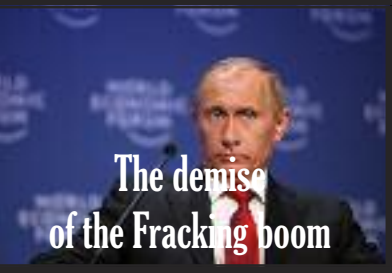
ONE

Only Natural Energy

The dream of flying with no fossil fuel



The demise of the Fracking boom

Anthropocene, the Great Acceleration

Western Diets Could Derail Climate Action

Lula's Hidden Treasure

YEAR I - NUMBER 2 - APRIL-JUNE 2015

ENERGY 2015

AMT Energy Conference

October 10-11 2015 - The View Hotel, Eastbourne, UK

TheAMT.com/conference

ONE
Only Natural Energy

Number 2 | APRIL-JUNE 2015

Editor: Gianni Serra

Editorial team: Eusebio Loria, Toby Lockwood, Giorgio Cucca, Alice Masili, Simone Meloni, Andrea Porcu

Contributors: Ben Ptashnik, Max Planck Gesellschaft, Peter Reuell, Laura Wellesley, Pete Danko, Dawn Santoianni, Rebecca Caygill

Thanks this issue: Truthout, Science Daily, Harvard Gazette, Chatham House, Breaking Energy, Cornerstone, UCL Institute for Sustainable Resources

Cover Photo: © Solar Impulse | Revillard | Rezo.ch

Publisher: Sotacarbo Ltd
CO2 Technology Centre
of Sulcis - Miniera di Serbariu
09013 Carbonia (Italy)

Reg. Nr: 2/2014 Cagliari Ordinary Court

Only Natural Energy [ONE] is a digital magazine published every three months.
www.onlynaturalenergy.com
info@onlynaturalenergy.com

The Dream of flying with no fossil fuel

Solar Impulse 2 takes-off from Ahmedabad to Varanasi (India)
Photo: © Solar Impulse | Revillard | Rezo.ch

The longest distance ever flown by a solar airplane in aviation history: 13 hours and 20 minutes of flight, reaching an altitude of 8,534 meters with a ground speed of roughly 100 knots.

In March 2015 Bertrand Piccard piloted Solar Impulse 2 (Si2) from Muscat (Oman) to Ahmedabad (India), flying across the Arabian Sea and setting a world record for straight distance, pre-declared waypoints record by travelling 1,468 km during Si2's flight - subject to validation by FAI [Fédération Aéronautique Internationale]; the record of straight distance, pre-declared waypoints 1,386.5 km was previously held by André Borschberg during the Si1 Across America mission in 2013.

"More important to us than the world record is the fact that Solar Impulse 2 is the first solar airplane to fly in Asia. It is also an honor of being welcomed by the state of Gujarat, a visionary state which leads India in terms of solar installation", said Piccard and Borschberg, the pilots and also the brains behind the project.

Solar Impulse's goal is clear: to inspire innovation and encourage the use of clean technologies. Staring at the sight of this solar plane is certainly intriguing enough to catch people's imagination. Hard to find a more efficient promotion for renewable energies than flying around the world without fossil fuel. ONE

Russia Blamed, US Taxpayers on the Hook, as Fracking Boom Collapses

By BEN PTASHNIK

Truthout

As Congress removes restrictions on taxpayers bailing out the too-big-to-fail banks, the right is blaming environmentalists and Russia for the demise of the fracking boom. In reality, the banks' junk bonds and derivatives have flooded Wall Street, and now the fracking bubble threatens another financial crisis.

Collapsing crude oil prices due to oversupply are reaching tsunami proportions, threatening Wall Street banks, investors and a dozen countries, foremost Russia, Iran and Venezuela, where revenue losses have caused severe financial degradation, and economies are about to implode. While Americans are today enjoying $2 per gallon gasoline, Wall Street's analysts predict that an imminent energy market collapse will bring financial institutions to their knees once again, and taxpayers are being set up for another mandatory bailout.

At the heart of these tectonic shifts in the entire energy sector is the recent expansion of the hydraulic fracturing (fracking) industry, a boom cycle that began in earnest when Congress and the Bush administration passed the Energy Policy Act of 2005, which exempted the new horizontal drilling technology from the Clean Water Act, the Safe Drinking Water Act and the National Environmental Policy Act. By tapping considerable quantities of new oil and gas resources from shale deposits, the fracking boom promised US energy independence, upending the world's prevailing paradigms around renewable energy and peak oil expectations. Environmentalists fought against the huge Keystone pipe-

line infrastructure that would deliver the fossil fuels to foreign markets, fearing that exploiting these resources would undermine the struggle for the curbing of carbon emissions.

Fracking also threatened the dominance of Russia and Saudi Arabia as the fossil fuel suppliers of Europe when it became evident that the United States would soon become a net exporter. In the United States, fracking was hyped on Wall Street as a get-rich-quick opportunity, attracting massive capital input, and creating an investment bubble. Bloomberg reported this year that the number of bonds issued by oil and gas companies has grown by a factor of nine since 2004.

"There's a lot of Kool-Aid that's being drunk now by investors," Tim Gramatovich, chief investment officer and founder of Peritus Asset Management LLC, told Bloomberg in an April 2014 article. "People lose their discipline. They stop doing the math. They stop doing the accounting," he continued. "They're just dreaming the dream, and that's what's happening with the shale boom."

Vladimir Putin at the World Economic Forum Annual Meeting- Davos, 2009. (Photo: World Economic Forum)

When gas fracking first popped onto the scene, grandiose claims were made that the United States had 100 years of gas supply in shale, or 2,560 trillion cubic feet. And Wall Street rode that initial estimate. The only downside (beside the environmental disaster left by this toxic industry) was that, like the housing bubble which depended on ever-growing home values to maintain profitability, shale gas wells had to deliver consistent or growing production and profitability to pay back heavy debt interest loans on well driller companies: $3 to $9 million per well. Fracking wells require not just drilling, but also huge injections of energy, water, sand and chemicals to fracture the rocks that hold the oil and gas deposits.

But in fact, no statistical evidence confirmed the hyped claims of a 100-year shale gas supply. In 2011, a study downsized this estimate from 2,560 trillion cubic feet to 750 trillion cubic feet, and by 2013, the US Geological Survey refined that down to 481 trillion cubic feet - less than a 19-year supply based on 2013 rates of production. Nevertheless, huge amounts of capital poured into increasingly marginal operations, and the fracking market was flooded with junk bonds and derivatives as investors piled in.

Meanwhile oil fracking, which is separate from gas fracking, also needed huge injections of capital, but more importantly, oil frackers needed oil prices to stay at $85 a barrel or higher on average to break even. Many of the shale oil wells that have sucked up a huge amount of investment have also turned out to have short lives and their operators required continued infusions of capital to drill new wells to keep afloat, even as prices tumbled due to the glut they themselves created. The Bakken, one of the largest oil fracking plays, is a typical example. It grew exponentially after environmental protections were removed. But since 2008, Bakken has required increasingly larger numbers of wells just to maintain level production and service debt. The industry, already in trouble in 2013, has now endured plunging revenues through a year of oil selling at $60 to $70 per barrel, on average, instead of $90 to $100.

Everyone had expected that in 2014 the Saudis would move to limit supply and maintain stable oil prices by cutting back production, as OPEC has done for decades. But an unexpected shockwave hit the industry in November 2014: The Saudis laid down the gauntlet and announced their intention to continue full production and let oil prices drop.

For the Saudis, this serves two purposes: First, it undermines the expansion of US shale oil by forcing prices down so low that many of the wells have to be shut down or lose money. Second, it punishes their enemy, Iran, whose oil export-based economy has been savaged by the lower prices. The Saudis are sitting pat, with a trillion-dollar war chest savings account accumulated over a decade of $100 per barrel oil. Oil Minister Ali al-Naimi has publicly admitted that the Saudis will wait as long as needed to retain market share, even if prices plunge further.

Wall Street is now flooded with fracking industry derivatives contracts that protect the profits of oil producers from dramatic swings in the marketplace.

Falling oil prices will place a huge stress on the world's junk bond market as energy companies now account for 15 percent of the outstanding issuance in the non-investment grade bond market. The plunge in the prices of crude could trigger a "volatility shock large enough to trigger the next wave of defaults," according to Deutsche Bank.

This explains why the Obama administration - with complicity of both congressional Democrats and Republicans - managed in the wee hours of the morning to slip a loophole into the supposedly "must-pass" cliff-hanger omnibus budget bill. This toxic Trojan horse, passed in December 2014, now includes a minor footnote provision that might cause taxpayers to pick up the tab on more than a trillion dollars (yes, trillion) if the energy market bubble implodes, which it must if oil stays at half the price it fetched just six months ago.

After last minute, heavy lobbying on the budget bill by Jamie Dimon of JPMorgan Chase and an army of 3,000 Wall Street lobbyists, it appears that once again sufficient insecurity and fear had been spread among the political class regarding destabilization of the financial markets (or withdrawal of campaign financing). They allowed a last minute amendment that killed Dodd-Frank protections, and allowed US taxpayers to be shaken down to cover Wall Street's shale gambling debacle.

The heavy-handed move by the financial industry has outraged progressives and libertarians alike. It seems that these Wall Street criminals, like junkies attached to their drugs of choice, just could not resist the high of easy cash from Ponzi scheme market bubbles, and so they have stuck it to the US public once again: Preposterously huge bonuses, Porsches, pricey call girls, and million-dollar Manhattan condos were at stake. So hey, why should they kick the habit? After all, not a single one of those con artists went to jail last time.

Wall Street is now flooded with fracking industry derivatives contracts that protect the profits of oil producers from dramatic swings in the marketplace. Derivatives are essentially insurance policies taken out by the oil industry to guard against fluctuations in the cost of fossil fuel supplies. Dramatic swings rarely happen, but when they do they can be absolutely crippling.

Derivatives taken out to ensure prices don't go down are now creating billions in losses for those who sold such bets on the market; someone is going to have to absorb massive losses created by the sudden drop in oil on the other end of those insurance contracts. In many cases, it is the big Wall Street banks, and if the price of oil does not rebound substantially they could be facing colossal losses.

The big Wall Street banks did not expect plunging home prices to implode the mortgage-backed securities market in 2008, but their current models also did not have $60 oil prices included in projections. The huge

losses may send a shock wave into the entire financial industry. It has been estimated that the six largest "too-big-to-fail" banks control $3.9 trillion in commodity derivatives contracts, those same gambling instruments that brought us the 2008 housing collapse. And a very large chunk of that amount is made up of oil derivatives. Combined with the huge flood of shale junk bonds on the market, the derivatives could initiate a bubble burst that could turn into a financial market implosion.

Meanwhile, the global climate change issue and energy market turbulence have morphed into geopolitical tensions over European fracking. Unsubstantiated allegations in a New York Times report by Andrew Higgins claim that the Russians are funding anti-fracking protests to maintain their hegemony over gas markets.

The allegations have infuriated environmentalists and climate justice activists. The last thing they want is to be made scapegoats for the fracking collapse and be played as the neo-Cold War dupes of the Russian empire. But memories of red-baiting suddenly hang in the air as (by seeming coincidence) dozens of right-wing media sites regularly devoted to anti-Soviet slanders or climate change denial immediatelypicked up Higgins' Times piece, as if on cue.

There are now dozens more of such published reports. Even as the US fracking industry collapses and tensions over control of Ukraine and other former Soviet satellites re-emerge, there seems to be a concerted right-wing effort to label fracking opponents Russian agents.

Vague innuendos dominate this narrative. In the Times piece, for example, former NATO Secretary General Anders Fogh Rasmussen is quoted: "I have met allies who can report that Russia, as part of their sophisticated information and disinformation operations, engage actively with so-called non-government organizations." Others write, "Some in Sophia believe" or "Those who suspect Russian involvement" or "There's no smoking gun, yet . . ."

