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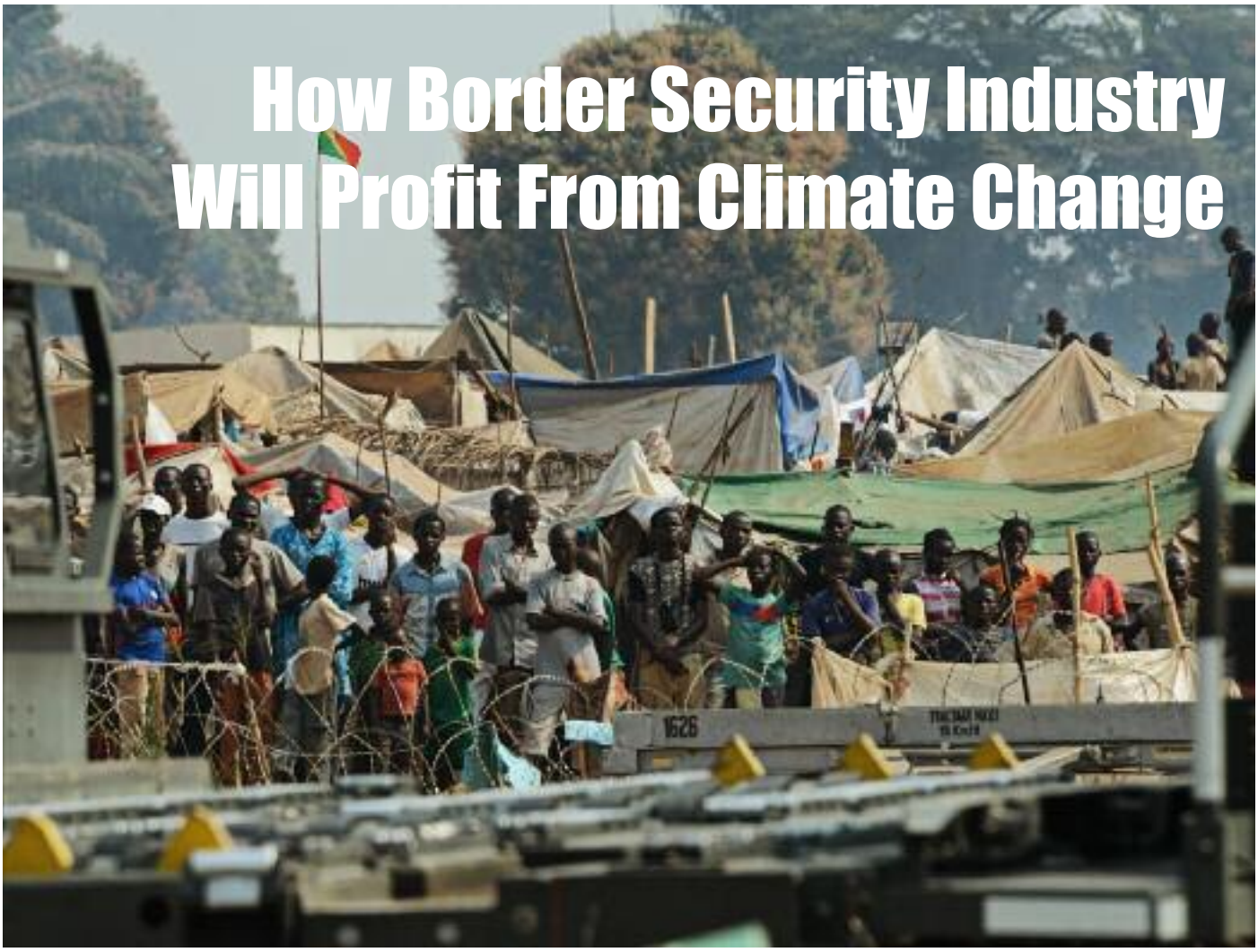

How Border Security Industry Will Profit From Climate Change

The Arctic (just begun) Challenge

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Only Natural Energy

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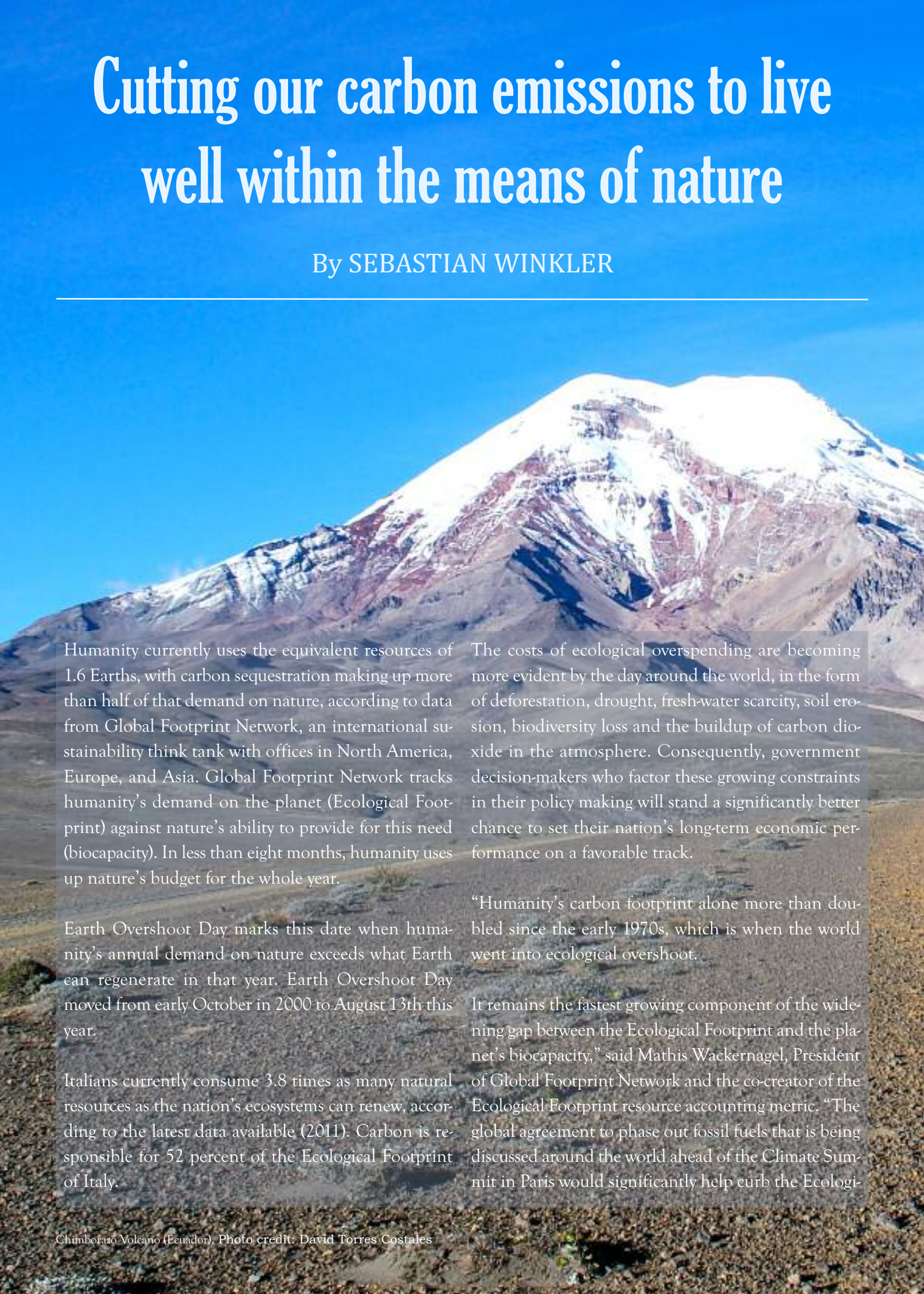
Cutting our carbon emissions to live well within the means of nature

By SEBASTIAN WINKLER



Humanity currently uses the equivalent resources of 1.6 Earths, with carbon sequestration making up more than half of that demand on nature, according to data from Global Footprint Network, an international sustainability think tank with offices in North America, Europe, and Asia. Global Footprint Network tracks humanity's demand on the planet (Ecological Footprint) against nature's ability to provide for this need (biocapacity). In less than eight months, humanity uses up nature's budget for the whole year.

Earth Overshoot Day marks this date when humanity's annual demand on nature exceeds what Earth can regenerate in that year. Earth Overshoot Day moved from early October in 2000 to August 13th this year.

Italians currently consume 3.8 times as many natural resources as the nation's ecosystems can renew, according to the latest data available (2011). Carbon is responsible for 52 percent of the Ecological Footprint of Italy.

The costs of ecological overspending are becoming more evident by the day around the world, in the form of deforestation, drought, fresh-water scarcity, soil erosion, biodiversity loss and the buildup of carbon dioxide in the atmosphere. Consequently, government decision-makers who factor these growing constraints in their policy making will stand a significantly better chance to set their nation's long-term economic performance on a favorable track.

"Humanity's carbon footprint alone more than doubled since the early 1970s, which is when the world went into ecological overshoot.

It remains the fastest growing component of the widening gap between the Ecological Footprint and the planet's biocapacity," said Mathis Wackernagel, President of Global Footprint Network and the co-creator of the Ecological Footprint resource accounting metric. "The global agreement to phase out fossil fuels that is being discussed around the world ahead of the Climate Summit in Paris would significantly help curb the Ecologi-

Chimborazo Volcano (Ecuador). Photo credit: David Torres Costales

cal Footprint's consistent growth and eventually shrink the Footprint." The carbon footprint is inextricably linked to the other components of the Ecological Footprint – cropland, grazing land, forests and productive land built over with buildings and roads. All these demands compete for space. As more is being demanded for food and timber products, fewer productive areas are available to absorb carbon from fossil fuel. It means carbon emissions accumulate in the atmosphere rather than being entirely absorbed.

A Second Chance

The main focus of the climate agreement at the United Nations Conference of Parties (COP) 21 this December is on maintaining global warming within the 2-degrees-Celsius range over pre-Industrial Revolution levels. This shared goal will require nations to implement policies to completely phase out fossil fuels by 2070, per the recommendations of the U.N.'s Intergovernmental Panel on Climate Change (IPCC), directly impacting the Ecological Footprints of nations.

Assuming global carbon emissions are reduced by at least 30 percent below today's levels by 2030, in keeping with the IPCC's suggested scenario, Earth Overshoot Day could be moved back on the calendar to September 16, 2030 (assuming the rest of the Footprint would continue to expand at the current rate), according to Global Footprint Network.

This is not impossible. While Italy's carbon Footprint has remained flat since the 1990s, Denmark, for instance, has reduced its carbon emissions by 33 percent. Had the world done the same (while not changing the rest of the Footprint), Earth Overshoot Day would have been on October 3 this year.

It is not to say that Denmark has already reached a sustainable Ecological Footprint. Humanity would require the resources of nearly three planets if everyone lived like the Danes, which would move Earth Overshoot Day to May 8.

Business As Usual

By contrast, business as usual would mean using the resources equivalent to two planets by 2030, with Earth Overshoot Day moving up on the calendar to the end of June. This projection assumes that biocapacity, population growth, and consumption trends remain on their current trajectories. However, it is not clear whether a sustained level of overuse is possible without significantly damaging long-term biocapacity, with consequent impacts on consumption and population growth.

