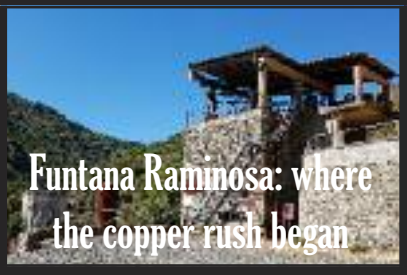
ONE

Only Natural Energy

The Kemper County CCS project – what went wrong and what next?

Paw-sitive climate change actions for pets

Climate change is a market failure



Funtana Raminosa: where the copper rush began

Greenhouse effect and hurricanes

YEAR III - NUMBER 4 - OCTOBER-DECEMBER 2017

22 & 23 December, 2017
IEP Karachi Centre

9th International Civil Engineering Conference

Striving Towards Resilient Built Environment

Jointly Organized by

NED University of Engineering & Technology Karachi - Pakistan

The Institution of Engineers Pakistan Karachi Centre

In Collaboration with

Conference Tracks


Traffic Simulation and Modeling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Geotechnical Engineering


Water Resources


Environmental Engineering


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Construction Project Management


Earthquake Engineering & Design


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Call for Papers

Abstracts are invited for the mentioned conference tracks. Abstracts must be typed and single spaced having a maximum length of 175 words with 5 keywords. It must contain paper title, author's name, organization, email, phone and fax numbers. Abstracts must be submitted through email only at **icec@iepkarachi.org.pk.**

Upon acceptance of abstracts, the authors will be invited to submit full paper

Deadlines & Registrations

Abstract Submission	September 30, 2017
Abstract Acceptance Announcement	October 10, 2017
Full Paper Submission	November 10, 2017
Full Paper Acceptance Announcement	November 30, 2017
Camera Ready Submission	December 08, 2017

For Registrations & other details, Visit ICEC website www.neduet.edu.pk/icec or email at icec@iepkarachi.org.pk

ICEC - Highlights

International Civil Engineering Conference (ICEC) is a regular feature in the calendar of events for Institution of Engineers Pakistan and its Organizing partner NED University of Engineering and Technology Karachi. It is being organized frequently for almost two decades now. Eight International Conferences have been organized in the past. Every year, the ICEC is held under an innovative theme related to contemporary issues that relate Civil Engineering and Socio-Economics of the society.

The latest version of ICEC was held on December 23-24, 2016 at Karachi. The Conference was organized in collaboration with Federation of Engineering Institutions of Islamic Countries (FEIC), Federation of Engineering Institutions of South and Central Asia (FEISCA) and The Asian Civil Engineering Coordinating Council (ACECC). Theme of this Conference was "Ensuring technological advancement through innovation based knowledge corridor." More than 40 international papers were presented at the 2016 Conference including those from United States, United Kingdom, Malaysia, Sri-Lanka, Bangladesh, Iran, Korea and Nepal.

This year, the 9th International Civil Engineering Conference (ICEC 2017) will be organized on December 22-23, 2017, under the theme **"Striving towards Resilient Built Environment"**. The idea is to bring together latest civil engineering knowledge, research and development efforts from scientific community, engineers and practitioners that can help in contributing towards enhancing the resilience of the societies and thus establish a better built environment. The Conference proceedings will also be published.

Registration Fee

Authors/Presenters/Foreign Delegates	Gratis
Early Bird (Before 30th October)	PKR 3000 or USD 30
Late Registration (After 30th October)	PKR 5000 or USD 50
IEP Members	PKR 2000 or USD 20
Students	PKR 1500 or USD 15
IEP Student Members	PKR 1000 or USD 10

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Glimpses of 8th INTERNATIONAL CIVIL ENGINEERING CONFERENCE

held at IEP-Karachi Centre, on 23rd & 24th December, 2016

ONE
Only Natural Energy

Year III - Number 4
OCTOBER-DECEMBER 2017

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Cover Photo:
Kemper County Plant
Mississippipowernews

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

Reg. Nr: 2/2014 Cagliari Ordinary Court

Only Natural Energy [ONE] is a digital magazine published every three months.
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Climate change is a market failure

Many economists describe climate change as an example of market failure, as free-wheeling capitalism has failed to stem rising pollution. Lack of information on how to reduce emissions and too few innovation incentives

By JEZ ABBOTT
ONE

US president Donald Trump is gearing up for war in the east, but not against North Korea and not by nuclear or conventional means of warfare. Trump's rhetoric this time is a continuation of his rant over climate change. China surpassed the United States as the top producer of renewable energy in 2016, according to the BP Statistical Review of World Energy released this July.

China continues to dominate renewables growth, contributing about 40 per cent of global growth, says BP chief economist Spencer Dale. He points out this represents more than the combined output of the 30 or so European countries plus the United States and Canada that make up the Organisation for Economic Co-operation and Development (OECD).

Just before BP's report Trump, who dismisses climate change as a "hoax," fired off another verbal missile - in the direction of India. Announcing withdrawal from the Paris climate accord, he claimed the world was victimising the USA.

New Delhi, for example, wanted to squeeze "billions and billions and billions" of dollars in foreign aid from the developed world to sign up to the accord. Inter-national conflict over climate change and lack of coherence or consistency in policy is taking a heavy toll, suggests the British social entrepreneur and writer Jeremy Leggett, who founded the company Solarcentury as well as SolarAid charity. "If only industry and government could begin acting in harmony on all this," he has written in UK's Guardian newspaper.

Meanwhile, a group of leading economists warned earlier this year of catastrophic global warming within 13 years unless countries collectively raised taxes on carbon emissions to up to $100 per tonne. Economist and Nobel laureate Joseph Stiglitz and former World Bank chief economist Nicholas Stern argued governments should slap a tax on carbon dioxide at $40 to $80 by 2020.

Emerging data on climate change are alarming but, occasionally, give cause for guarded optimism on what more unified thinking and then action can achieve. China has not only surpassed the USA as the largest producer of renewable power, but its carbon emissions are estimated to

Economist and Nobel laureate Joseph Stiglitz and former World Bank chief economist Nicholas Stern argued governments should slap a tax on carbon dioxide at $40 to $80 by 2020

A new neighborhood in Tieshan (Huangshi Prefecture-Level City, Hubei), all the buildings are equipped with solar water heaters. China has surpassed the USA as the largest producer of renewable power.

have fallen over the past two years, after growing by more than 75 per cent in the previous ten years, adds Dale. Greenpeace has also flagged up a positive shift in dynamic from what was once one of the world's worst polluters. By the end of July 2017, China's solar photovoltaic capacity topped 112 gigawatts, according to an online story from the environmental charity's Energy Desk, which went on to report about the installation of a "stunning" 35 GW in just seven months. Wind power is also hot.

China is well on course to thump out considerably more than the total wind power capacity of all of Europe including the UK. In fact, the astounding growth of wind and solar power in China means the country is on track to generate equal to Germany's total electricity consumption by 2020. Wind and solar amount to around 9% of China's own consumption, up from 5.2% last year.

And yet, as the Greenpeace Energy Desk insists, "it's not all rosy". *The Guardian* newspaper echoes this in a climate change series of 'frequently asked questions' including this specific one: Why do economists describe climate change as a market failure? The report, in collaboration with Grantham Research Institute at the London School of Economics (LSE), identified several market failures.

Many economists describe climate change as an example of market failure, as free-wheeling capitalism has failed to stem rising pollution. Adverse effects of greenhouse gases are usually seen as ethical, not economic, issues. A number of other market failures include those arising from a lack of information on how to reduce emissions and too few innovation incentives. Such incentives, or disincentives, include a highly controversial one: taxation. This September asset management company Schroders warned more than $1.5 trillion in company profits worldwide could be wiped out by taxes required to meet the Paris climate agreement. Intensive users of natural resources such as construction and steel firms could see profits topple 80 per cent.

Schroders' head of sustainable research Andy Howard says higher taxes to discourage heavy use of fossil fuels have come in the form of carbon pricing. Many schemes in the UK and Europe involve quota systems, where companies trade pollution permits on an exchange. The EU's emissions trading system (ETS) is the world's biggest scheme for trading greenhouse gas emissions allowances. It covers 11,000 power stations and industrial plants. And while Trump rejects calls to introduce a carbon tax in the US saying it would cost jobs, more countries are adopting carbon pricing, including China. President Xi Jinping has announced the country is to launch the world's largest market for emissions permits this year. When the Chinese scheme goes ahead, almost a quarter of the world's emissions will have a price attached.

Meanwhile, momentum for action on climate change is growing. At the end of August, a court in Brazil suspended mining on the Amazon's Renca reserve, which was a slap in the face for the country's president. Michel Temer had only recently signed a decree allowing the reserve, which is bigger than the size of Denmark, to be opened up to commercial mineral exploration.