Critics in Romania accused the Times and Higgins of scapegoating environmentalists and acting as partisan players in a renewed Cold War.

"What, exactly, is the grand total of evidence that Russia is financing these anti-fracking protests?" asks American blogger in Romania, Sam C. Roman, in his article, "Pot vs. Kettle," pointing out that the first anti-Russia allegation came from a politician who owned land that Chevron planned to frack, and is thus losing money from the protests. "Not one allegation against Russia in the entire article is proven by a single document, piece of evidence or other direct proof. All that exists are shadowy insinuations and allegations." He asserts that accusations by Lithuanian, Romanian and NATO officials against Russia have not yet to be backed up by any proof.

"Add it up," Roman writes. "You've got two former NATO [secretary generals] stumping for Chevron (which competes with Gazprom, a Russian energy company that also conducts fracking operations in Europe) blaming the Russian government for protests. . . . And all of this tied up in a neat little bow by an American journalist who has already been caught publishing anti-Russian propaganda in his newspaper before."

This all leaves the United States somewhat schizophrenic. On the one hand, the United States and NATO's foreign policy hawks are delighted by the oil price collapse; it serves to isolate and subdue Russia, expand NATO's influence in Eastern Europe, and puts pressure on Iran to negotiate on nuclear aspirations. Not to mention that with gasoline at $2 per gallon, consumer spending and economic growth will be enhanced. The US economy grew by a comparatively robust 5 percent in the third quarter of 2014.

According to an article by Larry Elliott in The Guardian, "Stakes Are High as US Plays the Oil Card Against Iran and Russia," the price drop was an act of geopolitical warfare by the United States, administered by the Saudis. Elliott suggests that US Secretary of State John Kerry allegedly struck a deal with Saudi Arabia's King Abdullah in September. That might explain how oil prices dropped during the crisis caused by Islamic State in Iraq and Syria, which would normally have cau-

sed prices to rise.

It would also explain why the Obama administration allowed the financial industry the amendment to Dodd-Frank that effectively exempts financial institutions from liability associated with derivatives. Though shale derivatives were not specifically mentioned by the Wall Street lobbyists as they pressured their allies in Congress and the White House, it is becoming increasingly clear that the too-big-to-fail banks were beginning to panic as dark clouds gathered on the horizon in the shale derivatives trade.

Most bank customers and voters don't know that Congress has already written into finance regulations that, in the case of insolvency, financial institutions could grab the assets of depositors and "bail-in" - which means they can save themselves from their losses in gambling operations at their investment divisions by grabbing cash assets of depositors, even those that are FDIC guaranteed, and legally convert them to bank stocks. That means that in the event of another market crash, Chase and Citi could take their depositors' cash in savings accounts or CDs, and give the customers back a bank stock certificate (of questionable value) instead.

There are also those who scratch their heads and ask, "Why did the TBTF banks push for a deletion of the Dodd-Frank provision now, instead of waiting for the friendlier Republican-controlled Congress to pass this legislation?" The only answer that seems to make sense, and explain their urgency, is that the collapse is imminent.

In the 1990s dot-com craze, every new Silicon Valley start-up company was advertised as the next Microsoft. What followed was the crash of 2000, when the NASDAQ dropped 4,000 points (80 percent) in months. This chart below is what the crash looked like in 2000 to 2002 after the market had reached 5,000 (almost exactly where it stands today).

Having learned their lesson well from the last bailout, and knowing that they will have a much harder time coming to Congress hat-in-hand after a collapse, the TBTF banks probably decided not to wait, pushing their minions in the Beltway to inoculate them as soon as possible from the potential market explosion.

In the meantime, they were probably dumping their own stocks on unsuspecting investors. Based on year-end reports for March 31, 2014, for 127 major oil companies, cash input for the fracking industry was $677 billion, while revenues from operations only totaled $568 billion - a difference of almost $110 billion. And this was before the price of oil started dropping six months ago.

In three out of seven major fracking fields in North America, companies are already reporting losses, with closures particularly acute in Canada. It's not clear whether economists fully appreciate what's about to transpire. This decline in rig count is just the beginning. Perhaps the end will come as early as this winter or spring, as fiscal reports for 2014's fourth quarter are published, operations shut down, crews are laid off, and many unprofitable oil and gas rigs are mothballed.

So, whom will the banks, brokers and investors scapegoat for this upcoming crash? Some predict that they will likely use every available media outlet to blame community activists, Democrats and Obama for stopping the Keystone pipeline and for opposing the fracking industry. And as in the climate change denier movement, the narrative will probably use "communist" and "socialist" rhetoric, which is why the Russian card is so important to play: Hence the Higgins article.

The pundits on Fox will likely play on the patriotism of the right and use their Big Lie ploy (say something enough times, it becomes the truth) to the hilt. Six months from now, while studiously avoiding mention of our "allies," the Saudis, or the Wall Street banks, they will likely be vociferously defending those poor "beleaguered US oilmen" who could have made our country strong and independent again in energy, but were broken by the Democrats and those "commie environmentalists" working for Putin. The market crash will be blamed on the "climate hoax."

Originally published
by Truthout
January 8, 2015

SARDINIA
Technology & Nature

CO2 Technology Centre of Sulcis

SOTACARBO

POLLUTION

Begins—And Ends—With *You*

Everyday Water Quality Problems

1 Undisturbed areas absorb rainwater and recharge the groundwater supply. Natural vegetation holds soil in place, preventing sedimentation of waterbodies. Pet waste pollutes our water. Scoop, dwobble bag, and throw pet waste in the garbage.

2 Paving an area prevents absorption of rainwater, increasing the potential for flooding and erosion of soil into waterbodies. Driveways and walkways can be sources of water pollution. Oil, antifreeze, and other pollutants can collect on your driveway. When spilled during maintenance or are dumped on the ground can be carried by runoff to our streams and bays.

3 Boat and engine maintenance can pollute. Toxic chemicals, oils, cleaners, and paint scrapings from boat maintenance can make their way into the water. While boating, treat and dispose of your sewage properly.

4 Zinc from aging pipes, gutters and metal roofs leaches into rainwater and enters the environment, where it may harm aquatic life. Asbestos and copper—both potential pollutants—leach into runoff from car and truck brake linings and worn pipes and linings.

5 Lawn clippings and yard waste in ravines and ponds can become unwanted fertilizer for streams. Lawn and garden fertilizers enter runoff and increase nutrient levels (nitrogen and phosphorous) in waterbodies. Too much plant growth in streams can use up all the oxygen choking water ways and killing fish and aquatic life.

6 Waste from leaf and grass clippings, garbage, animal droppings, and other organic debris pollute runoff. The decaying organics deplete oxygen levels in water and affect fish.

7 Used motor oil, household cleaners and chemicals disposed of outside can end up in our streams and bays. It washes down to local waterways where, oil harms fish and wildlife. Potential toxic chemicals can be taken up by animals whether we eat fresh clams. Since most animal foods contain high fish meal and fish oil contents, toxins can be found a few weeks later in commonly consumed food derived from livestock such as meat, eggs, milk, and butter.

8 Trash thrown directly into lakes, streams, and wetlands is unsightly, may hurt aquatic life and may pollute the water as it decays.

9 Sediment accumulates in waterbodies from soil erosion and destroys feeding grounds for aquatic life, clogs fish gills, blocks light transmission, and increase water temperatures.

Remember Everything You Do *DOES* Make A Difference!

Global warming slowdown: No systematic errors in climate models, comprehensive statistical analysis reveals

By MAX-PLANCK-GESELLSCHAFT

Science Daily

Skeptics who still doubt anthropogenic climate change have now been stripped of one of their last-ditch arguments: it is true that there has been a warming hiatus and that the surface of Earth has warmed up much less rapidly since the turn of the millennium than all the relevant climate models had predicted. However, the gap between the calculated and measured warming is not due to systematic errors of the models, as the skeptics had suspected, but because there are always random fluctuations in Earth's climate.

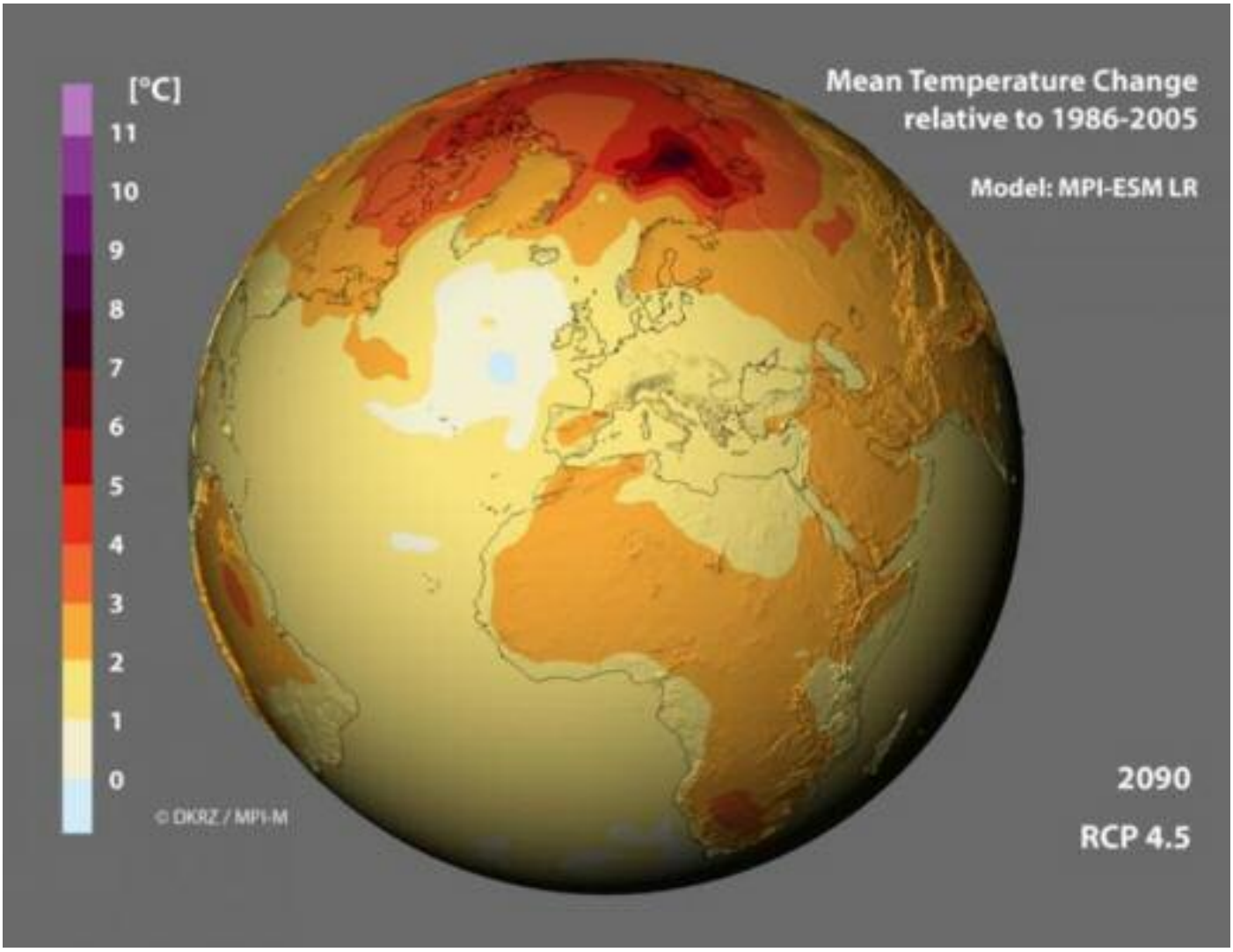
Recently, Jochem Marotzke, Director at the Max Planck Institute for Meteorology in Hamburg, and Piers M. Forster, a professor at the University of Leeds in the UK, have impressively demonstrated this by means of a comprehensive statistical analysis.