Tipping Point

"We are encouraged by the recent developments on the front line of renewable energy, which have been accelerating worldwide, and by the increasing awareness of the finance industry that a low-carbon economy is the way of the future," said Wackernagel. "Going forward, we cannot stress enough the vital importance of reducing the carbon footprint. It is not just good for the world, but increasingly becoming an economic necessity for each nation. We all know that the climate depends on it, but that is not the full story: Sustainability requires that everyone live well, within the means of one planet. This can only be achieved by keeping our Ecological Footprint within our planet's resource budget." ONE

Additional Resources

To calculate your own personal Ecological Footprint, and learn what you can do to reduce it, go to www.footprintcalculator.org

(Ecological Footprint Data on 182 countries): www.footprintnetwork.org/public2015

About Global Footprint Network

Global Footprint Network is an international think tank working to drive informed, sustainable policy decisions in a world of limited resources. Together with its partners, Global Footprint Network coordinates research, develops methodological standards, and provides decision-makers with a menu of tools to help the human economy operate within Earth's ecological limits.

We Shell Overcome, Someday

Late this September Shell announced it was shelving its Arctic oil and gas operations off the coast of Alaska – for now. The Arctic is so tantalising for many reasons and the recent knock back to Shell is unlikely to deter it or rival companies from further forays.

By JEZ ABBOTT

Arctic Sunset. Taken in Tromsø Kommune. Photo credit: PJ HANSEN

The Arctic holds around 30% of the world's undiscovered natural gas, 13% of its oil and 22% of its natural gas liquids, all of which are yet to be found, according to the US Geological Survey. In more tangible terms this amounts to around 400 billion barrels of oil equivalent, which to date is 10 times the total oil and gas produced in the North Sea. Tapping into the resources of the icy polar region at the northernmost tip of the Earth could be crucial to securing future energy supplies. But it means balancing economic, environmental and social challenges, admits one of the companies keen to drill. Last August the Obama administration gave the go-ahead to Royal Dutch Shell to drill for oil in the Chukchi Sea, about 100 miles off the north-west coast of Alaska.

The permission, met with optimism and outrage, meant Shell could start drilling exploratory wells on what is described as one of the best prospective offshore areas in the world. Shell signalled its intention to do just that: drill to depths of about 8,000ft below the ocean bed to strike black gold. Protesters saw red, fearing damage to the Arctic's delicate environment, possible oil spills and further global warming. The Bureau of Ocean Energy Management in the US reckons there is a fair chance of "one or more large spills" if extensive drilling takes place across the Arctic.

Shell didn't flinch, dispatching its first ship this June as part of a fleet to spearhead exploratory drilling for gas and oil. The Arctic Challenger, one of dozens of support vessels for the oil rigs, set sail from Seattle for the frigid waters off Alaska, with Shell aiming to drill from two platforms.

And then it stopped. Late this September Shell announced it was shelving its Arctic oil and gas operations off the coast of Alaska – for now. The company cited disappointing test results and a challenging regulatory environment. While there were indications of oil and gas reserves in the exploration well in the Chukchi Sea, the amount was not sufficient enough to justify further drilling. However, Shell "continues to see important exploration potential" and given its investment, the oil giant it is likely to be back.The Chukchi Sea, north of the Bering Strait, spans from Alaska to Siberia and Shell is spending more than $1 billion a year – well over $7 billion so far and counting on probably the most expensive well on earth. It has yet to yield one, single barrel of crude oil.

And it isn't the first drilling in this corner of the Arctic. Around 30 offshore wells went down in the Beaufort Sea in the 1980s and 1990s, and five in the Chukchi. None produced oil or gas, mainly because oil prices halved over that time period, putting the frighteners on further exploration. But as climate change renders the Arctic increasingly accessible, there has been a "substan-

tial uptick" in industry interest in the region, according to the US policy think tank the Wilson Centre. It is believed an estimated $100 billion could be invested in the Arctic over the next decade.

The Arctic is so tantalising for many reasons and the recent knock back to Shell is unlikely to deter it or rival companies from further forays. First: the shear amount of crude oil – at least a fifth of the world's undiscovered crude oil and natural gas - is thought to be holed up. Second: it could offer more energy security for USA, where crude production is expected to fall to the dreaded one-million-barrel-a-day threshold by 2040. Third: large stretches of the Chukchi Sea are shallow, no deeper than 200ft.

The Arctic "represents the final frontier of conventional hydrocarbon development", adds the Wilson Centre. But even sympathetic observers gasp at the challenge. Chevron, ConocoPhillips, Total, Statoil and ExxonMobil have all slapped holding orders on exploration plans. Nick Butler, a former BP strategy executive and an energy researcher at King's College London, warns exploration is "a dangerous wager". He told Bloomberg Business: "Given the environmental and regulatory risks in the Arctic and the cost of producing in that difficult setting - assuming they ever get to producing - Shell must anticipate an enormous find, and and future oil prices much higher than they are today."

And cutting across the haunting waterscapes echoes the voice of Greenpeace Arctic campaigner Ian Duff: "All the evidence shows Shell can't drill safely in the Arctic. The extreme conditions mean it's when, not if, a spill will happen."

This August Greenpeace launched a boycott against Shell, urging consumers not refuel at Shell stations for 40 days, until 27 September. Greenpeace Netherlands campaign manager for climate and energy Faiza Oulahsen insisted there was a 75% chance of an oil spill from drilling in the area. Shell hit back, insisting that fears of man-made global warming should not put the Arctic off limits.

Even as the world shifts to alternative energy sources, it will still need oil for decades to come, it argues. If production happens in US waters it can be controlled and done the right way, insists Shell. The company vowed it was "committed to operating in a safe, environmentally responsible manner".

Meanwhile the green light from the Obama administration is likely to trigger more activity, with Imperial Oil, Rosneft and Russian state-run Gazprom all keen to take to the waters. It also triggered problems closer to home for the American president. In a split with her boss, Hillary Clinton took to Twitter to warn the dangers of drilling in the

Greenpeace "Save the Arctic" campaign. Photo credit: ENSO London

Arctic outweighed the potential rewards because the Arctic was "a unique treasure", not worth risking for the sake of drilling.

It also went against the Obama grain: less than a month before his decision on the Arctic, the president ordered big cuts in emissions from power plants in a bid to slow climate change.

Such mixed messages have been leaped upon by campaigning groups. These include climate-activist group 350.org. Executive director May Boeve explains: "If this White House is serious about its legacy on climate action, it's time to stop the doublespeak and finally begin aligning the action with the rhetoric."

More campaigning rhetoric came from Britain's Green Party energy spokesman Andrew Cooper, who lamented: "It is incredibly disappointing to see Shell being given the green light for this risky and environmentally destructive endeavour.

"It comes at a time when governments should be doing all they can to curb the use and extraction of fossil fuels. And it is especially disheartening to see this project given the go-ahead so soon after president Obama appeared to be making positive steps towards tackling climate change."

Fears about Shell's Arctic venture spring in part from the ongoing trauma of the Deepwater Horizon disaster in the Gulf of Mexico five years ago. BP, which operated that well, has only recently reached an $18.7 billion compensation settlement.

Environmentalists warn that any such spill in the Arctic would be far more difficult to handle, not least because colder water would stop any natural breaking down of the oil. Shell counters by insisting it has capping stacks, which could fit over a failed blowout preventer if necessary.

The energy giant's president Marvin Odum remains confident the $7 billion gamble will pay off. Extraction, if it ever happens, won't start until 2030, by which time he speculates oil prices will have risen enough from their current $50 a barrel to justify the enormous cost of an Arctic project.

Odum also reckons Shell can handle any accident that might strike during exploration or extraction: "We can respond to a spill within an hour, which is unmatched anywhere in the world," he assured NBC News just before pulling the plug, for the time being, on this latest venture.

He remains resolute: "My reputation is staked on that. And the reputation of the company is staked on that."

How the Border Security Industry Will Profit Hugely From Climate Change

By TODD MILLER and ALEX DEVOID

In These Times

April 24, at the Defense, National Security, and Climate Change Symposium in Washington, D.C., Brigadier General Stephen Cheney stepped up to the podium to discuss "conflict and climate change." Although Cheney is CEO of the American Security Project think tank, he identifies first as a retired Marine who likes to talk about "war fighting." That's fitting for a gathering that revolved around the "war on climate change"—a phrase used by journalist Cyril Mychalejko to describe the tendency to fit the world's coming climatological upheavals into a "national security framework."

Denialism still holds some sway in Congress, with seven GOP senators expressing outrage in May that FEMA asked states to plan for climate change, but among the military and defense technology elites gathered at the symposium, no time was wasted on debating the science. Instead, the Obama administration's warning in February that the warming of the planet is "an urgent and growing threat to our national security" set the agenda. Much of the talk revolved around beefing up military infrastructure at home and abroad to be resistant to harsher climates. The army has embarked on a "Net Zero" initiative to make its U.S. bases water-and energy-independent through green technology, and it is conducting a review to assess the vulnerability of its 7,000-some overseas bases to climate change. However, it didn't take long for Cheney, like many speakers at the twoday event, to zero in on migration. "We know for a fact that [climate change] is already driving internal and cross-border migration," Cheney said to his audience of government officials—heavy on the Department of Defense—and industry reps from military contractors such as Lockheed Martin and Booz Allen Hamilton.

That's true: Scientists estimate that in Bangladesh, the "ground zero" of global warming, rising sea levels could displace 15 million people by 2050.Oxford University's Norman Myers has projected that there could be as many as 200 million "climate refugees" by mid-century, though other researchers have argued that this number is inflated. It's not just that climate change displaces people through floods, storms and rising sea levels; it also displaces them through scarcity of food and water, and by the conflicts that are in turn sparked by scarcity and migration. Sociologist Christian Parenti calls this "collision" of political, economic and ecological disasters the "catastrophic convergence."

Cheney's symposium presentation could have been billed as a PowerPoint tour of the world's catastrophic convergences. The desertification in the borderlands between Chad and Nigeria "has caused a lot of migration," Cheney said, and the terror organization Boko Haram "is simply taking advantage of that."

"One of the important drivers of strife," he noted, is "high prices and drought." A drought of "unparalleled length and severity" in Syria in the mid- 2000s, he ex-

"We know for a fact that [climate change] is already driving internal and cross-border migration"

Women wash the dishes in the droughtstricken Guacerique river outside Tegucigalpa, Honduras, on June 2. The drought has decimated crops and cattle, sending migrants north. Photo: © Inthesetimes

plained, led to the mass internal migration of 1.5 million people from rural to urban areas, such as Damascus, "where they had no jobs, no food—that's what started and fomented the civil war." Now, Syrian refugees are flooding into Europe.

Currently, international law does not grant refugee status to those driven from their homes by disasters or climate change. Jane McAdam, an expert on refugee law at the University of New South Wales in Sydney told Bloomberg News in March that there is "little political will among governments to create new categories of people requiring protection." She noted that a 2011 effort by the UN refugee agency to craft a global framework for handling climate change and disaster-driven displacement went nowhere. However, some see a hopeful legal precedent in a 2014 case in which New Zealand granted residency to a refugee family from the island nation of Tuvalu, which is being swallowed by rising seas. Many at the Defense, National Security & Climate Change Symposium showed sympathy for those whose massive displacement seems inevitable. However, for the most part, this climate refugee upsurge was presented as one national security menace, among many, to be managed.

The Department of Homeland Security's Climate Action Plan, in effect since 2013, acknowledges that it may be necessary to prepare U.S. borders for "frequent, short-term, disaster-driven migration." The plan anticipates increased population movements, "both legal and illegal, across the U.S. border," because of "severe droughts and tropical storms," particularly in Mexico, Central America and the Caribbean.

