction; the other six members will equally contribute the rest.
Basemat work was carried out by Fusion for Energy, the agency that represents the European Union on the project. Fusion for Energy is responsible for financial and technical supervision for construction of 39 scientific buildings and dedicated areas on the ITER platform.
The basemat cost Fusion for Energy about €100 million ($124 million USD).
"Europe is taking the ITER construction to the next level," said Professor Henrik Bindslev, director of Fusion for Energy.
"The basemat is the test bed of the biggest international collaboration in the field of energy. It's where the scientific work and industrial know-how will come together and be deployed to seize the power of fusion energy."

Tons of Materials

The nearly-five-foot-thick reinforced concrete floor has a surface area of 31,496 square feet. Construction materials included 45,931 cubic feet of concrete; 3,600 tons of steel; and 2,500 embedded plates.
Under the top layer of concrete, 493 seismic pads were placed to absorb the effect of an intense seismic shock. The pads consist of columns topped with nearly eight-inch-thick anti-seismic bearings made of alternate layers of metal and rubber.
Fifteen plots of concrete were poured in December 2013; the nine central sections were poured within seven weeks of approval by the French Nuclear Authority in July.

'Historical Moment'

According to Fusion for Energy, the design and validation process was "extremely challenging" because the basemat will be the floor of the tokamak building that will house the machine and shield it. The structure was subjected to "heavy scrutiny" from the ITER International Organization and the French Nuclear Authority.
"The conclusion of this task is a historical moment for the project," said

Professor Osamu Motojima, Director General of the ITER International Organization.
"Years of hard work by all ITER parties are bearing fruit as the facility takes shape and makes progress on all fronts."
Now that the basemat is finished, construction has started on the complex to house the huge core buildings.
Work has also begun on the Assembly Hall building, where massive ITER components will be put together.

15. Are mini fusion power plants possible?

Lockheed Martin's compact reactor concept / fusion drives for aircraft and trucks?

October 23, 2014
http://www.ipp.mpg.de/3787558/cfr?c=14226

Building a small, transportable fusion power plant has long been a dream of fusion researchers. In the course of their research, however, it became clear that a functioning power plant has to be of a certain minimum size. Nevertheless, there are occasionally renewed attempts (see "The fusion upstarts", in Nature, Vol. 511, 14/7/2014, p. 398 ff.). IPP scientists Professor Sibylle Günter and Professor Karl Lackner explain why also the latest version proposed by US technology concern Lockheed Martin might well remain a dream:

The patent applications for the device proposed by Lockheed Martin do not involve a really new concept, but combine the known concepts of a magnetic cusp and a magnetic mirror. Both are impaired by the fact that charged particles can escape along the magnetic field lines out of the confinement region. This leads to an intolerable energy loss, because it is primarily the fast, hot particles that get lost first. Nor does it help here, as proposed, to link several cusps behind one another or combine them with magnetic mirrors.

What is envisaged is incorporating coils in the vessel, i.e. inside the plasma. This needs connections to the outside and fixtures in the plasma vessel. Hot plasma particles from the core of the device would thus come into direct contact with these fixtures. The fundamental idea of magnetic confinement, however, is precisely to keep the high-energy plasma particles in the core moving along the magnetic field lines at always the same volume without impinging on material walls. Otherwise the plasma cools down very fast. One solution here would be

superconducting coils levitating in the vessel without support, this leaving, however, the above energy loss problem: The configuration proposed is not suitable for confining hot plasmas.

Furthermore, the coils inside the plasma vessel have to be shielded not only from the surrounding hot plasma, but also from the neutrons produced in the fusion process. With superconducting coils, at least 80 centimetres of shielding around each coil is needed. This does not accord with the power plant size envisaged.

All of these problems have been resolved by the tokamak and stellarator concepts pursued today. Nevertheless, it is not possible to build small, transportable power plants. This is because attaining a positive energy balance, i.e. producing more fusion power than needed for heating the plasma, calls for extremely good thermal insulation of the plasma, viz. about 50 times better than styropor. In a power plant a temperature in the plasma core of 100 to 200 million degrees is needed, while at the walls no more than 1,000 degrees is tolerable. Such large temperature differences in the plasma drive turbulent flows that mix hot and cold regions with one another, i.e. impair the thermally insulating effect of the magnetic field. This has to be compensated with a larger volume. Here it is the size of the temperature gradient that determines the turbulent flows and hence the minimum size of a power plant. How a positive energy balance is to be achieved with the compact version propagated by Lockheed Martin is not even remotely mentioned in the patent applications.