The 46,000 square kilometres of land contain gold, manganese, iron and copper, but are also home to nature and tribal communities. Judge Rolando Spanholo said the government had failed to consult its congress, as required under the constitution, and the decree would "put at risk the environmental protection of Renca and the protection of local indigenous communities". Temer insists opening up the gold and mineral-rich area to mining is vital to boost Brazil's weak economy. But campaign groups like Greenpeace, the World Wildlife Fund (WWF), celebrities, and Brazil's influential Catholic elite, have shown how a more unified example than currently demonstrated by many world leaders and national policy makers can result in positive action on the world's climate.

"Pressure is working," a Greenpeace Twitter post read after the court ruling. "We mustn't stop." ONE

Call For Papers

TSME-ICoME 2017

The 8th Thai Society of Mechanical Engineers, International Conference on Mechanical Engineering

Industry 4.0: Challenges and Solutions

12-15 December 2017 **Amoma Grand Hotel**, Bangkok, Thailand

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Applied Mechanics, Materials and Manufacturing (AMM)
Computation and Simulation Techniques (CST)
Engineering Education (EDU)
Industrial Entrepreneurship (IE)
Thermal System and Fluid Mechanics (TSF)
Automotive, Aerospace and Marine Engineering (AME)
Biomechanics and Bioengineering (BME)
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Energy Technology and Management (ETM)
Microsystem and Nanotechnology (MSN)

Selected papers will be invited to submit a full manuscript for publication consideration in Journal of Research and Applications in Mechanical Engineering (JRAME)

Important Dates

Abstract Deadline:	31 May 2017
Full manuscript submission deadline:	31 August 2017
Early-bird registration deadline:	30 October 2017
Conference date:	12-15 December 2017

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Coal mines leave a legacy of ruin

Oxpeckers publishes never-before-seen data exposing the lack of mine closures in South Africa, despite R45-billion being held in financial provisions for rehabilitation in 2015.

By MARK OLALDE
Oxpeckers Centre for Investigative Environmental Journalism

A 19-month data investigation of mine closures indicates that since at least 2011 no large coal mines operating in South Africa have been granted closure. This means the mines have not been rehabilitated and are simply abandoned, leaving a legacy of local and global pollution.

The country's operating and abandoned coal mines release greenhouse gases with a global warming effect equivalent to up to 4.3-million tonnes of carbon dioxide a year, estimates mining consulting firm Latona Consulting. That roughly equates to consuming 10-million barrels of oil and could be significantly decreased with proper mine rehabilitation, including backfilling pits, sealing shafts and replanting flora.

"The Department of Mineral Resources has been totally incapable of closing individual mines," said David Hallowes, a coal researcher at the non-profit organisation groundWork. "A lot of this land is high productive agricultural land, and it's ruined. End of story."

Never-before-seen data released by the Department of Mineral Resources (DMR) in response to Oxpeckers requests under the Promotion of Access to Information Act (PAIA) exposes a system of mine closure in which large operations rarely apply for closure certificates and almost never receive them. Without a closure certificate, liability cannot transfer from a mining company to the government and a mine is not considered legally closed.

Data derived from the documents depicts the largest miners in the country holding the vast majority of financial provisions for rehabilitation. However, as some extractive industries plateau or contract, junior miners that operate on slim profit margins and often hold insufficient funds for rehabilitation are replacing the major mining houses.

Lack of closure

Throughout the country, R45-billion was held in financial provisions for rehabilitation as of 2015, according to the DMR. Companies are required to set this money aside before obtaining mining licences. Once a mine is rehabilitated and closed, the money is returned. If a mine is abandoned, the department has the right to take these funds and use them for rehabilitation.

The largest funds are put up by holders of mining rights – one of three types of mining licences – which are larger than 5ha and can operate for decades without applying to renew the licence. The other two types are mining permits, which cover mines smaller than 5ha that must renew their permits every few years, and prospecting rights. Because of this definition, experts say certificates granted to mining rights carry the most weight.

Analysis of the documents obtained through PAIA requests, as well as information revealed in Parliament in response to questions from the Democratic Alliance, found that 787 closure certificates were issued across the country between 2011 and 2016. Of those, 83% went to prospecting rights, mining permits or borrow pits and other work associated with highway construction.

An additional 88 certificates were unspecified, while only 44 – less than 6% – went to mining rights. All but six of the closure certificates granted for mining rights were issued in the Western Cape.

The Blyvooruitzicht Gold Mine in Carletonville has no closure certificate and has been abandoned since 2013, but the PAIA documents show the mine's rehabilitation fund sits at about R35-million

Problems in the system

In the major gold mining provinces, large companies hold substantial financial provisions but do not close operations.

In the Free State, companies hold approximately 1,125 financial provisions for rehabilitation with a combined value around R5.4-billion. The largest 5% of the provisions comprise nearly 99% of the total funds. This means the remaining 95% of provisions hold, on average, less than R60,000.

However, of the 221 closure certificates granted in the Free State between 2011 and 2016, only one went to a mining right not associated with road construction.

The trend holds true in Gauteng, as well. Of the 628 bank guarantees – one type of financial provision – worth a combined R3.4-billion in Gauteng, the largest 5% account for 83% of all funds. The remaining bank guarantees average just less than R1-million.

Of the 15 closure certificates granted between 2011 and 2016 in Gauteng, zero went to mining rights. While many companies include their financial provisions in the sales of mines, whether a rehabilitation fund is passed on to the buyer is dependent on individual terms of the sale, the department said in a statement.

"This will depend on the parties structuring a commercial transaction. The department's role is to ensure that the state is not exposed to the risk of inheriting environmental liability in the long run," the statement said.

The Blyvooruitzicht Gold Mine in Carletonville, Gauteng, for example, has no closure certificate and has been abandoned since 2013, when a sale between DRDGOLD and Village Main Reef fell through.

The liquidator and activists failed to gain access to Blyvooruitzicht's financial provision, which is still managed by DRDGOLD personnel.

The PAIA documents show the fund sits at about R35-million, a level DRDGOLD admitted was vastly inadequate to clean up the mine. Several mining executives currently face criminal charges relating to environmental transgressions at Blyvooruitzicht.

On the West Rand, Mintails Mining South Africa holds three mining rights, which cover 1,715ha near Krugersdorp and operate in business rescue.

The business rescue plan shows that Mintails requires about R259-million to complete rehabilitation on those rights – a figure that is far too low, according to the environmental management programme report. The PAIA documents reveal that the company and related entities hold less than R17-million in funds for rehabilitation.

A mine shaft rises from the ruins of a former gold mine outside Welkom. Documents indicate that more than R5-billion is held in mine rehabilitation funds in the Free State, and the operations with the largest 5% of the funds account for 99% of that money. Photo: Mark Olalde

Financial provisions

According to Department of Environmental Affairs statistics obtained by Oxpeckers, 40% of operational mines held inadequate financial provisions in 2012/13. This insufficient provisioning was in part due to the fact that the guidelines for calculating financial provisions have not been updated in more than 12 years. Exacerbating the problem, legislation does not allow funds to be used for concurrent rehabilitation.

The information from the environment department also sheds light on the confusion and lack of oversight involved with the granting of closure certificates. The department was told 575 applications for closure certificates were under consideration and 159 were issued in 2013/14 – however, according to answers the Department of Mineral Resources (DMR) provided in Parliament in response to questions from the Democratic Alliance, only 102 were issued that year.

The Western Cape and North West were the only DMR offices that failed to provide information in response to the Oxpeckers' PAIA requests by the time of publication. The Mpumalanga and Limpopo offices handed over information relating to closure certificates, but they indicated a refusal to include information regarding financial provisions – in contravention of the national office's legally binding decision to grant the requests.

The Northern Cape's Springbok regional office provided a list of all closure certificate applications and all granted certificates since the Mineral and Petroleum Resources Development Act took effect in May 2004. Those records highlight the learning curve associated with new legislation. Between 2004 and 2008, companies applied for closure at only 13 sites.

A total of 184 mines applied for closure in Northern Cape's Springbok region since the implementation of the minerals act, and 124 were issued closure certificates. An official from the Springbok office told Oxpeckers that the DMR must wait for the Department of Water and Sanitation's comments on closure applications before granting certificates, a process that is often slow.

Evolving legislation

Laws governing environmental management of the mining industry are shifting with the advent of the One Environmental System (OES) in December 2014. The new system was created with the goal of streamlining environment regulations by bringing together the DMR, the DEA and the Department of Water and Sanitation.

Marthán Theart, an attorney at the Centre for Environmental Rights, has been closely following the evolution of the hotly debated financial provision regulations, an integral aspect of the new OES system.

"The new financial provision regulations provide for a fund that is big enough to cover three types of rehabilitation: annual rehabilitation and remediation, the decommissioning of a mine, and latent or residual impacts of a mine – in other words, the risk of acid mine drainage," Theart said.

In an imminent round of amendments to the provisions, the DEA plans to roll back its inclusion of "care and maintenance" oversight – a term the industry created to explain indefinitely mothballing unproductive mines – due to a belief held in the department that this oversight oversteps its mandate.