The ongoing drought in Honduras, Guatemala and El

The drought(here in San Francisco Libre, Nicaragua) is affecting large areas of Central America. Photo: © Sean Hawkey

Salvador, for example, caused massive crop failures this year, likely adding to the influx of migrants already heading for the United States to escape extreme violence and poverty. In the post-9/11 era, the Mexican border has been a place where three key U.S. foreign policy initiatives have converged: the war on drugs, the war on terror and the war on immigrants. To those a fourth can be added: the war on climate refugees.

Is that a camera in your cactus?

For companies like Northrop Grumman and General Dynamics Mission Systems attending the ninth annual Border Security Expo in Phoenix in April, that war on climate refugees spells a profitable business opportunity. The expo offered a dizzying look at our sprawling border-security industry.

More than 100 vendors filled a crowded exhibition hall in Phoenix with gadgets and displays that look like science fiction. Technologies range from miniature drones to motion sensors to mounted machine guns to spherical robots (originally designed by NASA to explore the planet Mars). This is where Homeland Security high brass meets private industry, and where a developing government-industry nexus envisions the future of the U.S. borderlands. What looks like a pile of rocks on one table is actually a surveillance camera. And rocks are just a small sample of what the engineering company Gans & Pugh Associates can create from fiberglass to disguise surveillance equipment.

"[A] log, all kinds of things. You name it. We basically need a sample or a picture ... and you tell us what you want to put in it," said the company's vendor. He declined to name a specific price, saying it ranges depending on the order size. TimberSpy's specialty is the surveillance-camera tree stump, perfect for patrolling the deforested "Montana border" against encroaching Canadians. At the Expo, TimberSpy employee Kurt Ludwigsen told Fox10 local news that two of their tree stump models are large enough for agents to hide inside.

Eyesight Surveillance has manufactured wireless cameras and motion sensors that can be concealed in, for example, one of Arizona's majestic saguaro cacti. "We just had some Border Patrol guys through here looking at this stuff say, 'Why don't we have this?' " said Eyesi-

ght's vendor. No panels focused on climate change, but there were many references to increases in migration. Former Customs and Border Protection (CBP) Commissioner David Aguilar told an audience of industry representatives during a panel, "Don't forget to look at what's happening tomorrow," citing the possibility of "imminent" and "dramatic" cross-border traffic. Later, in the keynote speech, Mark Borkowski, CBP's assistant commissioner and chief acquisition executive, told the audience of industry reps that the agency is "interested in [their] ideas on how to innovate."

Those innovations will add to what is already the most massive border enforcement apparatus in U.S. history. Never before have there been so many hundreds of miles of walls and barriers and concentrated surveillance technologies on the U.S.-Mexico border. Never before have so many U.S. Border Patrol agents policed that border:

Their ranks have swelled from 3,500 in the early 1990s to more than 18,000 today. During the past decade, the combined annual U.S. budgets for Immigration and Customs Enforcement and CBP have increased from $9.5 billion ($11.5 billion in today's dollars) in 2005 to more than $18 billion in 2015. The fiscal year 2015 budget request includes an increase of $90 million to upgrade remote and video surveillance programs. All of this spells a windfall for companies like Lockheed Martin and Boeing, which have received tens of millions of dollars in border-security contracts.

With denialism still ruling the day in Congress, the words "climate change" don't appear anywhere in the FY2015 budget request for CBP or ICE, but it appears that at least some parts of the federal government are taking measures to prepare for our rapidly changing weather patterns. Unfortunately, those preparations are most likely to benefit the likes of Boeing—not the millions worldwide who are most vulnerable.

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Suez Canal. Photo: © Hassan Ammar for AP

Egypt revives Suez dream amid global trade slump and escalating insurgency

By AMBROSE EVANS-PRITCHARD

The Telegraph

The Suez Canal enables a 44% reduction of the CO2 emissions compared to what would be released if vessels were sailing by the Cape of Good Hope. On the "Mexico line", this reduction reaches 68%.

Egypt has revived the Suez Canal on a grand scale with a flourish of patriotic fervour, vowing to reignite world trade almost a century and a half after the legendary waterway first opened.

The $8.2bn construction blitz adds a second shipping lane along a 45-mile stretch, allowing traffic to move in both directions. It shaves 11 hours off the journey and increases capacity by a quarter to 99 vessels a day.

The project was rushed through in less than a year – a third of the original estimate – in an engineering coup that enlisted three-quarters of all dredgers in existence to scoop out a new passage through the Great Bitter Lake.

President Abdel Fattah al-Sisi called the enlarged canal a "gift to the world" at an opening event with global leaders in the port of Ismailia, protected by a massive security blanket to fend off possible terrorist attacks from ISIS forces in the Sinai.

While the Egyptian government was at pains to stress that the country is safe, the event was overshadowed by ISIS threats to execute a Croatian engineer seized on the streets of Cairo if the state fails to release "Muslim women" prisoners within 48 hours.

Funding for the canal was raised by the Egyptian people in just eight days, with even the poorest buying interest-bearing certificates for as little as 80p. Cairo hopes to boost canal earnings from $5.3bn to $12.3bn by 2023.

Despite the display of national esprit – what the great Arab philosopher Ibn Khaldoun termed "asabiyah" - it is far from clear whether the venture will pay for itself. "It's all propaganda. There was no viability study done," said Ahmed Kamaly, an economist at Cairo's American University.

The average number of ships last year was 47 a day, well below the maximum capacity. The growth in world trade has stalled as China comes off the boil and shifts from heavy industry to a service-led economy.
The Swiss bank UBS says the "import-component" of China's exports has dropped to 33pc from 60pc in the mid-1990s, cutting reliance on shipped goods to drive economic growth.

The canal can no longer hope to attract booming shipments of liquefied natural gas (LNG). America plans to export LNG directly to Europe in growing volumes, effectively pushing LNG from Qatar and Asian suppliers towards markets in the Far East.

President al-Sisi has seized on the Suez venture to rally the nation and project a can-do confidence, hoping to pull the country out of a deep economic crisis with the shock therapy of free market reforms – the Arab world's answer to Chile's Augusto Pinochet.

He has already taken advantage of low oil prices to slash fuel subsidies and called for an "Islamic Reformation" to restore the historic dynamism of the Middle East and lift the Muslim world out of an economic cul-de-sac.
Yet the task is daunting. Egypt's public debt is almost 90pc of GDP, near the danger level for a developing country with thin capital markets. The budget deficit is 11pc of GDP. Foreign reserves are a wafer-thin $22bn, covering four months of imports.

The economy is being kept afloat by $25bn in annual aid from Saudi Arabia and the Gulf states, a source of funding that is increasingly in doubt as the oil slump drags on.

President al-Sisi hopes to capitalize on the presence of French president Francois Hollande and other Western politicians at the Suez ceremony to legitimize his gover-

nment, despite the bloody overthrow of the elected Muslim Brotherhood two years ago and human rights abuses on a systemic scale.

There is outrage across the world at the death penalty imposed on former president Mohamed Morsi and hundreds of his supporters. But global leaders are biting their tongues, reluctantly backing President al-Sisi as a defence against anarchy in the leading Arab nation.

The situation is extremely tense. The chief prosecutor was assassinated in June. It took Egyptian F-16 fighter jets hours to dislodged ISIS forces from the North Sinai town of Sheikh Zuweid in early July. Middle East security expert Gilad Baum said the greater threat is a simmering insurgency "spreading like wildfire throughout Egypt" as Salafist activists abandon non-violent resistance and take matters into their own hands.

A new group called "Revolutionary Punishment" has launched 120 pinpoint strikes this year in a well-crafted strategy to sabotage the economy and chip away at the props of the al-Sisi regime.

"Their targets range from electricity posts and public transportation to multinational corporations, as they hope to drive off potential foreign investors. Power cuts and service halts in strategic locations, as well as drive-by shootings at branches of KFC, Vodafone, HSBC, Carrefour and elsewhere, are now taking place on a weekly basis," he wrote in Foreign Policy Journal.

President al-Sisi told the ceremony that his country was holding the line for the whole of mankind. "Egypt this year has stood against the most dangerous terrorist ideology that would burn the world if it could. We are fighting them, and will defeat them," he said.

It became the central artery of the British Empire, and the lifeline to India.

The new Suez Canal scarcely compares with the original venture - a 100-mile waterway that slashed 4,200 miles off the Cape shipping route from Europe to Asia and transformed world trade. It was built by the French diplomat Ferdinand de Lesseps in the 1860s and was at first viewed with great suspicion in London as a rival strategic move by Napoleon III to gain dominant influence in Egypt.

British prime minster Benjamin Disraeli quickly saw its value and - after a tip-off from a journalist - jumped on the chance to buy a £4m stake from the Khedive in 1875 after Egypt spiraled into financial crisis. He secured the money through the elite Rothschild banking family, presenting Parliament with a fait accompli.

Within a decade, 80pc of the shipping in the canal was carried by British vessels. It became the central artery of the British Empire, and the lifeline to India.

The canal was nationalised by the firebrand military leader Gamal Abdel Nasser in 1956, triggering a botched intervention by Britain, France and Israel that extinguished the last European pretensions to empire and marked the end of Britain's days as a world power.

It was Washington that sealed the fate of the Franco-British venture. President Dwight Eisenhower let a speculative attack on sterling run its course, refusing to any credits to a prostrate Britain until the withdrawal of troops.

The Soviet Union took advantage of the global furore over the Suez Crisis to crush the anti-Communist uprising in Hungary.
Nikita Khrushchev chose his moment perfectly. The West could hardly take the moral high ground when it seemed to be doing the much same in Egypt. History plays its tricks.

Originally published by The Telegraph August 6, 2015

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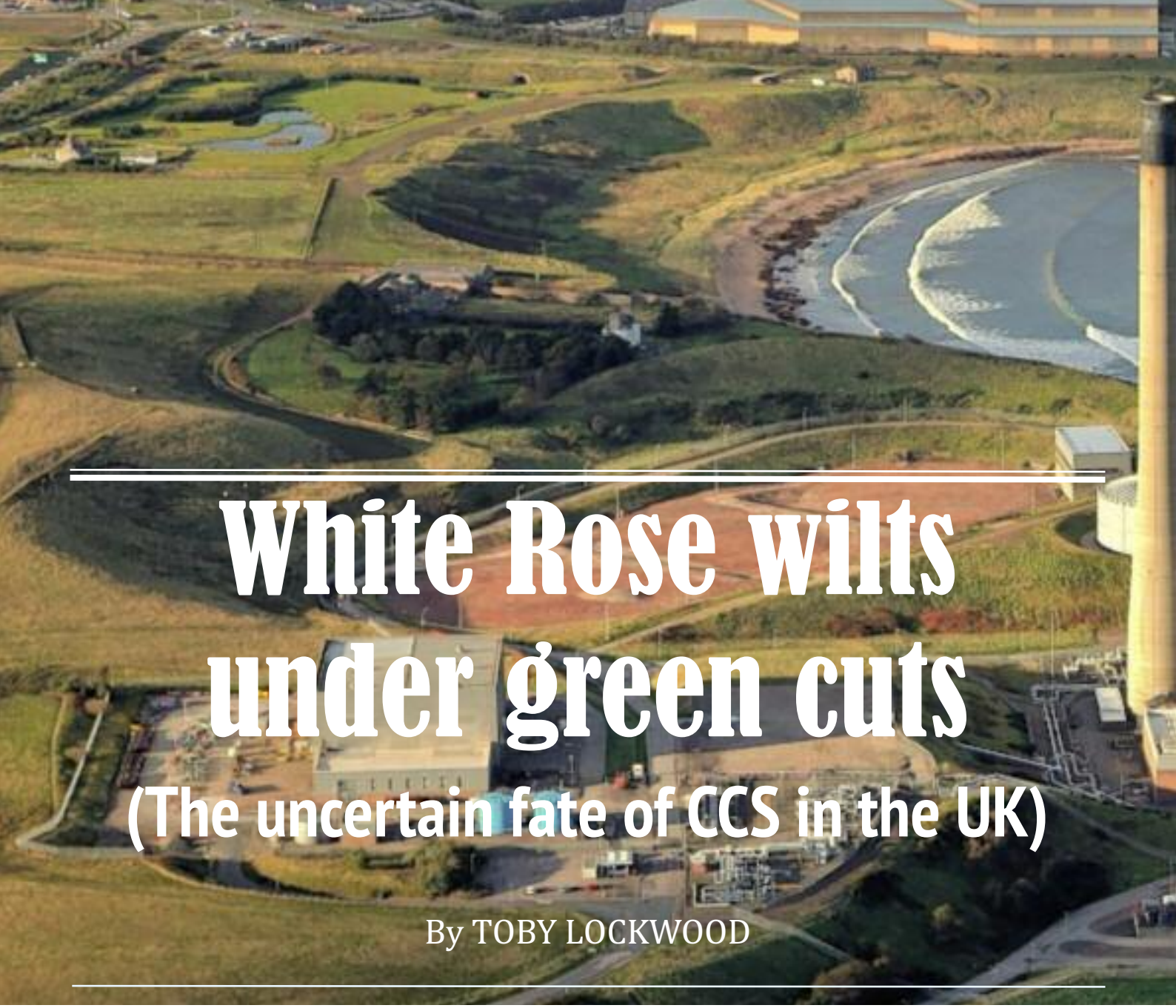