16.

Oct 23 2014 : The Times of India (Kolkata)

Fusion energy holds key to power dream

Subodh Varma

St. Petersburg

http://epaperbeta.timesofindia.com/Article.aspx?eid=31812&articlexml=Fusion-energy-holds-key-to-power-dream-23102014015039

In this picture postcard city , nearly 700 scientists from across the world have gathered to compare notes on the most elusive of scientific dreams -fusion energy . Obscure discussions on neutron energies and plasma temperatures spill out of conference rooms to breakfast tables and smokers' groups huddling at the hotel porch, whipped by chill northern winds. Everybody knows that success is decades away , yet there is an air of repressed excitement.

The 25th Fusion Energy Conference is being attended by scientists from 43 countries including India. The Indian contingent, led by Dhiraj Bora, director of the Institute for Plasma Research, Gandhinagar, is a small one but they have for the first time, revealed India's work on superconductivity , which complements fusion research.

"Most countries are doing research which is still not in public domain. In such conferences, a measured dose of their research is reported," Bora explains.

Fusion is what makes the Sun and billions of stars like it burn. When two nuclei of atoms combine, an enormous amount of energy is released. For example, just a kilogram of the most basic fusion fuel can release enough energy to run a 1GW (one billion watts) electrical power station for a day . For comparison, look at India's power generation capacity - it is about 250 GW per year.

Just 0.6 tons of fusion fuel can produce the same amount of energy as 2 million tons of coal or 1.3 million tons of oil, or even 30 tons of uranium oxide used in current nuclear power plants.So, why is this only a dream?

Because, to make atomic nuclei fuse together, incredible energy is needed. Temperatures running into millions of degrees, as in the Sun, put atoms into a state called plasma, a kind of atomic soup with protons, neutrons and electrons floating around excitedly . This is when fusion starts. Once you put in the needed energy , you get many times more through a chain fusion reaction. To create such conditions on Earth, under tight control, is what the scientists have laboured for nearly half a century .

Since 2006, a collaborative project called ITER is building the world's first fusion reactor in the south of France. An exclusive club of the US, Russia, China, India, Japan,Korea and the European Union is doing the research and building various parts of the giant reactor. It is slated to be completed only by 2019, and actual fusion will start only by 2027. Construction costs are estimated at over $50 billion.

Fusion energy - whenever it is achieved - will liberate humankind from both, energy constraints as also global warming because it does not

generate greenhouse gases. If this is the result then the dream is really worth working for.
At the conference inauguration, there is a bit of a sensation as the grand old man of Russian nuclear research Evgeny Velikhov, president of Kurchatov Institute, announces that Russia is going ahead with research on a `hybrid reactor', that is, one that combines fission (as in nuclear bombs and nuclear power plants) with fusion. In a keynote address to the stunned gathering he details the physics of the whole concept. Russia has upped the ante in the race for achieving controlled fusion energy .
It is an exciting development and India is also thinking along these lines, says Bora, talking to TOI later.
(Subodh Varma was at the 25th FEC at the invitation of Rosatom, the Russian Federation's department of atomic energy)

17. Natural gas the best way to act now on greenhouse gas emissions

- DAVID KNOX
- THE AUSTRALIAN

NOVEMBER 12, 2014 12:00AM

http://www.theaustralian.com.au/business/opinion/natural-gas-the-best-way-to-act-now-on-greenhouse-gas-emissions/story-e6frg9if-1227119951292

THE synthesis report released by the Intergovernmental Panel on Climate Change this week provides not only a reminder of the need for global action to address climate change but also of the important role that natural gas will play in the transition to a low-carbon economy.

Its report states there is robust evidence and high agreement that

“GHG (greenhouse gas) emissions from energy supply can be reduced significantly by replacing current world average coal-fired power plants with modern, highly efficient natural gas combined-cycle power plants or combined heat and power plants”.