An artisanal miner digs coal at an abandoned mine in the Wesselton township in Ermelo, Mpumalanga. The mine's complete lack of rehabilitation led to a booming illegal mining scene, which has resulted in numerous deaths. Photo: Mark Olalde

The department is also considering removing the requirement that prospecting rights hold financial provisions. In a statement sent to Oxpeckers, DEA spokesperson Albi Modise said: "Legislation and its implementation is generally an iterative process and therefore the system had to be tweaked to ensure that smoother operation was achieved."

The National Water Act is also in need of updating, as aspects of the recently published amendments to the water use licensing process remain "very vague", Theart said.

The Department of Water and Sanitation did not respond to repeated requests for comment on its role in the OES. The DMR only addressed some of the questions Oxpeckers sent for this story and did not comment on the implementation of the OES.

Modise said further amendments were necessary to comply with the Income Tax Act, to remove "restrictions on the use of trust funds" – another type of financial provision – and to provide "guidance on the manner of calculating the sum required to be set aside for financial provisions".

In the meantime, it is unclear which laws apply. "The transition is not going very smoothly," Theart said. "There is a big gap, and I think that gap is probably going to be filled by just applying the old regulations of the [Mineral and Petroleum Resources Development Act] that haven't been repealed."

In response to the OES regulations on financial provisions, members of the mining industry, including DRDGOLD and Sibanye Gold Limited, launched litigation in late 2016 against the three relevant government departments and others.

The court application – which Theart called "gun to the head litigation" – seeks to clarify aspects of the regulations, including how mine closure trust funds can be used, the tax implications of transferring funds among different types of financial provisions and clarifying environmental liability.

Tracy-Lynn Humby, a law professor at the University of the Witwatersrand and an expert on the legislation governing mining, said it is still too early to determine whether the OES will be a success, as the legislation needs to be fine-tuned.

"[The DEA] had a lot of pushback from industry. This is the single environmental system being tested," Humby said. "Is this really a more sustainable solution or is this simply business as usual but with a green veil?"

Originally published by Oxpeckers.org April 7, 2017

Paw-sitive climate change actions for pets

By LENORE M. HITCHLER

ONE

Is climate change one of your pet peeves? Do you care about the environment? Are you worried about global warming? Unfortunately, our pets increase the amount of greenhouse gases in the environment, and increased amounts of greenhouse gases lead to climate change.

The production and distribution of pet food are responsible for much of our pets' contribution to climate change. Other pet supplies, along with the disposal our pets' wastes, also contribute to climate change. And there are lots of pets around. According to the *American Veterinary Medical Association*, there are 72 million pet dogs and 82 million pet cats in the United States. This represents a lot of greenhouse gases and increased global climate change. Fortunately, there are paw—sitive actions that you can take to decrease your pet's carbon paw print.

Let's start with the food your pet eats. There are various statistics on the amount of carbon dioxide (CO2) produced during the manufacturing and distribution of pet food. For purposes of simplicity, even though there are other greenhouse gases, this article mainly discusses CO2. Specific numbers may vary from source to source because scientists examine different particular measurements. However, after analyzing the statistics, it is reasonable to assert that the way we feed our pets leads to a vast amount of CO2. University of California-Los Angeles geography professor Gregory Okin is the author of a study performed at the UCLA Institute of the Environment and Sustainability. Okin's research and analysis were published in the August 2, 2017, issue of the scientific journal PLUS One. He states that producing the meat used for dog and cat food generates sixty-four million tons of CO2 per year, therefore making a significant contribution to climate change. Hogs and cattle are some of the primary sources of pet food. According to a study found in the Proceedings of the National Academy of Sciences, the production of one kilo (around 2 pounds) of pork creates 24 kilograms (approximately 52 pounds) of CO2. The same study found that producing one kilo of beef yields 1,000 kilograms (about 2,204 pounds) of CO2. Another University of California study found that on the average, feeding a pet dog results in the production of 597 pounds of CO2 per year, whereas feeding pet cats results in 517 pounds of CO2 per year.

There is debate over whether or not animal byproducts should be used in pet foods. Regular pet products contain meat byproducts whereas premium pet food relies on the type of meat cuts that humans prefer to eat. Using byproducts in pet food is more ecological because meat byproducts are not wasted. Byproducts consist of bones, organs, blood, tendons, skins, intestines, lungs, etc. Many experts find that animal byproducts are safe for our pets to eat. Marion Nestle is the Paulette Goddard Professor of Nutrition, Food Studies, and Public Health at New York University. Nestle maintains that using meat byproducts is a green way of feeding pets. She states that if we did not feed byproducts to domestic animals, and instead fed all of them human-preferred meat we would need to produce the amount of food that it would take to feed an additional thirty-two million Americans. Giving our pets premium meat results in using more cropland, which frequently leads to deforestation, and deforestation also contributes to climate change. Additionally, more water is used, and extra CO2 is produced when raising livestock to feed our pets. Nestle also stated that only fifty percent of each slaughtered animal is consumed by humans, resulting in a large amount of waste if it was not used to feed pets.

Besides the debate over using animal byproducts, another problem with regular pet food is that it contains much more protein than dogs and cats require and frequently doubles or triples the amount they need. Extra land, water, fertilizer, and pesticides are used to grow feed crops for the livestock, in addition to the CO2 produced raising livestock. Besides using meat that could be used for feeding humans, premium pet food

contains, even more, protein than regular pet foods.

Some pet foods contain fish, and because of overfishing the marine food chain is disturbed. Overfishing is a major environmental problem and if continued could lead to human malnutrition and starvation. A 2008 study estimates that 2.5 million tons of fish are made into cat food each year which also contributes to climate change. It is estimated that fishing by either trawling or fish farming uses fourteen times more fossil fuel per gram of protein than raising vegetable protein. Most commercially caught fish are predators. New research suggests that removing predators in the marine ecosystem increases the production of CO2 in oceans.

The disposal of our pets' wastes results in damage to the environment. Dangerous parasites found in pet waste are dispersed into our soil and waterways. And overcrowded landfills are further burdened.

The poop on dog manure is that in addition to increased amounts of greenhouse gases it significantly adds to pollution. The Environmental Protection Agency (EPA) estimates that the typical dog excretes 274 pounds of feces per year. This rounds out to around a total of ten million tons of dog feces produced per year in the United States.

Moreover, the EPA estimates that forty percent or four million tons of dog waste is never picked up by owners. These dog feces eventually enter our waterways leading to both ground and surface water polluted with disease producing pathogens. In 1971, the EPA stated that dog feces are water pollutants and placed them in the same category of as oil, insecticides, herbicides, and oil spills. It is estimated that there are twenty-three million fecal coliform bacteria in a pea-sized amount of dog feces. Dog feces also contain giardia, parvovirus, hookworms, roundworms, and whipworms. Moreover, when dog feces end up in waterways, the high nitrogen content of the waste depletes oxygen in the water which leads to harmful effects on fish and other marine wildlife.

When dog manure is picked up and eventually arrives at landfills, it adds to the already heavy burden of our landfills. It is estimated that as much as four percent of garbage sent to landfills are dog feces. The transport of dog waste to the landfill also increases CO2 because garbage trucks run on fossil fuels. W. Rathje performed studies at the University of Arizona where he found that most modern landfills are packed very tightly, contain very little soil and a minimal amount of oxygen. These environmental conditions inhibit the breakdown of garbage that would be able to degrade in more hospitable environments. If dog feces do decompose in landfills, methane is produced which also adds to climate change. According to the Intergovernmental Panel on Climate Change, methane warms the planet by 86 times as much as CO2.

Petroleum is one of the substances used to manufacture the plastic bags used to carry dog feces, and energy is also used when they are manufactured. Biodegradable bags are better for the environment in that they are not made from plastic and break down quicker. However, fossil fuel energy is used to raise the crops used to produce biodegradable bags. Besides, energy is used to manufacture the bags. If your dog defecates twice a day, you will use 730 bags per year. That is a lot of energy used to manufacture, transport, and send to the landfill every year. Adding colors and scent to poop bags are even worse as more CO2 is added to the environment during the manufacturing and transportation processes of these additions. The decomposing bags emit methane, which will also contribute to climate change.

The scoop on cat litter is just as bad as the news about dog feces and results in an environmental cat—astrophe. It is estimated that two million pounds of cat litter are sent to U.S. landfills every year. Strip mining for clay that goes into cat litter is very damaging to the land. Petroleum is used for fuel to strip mine the land and to transport the clay to the drying facility, where it is processed into a powder or flakes and eventually transported to the store. Finally, the customer drives it home. When the cat litter is discarded, the used litter is sent to the landfill using fossil fuels and contributing to climate change. If the conditions are right for feces and urine to decompose in the landfill, methane is produced.

Just as pets significantly contribute to climate change, they will also be immensely harmed by climate change. According to the Royal Society for the Prevention of Cruelty to Animals, warmer temperatures lead to increased numbers of the parasites that afflict our pets. John Trumble, professor of entomology at the University of California-Riverside, warns that higher temperatures are creating larger populations of smaller fleas and ticks

that will eat more frequently, develop more rapidly and spread more pathogens. In fact, the health of our dogs has already been damaged by rising temperatures. Vectors are the organisms that serve as carriers of disease, and mosquitoes are the vector for heartworms. Ticks are the vector for Lyme disease. Heartworm, a potentially fatal disease, was formerly found only in the southern part of the U.S. However, because of rising temperatures, it is now found in all fifty states. Besides increasing the numbers and range of vectors, climate change might also decrease the number of their predators, leading to even greater numbers of parasites.