They also clearly showed that the models do not generally overestimate human-made climate change. Global warming is therefore highly likely to reach critical proportions by the end of the century – if the global community does not finally get to grips with the problem. Climate is subject to chance and chaos – which makes life difficult for climate researchers. No wonder that these two unpredictable climate factors lie at the root of a mystery that has baffled scientists since the start of the 21st century. Since then, the temperature of Earth's surface has increased by only around 0.06 degrees Celsius – much less than had been predicted by all 114 model simulations considered in the climate report by the IPCC.

Jochem Marotzke and Piers M. Forster have now explained the warming pause in terms of random fluctuations arising from chaotic processes in the climate system. Even more importantly for the two researchers and their colleagues around the world: they did not find any conceptual errors in the models. Most notably, the models do not generally react too sensitively to increases in atmospheric carbon dioxide.

The gap between the calculated and measured warming is not due to systematic errors of the models but because there are always random fluctuations in Earth's climate.

"The claim that climate models systematically overestimate global warming caused by rising greenhouse gas concentrations is wrong," says Jochem Marotzke.



Forecasts without systematic errors: climate models, such as the model MPI - ESM LR of the Max Planck Institute for Meteorology, predict a significant increase in temperature by the end of this century, especially at the Earth's poles. No model, however, has predicted the global warming hiatus which climate researchers have observed since the turn of the millennium. This, however, is not due to systematic errors of the models, but to random fluctuations in the climate system. The model predictions are therefore reliable, taking some statistical uncertainty into account.
Credit: MPI for Meteorology / Deutsches Klimarechenzentrum (DKRZ)

Climate skeptics often make precisely this claim, citing the warming pause as evidence. Yet they cannot deny that nine of the ten warmest years since systematic climate observations began have occurred in the new millennium and that global warming has slowed at a very high level. The skeptics also ignore the fact that ocean temperatures continue to rise as rapidly as many models have predicted.

"On the whole, the simulated trends agreed well with the observations"

To explain the puzzling discrepancy between model simulations and observations, Jochem Marotzke and Piers M. Forster proceeded in two steps. First, they compared simulated and observed temperature trends over all 15-year periods since the start of the 20th century. For each year between 1900 and 2012 they considered the temperature trend that each of the 114 available models predicted for the subsequent 15 years.

They then compared the results with measurements of how the temperature actually rose or fell. By simulating the average global temperature and other climatic variables of the past and comparing the results with observations, climatologists are able to check the reliability of their models.

If the simulations prove more or less accurate in this respect, they can also provide useful predictions for the

future.

The 114 model calculations withstood the comparison. Particularly as an ensemble, they reflect reality quite well: "On the whole, the simulated trends agree with the observations," says Jochem Marotzke. The most pessimistic and most optimistic predictions of warming in the 15 subsequent years for each given year usually differed by around 0.3 degrees Celsius. However, the majority of the models predicted a temperature rise roughly midway between the two extremes.

The observed trends are sometimes at the upper limit, sometimes at the lower limit, and often in the middle, so that, taken together, the simulations appear plausible. "In particular, the observed trends are not skewed in any discernible way compared to the simulations," Marotzke explains. If that were the case, it would suggest a systematic error in the models.

No physical reason explains the spread of the predictions

In a second step, the two scientists are now analysing why the simulations arrived at disparate results. This analysis can also explain why the various predictions for the past 15 years deviate from the actual observed trend. Random fluctuations and three physical reasons come into question to explain this: The model calculations are based on different amounts of radiant energy from the sun that impinge on Earth's surface and are stored as a result of the greenhouse effect, e.g. due to atmospheric carbon dioxide.

However, their predictions also respond with different degrees of sensitivity to changes in this radiant energy, for example if the carbon dioxide content of the atmosphere doubles. In other words, the models assume different proportions of energy that warm Earth's surface and the proportion that is sooner or later radiated back into space. Finally, all the climate models assume different amounts of energy stored on Earth that is transferred to the ocean depths, which act as an enormous heat sink.

Using a statistical method, Marotzke and Forster analysed the contributions of the individual factors and found that none of the physical reasons explains the distribution of predictions and the deviation from the measurements.

However, random variation did explain these discrepancies very well. In particular, the authors' analysis refutes the claim that the models react too sensitively to increases in atmospheric carbon dioxide: "If excessive sensitivity of the models caused the models to calculate too great a temperature trend over the past 15 years, the models that assume a high sensitivity would calculate a greater temperature trend than the others," Piers Forster explains. But that is not the case, despite the fact that some models are based on a degree of sensitivity three times greater than others.

Earth will continue to warm up

"The difference in sensitivity explains nothing really," says Jochem Marotzke. "I only believed that after I had very carefully scrutinised the data on which our graphs are based." Until now, even climatologists have assumed that their models simulate different temperature rises because they respond with different degrees of sensitivity to increased amounts of solar energy in the atmosphere.

The community of climatologists will greet this finding with relief, but perhaps also with some disappointment. It is now clear that it is not possible to make model predictions more accurate by tweaking them – randomness does not respond to tweaking.

Quite apart from their role as scientists, researchers have another reason for greeting the study with mixed feelings: no all-clear signal has been sounded. Climatologists have been fairly correct with their predictions. This means: if we continue as before, Earth will continue to warm up – with consequences, particularly for developing countries, that we can only begin to fathom.

Originally published by Science Daily February 2, 2015

The Beloyarsk reactor: history in the making?

By GIORGIO CUCCA

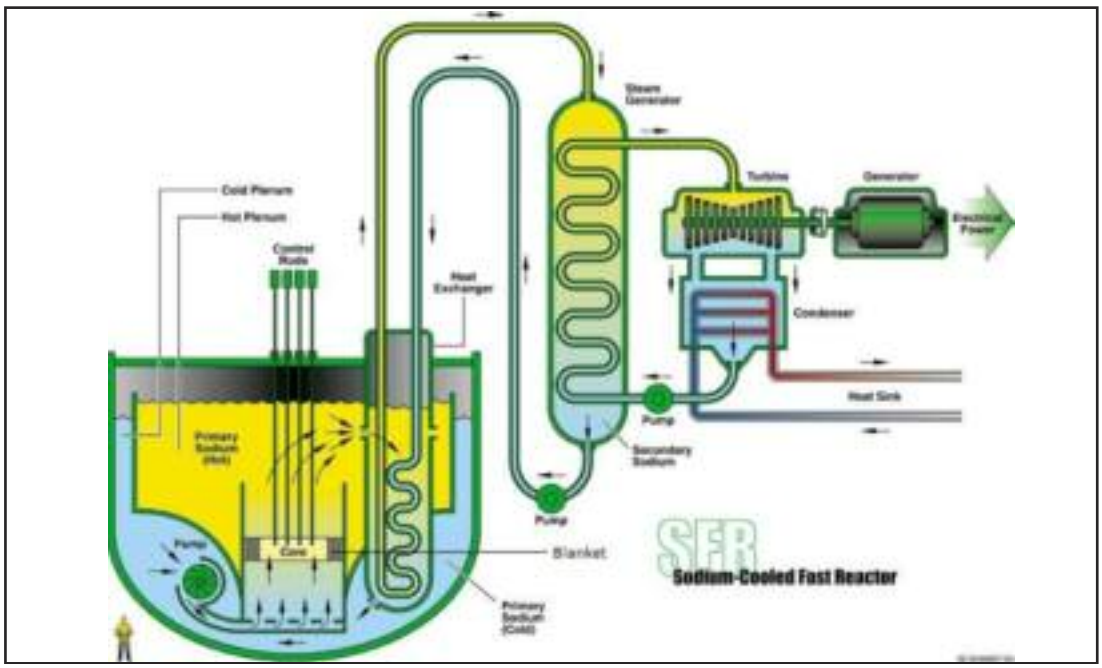
ONE

The kick-off of commercial power production by the 800 MWe BN-800 reactor at Beloyarsk Nuclear Power Station in Russia last year could be a defining moment in the history of the nuclear power industry.

"A step into the future" was the phrase used by Alexander Kharichev of Rosatom, Russia's state atomic energy corporation, to describe the occasion. Whilst this may sound somewhat grandiose, on 27 June 2014 when the Rosatom engineers brought the first commercial fast breeder reactor to criticality - meaning that the nuclear chain reaction was self-sustaining - an important page was surely written.

Fast breeder reactors ensure that a single fuel charge can last more than a century, and that the uranium is used in a way which is 60% more efficient than in any other standard reactor. The Beloyarsk unit therefore represents a big step towards a new generation of reactors with enhanced safety and minimal waste production. The name fast breeder reactor comes from two of their most important features: the use of "fast" neutrons and the ability to "breed" fresh fuel with each nuclear reaction.

FAST NEUTRONS. In a typical nuclear reactor, the neutrons produced by the reaction need to be slowed down, or "thermalized", in order to reach the right energy level to produce a nuclear reaction by fissioning an atom of uranium-235. Although this form of uranium represents only 0.7% of naturally occurring uranium, it is currently the only viable nuclear fuel. The abundant uranium-238 isotope which makes up the remainder is a so-called fissionable atom, but is not fissile like the 235 isotope. A fissionable element needs to be hit by a fast neutron to undergo a fission reaction, so it is very important to preserve the energy level of neutrons produced by the reaction rather than slowing them. For this reason the reactor has been designed to avoid any thermalization, and water cannot be used as



Sodium-Cooled Fast Reactor Schemata

Main building of Beloyarsk Nuclear Power Station as seen from the Beloyarskoye Reservoir near Zarechny, Sverdlovsk Oblast, Russia.

coolant as it would slow neutrons – the BN-800 reactor instead uses liquid sodium for this purpose.

THE CONVERSION RATIO. The other key trait in a fast breeder reactor is a conversion ratio (or breeding ratio) which is greater than one, meaning that for every nuclear fission, more than one fissile atom is created. There is no creation of any new material, just the mutation of some elements, such as the conversion of uranium-238 to fissile plutonium-239. In principle, this kind of reactor can convert fissionable atoms into fissile ones and use either as fuel. This versatility was the primary goal of the design peculiar to the Beloyarsk reactor.

UNIQUE DESIGN. The reactor is formed of a core section containing a mix of uranium-238 and plutonium-249 (known as mixed oxide fuel) and a so-called "blanket"of uranium-238, which is bred by the neutrons coming from the core. The new nuclear fuel produced in the blanket is periodically removed to be used in the core or in other fast reactors. This distinctive feature is the main asset of this kind of reactor.

COMPETITIVE EDGE. There are other important advantages too. When fully operational, fast breeder reactors burn mainly uranium-238, extending the life of uranium reserves by more than a thousand years compared to traditional reactors using uranium-239. In addition, they can burn actinides, which are the most dangerous elements present in nuclear waste. Although the waste will still take a thousand years to return to its natural level of radioactivity, this still represents a huge improvement on the typical timespan of millions of years.

NO FAIRYTALE. There are some downsides too. First of all the sodium used as coolant is corrosive and very reactive if it comes into contact with water. To prevent this, two heat exchangers are needed to avoid any contact between the sodium in the reactor and the steam sent to the turbine. Another drawback is a positive void coefficient of reactivity, which means that the reactivity (and consequently the power) tends to increase when voids such as steam bubbles form in the coolant - making the system unstable in case of overheating.

The Russian engineers' unique knowledge of fast breeder reactors derives from considerable experience gained with the smaller BN-600 reactor, operated at Beloyarsk since 1980. The implementation of the BN-800 reactor in the commercial grid is without doubt a great challenge, but should be regarded as a real turning point in the history of power generation. It now remains for fast breeder technology to prove its potential as a virtually CO2-free source of energy which combines the benefit of an abundant natural fuel source with the capability to dispose of nuclear waste and plutonium from nuclear warheads.