White Rose wilts under green cuts

(The uncertain fate of CCS in the UK)

By TOBY LOCKWOOD

September 2015 saw a major setback in plans to deploy carbon capture and storage (CCS) in the United Kingdom, as Drax Power withdrew support from their White Rose project even before a government decision is made on whether to award the project £1 bn in funding earmarked for the demonstration of the new technology.

Planned for the site of Drax's existing coal power station in Yorkshire, the project would see the building of a new coal plant with the means to separate its CO2 emissions and pipe them into permanent underground storage. Although White Rose is left with two committed backers, the development sends an ominous signal that the UK's supportive policy towards carbon capture and storage may lose some of its shine amidst increasing pressure to bring down the cost of electricity for consumers. This time, the project seems to have been an indirect victim of general government cuts to renewable energy subsidies, which have hit the bottom line of Drax's other significant interest in using old coal boilers to burn carbon neutral wood pellets.

Following last year's lengthy and unsuccessful legal battle with the government over whether their latest coal-to-wood conversion could receive a more lucrative subsidy, it is unsurprising that the power company is less willing to embark upon expensive new ventures. However, such wavering political support for green energy subsidies also raises doubts over how long the current government's current commitment to funding expensive carbon capture projects may last.

As numerous plans for other carbon capture power sta-

Peterhead Power Station

tions in Europe have come to nothing over the past few years, the UK has been left as one of the few remaining standard bearers for the technology in the region. In addition to the £1 bn in investment offered to a first large-scale demonstration, a plan to offer a guaranteed 'strike price' for electricity sales from CCS plants to help meet their inflated operating costs offers a much more tangible reward than the plummeting CO2 price on the EU's emissions trading scheme.

Perhaps most significantly, geological formations under the North Sea have been identified as ideal sites for storing the captured CO2, neatly avoiding the public concerns over onshore storage which blighted some of the failed continental projects. Recognition of this potentially valuable natural resource is such that the two other European countries still actively pursuing CCS also share North Sea coastlines. Whilst Norway's advanced plans to store CO2 emissions from the Möngstad oil refinery were cancelled two years ago, there is still ongoing research and interest in developing the technology at other industrial sites. In the Netherlands, a long-running plan to construct a new coal plant with capture is still afloat and ready to start construction if given the go-ahead by investors.

With commitment to White Rose faltering, advantage could be handed to the other project in the running to

receive the UK's CCS grand prize: an installation planned for the Peterhead gas power plant in Scotland. Like the proposed Yorkshire coal plant, this facility would capture around 1 million tonnes of CO2 every year and pipe it under the North Sea, filling a depleted gas field rather than the salt water aquifers which are targeted by White Rose and several other CCS projects. Using an existing gas pipeline which was once used to supply the plant, this presents the rather elegant scenario of simply reversing the historical flow of carbon back to its source.

Although the project will make use of one of the most established CO2 capture technologies, applying the technique to a gas power plant for the first time brings the challenge of far more dilute CO2 emissions than produced by other emitters.

In contrast, the 'oxyfuel combustion' technology planned for White Rose is a more novel approach to carbon capture in which coal is burnt in a mix of pure oxygen and recycled CO2 in order to produce a more easily captured, concentrated stream of the greenhouse gas. Having been tested at smaller scales, several other plans to apply this idea to large coal plants have stalled in the last few years for economic and political reasons. Another unique capability offered by White Rose is the potential for mixing wood pellets with the coal and achieving 'negative' carbon emissions, or a net reduction in atmospheric CO2, although in practice it could be challenging to apply this to oxyfuel combustion.

Whilst CCS remains in the doldrums in Europe, it is finally beginning to make headway on the other side of the Atlantic. The world's first power plant to capture and store its emissions opened at Boundary Dam in Canada's Saskatchewan province last year, and two more under construction in the US are scheduled to start up in 2016.

The contrasting fortunes of CCS in North America owes much to the presence of a thriving market for enhanced oil recovery, in which CO2 is pumped into flagging oil wells to help boost their production. So effective is the gas for this purpose that even natural reservoirs of CO2 are tapped, and around 6000 km of CO2 pipelines is already in place.

Despite the additional oil produced by the technique posing some problems for the carbon mitigation credentials of CCS, its ability to turn CO2 from worthless waste to a saleable product is, at worst, seen as a good way to get the industry going.

Whilst CCS remains in the doldrums in Europe, it is finally beginning to make headway on the other side of the Atlantic

However, revenue from sales of the gas are still well below the current cost of capturing it from power plants, and several other factors have also been crucial in getting these plants built. Saskpower, the regional utility behind the Boundary Dam plant, saw CCS as a means of retaining the value in its long-term supply of cheap local coal in the face of an incoming Canadian cap on power plant CO2 emissions.

With some of the freedom afforded by the company as a regional monopoly, the alternative of converting the grid entirely to less CO2-intensive gas power plants was seen as an unnecessarily risky exposure to the volatile natural gas market.

A similar CO2 cap is faced by new US coal plants, and similarly long-lasting and low-cost coal supplies are available to the plants being built there, along with an active government agenda to develop CCS.

Any CCS power plant carries a daunting up-front cost beyond the reach of most investors, and sizeable handouts and tax credits have been granted in both coun-


WORLD WATER DAY
WATERWORKS

Photo credit: saskatchewanderer.ca

tries. Perhaps most significantly, the US offers a tax incentive of up to $20 per tonne of CO2 stored, with some talk of even doubling this amount. Using captured CO2 for enhanced oil recovery in the oil fields of the northern North Sea has been touted as a possible option for the UK, but not one that forms part of the initial plans even for the well-placed Peterhead project.

With the country's coal mines almost all closed and North Sea gas supplies waning, the support seen in North America for preserving a cheap, home-grown energy supply is also not likely to play much of a role.

Another popular idea that pioneering CCS would put the UK in good stead to sell the technology to other parts of the world becomes increasingly hopeful as other regions take the lead. Nevertheless, if the government is truly committed to decarbonising the energy supply, CCS may yet turn out to be one of the cheapest ways of achieving the task.

Although the strike price agreed for a first CCS plant is likely to approach an eye-watering £200/MWh – around twice the price agreed for a new nuclear plant or a third more than offshore wind – the price of future plants is projected to drop rapidly.

First-time industrial projects tend to be beset by high costs and excessive design margins, and Saskpower estimate that the lessons learnt from Boundary Dam could help make their next CCS plant up to 30% cheaper.

Besides, the economics of CO2 transport and storage become more interesting once several plants are feeding into a shared infrastructure, and the pipeline planned for White Rose has been oversized with this in mind.

Based on such cost projections, a recent study estimated that the UK stands to save £32 bn if able to draw on CCS as part of its decarbonisation strategy. In the end, Drax Power's disowning of White Rose will probably not be as decisive in the project's fate as the course the UK government chooses to plot on energy policy.

With the green agenda increasingly obliged to make concessions to energy affordability, a costly first generation of CCS could struggle to make a compelling case without many of the drivers that have spurred it on in the US and Canada.

Whilst next year's announcement of the winner of the £1 bn in funding will be a crucial moment for the future of CCS in the UK and Europe, it may not amount to much unless the remaining project backers can be persuaded there is an adequate long-term business case for getting into the risky game of CO2 storage. In this respect, this new government is yet to fully show its hand. ONE

South Africa's Road to Growth is Paved With Coal

By NIKKI FISHER
Anglo American

South Africa is already largely urbanized. Today, nearly two thirds of South Africans live in urban centers. Although the rate of urbanization is slower in South Africa than some other emerging economies, it is projected that 77% of the country's population will reside in urban areas by 2050.

Energy from coal is intertwined with urbanization in South Africa in two important ways. First, in urban centers, baseload coal-fired power plants provide electricity to support much-needed industrial growth and the employment opportunities created.

Second, coal-fired power plants have directly supported the development of several urban centers, especially in the Mpumalanga region.

Since 1990, the percentage of South Africans living in urban centers has increased from 52% to 65%. The demand for electricity, and the coal that makes up 93% of South Africa's electricity generation, has grown at similar rates during this period *(see Figure 1)*.

Urbanites consume more electricity than their rural counterparts due to higher levels of access and more money to pay for services. The disparity is considerable: On average, urban households in South Africa consume 4800 kWh each year while rural households consume about 800 kWh.

Today, South Africa's electricity sector is facing considerable challenges—including a lack of sufficient, reliable baseload power—that could impact urbanization and overall economic growth. South Africa has also made climate commitments. All options are being explored

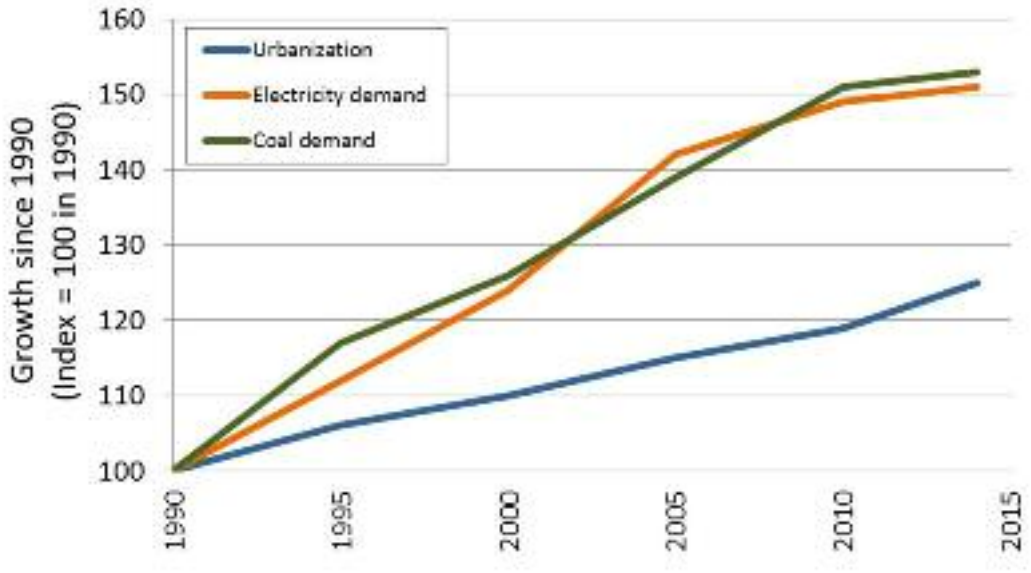

FIGURE 1. Growth in urbanization, electricity demand, and coal demand in South Africa since 1990 (U.S. Energy Information Admininstration and World Bank, 2015)

Medupi Power Station, South Africa. Photo: © Braam Daniels

as different energy sources will be called upon to make progress on increasing electricity generation while meeting the country's climate goals. Thus, the South African Coal Roadmap (SACRM) was prepared to explore the activities and interventions needed for the coal industry to maximize its contribution to the country in the face of an uncertain future.