Are you ticked off because of Lyme disease? Climate change is increasing the numbers and range of ticks which carry it. Chuck Lubelczk, a vector ecologist at the Maine Medical Center Research Institute's Vector-Borne Disease Laboratory, states "We have a longer tick season with milder temperatures and warmer winters."

Ticks carrying Lyme disease are currently found in forty-one states and one-third of all U.S. counties. Nearly 700,000 cases of Lyme disease in dogs have been reported over a recent five period in the US and Canada.

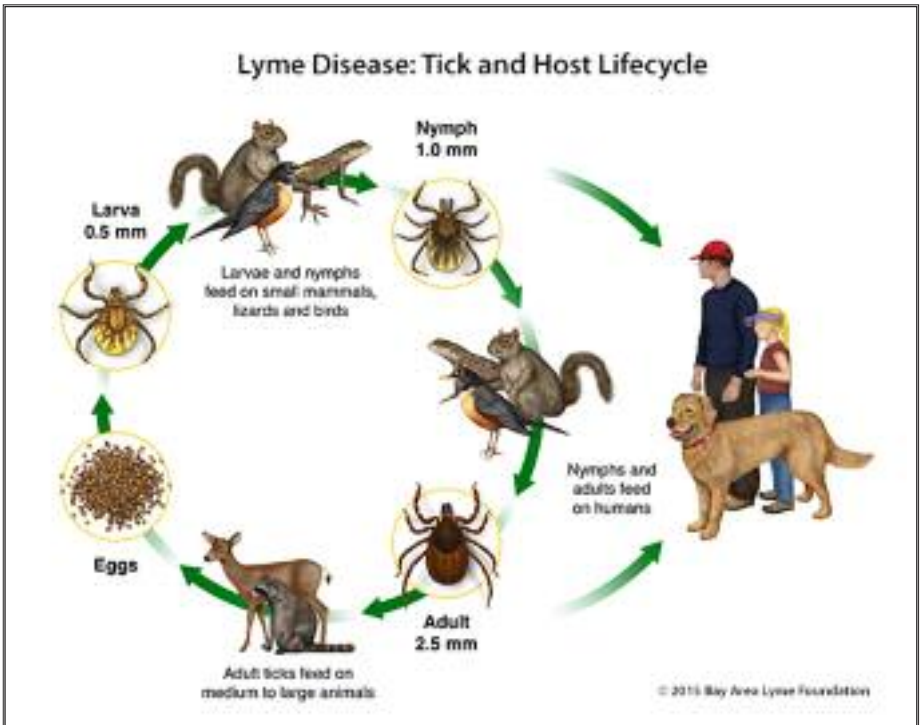
Unfortunately, climate change increases extreme weather events such as floods and hurricanes which will also harm our pets. When people must evacuate to get away from hazardous situations, they are not always able to bring their pets with them. It is estimated that 250,000 pets were homeless because of Hurricane Katrina. After Hurricane Sandy, the *American Society for the Prevention of Cruelty to Animals*, took care of more than 30.000 homeless pets. After natural disasters, many pets and owners are never reunited.

Luckily, positive alternatives exist for current practices of pet care. We can change the way we feed our pets to help stop global warming. If chickens or rabbits were raised for pet food in place of beef, pork, or lamb, less CO2 would be produced. It is important to not overfeed pets. It is estimated that 34% of dogs and 35% of cats in the United States are considered overweight or obese, which can lead to diabetes, orthopedic diseases, and respiratory problems.

Obesity can shorten life expectancy by as much as two years. In addition to the health benefits, cutting down the excess amount of food will, in turn, release fewer greenhouse gases. Make it a habit to feed pets only as much protein as they need. There are protein sources that use fewer fossil fuels that could be included in healthy pet food along with the animal protein needed for survival. Soy protein, for instance, is estimated to be six to twenty times more efficient in terms of fossil fuel requirements. The hemp crop uses much less fossil fuel than livestock and is also a good source of protein. Substituting vegetarian source of Omega-3 to replace krill oil will help prevent overfishing. A vegetarian source of glucosamine can also be utilized.

It would be good for our pets' health to include plant matter in their food. Even though dogs descended from wolves, there are a few genetic differences which result in dogs not requiring a 100% carnivorous diet. A study published in *Nature* found that dogs possess genes for digesting starches from grains and other plants that wolves do not have. Dr. Erik Axelsson, a genomics expert from Sweden's Uppsala University, told the *BBC* that "the dog evolved on the waste dump." In other words, as long as dogs receive adequate animal protein, their diet can be supplemented with plant nutrients.

Make your pet treats. This will avoid fossil fuel use for manufacturing treats, packaging for treats, and transporting them to retail stores. This will also eliminate unneeded ingredients, such as preservatives and artificial colors, thus saving fossil fuels to produce and transport them. Bite-size carrot pieces will prevent choking and will serve as healthy low-calorie treats. According to *petMD*, you can give apples without



Ticks carrying Lyme disease are currently found in forty-one states and one-third of all U.S. counties. Nearly 700,000 cases of Lyme disease in dogs have been reported over a recent five period in the US and Canada. Climate change is increasing the numbers and range of ticks which carry it, due to longer tick season with milder temperatures.

Rabbits are pet worth considering, as they leave smaller carbon foot prints than dogs or cats.

seeds or cores, watermelon without seeds, cantaloupe, frozen bananas, cooked sweet potato, zucchini, lettuce and spinach to your dogs and cats. Some cats love tomato and vegetable juice.

Another way to lower greenhouse gas emissions is to change the way that you dispose of your pet's wastes. Cat litter can be made from ground corn cobs, wheat, sawdust, kenaf plant pellets, compressed straw pellets, small animal-bedding pellets, and recycled newspapers. Baking soda is great for odor control.

Dog feces contain many harmful pathogens, and cat's wastes are also dangerous. It is imperative to not flush cat litter down the toilet because one-half of all cats are infected with Toxoplasma gondii, and water sewage treatment plants do not remove this pathogen. Clay litter can also plug up pipes. Dog and cat waste can be composted if you follow the proper instructions. Always keep dog and cat compost away from food crops. Use a compost bin rather than composting on the ground to help to keep pathogens from seeping into the ground. The National Resources Conservation Service offers advice on how to properly compost dog waste. Go on the web to find a safe method of composting. Please be careful with dog and pet waste. It is worth repeating that composted dog and cat waste material should never be placed near plants grown for food. Acquire your pets in an ecological manner. Obtain recycled pets through rescue organizations or shelters. Find a pet through rescue organizations if you want a specific breed. You can even get a particular breed at some shelters. *The Humane Society* states that twenty-five percent of animals in shelters are purebreds. Spay or neuter pets to cut reduce their population.

Sharing pets could also cut down the number of pets, thus cutting down on total pet carbon paw prints. Could you get together with a lonely neighbor to share a pet? Perhaps an older neighbor would love the companionship of a pet while your family members are at work or school.

Get the smallest size animal that you prefer. Chickens have a much smaller carbon footprint than dogs and cats, and if chickens are allowed where you live, they can make wonderful pets. Instead of worrying about ticks on your dog, chickens will eat ticks. Besides helping to get rid of ticks, they consume other insects, produce eggs and good compost for your garden. Give them rainwater to drink. They can be trained to come when called and some of them even enjoy petting and lap-holding.

Rabbits are another pet worth considering. They also leave smaller carbon foot prints than dogs or cats. They can eat

food waste such as carrot, beet and celery tops, cores of pineapple, bases of head lettuce, and cauliflower. You can ask your local co-op or grocery store for their wilted produce. They can also eat hay, which does not have to be manufactured or packaged. Their bedding can be shredded newspapers or hay which can be composted along with their feces and urine. They need to chew, so their toys can consist of cardboard paper towel tubes and toilet paper tubes. They make excellent paper shredders. They can make excellent pets and can be sweet, affectionate, and are naturally quiet. Get the smallest size dog that you like. They will eat less food and produce less waste. Great things come in small packages.

In addition to food and disposal of wastes, pet supplies add to your pet's carbon footprint. In 2015, pet owners spent almost $50 billion on pet products. According to the American Pet Products Association, pet food comprises only one-third of these purchases. Thus, two-thirds of expenditures are for pet equipment and toys. Do your best to curtail your pet's carbon paw print. Do not use plastic containers for food and water.

In 2015, in the USA alone, pet owners spent almost $50 billion on pet products. According to the American Pet Products Association, pet food comprises only one-third of these purchases. Thus, two-thirds of expenditures are for pet equipment and toys.

Plastic is made from petroleum and does not degrade for a long time. Plastic dishes can get nicks and breaks in them and thus become a breeding ground for germs.