Meet the Dutch Windwheel

By ALICE MASILI

ONE

A sustainable icon and an icon for sustainability. Still early days but the Dutch Windwheel design is impressive. Currently the project is in the concept phase (2015-2017) - after forming the consortium, there would be the need to develop the design and research the innovations which will be applied to the Windwheel.

Between 2017 en 2021 the preparations for the physical development will take place. The real development is expected between 2021 and 2024.

The Dutch Windwheel is an example of contemporary architecture. The state-of -the-art design consists of two of three-dimensional rings with a light, open steel and glass construction.

The double ring construction is not only an eye catcher, but also offers a diversity of functions. The outer ring houses 40 rotating cabins on a rail system (giant coaster), the inner ring is an innovative windmill housing a top class panorama restaurant, sky lobby and hotel,

Photo: © Dutch Windwheel Corporation

apartments and commercial functions in the plinth.
The proposed location of the Dutch Windwheel is the international port city of Rotterdam. This modern, dynamic and international metropolis is the architectural capital of the Netherlands and continues to renew itself.
One of the innovations that can be developed with the Dutch Windwheel is the EWICON (Electrostatic WInd energy CONverter) technology. This technology was developed by a consortium including the TU Delft and Wageningen University in the context of government innovation program.
This pioneering wind turbine converts wind energy with a framework of steel tubes into electricity without moving mechanical parts. Result: less wear, lower maintenance costs and no noise or moving shadow. This makes the Dutch Windwheel the most innovative 'windmill' in the world.

Moreover, the Dutch Windwheel is designed for disassembly and re-use and built with materials from the Rotterdam region, the harbour and the surrounding steel industry.

The innovative lighting concept and digital information layer in the cabins of the giant coaster make the Dutch Wind Wheel and it's interior an experience in itself. Parts of the facade are so-called 'smart walls', glass panels that include a virtual layer of information that give the visitor an extra dimension of information.

The integration of all kinds of sustainable and innovative technologies is an attraction in itself. Based on the current number of visitors to the Netherlands and Rotterdam it is expected that around 1.5 million people will visit the Dutch Windwheel per year. This ensures that the development will be profitable within 10 years.

Sea level correction (increase more intense)

By PETER REUELL

Harvard Gazette

The acceleration of global sea level change from the end of the 20th century through the last two decades has been significantly swifter than scientists thought, according to a new Harvard study.

The study, co-authored by Carling Hay, a postdoctoral fellow in the Department of Earth and Planetary Sciences (EPS), and Eric Morrow, a recent Ph.D. graduate of EPS, shows that calculations of global sea-level rise from 1900 to 1990 had been overestimated by as much as 30 percent.
The report, however, confirms estimates of sea-level change since 1990, suggesting that the rate of change is increasing more rapidly than previously understood. The research is described in a Jan. 14 paper in Nature.

"What this paper shows is that sea-level acceleration over the past century has been greater than had been estimated by others," Morrow said. "It's a larger problem than we initially thought."

"Scientists now believe that most of the world's ice sheets and mountain glaciers are melting in response to rising temperatures," Hay added. "Melting ice sheets cause global mean sea level to rise. Understanding this contribution is critical in a warming world."

Previous estimates had placed sea-level rise at between 1.5 and 1.8 millimeters annually in the 20th century. Hay and Morrow, however, suggest that from 1901 until 1990, the figure was closer to 1.2 millimeters per year. However, everyone agrees that global sea level has risen by about 3 millimeters annually since that time.

"Another concern with this is that many efforts to project sea-level change into the future use estimates of sea level over the time period from 1900 to 1990," Morrow said. "If we've been overestimating the sea-level change during that period, it means that these models are not calibrated appropriately, and that calls into question the accuracy of projections out to the end of the 21st century."

Hay and Morrow approached the challenge of estimating sea-level rise from a new perspective.

Typically, Hay said, estimates of sea-level rise are created by dividing the world's oceans into subregions, and gathering records from tide gauges — essentially yardsticks used to measure ocean tides — from each area. Using records that contain the most complete data, researchers average them to create sea-level estimates for each region, then average those rates to create a global estimate.

"But these simple averages aren't representative of a true global mean value," Hay said. "Tide gauges are located along coasts, therefore large areas of the ocean aren't being included in these estimates. And the records that do exist commonly have large gaps.

"We know the sea level is changing for a variety of reasons," she added.

"It's a larger problem than we initially thought."

Antarctic Sea Ice - Amundsen Sea **Photo: © NASA/Jane Peterson.**

"There are ongoing effects due to the last ice age, heating and expansion of the ocean due to global warming, changes in ocean circulation, and present-day melting of land ice, all of which result in unique patterns of sea-level change. These processes combine to produce the observed global mean sea-level rise."

The new estimates developed by Hay and Morrow grew out of a separate project aimed at modeling the physics that underpin sea-level "fingerprints."

"What we were interested in — and remain interested in — was whether we can detect the sea-level fingerprints we predicted in our computer simulations in sea-level records," Morrow said. "Using a global set of observations, our goal has been to infer how individual ice sheets are contributing to global sea-level rise."

The challenge, Hay said, is that doing so requires working with "very noisy, sparse records."
"We have to account for ice age signals, and we have to understand how ocean circulation patterns are changing and how thermal expansion is contributing to both regional patterns and the global mean. We try to correct for all those signals using our simulations and statistical methods, then look at what's left and see if it fits with the patterns we expect to see from different ice sheets.

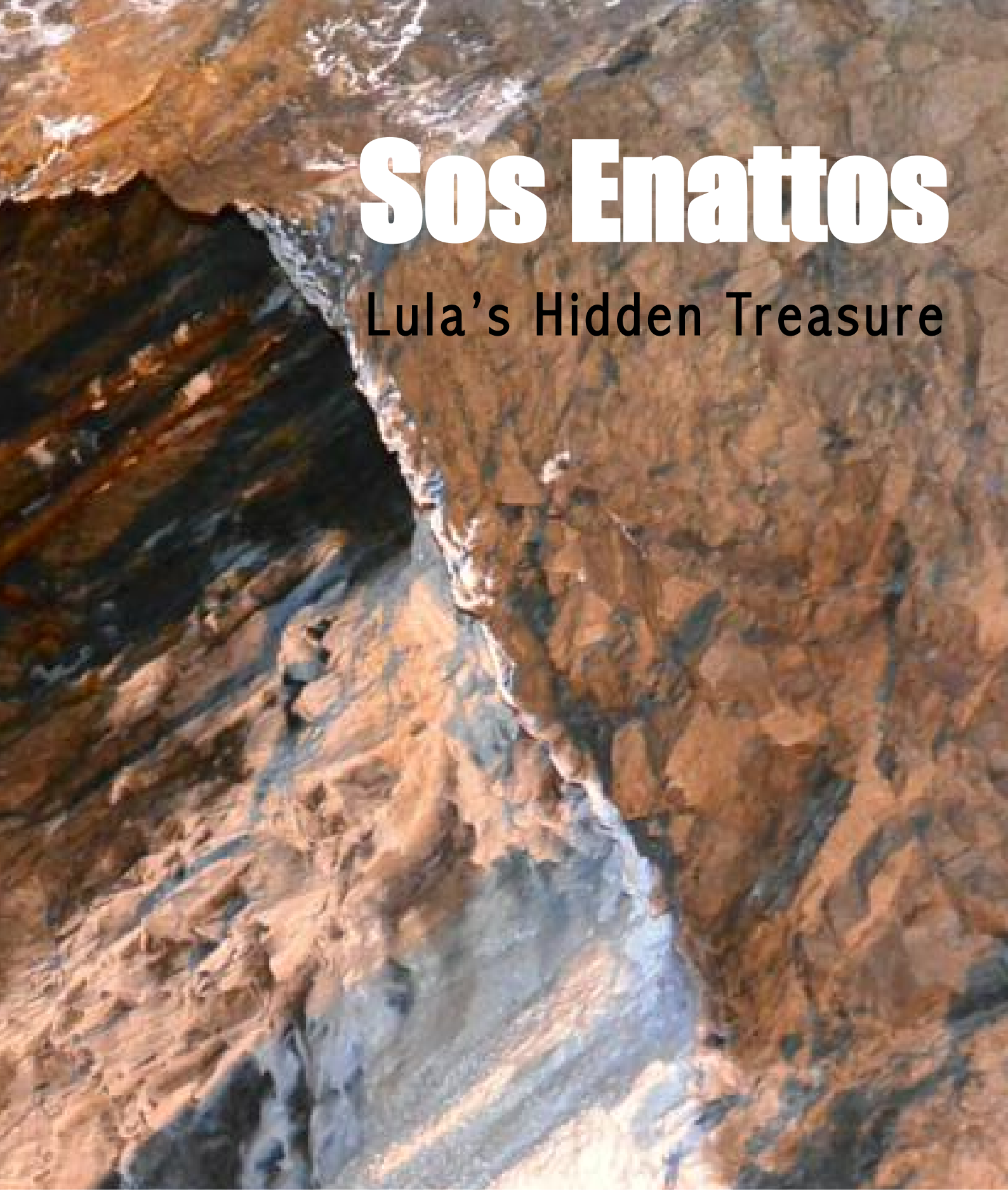
"We are looking at all the available sea-level records and trying to say that Greenland has been melting at this rate, the Arctic at this rate, the Antarctic at this rate, etc.," she continued. "We then sum these contributions and add in the rate that the oceans are changing due to thermal expansion to estimate a rate of global mean sea-level change." To the researchers' surprise, Hay said, it quickly became clear that previous estimates of sea-level rise over most of the 20th century were too high.

"We expected that we would estimate the individual contributions, and that their sum would get us back to the 1.5 to 1.8 mm per year that other people had predicted," Hay said. "But the math doesn't work out that way. Unfortunately, our new lower rate of sea-level rise prior to 1990 means that the sea-level acceleration that resulted in higher rates over the last 20 years is really much larger than anyone thought."

Originally published in the Harvard Gazette January 14, 2015

Photo: © ONE

Vanishing Point



Sos Enattos

Lula's Hidden Treasure

Photo: © ONE

A hidden jewel. Very well hidden. Maybe too well. The mine of Sos Enattos (Lula, Italy) is one of those treasures often unknown even to next-door neighbours. But that's probably part of their special aura.

The Sos Enattos mine is arguably the most underrated of the vast collection of Sardinia former mining sites: Montevecchio, Monteponi, Serbariu, Argentiera, Rosas and many others. Nearly all of them provide a stunning combination of industrial archaelogy and naturalistic landscape. Sos Enattos certainly does.

This is a real mine, with a long history (Sphalerite and Argentiferous Galena were extracted at Sos Enattos from 200 AC), where everything is kept in the right place, in the best shape. Here ex miners - still employed but with different duties - look quite different than the iconic miner whose face is covered by that mixture of black dust and sweat. Third millennium miners need to re-invent themselves. They look young, bright, full of ideas and projects to ensure a future for a symbol of yesteryear. But most of all it's their love for the place - the mine, more than its splendid surroundings - that touches you skin deep.

"This mine is not a Ferrari locked in a garage, it is a Ferrari without petrol. Spotless, extremely well maintained, ready to go but with the engine idling" says Paolo Calia,

the director of the Sos Enattos mine.

"You need to be blind to misjudge the value, the potential of this place. Not only for tourists but for scientists too. But without adequate promotion and cash injection it is hard to do anything, which is it a pity".

Everyone would agree. The mining activity in Lula began with Ancient Romans, and kept going through many ups and downs until 1996. Despite being closed for nearly two decades, Sos Enattos is quite different than other old mining sites. You don't see it as a "monument" of what has been.