A NATION CONSTRAINED

South Africa is currently facing an electricity crisis deemed to be one of the country's greatest challenges over the last 20 years. Rolling blackouts began in November 2014 and the power supply system will continue to be under extreme pressure, with an imminent risk of load-shedding of up to 2000 MW at any time for at least the next two to three years.

This is not the first time that the country has experienced rolling blackouts. In 2007/2008, several months of load-shedding occurred, which motivated the recommissioning of three previously moth-balled power stations and a strong demand-side energy efficiency drive. Coupled with the global financial crisis and subsequent in-country economic downturn, the result was decreased electricity demand and temporary relief of pressure on the grid. Even so, ensuing grid constraints have resulted in slower economic development estimated at roughly R300 billion (~US$25 billion) or 10% of the potential economic growth. Economists' estimates about the economic impact of the controlled blackouts on the country vary between R6 billion6 and R20 billion per month (US$0.5 billion and US$1.65 billion, respectively) for Stage 1 load shedding (i.e., 1000 MW load shed). These estimates are based on the day-to-day impact on business of running generators, changing shifts, and lost work time; the less conservative estimates include the long-term costs of job losses, stunted economic growth, and less investment in the country. The inability of the country to meet electricity demand has led to downward revisions of the economic growth forecast by the South African Reserve Bank from 2.5% to 2.2% for 2015. Several ratings agencies have also downgraded the country's credit rating, which has had a negative impact on investor confidence in the economy.

THE ROLE OF COAL

In 1994, the majority of South Africans did not have access to electricity. Since then an ambitious electrification program has increased the proportion of electricity users in the total population from 36% to 84%.

This electrification program would not have been as widespread without low-cost electricity, which, in turn, could not have been achieved without coal as a fuel source. It is because coal is abundant, accessible, secure, reliable, and affordable that it is the cornerstone of energy in South Africa—today coal is used to produce

93% of electricity and 30% of liquid fuels. In excess of 60 billion tons of coal resources and reserves remain in South Africa.

The nation benefits from the coal industry in several ways apart from its contribution to affordable electricity. It is the mining industry's top revenue earner, ahead of platinum and gold. At a time when the current account deficit is precarious, the country can ill afford to lose revenue from coal exports. Moreover, the coal industry as a whole employs 83,000 people in a country with a 25% unemployment rate, with employees earning a combined $1.6 billion in salaries and wages.

With the majority (i.e., 72% in 2014) of South Africa's primary energy coming from coal and given its demonstrated benefits to the economy, new coal-fired power plants were planned. The greatly anticipated new 4800-MW coal-fired power stations, Medupi and Kusile, were originally anticipated to start coming online in 2012. However, both projects have been plagued by construction delays and budget overruns. The first unit of Medupi was synchronized onto the grid on 2 March 2015 and was expected to deliver roughly 780 MW onto the grid by June 2015. Neither plant will be running at full capacity before 2020.

As a consequence of these delays, Eskom has been running many of the existing, aging power stations beyond their expected lifetimes and delaying scheduled maintenance to keep the lights on; this has led to breakdowns, unplanned maintenance, and a severely constrained system. Almost one third of Eskom's 45 GW of installed capacity is presently offline due to planned and unplanned maintenance. Despite the new capacity that has come online, including an increase in non-Eskom power production by 8.5% from 2013 to 2014, overall production has decreased by 1%.

The large build program, primarily funded through tariffs, resulted in the electricity price in South Africa increasing 78% between 2008 and 2011, and it will continue to rise in real terms for several more years. The National Energy Regulator of South Africa (NERSA) approved a 12.7% increase in the electricity price for Eskom for the 2015/2016 financial year. This has significant impacts on affordability and continued access to electricity for many households and on energy-intensive businesses.

SOUTH AFRICA'S ENERGY CHALLENGES WILL REQUIRE CONTINUED COAL USE

The SACRM was developed and published in 2013 as

Medupi Power Station. Photo: Leita Steel Construction (Pty) Ltd

a means to explore the activities and interventions that the coal industry should undertake to maximize its contribution to the country in the face of an uncertain future. Despite South Africa's energy challenges, the country is working to balance its development and climate priorities.

The SACRM is the only place that comprehensive information about the coal value chain has been compiled into a single document. Four scenarios were developed.

These scenarios were based on the local and international response to climate change as a framework for developing the roadmap. According to the Roadmap, the country will need a total of between 85 and 125 GW of installed capacity by 2040, depending on the level of renewable energy in the mix, up from 42 GW in 2010.

THE FUTURE OF COAL IN SOUTH AFRICA

To encourage economic growth and build a thriving society, energy security is a priority. Under all of the scenarios modeled in the SACRM, including the "Low-Carbon World", South Africa cannot afford early retirement of existing power stations. In line with this, the lives of many of the existing coal-fired power stations have been extended and are now scheduled for closure between 2030 and 2040. New power stations will be required to replace this capacity and, to meet demand growth, clarity is required on technology options that will be used. The SACRM makes some recommendations for actions necessary to keep the lights on.

Coal Roadmap Recommendations

Secure contracts for continued coal supply to existing power stations and invest in new mines. Impending coal shortfalls for the existing power stations are a serious risk to energy security. Dubbed the "coal supply cliff", a massive shortage (in excess of 60 million tons) in coal supply is anticipated from 2018. The reasons for this are several. When the current fleet of power stations was commissioned, long-term supply contracts were signed for the life of the power station (usually 40 years). The lives of many of these power stations have since been extended, and most power stations have been run at loads higher than originally expected when the coal supply contracts were signed. In addition, some of the resources have not been as extensive as originally assumed. The recommissioning of the three moth-balled power stations in 2008 also created additional and unexpected demand for coal. The majority of the new coal resources that could potentially fill the supply gap require extensive exploration and feasibility studies before mines can be opened and supply contracts signed. The cost of mining is increasing, due to coal being sourced from lower-quality deposits with higher operating costs associated with increased processing requirements and longer transport distances. In all scenarios in the SACRM, the price of coal to Eskom will increase. Agreement must be reached on a coal price mechanism and a fair rate of return on investment being sought by mining companies to encourage investment in new mines. The most viable model for a domestic supply coal mine is for it to be a multi-product mine that benefits from the higher returns possible on the export market. *Figure 2* shows the disparity between export and domestic tonnages and prices for 2012.

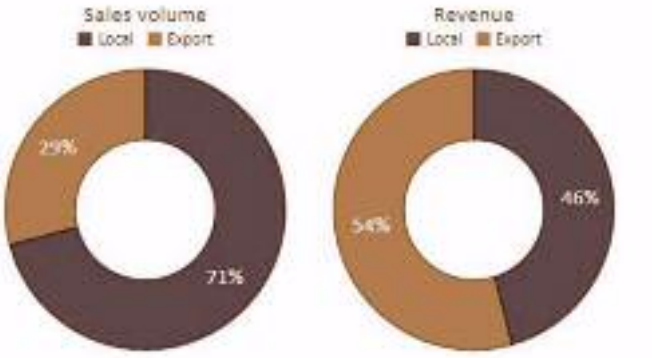

FIGURE 2. Domestic versus export tonnages by sales volume and revenue.

Open new coal fields. Traditionally, the coal supply has come from the Central Basin, where the majority of the coal-fired power stations are located. All scenarios in the SACRM show that high-grade utility coal from the Central Basin will be very constrained from the mid-2020s onward and essentially depleted by 2040. During this time, just one mine switching from domestic to

low-grade export supply could create an immediate domestic coal shortfall. To reduce this risk, it is prudent to open alternate sources of coal, of which the largest and most likely resource is the Waterberg coalfields. As rail, transmission, and water infrastructure from this area to the power stations in the Central Basin is lacking, and given the long lead times required for construction of such infrastructure, the SACRM recommends that access to the Waterberg be enabled without delay.

Resolve coal transport challenges to Central Basin power stations. In 2010, roughly 22% of the coal supplied to Eskom was delivered via road. The externalities associated with road transport include damage to roads, increased road accidents and fatalities, and increased air pollution leading to human health impacts. To address this, Eskom is undertaking a road-to-rail migration together with Transnet Freight Rail. A shift from road to rail will impact the trucking companies and associated jobs and these impacts must be carefully considered and minimized.

Align policy and licensing procedures. Investment in new mines requires a supportive and enabling regulatory environment. The current regulatory situation relating to complex environmental permitting requirements under multiple laws (and consequently multiple government departments) creates extensive delays and affects the timely delivery of mining investments.

Alignment and certainty of regulatory and permitting procedures for new mines is critical. Other policies where certainty is needed include statements made by the Department of Mineral Resources regarding coal as a strategic resource, which may limit coal exports and impact negatively on investment; carbon tax or other carbon pricing mechanisms; Broad-Based Black Economic Empowerment requirements and interventions to prevent hoarding of rights and situations where a resource may be urgently needed for Eskom supply, but is not a priority for the mining company that holds the rights.

The mining "majors" (Anglo American, BHP Billiton, Glencore, Exxaro, and Sasol) account for 85% of coal production in South Africa and 90% of the supply to Eskom. The remaining supply is from smaller players. Eskom now requires that 55% of their supply be sourced from black-owned businesses. The capacity of these smaller businesses to fund and develop mines may be limited, which indicates that there is a strong need for cooperative business partnerships between either Eskom or the existing majors and the smaller players.

Provide clarity on new electricity build. The future of electricity in South Africa is governed by the Integrated Resource Plan for Electricity 2010–2030 (IRP). The IRP included 9 GW of nuclear power by 2023; however, the program for investment and development of nuclear power is far behind the schedule required to have it online by 2023. A revision of the IRP is due for publication in the near future, and clarity is needed on new and replacement baseload generation as well as who is to take responsibility for the new build.

The Renewable Energy Independent Power Producer Programme has been successful, bringing 1700 MW capacity on to the grid, and expedition of the baseload Independent Power Producer Programme (IPP), for both coal and gas, will help to ensure energy security if favorable market conditions are created for the IPPs. Investment in electricity infrastructure ranges from R930 billion in the "More of the Same" scenario to R2060 billion in the "Low-Carbon World" scenario because of the higher capital cost of renewable technologies, which may decrease over time, and because of the additional installed capacity required due to the lower load factors of renewables. The higher capital costs are offset by lower operating costs, a diversified investment mix, and a more resilient grid. However, increased nuclear and renewables in South Africa's energy mix is likely to result in higher electricity prices which may put additional strain on an emerging economy.