Gum disease can be caused by bacteria. Plastic bowls may contain bisphenol-A or include other hazardous chemicals such as phthalates, which is a plastic softener that the Canadian Cancer Agency has found to cause tumors in mice and lab animals.

Also, some pets are allergic to plastic. Use stainless steel bowls because they last longer, are not made from petroleum, and are unbreakable. Do not buy a new ceramic bowl because they can break and then need replacing. However, a used ceramic bowl would be more ecological than purchasing a new stainless steel bowl.

Do not buy other plastic pet products, including toys and beds. They can contain polyvinyl chloride, which is classified as a carcinogen and a danger to animal health by the EPA. Try making your pet supplies, such as shampoos and insect repellents. According to veterinarian Patrick Mahaney, "There are natural oils, topical products, collars, and shampoos that can have an anti-tick effect." Doing so would not only be more environmentally safe, but it would also reduce exposure to toxic chemicals.

According to the Natural Resources Defense Council, some flea and tick control products pose a cancer risk to children. These pesticides can exceed the safe levels established by the EPA 500 times. Always vaccinate for canine Lyme disease.

Purchase as many supplies that you can from a second-hand store. For bedding, stuff old clothing, blankets and towels into a duvet. This would be an excellent alternative to foam filled pet beds which can be contaminated with flame retardants which are endocrine-disputers. With directions from the Internet, you can recycle many used items into toys.

The Humane Society points out that many pet owners report their cats love simple toys. Give them cardboard boxes, paper towel rolls, or toilet paper rolls to play with. You can also buy earth-friendly pet care products, such as hemp leashes, collars, pet carriers, beds, and toys. If you buy something that your pet hates, donate the item to an animal shelter.

There are many things that pet owners can do as individuals. Purchase pet products that do not involve as much CO2 production as other products.

Remember that manufacturing and transporting every item found in a product adds to its carbon footprint. Do not buy plastic pet supplies. Social and political activism could lead to innovations to alleviate excessive production of CO2.

Pet products could be sold in bins to eliminate packaging. Research could be performed to determine the most non-toxic and energy efficient method to eliminate pathogens found in cat and dog wastes so that they could be returned to the ground as compost for fertilizer.

Thus, our pets contribute to climate change and, in turn, will be harmed by it. *Fur—tunately*, there are things that we can do to lessen their carbon paw prints. Make the world a better place while your pets are making your life better!

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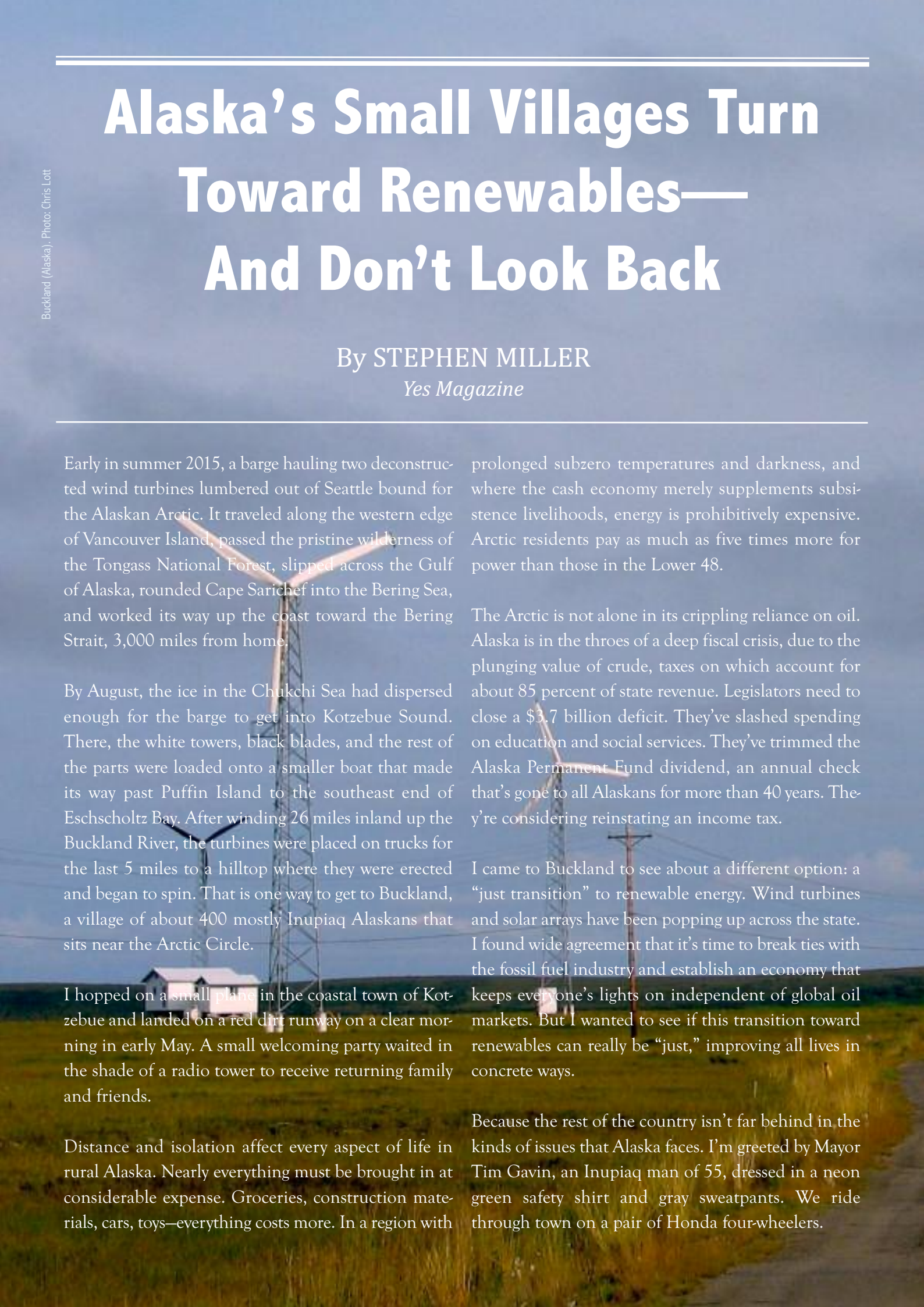

Buckland (Alaska). Photo: Chris Lott

Alaska's Small Villages Turn Toward Renewables—And Don't Look Back

By STEPHEN MILLER
Yes Magazine

Early in summer 2015, a barge hauling two deconstructed wind turbines lumbered out of Seattle bound for the Alaskan Arctic. It traveled along the western edge of Vancouver Island, passed the pristine wilderness of the Tongass National Forest, slipped across the Gulf of Alaska, rounded Cape Sarichef into the Bering Sea, and worked its way up the coast toward the Bering Strait, 3,000 miles from home.

By August, the ice in the Chukchi Sea had dispersed enough for the barge to get into Kotzebue Sound. There, the white towers, black blades, and the rest of the parts were loaded onto a smaller boat that made its way past Puffin Island to the southeast end of Eschscholtz Bay. After winding 26 miles inland up the Buckland River, the turbines were placed on trucks for the last 5 miles to a hilltop where they were erected and began to spin. That is one way to get to Buckland, a village of about 400 mostly Inupiaq Alaskans that sits near the Arctic Circle.

I hopped on a small plane in the coastal town of Kotzebue and landed on a red dirt runway on a clear morning in early May. A small welcoming party waited in the shade of a radio tower to receive returning family and friends.

Distance and isolation affect every aspect of life in rural Alaska. Nearly everything must be brought in at considerable expense. Groceries, construction materials, cars, toys—everything costs more. In a region with prolonged subzero temperatures and darkness, and where the cash economy merely supplements subsistence livelihoods, energy is prohibitively expensive. Arctic residents pay as much as five times more for power than those in the Lower 48.

The Arctic is not alone in its crippling reliance on oil. Alaska is in the throes of a deep fiscal crisis, due to the plunging value of crude, taxes on which account for about 85 percent of state revenue. Legislators need to close a $3.7 billion deficit. They've slashed spending on education and social services. They've trimmed the Alaska Permanent Fund dividend, an annual check that's gone to all Alaskans for more than 40 years. They're considering reinstating an income tax.

I came to Buckland to see about a different option: a "just transition" to renewable energy. Wind turbines and solar arrays have been popping up across the state. I found wide agreement that it's time to break ties with the fossil fuel industry and establish an economy that keeps everyone's lights on independent of global oil markets. But I wanted to see if this transition toward renewables can really be "just," improving all lives in concrete ways.

Because the rest of the country isn't far behind in the kinds of issues that Alaska faces. I'm greeted by Mayor Tim Gavin, an Inupiaq man of 55, dressed in a neon green safety shirt and gray sweatpants. We ride through town on a pair of Honda four-wheelers.

Buckland is quiet this morning. "Village life," Gavin says with a grin. "Everyone's up all night and sleeps to noon." Last night he took his daughters caribou hunting, and brown pelts are draped over a four-wheeler out front. Like the other houses in Buckland, Gavin's place is single-story, wooden, rectangular, and built on stilts.