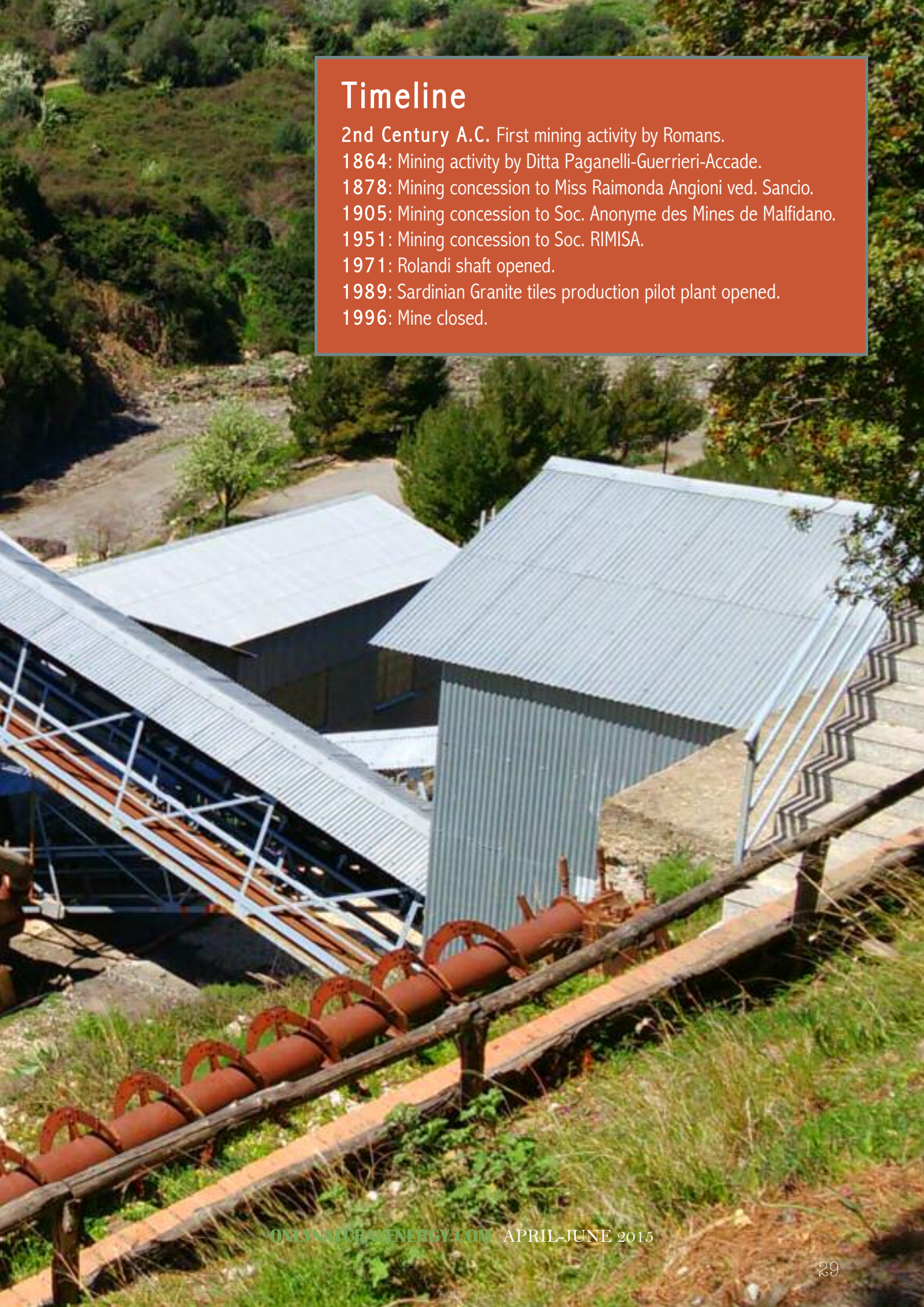
Once there you feel like you are part of something very much alive and kicking, which in reality is not the case anymore.

Then you realize that being kept true to its original mission and purpose, despite being forced to stop any operational activity, is the real charm of this place; something which is absent from those mines altered too much to fit with modern museum criteria and standard expectations. Never the case with *Soul Enattos*.

Minerals extracted at Sos Enattos:

Sphalerite
Argentiferous Galena
Chalybite
Azurite
Calcite
Chalcopyrite
Fluorite
Malachite
Pyrite
Smithsonite
Quartz

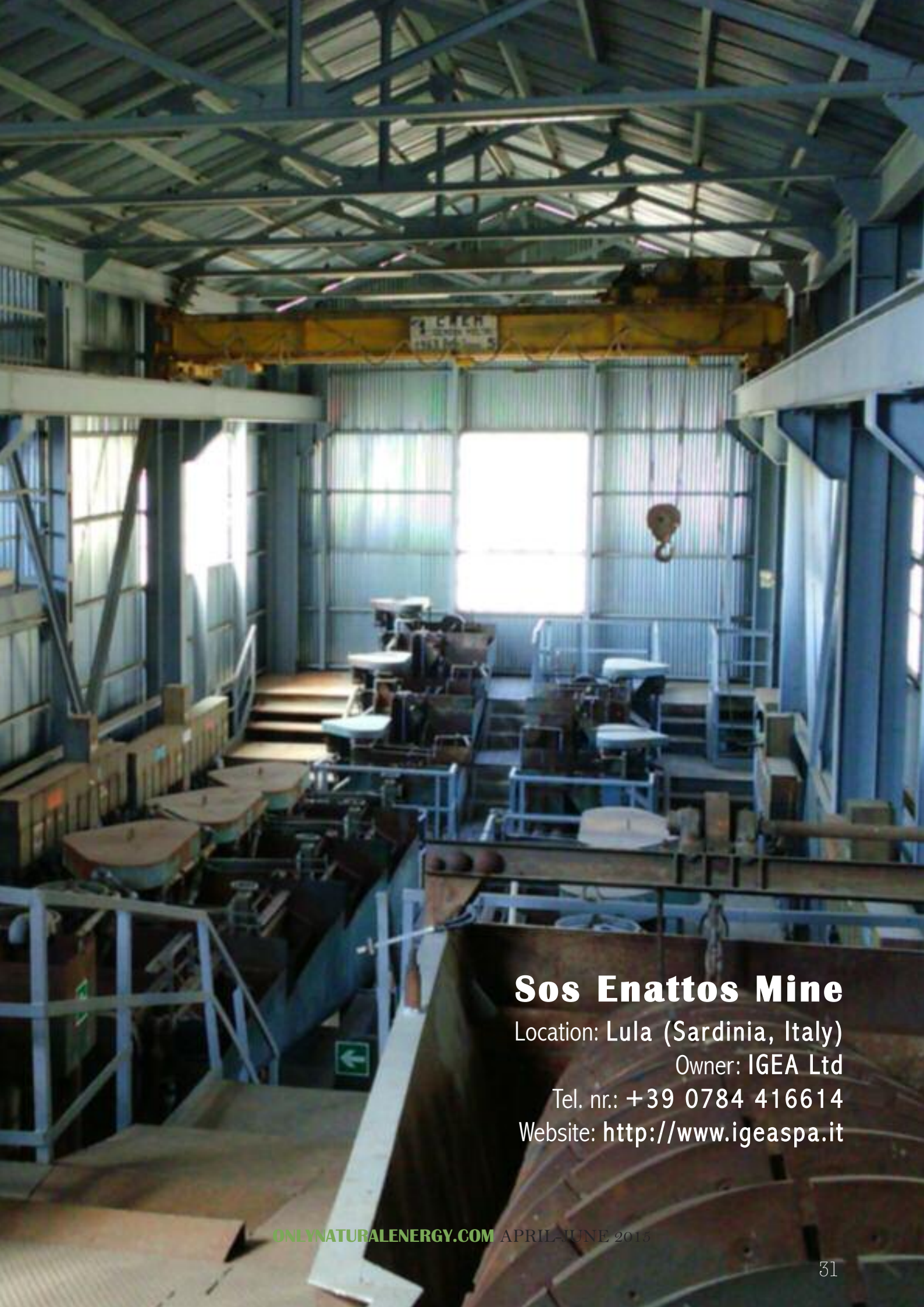
Photo: © ONE



Timeline

2nd Century A.C. First mining activity by Romans.
1864: Mining activity by Ditta Paganelli-Guerrieri-Accade.
1878: Mining concession to Miss Raimonda Angioni ved. Sancio.
1905: Mining concession to Soc. Anonyme des Mines de Malfidano.
1951: Mining concession to Soc. RIMISA.
1971: Rolandi shaft opened.
1989: Sardinian Granite tiles production pilot plant opened.
1996: Mine closed.


Photo: © ONE



Sos Enattos Mine

Location: **Lula (Sardinia, Italy)**
Owner: **IGEA Ltd**
Tel. nr.: **+39 0784 416614**
Website: **http://www.igeaspa.it**

Left Unchecked, Western Diets Could Derail Climate Action

By LAURA WELLESLEY
Chatham House

A growing body of evidence shows the impact that unsustainable levels of meat consumption – particularly of meats like beef and lamb – have on the planet. As shown in a recent Chatham House report, the livestock sector contributes nearly 15 per cent of all greenhouse gas emissions, roughly equivalent to those from transport. Yet minimal attention has been paid to the unsustainable manner in which we produce and consume meat, and public awareness of the impact of dietary choices on our environment is low.

The UK Department for Energy and Climate Change recently launched an interactive web tool that allows users to explore various lifestyle choices and energy uses, and their effect on global greenhouse gas emissions and subsequent temperature rise by the end of the century. The 'Global Calculator' provides a striking visualization of what experts already know: if adopted globally, the Western diet is incompatible with staying below the limit of two degrees above pre-industrial levels, deemed necessary to avoid dangerous climate change.

The results are compelling. If the energy sector is successfully decarbonized by 2050, our diets can make the difference between the two-degree scenario in which dangerous climate change is averted and the four-degree scenario described by the World Bank as one of 'cataclysmic' climate change.

If current consumption trends continue, with meat consumption in emerging and developing countries increasing but remaining considerably below Western levels, we will stay on track for a global temperature rise of two degrees.

But if the Western diet becomes the norm by 2050, even with cleaner energy and ambitious action in other areas of our lifestyles, we are headed for a global temperature rise of four degrees. Such a scenario implies a considerable escalation compared with current trends but is not inconceivable: consumption in emerging and developing economies is rising rapidly, and China, Brazil and India are among the world's largest and fastest growing meat-eating countries.

If this scenario were realized, additional emissions resulting from the growth in global consumption of beef, lamb and other meats would be significant enough to derail successful mitigation efforts in other sectors. Put simply, the Western diet is a four-degree diet. The rest of the world cannot afford to converge around such levels of excess.

Thankfully, there is a positive side to this sobering conclusion. Unsustainable consumption represents a significant and untapped area for relatively low-cost mitigating action that, if harnessed, would offer grounds for more ambitious international climate goals. As the 'Global Calculator' demonstrates, if decarbonization is accompanied by a push to curb unsustainable levels of emissions-intensive meat consumption, a 1.5 degree world – which offers the best chance of avoiding drastic climate impacts and ensuring the survival of low-lying island states – begins to look like a very real possibility.

A shift towards less meat-intensive, emission-intensive

The 'Global Calculator' provides a striking visualization of what experts already know iif adopted globally, the Western diet is incompatible with staying below the limit of two degrees above pre-industrial levels. Photo: Keith Weller (USDA).

diets would also realize important co-benefits. The average European today consumes over twice as much meat as is recommended by the World Health Organization. A move to promote a diet that is less rich in meat, and that has a greater share of chicken and pork as opposed to beef and lamb, would bring significant benefits to public health, including reduced incidence of heart disease, cancers and diabetes associated with over-consumption of meat.