Mitigate impacts and the transition to a low-carbon economy. In the longer term, the role of coal in the electricity mix will be dependent on the ability to mitigate the environmental impacts of coal-fired power generation. Transition to a diversified grid will help to mitigate emissions, as can the improvement of power station efficiency, which will significantly reduce emissions per unit of power compared to the existing fleet.

The demonstration of technologies such as underground coal gasification and high-efficiency combustion is also important. Carbon capture and storage (CCS) may also help to reduce emissions, but CCS in South Africa is in its infancy and any mitigation potential would only be realized in the long term.

Plan for closure. At least six power stations will close in the Mpumalanga region before 2040. The resulting job losses could ultimately lead to the decline of the existing urban centers that have developed around the coal-mining and power-generating region.

It will be important to create diversified industries in this area and to undertake capacity building as well as skills development for the people in those areas to help to mitigate these impacts. It is recommended that transition plans are in place for communities that have developed around power plants now slated for closure.

PLANNING FOR ACTION

South Africa is currently best represented by the "At the forefront" scenario, where ambitious (albeit conditional) climate change commitments have been made. Continuing on this trajectory could have serious implications for global competitiveness, employment opportunities, and energy security. The outcome of COP21 and the country's Intended Nationally Determined Contributions committed to at COP21 will play a large role in determining our energy future.

South Africa is on the precipice of a crisis. Careful planning and prompt action are essential for a future where electricity demand can be met, economic growth takes place, and a just transition to a lower-carbon economy is possible.

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Arnot Coal Power Station, South Africa. Photo: © Gerhard Roux

Nuclear fusion, the clean power that will take decades to master

By THECONVERSATION

Nuclear fusion is what powers the Sun and the stars – unleashing huge amounts of energy through the binding together of light elements such as hydrogen and helium. If fusion power were harnessed directly on Earth, it could produce inexhaustible clean power, using seawater as the main fuel, with no greenhouse gas emissions, no proliferation risk, and no risk of catastrophic accidents. Radioactive waste is very low level and indirect, arising from neutron activation of the power plant core. With current technology, a fusion power plant could be completely recycled within 100 years of shutdown.

Today's nuclear power plants exploit nuclear fission – the splitting of atomic nuclei of heavy elements such as uranium, thorium, and plutonium into lighter "daughter" nuclei. This process, which happens spontaneously in unstable elements, can be harnessed to generate electricity, but it also generates long-lived radioactive waste.

Why aren't we using safe, clean nuclear fusion power yet? Despite significant progress in fusion research, why do we physicists treat unfounded claims of "breakthroughs" with scepticism? The short answer is that is it very difficult to achieve the conditions that sustain the reaction.

But if the experiments under construction now are successful, we can be optimistic that nuclear fusion power can be a reality within a generation.

The fusion process

Unlike fission, nuclei do not spontaneously undergo fusion: atomic nuclei are positively charged and must overcome their huge electrostatic repulsion before they can get close enough together that the strong nuclear force, which binds nuclei together, can kick in.

In nature, the immense gravitational force of stars is strong enough that the temperature, density and volume of the star's core is enough for atomic nuclei to fuse through "quantum tunnelling" of this electrostatic barrier. In the laboratory, quantum tunnelling rates are far too low, and so the barrier can only be overcome by making the fuel nuclei incredibly hot – six to seven times hotter than the Sun's core.

Even the easiest fusion reaction to initiate – the combination of the hydrogen isotopes deuterium and tritium, to form helium and an energetic neutron – requires a temperature of about 120 million C. At such extreme temperatures, the fuel atoms are ruptured into their component electrons and nuclei, forming a superheated plasma.

Keeping this plasma in one place long enough for the nuclei to fuse together is no mean feat. In the laboratory, the plasma is confined using strong magnetic fields, generated by coils of electrical superconductors which create a donut-shaped "magnetic bottle" in which the plasma is trapped.

Today's plasma experiments such as the Joint European Torus can confine plasmas at the required temperatures for net power gain, but the plasma density and energy confinement time (a measure of the cooling time of the plasma) are too low to for the plasma to be self-heated. But progress is being made – today's experiments have

fusion performance 1,000 times better, in terms of temperature, plasma density and confinement time, than the experiments of 40 years ago. And we already have a fair idea of how to move things to the next step.

The ITER Reactor (Tokamak Building). Photo credit: ITER Organization

Regime change

The ITER reactor, now under construction at Cadarache in the south of France, will explore the "burning plasma regime", where the plasma heating from the confined products of fusion reaction exceeds the external heating power. The total power gain for ITER will be more than five times the external heating power in near-continuous operation, and will approach 10-30 times for short durations. At a cost exceeding US$20 billion, and funded by a consortium of seven nations and alliances, ITER is the largest science project on the planet. Its purpose is to demonstrate the scientific and technological feasibility of using fusion power for peaceful purposes such as electricity generation.

The engineering and physical challenge is immense. ITER will have a magnetic field strength of 5 Tesla (100,000 times the Earth's magnetic field) and a device radius of 6 m, confining 840 cubic metres of plasma (one-third of an Olympic swimming pool). It will weigh 23,000 tonnes and contain 100,000 km of niobium tin superconducting strands. Niobium tin is superconducting at 4.5K (about minus-269C), and so the entire machine will be immersed in a refrigerator cooled by liquid helium to keep the superconducting strands just a few degrees above absolute zero. ITER is expected to start generating its first plasmas in 2020. But the burning plasma experiments aren't set to begin until 2027. One of the huge challenges will be to see whether these self-sustaining plasmas can indeed be created and maintained without damaging the plasma facing wall or the high heat flux "divertor" target.

The information we get from building and operating ITER will inform the design of future fusion power plants, with an ultimate aim of making the technology work for commercial power generation. At the moment it seems likely that the first prototype power plants will be built in the 2030s, and would probably generate around 1 gigawatt of electricity.

While first-generation power plants will probably be on a similarly large scale to ITER, it is hoped that improvement in magnetic confinement and control will lead to more compact later generation power plants. Likewise, power plants will cost less than ITER: long-term modelling which extrapolates to power plants suggest fusion could be economic with low impact on the environment. So while the challenges to nuclear fusion are big, the pay-off will be huge. All we have to do is get it to work.

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[This article is part of The Conversation's worldwide series on the Future of Nuclear.]

Entering the Nuclear Age, Body by Body

By SUSAN SOUTHARD
Viking/Penguin Random House

Korean and Chinese workers, prisoners of war, and mobilized adults and students had returned to their work sites; some dug or repaired shelters, others piled sandbags against the windows of City Hall for protection against machine-gun fire. In the Mitsubishi sports field, bamboo spear drills in preparation for an invasion had just concluded. Classes had resumed at Nagasaki Medical College. Streetcars meandered through the city.

Hundreds of people injured in the air raids just over a week earlier continued to be treated in Nagasaki's hospitals, and at the tuberculosis hospital in the northern Urakami Valley, staff members served a late breakfast to their patients. One doctor, trained in German, thought to himself, Im Westen nichts neues (All quiet on the western front). In the concrete-lined shelter near Suwa Shrine that served as the Nagasaki Prefecture Air Defense Headquarters, Governor Nagano had just begun his meeting with Nagasaki police leaders about an evacuation plan. The sun was hot, and the high-pitched, rhythmic song of cicadas vibrated throughout the city.

Six miles above, the two B-29s approached Nagasaki. Major Sweeney and his crew could hardly believe what they saw: Nagasaki, too, was invisible beneath high clouds. This presented a serious problem. Sweeney's orders were to drop the bomb only after visual sighting of the aiming point – the center of the old city, east of Nagasaki Harbor. Now, however, a visual sighting would likely require numerous passes over the city, which was no longer possible due to fuel loss: Not only had a fuel transfer pump failed before takeoff, rendering six hundred gallons of fuel inaccessible, but more fuel than expected had been consumed waiting at the rendezvous point and while circling over Kokura.

Bockscar now had only enough fuel to pass over Nagasaki once and still make it back for an emergency landing at the American air base on Okinawa. Further, Sweeney and his weaponeer, Navy commander Fred Ashworth, knew that not using the bomb on Japan might require dumping it into the sea to prevent a nuclear explosion upon landing. Against orders, they made the split-second decision to drop the bomb by radar.

Air raid alarms did not sound in the city – presumably because Nagasaki's air raid defense personnel did not observe the planes in time or did not recognize the immediate threat of only two planes flying at such a high altitude. When antiaircraft soldiers on Mount Kompira finally spotted the planes, they jumped into trenches to aim their weapons but didn't have time to fire; even if they had, their guns could not have reached the U.S. planes.

Several minutes earlier, some citizens had heard a brief radio announcement that two B-29s had been seen flying west over Shimabara Peninsula. When they heard the planes approaching, or saw them glistening high in the sky, they called out to warn others and threw themselves into air raid shelters, onto the ground, or beneath beds and desks inside houses, schools, and workplaces. A doctor just about to perform a pneumothorax procedure heard the distant sound of planes, pulled the needle out of his patient, and dived for cover. Most of Nagasaki's residents, however, had no warning.

By this time, the crews on both planes were wearing pro-

Ruins of Nagasaki. Photo: © U.S. National Archives.

tective welders' glasses so dark that they could barely see their own hands. Captain Kermit Beahan, Bockscar's bombardier, activated the tone signal that opened the bomb bay doors and indicated 30 seconds until release. Five seconds later, he noticed a hole in the clouds and made a visual identification of Nagasaki.

"I've got it! I've got it!" he yelled. He released the bomb. The instrument plane simultaneously discharged three parachutes, each attached to metal canisters containing cylindrical radiosondes to measure blast pressure and relay data back to the aircraft. Ten thousand pounds lighter, Bockscar lurched upward, the bomb bay doors closed, and Sweeney turned the plane an intense 155 degrees to the left to get away from the impending blast.

"Hey, Look! Something's Falling!"

On the ground below, 18-year-old Wada had just arrived at Hotarujaya Terminal at the far eastern corner of the old city.

Nagano was at work in the temporary Mitsubishi factory in Katafuchimachi, on the other side of the mountains from her family's home.

Taniguchi was delivering mail, riding his bicycle through the hills of a residential area in the northwestern corner of the city.

Sixteen-year-old Do-oh was back at her workstation inside the Mitsubishi weapons factory, inspecting torpedoes and eagerly awaiting her lunch break.

On the side of a road on the western side of the Urakami River, Yoshida was lowering a bucket into the well when he looked up and, like others across the city, noticed parachutes high in the sky, descending through a crack in the clouds.

"Rakka-san, they were called back then," he remembered. Descending umbrellas. "I just thought that they were regular parachutes – that maybe soldiers were coming down."

"Hey, look! Something's falling!" he called out to his friends. They all looked up, putting their hands to their

foreheads to block the sun so they could see."The parachutes floated down, saaatto," he said. Quietly, with no sound.

A Deafening Roar

The five-ton plutonium bomb plunged toward the city at 614 miles per hour. Forty-seven seconds later, a powerful implosion forced its plutonium core to compress from the size of a grapefruit to the size of a tennis ball, generating a nearly instantaneous chain reaction of nuclear fission. With colossal force and energy, the bomb detonated a third of a mile above the Urakami Valley and its 30,000 residents and workers, a mile and a half north of the intended target. At 11:02 a.m., a superbrilliant flash lit up the sky – visible from as far away as Omura Naval Hospital more than 10 miles over the mountains – followed by a thunderous explosion equal to the power of 21,000 tons of TNT. The entire city convulsed.