It's the shoulder season. The snow has nearly disappeared from the rolling hills but the tundra has not yet regained its vibrant green. For months out of the year, Buckland sits in the dark and cold. Now, each day adds about nine minutes of light, and the river is breaking up, taking chunks of ice downstream to the Chukchi Sea.

There is a school with about 180 students, a health clinic, and a grocery store where a gallon of milk typically runs around $8 and cigarettes $13. As with most Native villages, there is not much of a cash economy. The sale of homemade wares brings in a bit. Most paid jobs are with the tribe or state government, and these are most often held by women. Men pick up odd jobs and hunt and fish year round.

Hunting may put food on the table, but it doesn't keep on the lights—or the internet. This morning, one of Gavin's daughters sings along to a YouTube video on a computer as another scrolls through her iPhone. Gavin's electricity bill has run as high as $900 a month. That's expensive, even by Arctic standards; though others in the region pay as high as $600. In the Lower 48, the average is $114. The turbines have helped bring Gavin's bill down to around $400.

To address cost disparities, Alaska pays a subsidy to rural users who draw less than 500 kilowatt-hours a month. Heavy users, like Gavin and businesses, see the immediate effects of renewables.

To say people here are dependent on oil is an understatement. Even with the turbines, the town relies on five 300-gallon tanks to supply its diesel generators, and each home has its own supply of heating fuel. "We burn through them quick when it's 40 below," Gavin says.

Alaska has become a proving ground for sustainable energy; in particular, the microgrid—a small power grid that serves one community in isolation.

Critics argue that renewable energy performs inconsistently, but microgrids mix sources like wind and solar with existing diesel generators. Engineers can manage a grid and keep fossil fuel input to a minimum. The Renewable Energy Alaska Project estimates that efficiency and renewable projects across the state saved 22 million gallons of diesel fuel in 2015 alone—worth nearly $61 million. While the grid does not yet run entirely on renewables, that is now within reach. I had thought I could get to know Alaska's renewable energy transition by touring Buckland's renewable energy facilities, but it turns out the real story is more pragmatic.

The first stop is not the wind turbines on the hill, but a state-of-the-art treatment plant that pulls water from the river and filters it using a magnetic process that removes organic matter and inorganic contaminants like iron. There are only a few of these in the state. The facility was built when fuel prices were lower. As the cost of diesel to power the plant rose, residents couldn't afford their bills and began to default.

"We realized we had a real crisis on our hands," says Ingemar Mathiasson, energy manager for the Northwest Arctic Borough. He says failing water and sewage systems and $12-a-gallon fuel pushed a coalition that included the borough and tribal corporations to look seriously into energy alternatives.Mathiasson led a feasibility study and inventory of resources that found the region was rich in wind and, perhaps surprisingly, solar potential. Solar can work in the Arctic during the several months of the year when the sun hardly sets. Towns in other parts of the state have also tapped geothermal energy, and communities along the coast can use hydroelectric power. Kodiak, a town of 6,300 at the top of the Aleutian Islands, is the state's poster child for renewable energy: Wind and hydro generate nearly all its power.

In 2010, the coalition received funding from the federal government's Coastal Impact Assistance Program. They

then began the years-long process to install the 30 solar panels that now reduce the cost of powering the treatment facility, and the two wind turbines west of the village.

It's early afternoon when Gavin and I make our way up the hill to the two 100-kilowatt wind turbines. It's a clear day and a parade of clouds casts shadows on the tundra below. It appears endless.

The turbines looming 120 feet above us were developed specifically for the Arctic. Black blades reach out 68 feet from a rotating hub and pivot to make the best use of wind speeds as low as 7 miles per hour and as high as 56. The blades operate well in dense air at extremely low temperatures. On a decently windy day, the turbines can produce about a third of Buckland's power.

Buckland takes advantage of every possible energy savings. Efficiency is the first step toward sustainability.

The parts, labor, and 5-mile cable back to town cost about $6.2 million, money the coalition scraped together from federal and state grants. Mathiasson's research shows that the region, including Buckland, nearby Deering, and the city of Kotzebue—a combined population of fewer than 4,000 people—has saved $4.5 million in diesel fuel since Kotzebue's wind turbines came online more than a decade ago. Kotzebue has been experimenting with wind in the Arctic since the late 1990s. The village projects are new and relatively small, though planned solar and battery additions will significantly increase their impact.

"The bottom line for rural Alaska is that the more independent we can become from having to import fuel from other places, the more resilient the communities and Alaska as a whole will be," Mathiasson says.

Buckland and other communities take advantage of every possible energy savings. When the windmills generate more power than is needed, the excess goes to heat water pipes in the treatment plant. Waste heat from the diesel generators is used to warm the city office. In Kotzebue, the electricity co-op uses its waste heat in that city's hospital. Efficiency is the first step toward sustainability.

Heading back into town, I can't help noticing yards that spill over with nets, traps, engine parts, steel drums, and all manner of apparent refuse. Anything within reach, however, may still hold some value. Arctic life is a struggle just to get the things one needs. Imagine waiting for the sea to thaw to receive deliveries replacing something that had been thoughtlessly tossed away a season before.

The Inupiaq people of this region were semi-nomadic when Western settlers established towns. They still rely on the land and ocean for their food and living, but the land is changing.

On a projector in a back room of his house, Gavin traces the river's course via Google Earth. He points out previous Bucklands—abandoned settlements his ancestors inhabited years ago, before the ever-braiding river or changing food sources caused them to relocate. The site of the previous village is within view, across the river where a few weathered wooden structures still cling to the tundra. The Inupiaq keep adapting.

Today, the river is foremost in Gavin's mind. As long as anyone can remember, the river, swollen by melting snow, begins to break up in early June. The event lasts a couple of days and usually results in an ice dam that floods the village (hence, houses on stilts). But in recent years, the ice has slipped out quietly in May.

"Look!" Gavin says, pointing to a live-feed screen that displays a view of the river. "We're supposed to be flooding right now, but there ain't enough snow out there."

But it's not really the flooding Gavin's worried about. At this time in previous years, there would still be enough ice to support a snow machine, allowing hunters and trappers to work their routes. Instead, the river is a slushy mess not strong enough to hold a hunter, not open enough for a boat. Gavin and the others are usually stuck waiting on the banks.

At breakfast the following morning, Oscar Walker drops by for coffee. His wife works for the school district, and he is a subsistence hunter who, unlike Gavin,

has shunned the digital age. He prefers the old ways of doing things.

Walker recently learned that his wife has gout. "The doctors want to put her on meds, but I won't let them," he says. "They keep you in a cycle where you depend on them for assistance programs to make it easier." Instead, he's committed to healing her body by harvesting as much of their food from the land as That has become more difficult as the ice has dissipated, he says.

In recorded history, there has never been less ice in the Arctic seas than this past year. A biologist with the U.S. Fish and Wildlife Service in Kotzebue put an early end to his team's study of Chukchi Sea polar bears because the ice had retreated so far north they couldn't find the animals.

In recorded history, there has never been less ice in the Arctic seas than this past year.

In the spring and fall, the Inupiaq hunt oogruk, or bearded seal. Oogruk rest on shelves of solid ice between dives for mollusks. Hunters use the ice to get within striking distance of a seal. (Hit an oogruk in the water and good luck getting it out.) Poor ice has both diminished the chances hunters will find a seal and increased the difficulty of getting to it if they do.

Gavin and Walker know that these changes are the result of fossil fuel use on a grand scale. If Buckland were to power itself entirely on renewables, the impact on global warming would be negligible. But making that switch would save the community thousands of dollars a year—money that could then be spent at the grocery store to supplement a livelihood that used to come from the land.

Construction of a few wind turbines in Arctic villages won't stop climate change and can't undo much of the damage the fossil fuel economy has already done here. But the transition to renewables and microgrids like Buckland's can provide local economies a measure of control. Energy ownership is crucial to the just transition I came to the Arctic to explore. And this is where Alaska Native tribes are particularly well-positioned to benefit.

Alaska's tribal system is unique. Tribes were organized into 13 for-profit corporations under the Alaska Native Claims Settlement Act of 1971, an effort to resolve ownership disputes over 44 million acres of land. Tribal corporations, like any other, invest and pass profits on to their shareholders—in this case, tribal members.

Though ANCSA resolved bitter land disputes in a way that empowered Native groups, some criticize it for encouraging tribal corporations to develop resources for profit.

"Sometimes living and thriving on your land is best accomplished without developing the land. But what is your cash economy in rural Alaska if you don't develop your land?" said Elisabeth Balster Dabney, executive director of the Northern Alaska Environmental Center, which promotes conservation and sustainable resource stewardship in interior and Arctic Alaska. As resource extraction can damage the land on which indigenous cultures depend, tribal leaders looking to bolster their economies face difficult decisions.

Buckland falls within the NANA Regional Corporation, which owns the only hotel in Kotzebue and has investments ranging from an oil company in the Gulf of Mexico to the town's grocery store. Profits from these ventures are paid to Inupiaq members as a dividend, as are those generated by the energy co-op. This model localizes economic investment and keeps cash in the community.