While the IPCC recognises that Carbon Capture and Storage may also play a role in -enabling coal to be a part of a low carbon future, natural gas can have an impact right now.

Santos is helping achieve this and is able to play an increasingly significant role. We have been providing natural gas safely and securely in Australia for 60 years and because of the global need for energy — especially in the Asia--Pacific — Santos has grown into a regional energy company. We have new and established projects in PNG, Indonesia and Vietnam.

But a really exciting part of what we’re doing is located here in Australia, where a new industry is being born. Our new projects will produce the same natural gas and use techniques Santos has been using safely for decades. Asian economies are turning to natural gas to meet their rapidly increasing energy needs while reducing their carbon footprint.

Our LNG plant on Curtis Island near Gladstone, Queensland, will provide 9 per cent of the entire gas requirements of South Korea, and 11 per cent of Malaysia’s.

Every million tonnes of LNG that is used in Asia instead of coal to produce electricity is the equivalent carbon benefit of taking 900,000 cars off the road.

Santos’s LNG plant can produce up to 7.8 million tonnes of LNG per year — that is the equivalent of taking more than seven million cars off the road every year.

Natural gas is already cutting global emissions and the US — a massive energy consumer — provides a real example of what is

possible. At the end of 2012 US carbon emissions were the lowest they had been since 1994. That’s during a period in which its population has grown by 60 million and use of devices like smartphones and plasma TVs has rocketed.

They have achieved this primarily because electricity production in the US has become cleaner. A third of that transition to cleaner electricity was due to an increase in renewable and nuclear power whereas two-thirds was due to fuel switching to natural gas.

President Barack Obama in his State of the Nation address last year declared natural gas the key to meeting US energy needs while moving to a lower carbon future.

This acknowledges that while we want low carbon energy, we can’t switch to 100 per cent renewables overnight. The global energy mix will be diverse. Renewables must continue to grow. Nuclear power will continue to have its place. In many situations coal will continue to provide the cheapest energy and oil will probably remain the largest part of the global energy mix for some time.

But the energy bridging all of these other sources is natural gas. It is without question the key to a cleaner energy future. Natural gas is available, abundant, and cleaner. Its benefits and sustainability are backed by science.

Increasing use of natural gas can make immediate inroads into our emissions intensity.

David Knox is managing director and chief executive of Santos.

18. Kyoto deja vu as Paris becomes Copenhagen

- BJORN LOMBORG
- THE AUSTRALIAN

NOVEMBER 14, 2014 12:00AM

http://www.theaustralian.com.au/opinion/columnists/kyoto-deja-vu-as-paris-becomes-copenhagen/story-fni1hfs5-1227122325610

ON Tuesday, China and the US made a joint statement on their intentions to limit CO2 emissions. This took part of the media by storm. CNN told us "US and China reach historic climate change deal"; the *Los Angeles Times* called it a "landmark climate deal"; the Huffington Post spoke of "ambitious climate change goals". But this looks awfully like the original "solution" to global warm-ing, the Kyoto Protocol, which consisted of mostly broken promises.
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The US-China statement hedges itself, making no new obligations: "The United States intends to achieve an economy-wide target of reducing its emissions by 26 to 28 per cent below its 2005 level in 2025 and to make best efforts to reduce its emissions by 28 per cent. China intends to achieve the peaking of CO2 emissions around 2030 and to make best efforts to peak early and intends to increase the share of non-fossil fuels in primary energy consumption to around 20 per cent by 2030. Both sides intend to continue to work to increase ambition over time."
China essentially promised what it was already going to do. In the International Energy Agency's baseline scenario, China's CO2 emissions peak in 2030 at about 10 gigatonnes, or 25 per cent higher than today. And China already emits more than a quarter of the world's CO2 emissions.
Many, including CNN, read that China would get 20 per cent of its energy from renewable resources by 2030, but China promised only 20 per cent would come from non-fossil fuels — and guess what? In the baseline scenario of the IEA, China already plans to

get 18 per cent of its energy from non-fossil fuels and solar and wind will make up only about 3 per cent. The rest come from nuclear (5.5 per cent), hydro (3 per cent) and wood (6 per cent) which in 2030 will still power the stoves of more than 240 million Chinese, contributing to devastating indoor air pollution and killing more than a half-million people each year.