Shifting diets will not be easy. A recent survey commissioned by Chatham House and undertaken by Ipsos MORI revealed a marked lack of public awareness of the impact of meat consumption on climate change. Furthermore, it outlined the importance of awareness as a precondition for behaviour change. Addressing this awareness gap will therefore be a critical first step in legitimizing interventions at the national and international level.

As consumers around the world look to experts and environmental groups to inform them about climate change and its causes, communication tools like the Global Calculator could be an invaluable means of broadcasting a message that has gone largely unheard. And with such powerful evidence, the need for urgent action on diets will be difficult to ignore.

Originally published by Chathamhouse.org January 28, 2015

Anthropocene: the "Great Acceleration" driven by human activities (and not by natural variability)

By EUSEBIO LORIA

ONE

The second half of the 20th Century is unique in the history of human existence. The last 60 years have without doubt seen the most profound transformation of the human relationship with the natural world in the history of humankind.

Human activity, predominantly the global economic system, is now the prime driver of change in the "Earth System" (the sum of our planet's interacting physical, chemical, biological and human processes), according to a set of 24 global indicators, or "planetary dashboard".

A decade on, IGBP in collaboration with the Stockholm Resilience Centre has reassessed and updated the Great Acceleration indicators, first published in the IGBP synthesis, Global Change and the Earth System in 2004.

"After 1950 you can see that major Earth System changes became directly linked to changes largely related to the global economic system. This is a new phenomenon and indicates that humanity has a new responsibility at a global level for the planet" said Professor Will Steffen, a researcher at the Australian National University and the Stockholm Resilience Centre and lead author of the new research paper "The trajectory of the Anthropocene: The Great Acceleration"published in Anthropocene Review journal (16 January 2015).

Co-author IGBP Deputy Director, Dr Wendy Broadgate said, "The Great Acceleration indicators allow us to distinguish the signal from the noise. Earth is in a quantifiably different state than before. Several significant Earth System processes are now driven by human consumption and production."

The new research charts the "Great Acceleration" in human activity from the start of the industrial revolution in 1750 to 2010, and the subsequent changes in the Earth System – greenhouse gas levels, ocean acidification, deforestation and biodiversity deterioration.

Take a look at Great Acceleration

"It is difficult to overestimate the scale and speed of change. In a single lifetime humanity has become a planetary-scale geological force," says Professor Will Steffen, who led the joint project between the International Geosphere-Biosphere Programme (IGBP) and the Stockholm Resilience Centre.

The human imprint influences all components of the global environment - oceans, coastal zone, atmosphere, and land.

Dramatic though these human-driven impacts appear to be, to begin to understand their significance their rates and magnitudes must be compared to the natural patterns of variability in the Earth system. The increase

in atmospheric carbon dioxide concentration provides a useful measure to evaluate the rate and magnitude of human-driven change compared to natural variability. The human imprint on carbon dioxide is unmistakable. In December 2014, atmospheric carbon dioxide concentration stood at 399 parts per million by volume (ppmV), over 100 ppmV above the previous maximum level of around 280 ppmV recorded in the Vostok ice core. Within the current limits of resolution of the ice-core records, the present concentration has been reached at a rate at least 10 and possibly 100 times faster than carbon dioxide increases at any other time during the previous 420 000 years. Thus, in this case human-driven changes are well outside the range of natural variability exhibited by the Earth system for the last half-million years at least.

The domino effect

A single type of human-driven change triggers a large number of responses in the Earth system, which themselves cascade through the system, often merging with patterns of natural variability.

The nature of the Earth system's responses to the increasing anthropogenic forcing is more complex than simple cause-effect relationships, such as greenhouse gas emissions causing global warming.

The responses seldom follow linear chains, but more often interact with each other, sometimes damping the effects of the original human forcing and at other times amplifying them.

Fossil-fuel combustion produces a range of gases that have a large number of cascading effects. For example, carbon dioxide not only affects climate but directly affects how vegetation grows. It changes the carbonate chemistry in the ocean – the oceans are becoming more acidic, which in turn affects marine organisms. Changing carbonate chemistry is a factor in the widespread decline of coral reefs around the world. Fossil-fuel combustion also produces oxidising gases such as nitric oxide and sulphur dioxide that have well-known effects such as acidification and eutrophication of ecosystems. However, these gases can eventually contribute to changes in fundamental Earth system functioning because of their indirect effects on the radiative properties of the atmosphere, and hence climate. The mechanisms are through reactions with other gases plus their impacts on the ability of the atmosphere to cleanse itself through oxidation and other processes.

We can trace even more subtle effects back to fossil-fuel combustion. Increasing carbon dioxide levels affect the stomatal opening of terrestrial vegetation, reducing water vapour loss through the stomates. This results in higher water-use efficiency.

This effect is especially pronounced in semi-arid vegetation, and can lead to increased productivity through enhanced soil moisture. More generally, no two species react in an identical way to elevated atmospheric carbon dioxide concentration.

Like fossil-fuel combustion, land-cover and land-use change also trigger widespread cascading effects at local, regional and global scales. Global change does not operate in isolation but rather interacts with an almost bewildering array of natural variability modes and also with other human-driven effects at many scales. Especially important are those cases where interacting stresses cause a threshold to be crossed and a rapid change in state or functioning to occur.

Earth-system trends

The Great Acceleration trends support the proposal that Earth has entered a new geological epoch, the Anthropocene, coined by researchers Paul Crutzen and Eugene Stoermer in 2000. Since then, the onset of the Anthropocene has been keenly contested by geologists,

Earth System scientists and others, even though the term has not yet been formalised by the International Commission on Stratigraphy. Some say the dawn of agriculture 10,000 years ago – the Neolithic Age – is a likely candidate. Others say the industrial revolution, around the late 1700s.

The new paper argues that, "Of all the candidates for a start date for the Anthropocene, the beginning of the Great Acceleration is by far the most convincing from an Earth System science perspective. Only beyond the mid-20th century there is clear evidence for fundamental shifts in the state and functioning of the Earth System that are beyond the range of variability of the Holocene, and driven by human activities and not by natural variability."

Co-author, Dr Lisa Deutsch, Senior Lecturer at the Stockholm Resilience Centre notes that: "Of all the socio-economic trends only construction of new large dams seems to show any sign of the bending of the curves – or a slowing of the Great Acceleration. Only one Earth System trend indicates a curve that may be the result of intentional human intervention – the success story of ozone depletion. The levelling off of marine fisheries capture since the 1980s is unfortunately not due to marine stewardship, but to overfishing."

From Holocene to Anthropocene

Recent findings provide strong evidence that in recent decades key components of the Earth System have moved beyond the natural variability exhibited in the last 12,000 years, a period geologists call the Holocene. The Holocene, Latin for "entirely recent", began at the end of the last ice age and provided the stability for agriculture to develop, leading eventually to townships and cities to flourish.

The beginning of Anthropocene

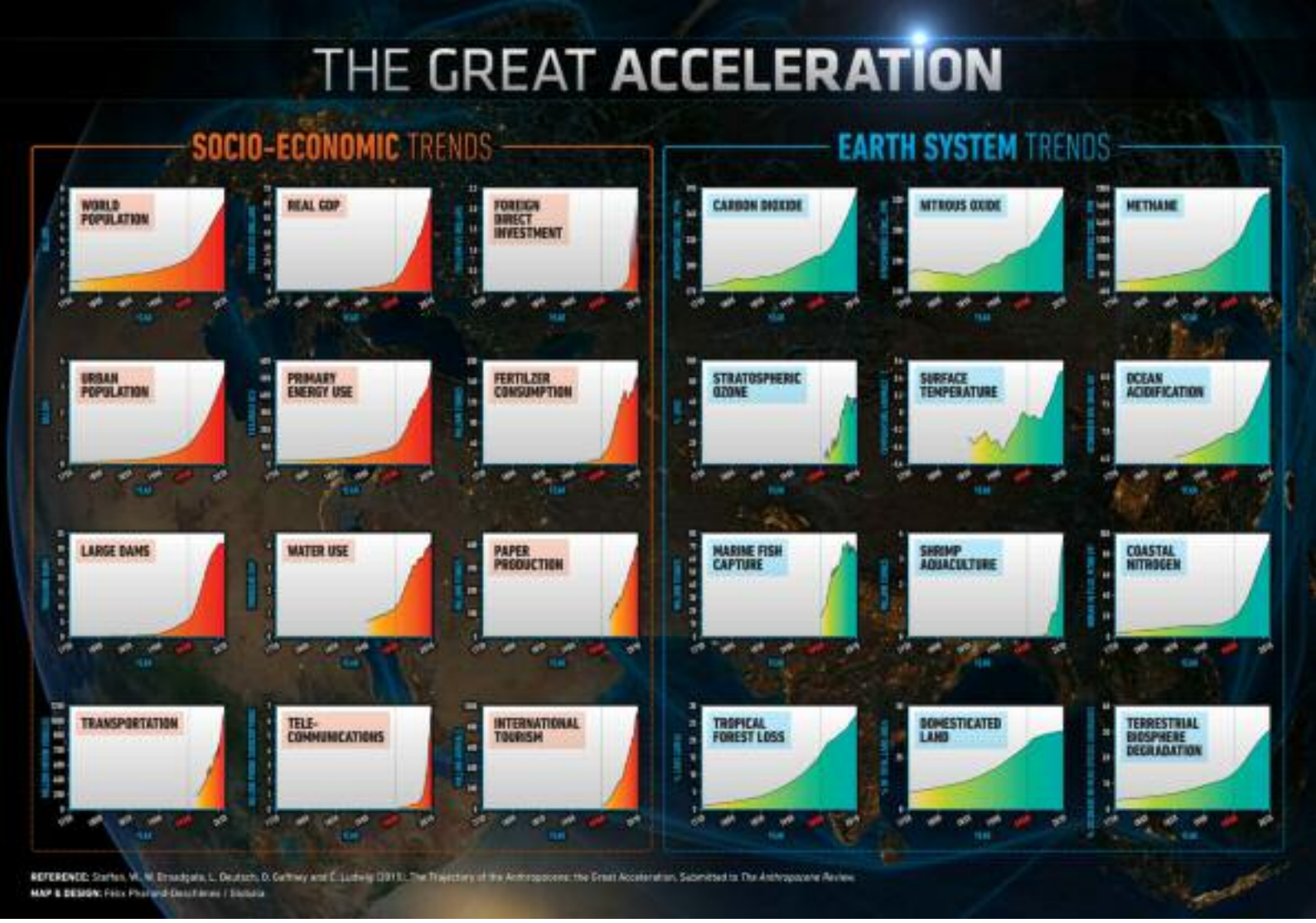
Furthermore, choosing the beginning of the Great Acceleration leads to a possible specific start date: when the first atomic bomb was detonated in the New Mexico desert on Monday 16 July 1945.

"Radioactive isotopes from this detonation were emitted to the atmosphere and spread worldwide entering the sedimentary record to provide a unique signal of the start of the Great Acceleration, a signal that is unequivocally attributable to human activities," the paper reports.

Globalisation drives

The research explores the underlying drivers of the Great Acceleration: predominantly globalisation.

Image taken form the film "Welcome to the Anthropocene" Photo: © Globaia, Planet Under Pressure, SEI, SRC, CSIRO.



The bulk of economic activity, and of consumption, remain largely within the OECD countries, which in 2010 accounted for about 74% of global GDP but only 18% of the global population.

This points to the profound scale of global inequality, which distorts the distribution of the benefits of the Great Acceleration and confounds international efforts, for example climate agreements, to deal with its impacts on the Earth System.

However, the paper shows that recently, global production, traditionally based within OECD countries, has shifted towards BRICS nations – Brazil, Russia, India, China and South Africa. Moreover, the mushrooming middle classes in BRICS nations are driving greater consumption here too.

About one half of the global population now lives in urban areas and about third of the global population has completed the transition from agrarian to industrial societies. This shift is evident in several indicators. Most of the post-2000 rise in fertilizer consumption, paper production and motor vehicles has occurred in the non-OECD world.