"The only sustainable future is harvesting energy as close to home as you can," Mathiasson says. "By harvesting energy locally, you're also creating a local workforce, and that money stays in the communities instead of being part of the diesel fuel equation."

That's not to say these small renewable grids are sizeable employers. Buckland sent two workers to Anchorage for training on the new systems and as line technicians to handle outages and other issues.

Buckland, Deering, and Kotzebue will add solar arrays and new batteries in 2018. The towns can then run almost entirely on renewables for half the year, and supplement with wind power year round. As these systems expand throughout the region, more technical positions will become available, with preference for local hires. The North Slope oil industry, in contrast, hires nearly 40 percent of its workforce from outside the state.

For most people, a better future is about economics. Fisheries built towns up and down the coast, and the Klondike gold rush brought tens of thousands of eager prospectors, but nothing transformed Alaska like the oil industry. The state's first oil well was drilled in 1902, and at the peak in 1988, oil companies pumped 2 million barrels of crude a day. When the oil money was flowing, it built Alaska's schools, hospitals, roads, and bridges and established the Alaska Permanent Fund—the world's only universal basic income program.

Now that the price of oil has plummeted, that money no longer fills the state treasury. And though industry investors are seeing profits decline, it is state residents who must live with the long-term effects.

"The oil companies are not committed to the long haul, and Native people are paying the price as their hunting and fishing get destroyed," says Enei Begaye, a Navajo woman who directs the indigenous rights advocacy group Native Movement in Fairbanks.

In the past when the economy slumped, state lawmakers responded by calling to expand drilling, to get oil flowing through the pipeline again. But the latest bust even has conservative residents doubting the economic strategy of "drill, baby, drill."

Wind turbines in Kotzebue, Alaska.
Photo: U.S. Air Force/Capt Jason Goins

"The oil companies like to push the narrative that Alaskans want more oil development, but that's not true," Begaye says. "Nothing will replace the oil money," and never again will the state see such profits. "If we just think about how much money we can make, we're missing out on what an economy can be."

The question I brought to the Arctic was whether this oil low point, coupled with the effects of climate change in a state proud of its wild beauty, is enough to tip the scale toward a new way of thinking.

Only a few of those I spoke to had even heard of the "just transition" movement. People here focus on more immediate, practical issues—but that's why renewable energy is winning. It makes economic sense.

The microgrid technology has been proven, and costs are coming down. One important lesson for the Lower 48 is the need for political will. None of this transformation would exist without significant government investment, and the current fiscal crisis has brought many plans to a halt.

For the transition to continue, Alaska's legislators will need to get fully on board. Though the state has weathered economic downturns before, it hasn't had to do so with billions of dollars of infrastructure fixes necessitated by melting permafrost. It hasn't done so while ocean acidification threatens its fishing industry. And it hasn't done so at a time when renewable energy sources can outcompete oil.

"Renewables are growing," Mathiasson says. "I think the grassroots level is strong enough; the people want a cleaner energy source, and they want to see a better future."

Originally published by YES Magazine August 25, 2017

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Energy Market Outlook due to Change in Industry Environment

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The Kemper County CCS project – what went wrong and what next?

By TOBY LOCKWOOD

ONE

A long-running saga finally came to an end this July, as the Kemper County carbon capture and storage (CCS) facility was ordered to cease operations by a Mississippi State public regulator, following years of delays and cost overruns by the project.

Launched by major US power producer Southern Company in 2010, Kemper was built to turn low quality coal to hydrogen gas which could then be cleanly burned in a gas turbine power plant. Much of the CO2 produced in this 'gasification' process was to be purified and sold to oil companies which find a valuable use for the gas in forcing more oil out of drying-up wells – providing the major additional benefit of keeping the CO2 out of the atmosphere.

Unfortunately for Southern Company, the explosion of fracking and plummeting gas prices in the US since 2010 have put the project on shaky financial footing. With the coal gasification process beset by a series of technical problems, the utility was directed to simply run its gas turbines on cheap shale gas rather than subject its customers to electricity rate hikes to support the ongoing work. However, the facility is not designed to capture the CO2 released by natural gas and is now more polluting than the planned 'clean coal' plant.

My visit to the facility helped shed some light on the tribulations faced by Kemper, and its possible future.

The wider media has reported final costs for the plant as ranging from $7.8 to $9 bn, compared to a supposed original estimate of $2.8 bn. Southern Company are quick to point out that this original figure does not include work on creating the new coal mine, CO2 pipeline, and other costs external to the plant itself, which would take the estimate to $4.1 bn. Nevertheless, the plant has taken over three years longer than intended, and its cost nearly doubled. Where did it all go wrong?

Coal gasification for power generation is not a new idea and has been used at a number of plants around the world – three of them in the USA itself. Two such plants are currently being built to replace the Fukushima nuclear power plant in Japan, although these will not include CO2 capture. On the other hand, this technology has never been cheap, and some of the other plants have also run into cost increases and technical issue.

Southern Company did not make things easy for themselves by choosing to use their own new gasification technology which had never before been tested at such a large scale – presumably with a view to commercialising the technology around the world. Besides criticising this ambitious plan, a report by the Mississippi Public Service Commission has highlighted instances of poor project management which led to cost overruns. These include the accusation that the

Southern Company did not make things easy by choosing to use their own new gasification technology never tested before at such a large scale

project was rushed to meet a 2014 operational deadline required to obtain a federal tax credit, apparently leading to it still being partly designed after construction had begun.

The company may have also not paid adequate attention to tracking changes in the cost of commodities and labour. In any event, it seems clear that the original cost estimate was somewhat optimistic, and a three-year delay is bound to rack up costs for any project, in labour costs alone.

Visiting Kemper brings home the scale of the equipment that may never be used. The three acres of the plant site house a labyrinth of stainless steel piping and reaction vessels which look more like a chemical facility than a power plant. Most of this equipment now stand idle, while the two gas turbines turn quietly in one corner of the site.

Although the whole site is huge, it still seems compact relative to the alternative 'post-combustion' approach to carbon capture, which employs towering chemical absorbers to remove the CO2 from the flue gas produced by conventional power plants. This size reduction is thanks to the high pressures at which the Kemper process operates, which also make CO2 easier to separate and explains much of the early interest in gasification for carbon capture.

Smaller sub-plants of various colours dotted around the site are evidence of another key advantage. These facilities are designed to take sulphur and nitrogen compounds produced by the coal – usually air pollutants – and convert them to useful by-products in the form of sulphuric acid and ammonia.
Many have proposed that even the hydrogen produced by this kind of plant could be used for chemical manufacture rather than power generation, although this was not tried at Kemper.

The whole gasification and CO2 capture process was successfully tested last year, but ongoing technical issues have led to the state's eventual loss of patience. Southern Company attributes most of these problems to standard teething issues, or unforeseeable errors by contractors. Having been sitting around for months in the open air, the coal supply had absorbed too much water and weathered into small particles, making it difficult to dry.

Kemper County Coal Gasification Plant

The heat resistant lining of the gasifier units had been poorly installed and would flake off and clog other parts of the plant – this had been scheduled for replacement. Earlier this year, some of the thin tubes designed to cool the hot gas with steam began to burst in places, apparently due to weak spots where they were welded to supports.

The company remains bullish about the viability of the plant, maintaining that all these problems were fairly easily solved and that such issues are not unusual for first examples of industrial technologies at large scale. They also point out that the plant's reliability compared favourably with the early months of operation of other gasification technologies.

However much money has been poured into Kemper so far, it seems even more wasteful not to find some use for this pioneering facility and few doubt that it could operate reliably given a bit more time.
While the shale gas revolution may have condemned coal gasification to the history books in the US, the technology will undoubtedly still prove valuable in East Asia, where gas is expensive, and coal remains king.
An operating Kemper could send a strong global message on the viability of CCS and the strength of US commitment to the technology, and past short-comings may be sooner forgotten. Instead, it risks standing as a high-profile monument to the supposed expense and impracticality of the technology, even while other plants have proved much more successful.

Saving Kemper may be well out of reach of the President's Office, but it is certainly ironic that such a flagship 'clean coal' project should fail under the watch of the pro-coal Mr. Trump.

There may yet be political salvation for the facility though. A current (pre-Trump) bill to raise an existing tax credit for every ton of CO2 stored by CCS plants from the current $22 to as high as $50 could change the game for Kemper.

To obtain the maximum reward the plant would have to pump CO2 underground without using it in oil production, but Southern Company geologists have already extensively explored this option for the plant and prospects look good. It seems unlikely, but Kemper may still be put to use for the purpose it was intended. INE

The alarming link between greenhouse effect and hurricanes

By ALICE MASILI

ONE

Who lives by the fossil fuels shall die by the global warming. Cynical, unforgiving, bitter, acrimonious and catastrophic? Sure. It ticks all the boxes.

But it's undeniable that the extension and magnitude of the destruction caused in the Caribbean and Florida by Hurricane Irma and the previous devastation in the Houston area (Texas) from Harvey typhoon led many to wonder if there is a link between extreme weather events and the greenhouse effect.