All this resembles the lead-up to the Copenhagen negotiations in 2009 when the Chinese promised they would emit 40 per cent to 45 per cent less CO2 per dollar of gross domestic product by 2020. It was hailed as a big breakthrough but was just business as usual as projected by the IEA.

The target Barack Obama is offering is, on the other hand, is a real and significant reduction. Without any new climate policies, the shale gas revolution will see US emissions reduced by 11 per cent in 2025, so getting an extra 16 percentage points requires a lot of new, stringent climate policies. But clearly Obama lacks any legislative basis for making such a promise.

This is reminiscent of Al Gore going to Kyoto in 1998. Back then, a Senate resolution with 95 votes to zero had already established that the US would not ratify the Kyoto Protocol. So the Clinton administration never submitted Kyoto for ratification, but still promised a 7 per cent cut by 2008-12. In fact, the US emissions increased by 9 per cent across the period, ironically 16 percentage points more than promised, just like Obama is now promising.

For the past 20 years the main solution to global warming has been grandiose promises of reductions that rarely materialise. Remember Canada promising a 6 per cent reduction at Kyoto but delivering a 24 per cent increase?

There is a real climate problem and a smart way to fix it. If we invest more in green innovation we can eventually solve the

problem. If we innovate the price of green energy down below fossil fuels, everyone will buy it, including the Chinese and the Indians.
Americans have spent $10 billion on research into shale gas, which has spurred a great switch from coal to cheaper and less polluting gas, reducing US emissions by about 300 million tons of CO2 a year and making the US about $200bn more in GDP.
Compare this with the European approach, which has cut just 91 million tons of CO2 with solar and wind, but costs $40bn in subsidies each year.
If we spent $100bn a year on green research, it would likely cut long-term emissions dramatically, and every dollar spent would do about $11 worth of good.
Yet the China and US promises suggest that the world is going to replay the Kyoto strategy of making empty promises. Kyoto lost us 20 years. If we're not careful, in 2030 we will have little but broken promises. It is time the world took climate change serious and -focused on green R&D instead.

19. Can Nuclear Fusion Save the Planet?

http://peakoil.com/alternative-energy/can-nuclear-fusion-save-the-planet

Our ability to transition from fossil fuels to renewable sources of energy will likely determine the fate of the planet. Some countries are making progress toward this goal, using solar, wind and water power. In the historic deal struck on Wednesday between the U.S. and China, for instance, China pledged that solar and wind power would account for 20 percent of China's total energy production by 2030. Denmark, which aims to completely eliminate its use of fossil fuels by 2050, will rely on its cutting-edge wind power industry. Germany has focused on solar and wind power in its push to remake its electricity system, and Brazil now derives more than 75 percent of its electricity from hydro-power sources.
Yet, the real 'solution' to global warming may lie in a fourth renewable energy source, and one about which we typically hear almost nothing: nuclear fusion.

The science

Nuclear fusion isn't new. In fact, the oldest thermonuclear reactor is approximately 13 billion years old or the approximate age of the universe and the first star. Our most popular fusion reactor is the sun. Explaining the real science behind nuclear fusion is best left to the experts, but the short of it is that fusion, the reaction that gives stars their energy, is the opposite of *fission*. Whereas nuclear fission creates energy by splitting one atom into two, fusion does it by joining two (hydrogen) atoms together to create one (helium), and the resulting reaction releases neutrons and an unbelievable amount of energy.

As it turns out, this is quite difficult, because in order to get the nuclei of two hydrogen atoms to fuse, one must defeat the protons' natural tendency to repel each other. Overcoming this tendency requires temperatures of over 100 million Kelvin (~six times hotter than the temperature at the sun's core) and incredibly high pressure. The prevailing method for accomplishing this is known as magnetic confinement, using a reactor known as a tokamak, and it is impossible to understand. (There's also another method that involves lasers, and it is even more confusing.)