Planetary boundaries

Coinciding with the publication of the Great Acceleration indicators, researchers also led by Professor Steffen have published a new assessment of the concept of "planetary boundaries" in the journal Science. The international team of 18 scientists identified two core planetary boundaries: climate change and "biosphere integrity". Altering either could "drive the Earth System into a new state".

***

The International Commission on Stratigraphy has set up a working group to analyse the validity of the Anthropocene claim. Professor Steffen is a member of this working group, which is due to report its conclusions in 2016.

US Geothermal Stuck in the Mud, but 2014 Global Growth Boosts Industry

By PETE DANKO
Breaking Energy

The geothermal industry's efforts to grab a bigger slice of the growing renewable energy pie met with some success in 2014, though that wasn't reflected in the United States, where questions remain as to when – or if – geothermal might become more than a relatively small, regional player.

Previewing its latest annual report, the U.S.-based Geothermal Energy Association on Tuesday put 2014 global capacity additions at 620 megawatts. That was the most since 1997, but don't get the idea there was a big ramp-up in the industry's growth curve.

"Overall, the global geothermal industry grew at about 5% for the third year in a row, reaching 12.8 GW (gigawatts)," the GEA said in a press release. They would have loved to have seen half that rate of growth in the United States.

Thanks to a boom in the 1970s and '80s, the U.S. is the world leader in geothermal energy, with around 3.5 GW of installed capacity, but growth hasn't been so swift in recent years, especially compared to solar and wind. In 2014, the U.S. added a mere 3.5 megawatts of geothermal capacity – a 1.5 MW plant at the Oregon Institute of Technology and a 2 MW plant also in southern Oregon, the GEA reported.

Wind added nearly 5 GW in 2014. A final solar total hasn't come in yet, but around 6 GW is expected.

According to the Geothermal Energy Association, two small geothermal energy plants came online in the U.S. in 2014, including this one in Paisley, Oregon. Photo: © Surprise Valley Electric.

The GEA said U.S. "growth in geothermal power has stalled due a lack of demand for new power, meaning a lack of new power purchase agreements, and mixed messages from Washington D.C." on tax incentives for geothermal investment and production.

Geothermal energy was part of the retroactive Production Tax Credit extender that Congress put through in December, but the extension – comically or cruelly, depending on your point of view – was only until the end of 2014, rendering it moot for an industry with long development horizons.

Geothermal developers can get a 10 percent Investment Tax Credit on their project expenditures, far from the 30 percent ITC that solar developers now enjoy.

The GEA said 1,275 MW of geothermal capacity remained "under development" in the United States, with 500 MW of that in what's called "Phase 3," meaning that a developer has procured and explored a site and confirmed the resource.

Moving through permitting and initial development to resource production and plant construction requires a power purchase agreement – and that's where projects that add up to 500 MW in capacity are stuck. No PPAs. With PPAs, they could be online in 17 to 33 months, the GEA said.

Much of that Phase 3 stuff is in California's Imperial County, around the Salton Sea, already a hot-spot for geothermal.

The industry has high hopes for substantial new development there, but while California wants more renewable energy, it's a competitive field. Solar, easier to build and falling in cost, has dominated lately and utilities, on course to meet their 2020 renewable portfolio standard targets, can be a little choosey.

Last year, the geothermal industry and Imperial-area pols and groups pushed for a state carve-out for geothermal, a requirement that utilities buy 500 MW of electricity from new plants over the next decade, but it failed to make it through the legislature. Utilities opposed the bill, saying it would drive up electricity prices.

In a media briefing on Monday, GEA board member Mike Long, a senior project manager for POWER Burns and Roe, a U.S. company that does a lot of international business, said domestic PPA prices for geothermal were sometimes "under 9 cents per kilowatt-hour" ($90 per megawatt-hour).

Last August, GTM Research reported that "the first half of 2014 has seen utility-scale solar fetch PPA prices between $50 per megawatt-hour and $75 per megawatt-hour."

The industry argues that geothermal power – more flexible than intermittent solar or wind – offers benefits that aren't valued by the market as presently shaped. They're pushing for regulatory changes that will help their cause, while also looking to the EPA's Clean Power Act and Gov. Jerry Brown's plans for ratcheting up California's RPS to inspire new demand.

Meanwhile, overseas, it isn't just climate change that's driving geothermal growth; geothermal's ability to deliver raw baseload power also makes it a winner in developing countries. Kenya is a good example – the utility Kengen recently brought online 280 MW of geothermal with of a pair of new, two-unit plants at the Olkaria field (the projects were in the GEA's 2014 global total).

"Supported by the World Bank Group, Olkaria is one of the largest single geothermal investment projects in the world and geothermal is now the largest source of electricity for Kenya, ahead of hydro which has dominated the country's power supply for decades," the World Bank said. "In 2010, geothermal accounted for a mere 13% of (leading Kenya power company) Kengen's power mix."

Turkey, Indonesia and the Philippines also saw strong growth in 2014, and Latin America is expected to be another contributor in the coming years, even as it looks to take advantage of solar's improving economics.

Originally published by Breaking Energy February 24, 2015

Setting the Benchmark: The World's Most Efficient Coal-Fired Power Plants

By DAWN SANTOIANNI
Cornerstone

International efforts to mitigate climate impacts have intensely scrutinized carbon emissions from the electricity sector. Coal, in particular, has been targeted as a source of emissions that could be reduced. The International Energy Agency recognizes that "coal is an important source of energy for world...we must find ways to use coal more efficiently and to reduce its environmental footprint." With global coal demand projected to increase 15% through 2040, reducing carbon emissions from coal-fired electricity has become a policy focus in many countries as part of an overall strategy to reduce emissions. Although roughly half of new coal-fired power plants constructed during 2011 used high-efficiency low-emissions (HELE) technologies, approximately 75% of operating coal-fired units worldwide are based on less efficient, non-HELE technology.

Globally, the average efficiency of coal-fired generation is 33% HHV (higher heating value) basis or 35% LHV (lower heating value) basis. In a survey of countries worldwide, the average three-year (2009–2011) efficiency of coal-fired electric generating fleets ranged from a low of 26% in India to a high of 41% in France, normalized to LHV. Those countries that were among the first to widely deploy HELE technology now have the most efficient coal-fired fleets.

Achieving higher steam temperatures and pressures (*see Figure 1*), HELE generating units employ advanced steam path design with multiple steam turbine pressure modules to extract the maximum amount of power from the steam produced. As the steam passes through each turbine module, the pressure decreases. These modules are referred to as the high-pressure (HP), intermediate-pressure (IP), and low-pressure (LP) turbine sections. Some turbine designs feature multiple IP or LP modules, while others may have a combined HP/IP cylinder. Steam exiting the HP section is returned to heaters that increase the steam temperature (reheat) to about the primary steam temperature before undergoing further expansion through the IP section. In double-reheat turbines, the steam exiting the IP module is again reheated before passing through the LP turbine module. Reheating is used to keep the steam humidity low, pre-

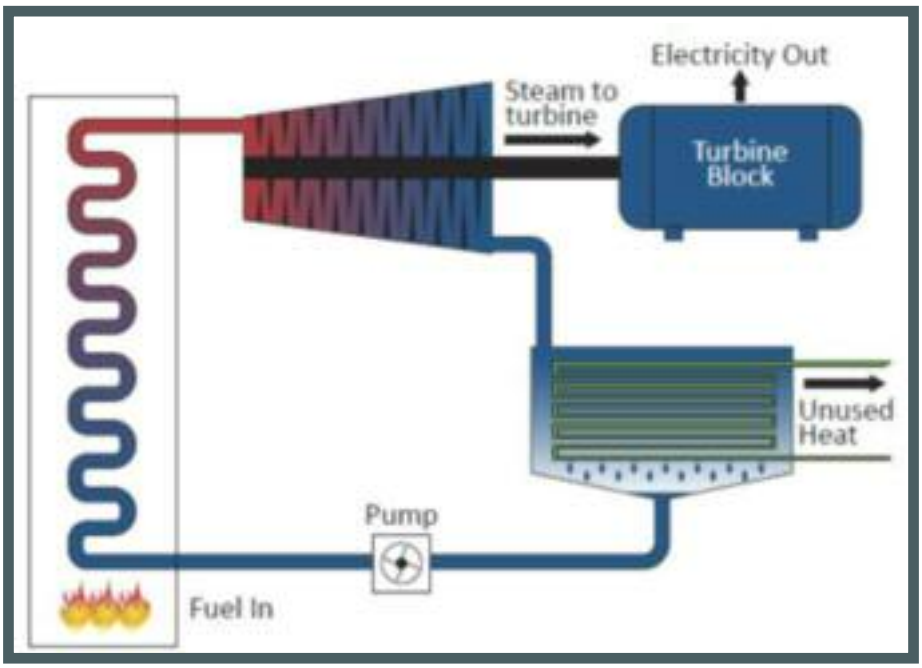


FIGURE 1. Steam cycle is at the heart of coal-fired power plant efficiency.

Nordjyllandsværket Power Station boasts the world's most efficient coal use.

venting the formation of water droplets that could damage turbine blades. Turbine blades are designed for each module to limit turbulence and efficiently convert steam kinetic energy into torque.

The upfront cost of ultra-supercritical (USC) HELE technology is 20–30% more expensive than a subcritical unit, but the greater efficiency reduces emissions and fuel costs. Therefore, USC units are being constructed where new coal-fired capacity is integral to maintaining security of energy supply while reducing emissions and also where older, less efficient fossil units are being retired. Although there are numerous examples of highly efficient coal-fired power plants around the world, four generating stations are highlighted in this article because they are particularly notable based on economic, technical, and policy perspectives.

CLAIMING THE WORLD RECORD: NORDJYLLAND POWER STATION UNIT 3, DENMARK

Nordjylland Power Station (Nordjyllandsværket) is touted by its owner Vattenfall as holding the world record for most efficient coal utilization since Unit 3 was commissioned in 1998.

Nordjyllandsværket is a combined heat and power (CHP) plant located in northern Jutland, Denmark. The decision to build Nordjylland Unit 3 was made in 1992, at a time when European energy markets were being liberalized to create an EU-wide integrated energy market. This market restructuring and competition demanded increased efficiency, improved environmental performance, and cost-effectiveness of heat and power supply. These priorities were used to determine the plant design criteria. In addition to electricity supplied to the Nordic Power Exchange, Unit 3 provides district heating to the city of Aalborg using low-pressure steam extraction.

The 400-MWe USC Unit 3 employs a 70-m-high once-through steam generator and double-reheat steam cycle. To accommodate steam pressures of 29 MPa (4200 psi) and primary and two reheat temperatures of 582°C/580°C/580°C, high-performance superalloys were used for boiler and turbine components. An impulse turbine (in which fast-moving fluid is fired through a narrow nozzle) expands the steam from 29 MPa to 0.7 MPa. The HP and IP steam paths are combined in a common HP/IP module. Steam is passed back to the boiler for reheating before it continues through the IP and LP turbine modules. With the double-reheat cycle and cold seawater for cooling, Unit 3 boasts a net electrical efficiency of 47% (LHV basis). The asymmetric double-flow IP steam path (steam is received in the center of the cylinder and discharges at the ends) is configured to suit district heating requirements. Extracted steam is passed through two heat exchangers where water from the Aalborg city grid is heated to 80–90°C. This dual use allows Unit 3 to utilize up to 91% of the energy content in the bituminous coals it burns.