At its burst point, the center of the explosion reached temperatures higher than at the center of the sun, and the velocity of its shock wave exceeded the speed of sound. A tenth of a millisecond later, all of the materials that had made up the bomb converted into an ionized gas, and electromagnetic waves were released into the air. The thermal heat of the bomb ignited a fireball with an internal temperature of over 540,000 degrees Fahrenheit. Within one second, the blazing fireball expanded from 52 feet to its maximum size of 750 feet in diameter. Within three seconds, the ground below reached an estimated 5,400 to 7,200 degrees Fahrenheit. Directly beneath the bomb, infrared heat rays instantly carbonized human and animal flesh and vaporized internal organs.

As the atomic cloud billowed two miles overhead and eclipsed the sun, the bomb's vertical blast pressure crushed much of the Urakami Valley. Horizontal blast winds tore through the region at two and a half times the speed of a category five hurricane, pulverizing buildings, trees, plants, animals, and thousands of men, women, and children. In every direction, people were blown out of their shelters, houses, factories, schools, and hospital beds; catapulted against walls; or flattened beneath collapsed buildings.

Those working in the fields, riding streetcars, and standing in line at city ration stations were blown off their feet or hit by plummeting debris and pressed to the scalding earth. An iron bridge moved 28 inches downstream. As their buildings began to implode, patients and staff jumped out of the windows of Nagasaki Medical College Hospital, and mobilized high school girls leaped from the third story of Shiroyama Elementary School, a half mile from the blast.

The blazing heat melted iron and other metals, scorched bricks and concrete buildings, ignited clothing, disintegrated vegetation, and caused severe and fatal flash burns on people's exposed faces and bodies. A mile from the detonation, the blast force caused nine-inch brick walls to crack, and glass fragments bulleted into people's arms, legs, backs, and faces, often puncturing their muscles and organs. Two miles away, thousands of people suffering flesh burns from the extreme heat lay trapped beneath partially demolished buildings.

At distances up to five miles, wood and glass splinters pierced through people's clothing and ripped into their flesh. Windows shattered as far as eleven miles away. Larger doses of radiation than any human had ever received penetrated deeply into the bodies of people and animals. The ascending fireball suctioned massive amounts of thick dust and debris into its churning stem. A deafening roar erupted as buildings throughout the city shuddered and crashed to the ground.

"The Light Was Indescribable"

"It all happened in an instant," Yoshida remembered. He had barely seen the blinding light half a mile away before a powerful force hit him on his right side and hurled him into the air. "The heat was so intense that I curled up like surume [dried grilled squid]." In what felt like dreamlike slow motion, Yoshida was blown backward 130 feet across a field, a road, and an irrigation channel, then plunged to the ground, landing on his back in a rice paddy flooded with shallow water.

Inside the Mitsubishi Ohashi weapons factory, Do-oh

The atomic cloud over Nagasaki.
Photo: © Hiromichi Matsuda/Nagasaki Atomic Bomb Museum.

had been wiping perspiration from her face and concentrating on her work when PAAAAAHT TO! – an enormous blue-white flash of light burst into the building, followed by an earsplitting explosion. Thinking a torpedo had detonated inside the Mitsubishi plant, Dooh threw herself onto the ground and covered her head with her arms just as the factory came crashing down on top of her.

In his short-sleeved shirt, trousers, gaiters, and cap, Taniguchi had been riding his bicycle through the hills in the northwest corner of the valley when a sudden burning wind rushed toward him from behind, propelling him into the air and slamming him facedown on the road. "The earth was shaking so hard that I hung on as hard as I could so I wouldn't get blown away again."

Nagano was standing inside the school gymnasium-turned-airplane-parts factory, protected to some degree by distance and the wooded mountains that stood between her and the bomb. "A light flashed – pi-KAA-AAH!" she remembered. Nagano, too, thought a bomb had hit her building. She fell to the ground, covering her ears and eyes with her thumbs and fingers according to her training as windows crashed in all around her. She could hear pieces of tin and broken roof tiles swirling and colliding in the air outside.

Two miles southeast of the blast, Wada was sitting in the lounge of Hotarujaya Terminal with other drivers, discussing the earlier derailment. He saw the train cables flash. "The whole city of Nagasaki was – the light was indescribable – an unbelievably massive light lit up the whole city." A violent explosion rocked the station. Wada and his friends dived for cover under tables and other furniture. In the next instant, he felt like he was

floating in the air before being slapped down on the floor. Something heavy landed on his back, and he fell unconscious.

Beneath the still-rising mushroom cloud, a huge portion of Nagasaki had vanished. Tens of thousands throughout the city were dead or injured. On the floor of Hotarujaya Terminal, Wada lay beneath a fallen beam. Nagano was curled up on the floor of the airplane parts factory, her mouth filled with glass slivers and choking dust. Do-oh lay injured in the wreckage of the collapsed Mitsubishi factory, engulfed in smoke. Yoshida was lying in a muddy rice paddy, barely conscious, his body and face brutally scorched. Taniguchi clung to the searing pavement near his mangled bicycle, not yet realizing that his back was burned off. He lifted his eyes just long enough to see a young child "swept away like a fleck of dust."

Sixty seconds had passed.

"A Huge, Boiling Caldron"

The enormous, undulating cloud ascended seven miles above the city. From the sky, Bockscar's copilot Lieutenant Frederick Olivi described it as "a huge, boiling caldron." William L. Laurence, the official journalist for the Manhattan Project who had witnessed the bombing from the instrument plane, likened the burgeoning cloud to "a living thing, a new species of being, born right before our incredulous eyes." Captain Beahan remembered it "bubbling and flashing orange, red and green... like a picture of hell."

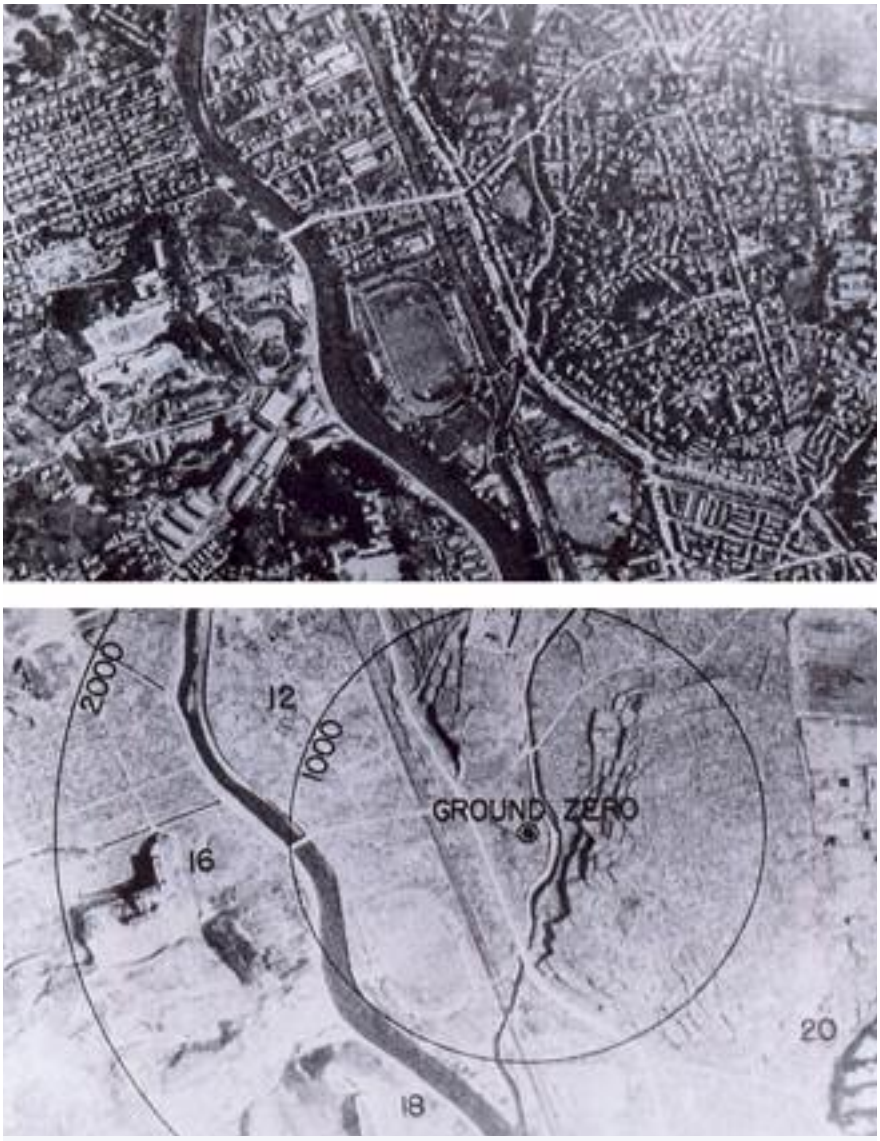
Outside the city, many people who saw the flash of light and heard the deafening explosion rushed out of their homes and stared in wonder at the nuclear cloud heaving upward over Nagasaki. A worker on an island in Omura Bay, several miles north of the blast, described it as "lurid-colored... curling like long tongues of fire in the sky." In Isahaya, five miles east of the city, a grandmother feared that "the sun would come falling down," and a young boy grabbed at ash and paper falling from the sky, only to realize that they were scraps of ration books belonging to residents in the Urakami Valley.

From the top of Mount Tohakkei four miles southeast of Nagasaki, a man loading wood into his truck was "stunned speechless by the beauty of the spectacle" of the giant rising cloud exploding over and over again as it transformed from white to yellow to red. In neighborhoods at the edge of the city, people peered out of windows and stepped outside to see the atomic cloud rising above them, only to bolt back inside or to nearby shelters in anticipation of a second attack.

Inside the city, the bomb's deadly gale quieted, leaving Nagasaki enveloped in a dark, dust-filled haze. Nearest the hypocenter (the point on the ground above which the bomb exploded), almost everyone was incinerated, and those still alive were burned so badly they could not move. In areas beyond the hypocenter, surviving men, women, and children began extricating themselves from the wreckage and tentatively stood, in utter terror, for their first sight of the missing city. Twenty minutes after the explosion, particles of carbon ash and radioactive residue descended from the atmosphere and condensed into an oily black rain that fell over Nishiyama-machi, a neighborhood about two miles east over the mountains.

Nagano pulled herself up from the floor of the airplane parts factory and stood, quivering, rubbing debris from her eyes and spitting dust and glass fragments from her throat and mouth. Around her, adult and student workers lay cowering on the ground or rose to their feet, stunned and bewildered. Opening her eyes just a bit, Nagano sensed it was too dangerous to stay where she was. She ran outside and squeezed herself into a crowded mountain air raid shelter, where she crouched down and waited for another bomb to drop.

"The whole Urakami district has been destroyed!" one of the male workers called out to her. "Your house may have burned as well!" Nagano fled from the bomb shelter and ran toward the Urakami Valley. Outside, the neighborhood around the factory was almost pitch-dark and hauntingly still. Large trees had snapped in half, tombstones had fallen in a cemetery nearby, and streets were filled with broken roof tiles and glass. Small birds lay on the ground, twitching. Compared to what she had imagined, however, the damages around her seemed minimal, and Nagano – who could not see the



Nagasaki: before and after the explosion. **Photo: © U.S. National Archive.**

Urakami Valley – half believed that her family might be safe after all.