Humans have been experimenting with nuclear fusion since the 1950s, and the scary amount of energy released by a fusion reaction was the impetus for the hydrogen bomb. As our own RP Siegel pointed out, the goal of those working to turn nuclear fusion into a renewable energy source — as opposed to a weapon — is to take the science behind the H-bomb and control it, thereby allowing for the gradual (and self-sustaining) release of energy. Unfortunately, doing this has heretofore proved impossible.

The challenges

We owe our fusion failures to the the incredible temperature and pressure required to ignite a fusion reaction. Fusion demands an enormous energy input, which is almost always greater than the energy it creates, resulting in a net energy loss. Second, because fusion scientists are effectively setting out to create a star contained by a magnetic bottle (or pounded by lasers), the necessary materials are either too expensive or simply do not exist. To put it in context, some believe that a large-scale, functioning fusion reactor "would be a monument to human achievement surpassing the pyramids of Giza."

Nuclear fusion's tenuous future as a reliable energy source is perhaps best illustrated by the history of the International Thermonuclear Experimental Reactor (ITER) project. ITER formed in 1985, when the Soviet Union proposed to the U.S. that the countries work together to explore the peaceful applications of nuclear fusion. Since then, ITER has ballooned into a 35-country project with an estimated $50 billion price tag. It is the largest nuclear fusion project on earth and arguably the most ambitious engineering endeavor in human history. Unfortunately, the 30 years since ITER's founding have been marred by political in-fighting, cronyism, budget cuts, plummeting morale, and the suffocating bureaucracy of an international organization that represents half the world's population.

Not to mention the engineering challenges resulting from ITER's size. When

complete, the reactor will stand 100 feet tall and weigh 23,000 tons. It will use the largest system of superconducting magnets in the world. Though the core will be hotter than the sun, the all-important magnets must be cooled to the temperature of deep space. If the magnets fail, the reactor would have to contend with a force comparable to two 747s simultaneously crashing into it.
All of this is in addition to the fact that nobody knows what will happen when ITER is finally turned on (hopefully in the next decade), in part because fusion, "the most plentiful energy source in the universe, has never produced energy on Earth."

Why do we care?

A reasonable question, then, is: Why is anyone even bothering? Well, as Raffi Khatchadourian put it in his *New Yorker* story on ITER, "The technology could solve the world's energy problems for the next 30 million years, and help save the planet from environmental catastrophe."
How, exactly? For one, hydrogen — the element used to create the fusion reaction — is the most abundant atom in the universe, meaning the reactor's "fuel" is likely limitless and could be sourced from seawater and the lithium found in the Earth's crust. Fusion reactors are also safe (they produce less radiation than we live with every day); clean (there's no combustion, so there's no pollution); and will create less waste than fission reactors.
Simply put, "Creating miniature stars on Earth is a non-optional part of humanity's future."

Causes for hope and despair

Last month, the Pentagon's largest supplier, Lockheed Martin, announced that its Skunk Works program was a year away from completing a relatively tiny, 100-megawatt test fusion reactor — and that a prototype could be completed in five years. At 7-by-10 feet, the reactor could fit in a tractor trailer and produce roughly a fifth of the energy that ITER's gargantuan reactor will hopefully generate. The ostensible purpose of Lockheed's announcement was to secure partners in academia, industry and government in order to advance the work, which could end up yielding a commercial application in a decade. Amazing, right? Well, the scientific community's reaction to the Lockheed announcement was … muted at best. Lockheed's supposed 'breakthrough' was the creation of a magnetic bottle' that would contain the heat and pressure of the fusion reaction; however, this is the same technology that has been around for 50-plus years, and Lockheed did not explain how *its* tokamak was different and able to achieve a net energy gain. In fact, it offered no data at all, and the little information it did release suggested that it might not even have the basic science right.
Meanwhile, key structures are still being built at ITER — a fact that, in and of itself, is reason for hope — and the scientific community continues to make incremental progress toward the goal of net energy gain.
Here in the U.S., things look a bit bleaker. In July, a U.S. Senate panel voted to zero-out America's funding for ITER, and the red wave brought by last week's midterm elections should usher in a Congress that is even more hostile to climate science.
As always, then, a cloud of uncertainly hovers over the future of nuclear fusion

even as the future of the planet depend on its success.
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