BRIDGING THE ENERGY GAP: TRIANEL KOHLEKRAFTWERK LÜNEN, GERMANY

In a country where the transition to renewable energy is being spurred by government investment, building a new coal-fired power plant might seem incongruous. However, the shutdown of Germany's nuclear plants is

presenting challenges to maintaining a reliable and dispatchable power supply. Many of Germany's existing fossil-fueled power plants are over 25 years old—replacing aging plants with more efficient generation also supports the country's decarbonization efforts. Construction of the €1.4 billion Lünen plant in North-Rhine Westphalia began in 2008; the plant has been delivering power to the electric grid since December 2013. Lünen is owned by Trianel Kohlekraftwerk Lünen GmbH & Co. KG, a consortium of 31 municipal utilities and energy providers. The plant was built to allow the municipal utilities to be independent and ensure a safe and affordable energy supply for 1.6 million households.

Kohlekraftwerk Lünen power plant Photo: © Trianel

The 750-MW Lünen plant has a USC tower-type once-through boiler that burns low-sulfur hard coal delivered via canal. Main steam is produced at 28 MPa (4060 psi) and 600°C. The Siemens SST5-6000 steam turbine has one HP, one IP, and two LP cylinders. The plant uses Siemens' advanced 3DV technology (three-dimensional design with variable reaction levels) for the HP and IP blades, which optimizes stage reaction and loading to achieve the highest efficiencies. Using USC technology, the Lünen plant has saved over one million tons of CO2per year compared to the average German coal-fired power plant.

In addition to supplying electricity, steam is extracted to heat water for district heating purposes. The plant has an electrical efficiency of nearly 46% (LHV basis) while meeting stringent German environmental requirements, making it the cleanest hard coal-fired power plant in Europe.

While Lünen is one of the most efficient coal-fired power plants in Europe, what makes it particularly notable is the ability of Unit 3 to ramp quickly, making it ideally suited to balance intermittent wind and solar loads.

To remove the ramping constraint posed by heat transfer into thick-walled HP turbine components, an internal bypass cooling system allows a small amount of cooling steam to pass through radial bores between the HP casings. This system protects the casing surfaces so the wall thickness could be less than without the cooling steam. This design also effectively allows more rapid heat-up (and thus startup) of the turbine.

FIRST USC IN THE U.S.: JOHN W. TURK JR. POWER PLANT

The 600-MW John W. Turk Jr. power plant in Arkansas holds many distinctions. Completed in December 2012, it was the first USC plant built in the U.S. It also reigns as the country's most efficient coal-fired power plant with an electrical efficiency of 40% HHV basis (~42% LHV basis).

After the project was announced in 2006, American Electric Power's (AEP) Southwestern Electric Power Co. (SWEPCO) spent several years trying to secure the necessary permits while fighting legal battles launched as part of national anti-coal campaigns. Under the legal settlement, SWEPCO agreed to retire an older 582-MW coal-fired unit in Texas, secure 400 MW of renewable power, and set aside US$10 million for land conservation and energy efficiency projects. At a final cost of US$1.8 billion to build the plant, the Turk plant also became the most expensive project ever built in Arkansas.

The Turk plant burns low-sulfur subbituminous coal in a spiral-wound universal pressure-type boiler, producing steam at 26.2 MPa (3789 psi) and 600°C. The plant has an Alstom STF60 single-reheat four-casing turbine with a single-flow HP section, double-flow IP section, and two double-flow LP sections. Using separate cylinders for the HP and IP turbines allowed the number of stages to be increased by about 25% compared to a subcritical steam turbine. The Turk steam turbine was

manufactured such that different superalloys were selected for each section of the rotor to match the exact steam conditions with a specific stage on the rotor, allowing faster startups. The Turk plant is equipped with state-of-the-art emissions control technologies, including a selective catalytic reduction (SCR) system, flue gas desulfurization (FGD), fabric filter baghouse, and activated carbon injection. With inexpensive natural gas and proposed carbon standards for new power plants that would require carbon capture for coal-fired units, permitting another HELE plant in the U.S. could be extremely difficult for economic reasons. Thus, despite its efficiency and excellent environmental performance, the Turk plant may be the last HELE plant built in the U.S. for the foreseeable future.

SETTING THE STANDARD FOR CLEAN COAL: ISOGO NEW UNITS 1 & 2, JAPAN

The Isogo Thermal Power Station is located only six kilometers from Yokohama, the second largest city in Japan. The power station originally consisted of two 1960s-vintage 265-MW subcritical units. During the late 1990s, Yokohama's environmental improvement plans aimed to enhance the stability of electric power supply while retiring older facilities. Electric Power Development Co., Ltd. (J-POWER), which owns and operates Isogo, entered into a pollution prevention agreement with the city. The new USC Unit 1 (600 MW) was built while the original facility remained in operation, becoming operational itself in 2002. The two older units were then shut down and demolished. The new USC Unit 2 (also 600 MW) was constructed on the site of the old plant and started commercial operation in 2009. Isogo Unit 2 operates at 25 MPa (3626 psi) and 600°C/620°C reheat achieving 45% efficiency, while Unit 1 operates at a slightly lower 600°C/610°C. Completion of both units more than doubled the power generated at the small peninsula site while lowering emissions levels to that of a natural gas-fired combined-cycle plant.

Combined, the two larger new units emit 50% less SOx, 80% less NOx, 70% less particulate, and 17% less CO2 than the older subcritical units that were replaced. The reduction in criteria emissions has been accomplished using a multipollutant regenerative activated coke dry-type control technology (ReACTTM) that captures SOx, mercury, and NOx while only using 1% of the water required by conventional wet FGD systems.

ReACTTM technology consists of a moving bed adsorber with activated coke pellets downstream of the electrostatic precipitator. Mercury, SOx, and NOx are adsorbed onto the carbon pellets with ammonia injected to promote the nitrogen and sulfur reactions. In addition, the ReACTTM system offers a secondary method of particulate control as the flue gas impinges on the coke pellets. Activated coke from the adsorber is regenerated to reduce NOx to N2 and drive off SOx. In the process, the concentrated sulfur-rich gas stream created is used to produce sulfuric acid as a byproduct for commercial sale. Isogo's Unit 2 has permit levels of 10 ppm and 13 ppm for SO2 and NOx, respectively, and usually achieves single-digit ppm concentration emissions. The system provides such exceptional pollution control that Isogo is ranked the cleanest coal-fired power plant in the world in terms of emissions intensity.

THE FUTURE OF HELE TECHNOLOGY

With USC well established, R&D is underway to increase steam temperatures to 700°C and beyond, which could achieve coal-fired efficiencies as high as 50%. Known as advanced ultra-supercritical technology (AUSC), such high pressures and temperatures will require more advanced (nickel or nickel-iron) superalloys that are expensive and currently present fabrication and welding challenges. In early 2014, Alstom and Southern Company (U.S.) announced a milestone in the development of AUSC, with steam loop temperatures maintained at 760°C for 17,000 hours during a trial at Plant Barry Unit 4 in Alabama. The loop contained an array of different superalloys and surface coatings that enabled it to withstand the exceedingly high temperatures within the boiler.

Further advances in HELE technology, material science, and emissions control will enable coal-fired power to retain a primary role in future power systems.

Originally published
in Cornerstonemag.net
January 29, 2015


Conference 2015
Communicating Geography: serving our world
21-22 May 2015, Ankara, Turkye

Study identifies which fossil fuel reserves must stay in the ground to avoid dangerous climate change

By REBECCA CAYGILL
UCL Institute for Sustainable Resources

A third of oil reserves, half of gas reserves and over 80% of current coal reserves globally should remain in the ground and not be used before 2050 if global warming is to stay below the 2°C target agreed by policy makers, according to new research by the UCL Institute for Sustainable Resources.

The study funded by the UK Energy Research Centre, also identifies the geographic location of existing reserves that should remain unused and so sets out the regions that stand to lose most from achieving the 2°C goal.

The authors show that the overwhelming majority of the huge coal reserves in China, Russia and the United States should remain unused along with over 260 thousand million barrels oil reserves in the Middle East, equivalent to all of the oil reserves held by Saudi Arabia. The Middle East should also leave over 60% of its gas reserves in the ground. The development of resources in the Arctic and any increase in unconventional oil – oil of a poor quality which is hard to extract – are also found to be inconsistent with efforts to limit climate change.

For the study, the scientists first developed an innovative method for estimating the quantities, locations and nature of the world's oil, gas and coal reserves and resources. They then used an integrated assessment model to explore which of these, along with low-carbon energy sources, should be used up to 2050 to meet the world's energy needs. The model, which uses an internationally-recognised modelling framework, has multiple improvements on previous models, allowing it to provide a world-leading representation of the long-term production dynamics and resource potential of fossil fuels. Lead author Dr Christophe McGlade said: "We've now got tangible figures of the quantities and locations of fossil fuels that should remain unused in trying to keep within the 2°C temperature limit."

Co-author Professor Paul Ekins said: "Companies spent over $670 billion (£430 billion) last year searching for and developing new fossil fuel resources. They will need to rethink such substantial budgets if policies are implemented to support the 2oC limit, especially as new discoveries cannot lead to increased aggregate production."

The scientists' analysis shows that their results are consistent with a wide variety of alternative modelling approaches from groups across the world with differing assumptions. Building on this analysis, their future work aims to investigate further the shifts in cumulative fossil fuel production between scenarios that lead to different long-term average global temperature rises. Now that's a Story to Watch.

Originally published by UCL January 7, 2015

Sperrgebiet

Kolmanskop is located in Namibia's "Sperrgebiet" (*forbidden territory*). In 1908 a sparkling stone was found amongst the sand, just next to the railway line near the Kolmanskop village. It was a diamond. The village soon developed into an African version of a German town. Kolmanskop's decline began soon after World War I - when diamond prices collapsed. It didn't help that richer diamond sites were discovered further south in Oranjemund. And mining operations were moved there. In less than 50 years Kolmanskop lived, reached its pinnacle and died. In 1980, the mining company De Beers, restored a number of buildings and opened a museum.

International Sulcis

CCS Summer School

3rd edition

The International Sulcis CCS Summer School website http://www.sulcisccssummerschool.it

Carbon Capture & Storage
Summer School

Monday, July 13th, 2015
Introduction to CCS

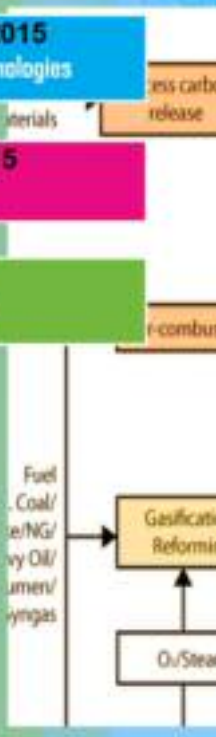
Tuesday, July 14th, 2015
CO_2 capture approaches and technologies

Wednesday, July 15th, 2015
CO_2 utilization and transport technologies

Thursday, July 16th, 2015
CO_2 storage

Friday, July 17th, 2015
Costs and CCS diffusion potential

The interest in the Sulcis CCS Summer School can easily be explained by the growing attention worldwide for the technologies of separation and containment of carbon dioxide (so-called CCS - "Carbon Capture and Storage"). The lecture programme will cover the range of techniques developed for the capture, transport and geological storage of CO2, for which the Sulcis basin is the ideal laboratory for experimentation. It is one of the few sites in the world potentially able to accommodate large amounts of carbon dioxide with almost no environmental risks, thanks to the presence of deep layers of coal (suitable for the permanent storage of large quantities of CO2 due to its peculiar geological features) and also of an aquifer underneath the coal basin.



Centro Ricerche Sotacarbo
Grande Miniera di Serbariu
Carbonia, Italy

13-17 July 2015

ENEA
Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile

SOTACARBO

IEA CLEAN COAL CENTRE

CO2 GeoNet

FUNDED BY

REGIONE AUTÒNOMA DE SARDIGNA
REGIONE AUTONOMA DELLA SARDEGNA

Ministero dello Sviluppo Economico

www.onlynaturalenergy.com
info@onlynaturalenergy.com