She hurried through the streets to the southern end of Nishiyamamachi toward Nagasaki Station, over a mile to the east, pressing past partially collapsed wooden houses and people fleeing the blast area. As the road curved west, Nagano rushed by the 277-step stone staircase leading up to the seventeenth-century Suwa Shrine, still intact, and Katsuyama Elementary School, just next to City Hall. Forty-five minutes later, Nagano finally passed the mountains that had stood between her and the expanse of atomic destruction.

In front of her, the main building of Nagasaki Station had collapsed. But it was the view to her right that shocked her into finally realizing that the rumors she had heard about the Urakami Valley were true. Where the northern half of Nagasaki had existed only an hour before, a low heavy cloud of smoke and dust hovered over a vast plain of rubble. Nothing remained of the dozens of neighborhoods except tangled electrical wires and an occasional lone chimney. The huge factories that had lined the river near Nagasaki Station were crumpled into masses of steel frames and wooden beams, and the streetcar rails were, in one survivor's words, "curled up like strands of taffy."

No trace of roads existed beneath miles of smoking wreckage. Blackened corpses covered the ground. Survivors were stumbling through the ruins moaning in pain, their skin hanging down like tattered cloth. Others raced away, shrieking, "Run! Escape!" A barefoot mother in shredded clothes ran through the wreckage screaming for her child. Most people, however, were silent. Many simply dropped dead where they stood.

Nagano's house was just over a half mile to the north and west, a 10-minute walk on any other day. She faced in that direction to scan the area, but there was nothing – no buildings, no trees, and no sign of life where she had last seen her mother and younger brother and sister. Her eyes searched frantically for a way home, but the flames spreading through the ruins prevented access from all directions. Paralyzed and confused, Nagano stood in front of Nagasaki Station, alone, with no idea what to do next.

Four Signs the Tide May Be Turning Against Lion Hunting, and One It Isn't

By BRIAN CLARK HOWARD
National Geographic

Who could shoot a lion? That's the question many people are asking on social media and in protests outside the offices of big game hunters, after the illegal killing of Cecil the lion last month. Although some hunting groups are digging in on their support of the legal, regulated pastime, there are also signs that a cultural shift away from big game hunting may be happening.

Social outrage, leading to action

There have been more than a million signatures to online petitions calling for the end of legal lion hunting. National Geographic conducted a survey of more than 1,000 American adults over the weekend to gauge their response to Cecil's story and the broader issues of hunting and conservation. The polling firm Ipsos found that 71 percent of respondents were familiar with Cecil's shooting, and ten percent of those respondents had signed an online petition on Cecil's behalf. Four percent said they donated to a related charity. Despite high familiarity with the story, a more modest 41 percent of respondents were aware of the rapid decline of big cats in general and only 19 percent feel much more aware of the issue as a result of recent news coverage. A century ago Africa had more than 200,000 lions, but today there are an estimated 30,000. With so few lions left, none should be put in the crosshairs, says Jeff Flocken, North American director for the International Fund for Animal Welfare. "Killing for conservation sounds like an oxymoron and it is," says Flocken. The old arguments in favor of trophy hunting—raising money for conservation and culling disruptive individuals—"no longer hold water," says Flocken. "Economically it makes more sense to have renewable, wildlife-friendly value through ecotourism than a one-time kill fee." Flocken says more people are coming to realize that, in 2015, "we don't have to kill an animal to save it."

Airlines ban lion trophies

Today, about 65 percent of legal trophy hunts in Africa are done by Americans. And this week, three

Lions roaming Africa have dropped in number from 200,000 to 30,000 over the last century. Photo: © Brent Stapelkamp

major U.S. airlines made it harder for those hunters to bring back their trophies. Delta, United, and American announced that they would no longer allow the transport of hunting trophies from endangered animals on their flights. This follows a ban enacted by Emirates in May and by a South African carrier before that. These bans "reflect our values as a society, since many people clearly have a visceral reaction to trophy hunting of endangered species," says Flocken. Hunters can still ship their trophies back to the U.S. if they secure permission from the Fish and Wildlife Service and if they use a freight company like UPS, which has declined calls for a ban. "But the more challenging it is to bring back a trophy the less likely American hunters will be to engage in that hunt," says Flocken, who notes that trophy hunting of polar bears plummeted after their trophies were banned in the U.S. in 2008.

Legislative pressure in the U.S.

Cecil's death has also resulted in a bill in Congress. Senator Bob Menendez (D-N.J.) has introduced the Conserving Ecosystems by Ceasing the Importation of Large (CECIL) Animal Trophies Act, which would prevent importation of trophies from animals that are being considered for listing as endangered by the Fish and Wildlife Service. A petition to list the African lion as endangered was filed in 2011, but the Fish and Wildlife Service has yet to finalize its ruling. Since that time, more than 1,700 lions have been killed legally, on top of even more killed illegally, says Flocken.

Debate in Africa

Although many Africans had not heard of Cecil and are not involved in trophy hunting or tourism, the international outcry has resulted in changes on the continent. Zimbabwe, where the hunt occurred, has suspended hunts of several species in the region where Cecil lived, pending investigations. After Cecil's death, a spokesperson for the government of Botswana said, "It is our stern belief that safari hunting of threatened species such as lions has the potential to undermine our regional anti-poaching efforts as it encourages illegal trade which in turn promotes poaching." Botswana outlawed trophy hunting in 2013, along with Zambia. Last month, Hermann Meyeridricks, president of the Professional Hunters' Association of South Africa (PHASA), asked his membership to reconsider its position on hunting lions in private reserves. "It has become clear to me that those against the hunting of lions bred in captivity are no longer just a small if vociferous group of animal-rights activists," wrote Meyeridricks. "Even within our own ranks, as well as in the hunting fraternity as a whole, respected voices are speaking out publicly against it." All these recent developments "are good first steps" toward protecting lions, says Flocken. But it's not yet clear whether long-term changes will result from the death of one of Africa's most famous lions, because …

Some hunters remain committed

It's safe to assume most of the people who signed petitions to ban trophy hunting were not trophy hunters. In response to the outcry over Cecil's death, the hunting association Safari Club International suspended the membership of those involved in his hunt. The group has not responded to request for comment but issued a statement that condemned illegal hunting but upheld the right for people to pursue big game in accordance with local and international laws. Despite recent criticism, the club continues to support "the conservation of wildlife, protection of the hunter's rights, and education of the public concerning hunting and its use as a conservation and management tool." A pair of Idaho big game hunters also recently made news by defending trophy hunting, calling it "about the pursuit and the adventure of the hunt.

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Rise in CO2 could restrict growing days for crops

By TIM RADFORD
Climate News Network

The positive consequences of climate change may not be so positive. Although plants in the colder regions are expected to thrive as average global temperatures rise, even this benefit could be limited.

Some tropical regions could lose up to 200 growing days a year, and more than two billion rural people could see their hopes wither on the vine or in the field. Even in temperate zones, there will be limits to extra growth.

Plants quicken, blossom and ripen as a response to moisture, warmth and the length of daylight. Global warming will clearly change the temperatures and influence the patterns of precipitation, but it won't make any difference to the available hours of sunlight at any point on the globe.

Scientists at the University of Hawaii at Manoa report in the Public Library of Science journal PLOS Biology that they looked at the big picture of complex change. Higher concentrations of atmospheric carbon dioxide – the greenhouse gas from car exhausts, forest fires and factory chimneys – are expected overall to aid crop and forest growth.

Extended Season

His team is not the first to try to calculate the potential impact of catastrophic global warming on global food supply. Cereals are vulnerable to extremes of heat, and climate change may already be affecting yields in Europe. But the Hawaiian scientists tried a simple theoretical approach, by first identifying the ranges of temperature, soil moisture and light that drive 95% of the world's plant growth today.

They then tried to calculate the number of days in a year in which these growth conditions could be expected at various latitudes in the future, as carbon dioxide levels – and average temperatures – climb. They found that, nearer the poles, the number of days above freezing would increase by 7%.

"But many plants will not be able to take advantage of those warmer temperatures because there will not be enough sunlight to sustain their growth," says Iain Caldwell, of the Hawaii Institute of Marine Biology. The same warming at the lowest latitudes could be devastating: in some tropical regions, conditions could become too hot and dry for any growth.

Overall, the planet could see an 11% reduction in the number of days suited to growth, and some places in the tropics could lose 200 growing days a year.

Although some regions in China, Russia and Canada will see an improvement, around 2.1 billion people who rely on forests and agriculture for food and revenue could lose 30% of the days they now bank on for plant growth.

But rising levels of carbon dioxide could also affect the quality of plant growth, according to a new study in

Global Change Biology.

Zhaozhong Feng, of the Department of Biological and Environmental Sciences at the University of Gothenburg, Sweden, and colleagues looked at the results of eight experiments in four continents on crops, grasslands and forests, and found that as carbon dioxide levels go up, the nitrogen content of the crop is lowered. In the case of wheat and rice, this would also mean lower protein levels.

Negative effect

"Furthermore, we can see that this negative effect exists regardless of whether or not the plants' growth increases, and even if fertiliser is added," says Johan Uddling, a plant physiologist at Gothenburg, and a co-author of the report. "This is unexpected and new."

In the same week, a team of scientists at the University of Alaska Fairbanks produced evidence that climate change has already begun to alter the forests of the far north.

They report in the journal Forest Ecology and Management that in the interior of Alaska, already at the optimum temperature range for white spruce, tree growth slowed as summer temperatures rose.

In Western Alaska, once at the low end of the ideal temperature range for the same species, trees are now growing more rapidly.

"For the first time across a major forest region, we have real data showing that biome shift has started", said Glenn Juday, professor of forest ecology at the university's School of Natural Resources.

"This is not a scenario model, or a might, or a maybe. The boreal forest in Interior Alaska is very near dying from unsuitably warm temperatures. The area in Western Alaska where the forest transitions to tundra is now the productive heart of the boreal forest."

Originally published by Climatenewsnetwok.net June 20, 2015

Sand Point, Western Alaska. Photo: © Hannahgoesfishing

LAST STAND

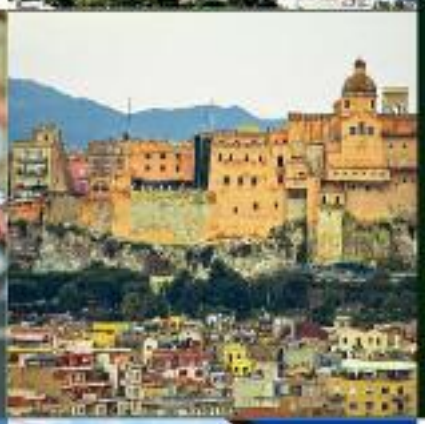
Photo: somethingsighted.blogspot.com

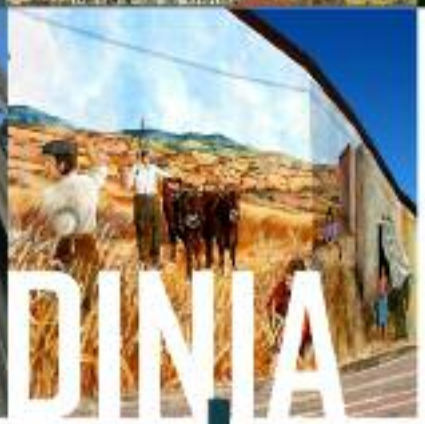
The Philadelphia Electric Company [PECO] coal-fired power plant was designed in 1917 by John T. Windram and W.C.L. Elgin, and opened in 1920. The steam plant was shut down in 1984 and the remaining parts were used intermittently, during times of peak load until 2004. Exelon Generation has recently sold it to developers who intend to turn the former generation plant into boutique hotels. ONE







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