The scientific debate on this aspect of climate change has been going on for years, and it has produced numerous scientific studies, identifying clues and probable links.

Although it has not yet come to a definitive response, there is a variety of scientific approaches to demonstrate that the sharpening of the intense and devastating meteorological phenomena is related to climate change, even if it did not cause the entire event.

According to the draft of "U.S. Global Change Research Program and Climate Science Special Report (CSSR)" recently published by *The New York Times*, in the article titled "Read the Draft of the Climate Change Report," the global warming would be the man's fault.

Recently, a team of scientists from 13 federal agencies completed the report on climate change and its future effects, concluding that Americans are feeling its effects right now. This document, commissioned by the National Climate Assessment, explains the apparent consequences of global warming and determines how much this result increased the probability of extreme climatic events."

Based on the evidence and understanding of the issues leading to uncertainties, confidence is high that heavy precipitation events have increased in the U.S. Furthermore, confidence is also high, that the important regional and seasonal differences in changes documented in the text […] are robust."[…] "Evidence of future change in precipitation is based on climate model projections and our understanding of the climate system's response to increasing greenhouse gases and on regional mechanisms behind the projected changes." (Chapter 7 of CSSR)

By 1880 temperatures increased by 1,6 degrees Fahrenheit as the effect of human activities, especially greenhouse gas emissions. Since 1980, the situation has been worsening, reaching the hottest climate in the last 1500 years. According to the National Climate Assessment it legitimizes the relationship between climate change and extreme atmospheric events.

The American scientific community is on alert, also because they fear that US President Donald Trump and his administration may attempt to block the study or slow down its dissemination. There is concern even in Europe.

Following the massive heat wave that hit Europe in the summer of 2003, a team of British researchers started to use environmental data and model simulations to establish a statistical link between climate change and heat wave, giving life to the "science attributions".

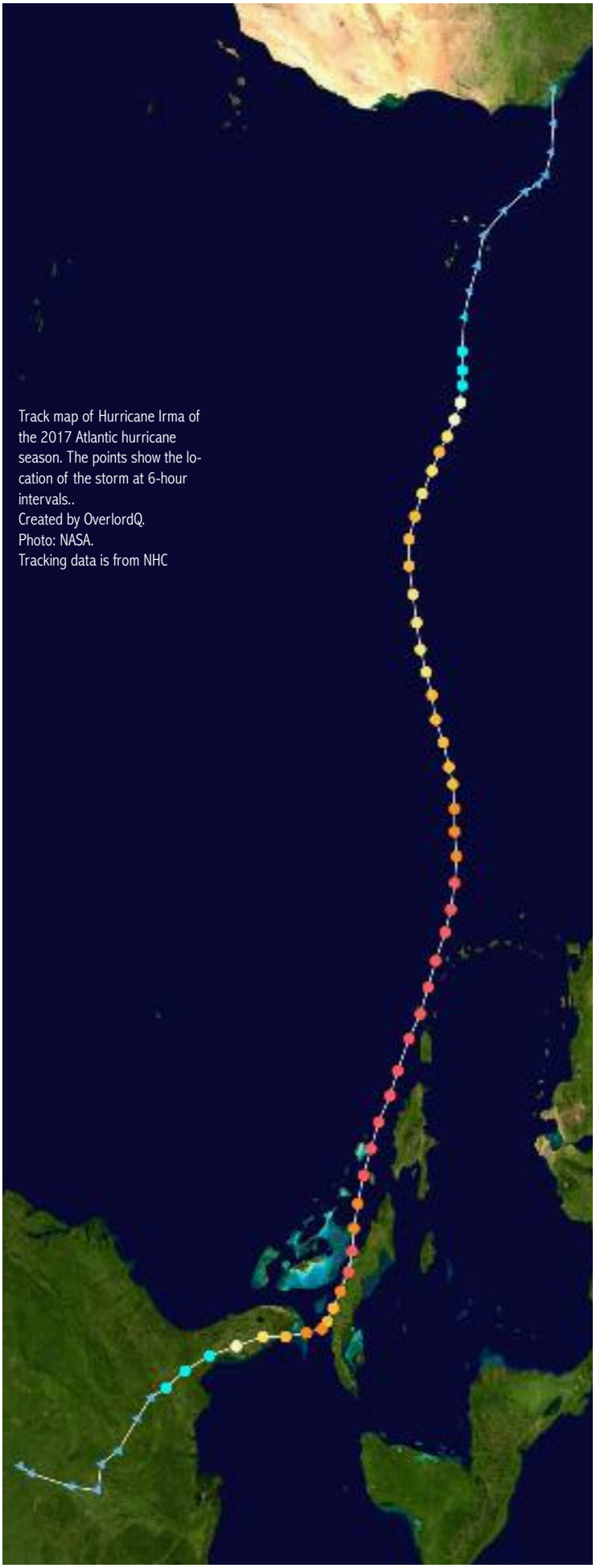
Researchers from the University of Melbourne, the Australian National University and the University of New South Wales of Sydney also argue that the abnormally high temperature recorded in Australia in 2013 are relatively substantial evidence of human contributions.

According to their report, published in the Bulletin of the American Meteorological Society, meteorological phenomena such as heat waves, followed by droughts and floods, are more comfortable to attribute to climate change, but the science does not assign a single cause to the magnitude and severity of storms. The National Oceanic and Atmospheric Administration (NOAA), in particular, the division of Geophysical Fluid Dynamics Laboratory (GFDL), which contribute to the CSSR, has recently updated one of the most complete and articulated reviews of studies published so far on hurricane relationship and global warming. By developing more and more accurate statistical prediction models, researchers are increasingly confident to prove that storm intensity, droughts, and heatwaves occur more frequently because of man.

Research suggests that human activity has probably led to changes, but we are still unable to detect them because of their scale and our technical limits in analyzing.

It is proven that rising sea levels, due to global warming, brings more likely flood in coastal areas to hurricane routes, and there is a relationship between increasing temperatures and storm intensity formed in the Gulf of Mexico. Based on the data collected over the years, researchers also

Hurricane Irma - the day after: a rescue mission on St. Thomas in the U.S. Virgin Islands.
Army National Guard photo by Sgt. Priscilla Desormeaux.



Track map of Hurricane Irma of the 2017 Atlantic hurricane season. The points show the location of the storm at 6-hour intervals..
Created by OverlordQ.
Photo: NASA.
Tracking data is from NHC

agree that anthropogenic warming will lead to tropical cyclones (hurricanes, typhoons, tropical storms) at an average of 2 to 11 percent depending on prediction models. Assuming that the size of storms does not diminish - there are no suggestions - the destructive potential will be even more powerful.

The High-Resolution Atmospheric Model (HiRAM C180; 50-km grid) used to simulate the genesis of tropical cyclones can reproduce the inter-annual variability of tropical cyclone occurrence quite realistically, especially in the Atlantic basin.

The studies cited by the GFDL also assert that the most intense storms are getting stronger in recent years. Tropical cyclones with the strongest winds ever recorded have occurred in the last two years, confirming the models' trend.
Also, stronger winds increase the risk of damages to buildings and trees, leading to the production of more debris that can hinder water outflows and make coastal areas even more dangerous during storms.

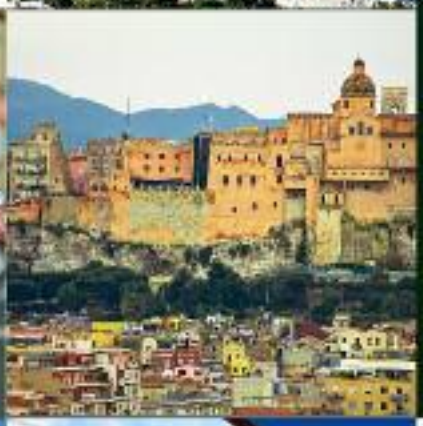
To highlight this connection, *Carbon Brief* (read the article "Mapped: How climate change affects extreme weather around the world") mapped all the extreme weather events subjected to relevant studies with the aim of tracking in real time the evolution of the attribution of these climatic phenomena.

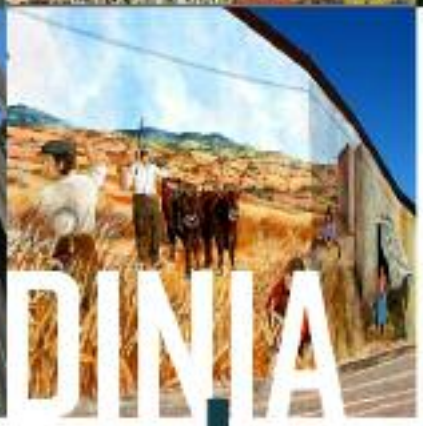
An average of ten meteorological disasters has been estimated, each one costing more than a billion dollars between 2012 and 2016. Despite numerous parameters are the concause (population density, building installations in coastal areas, etc.), the impact of heating can no longer be denied. ONE










SARDINIA
Technology & Nature

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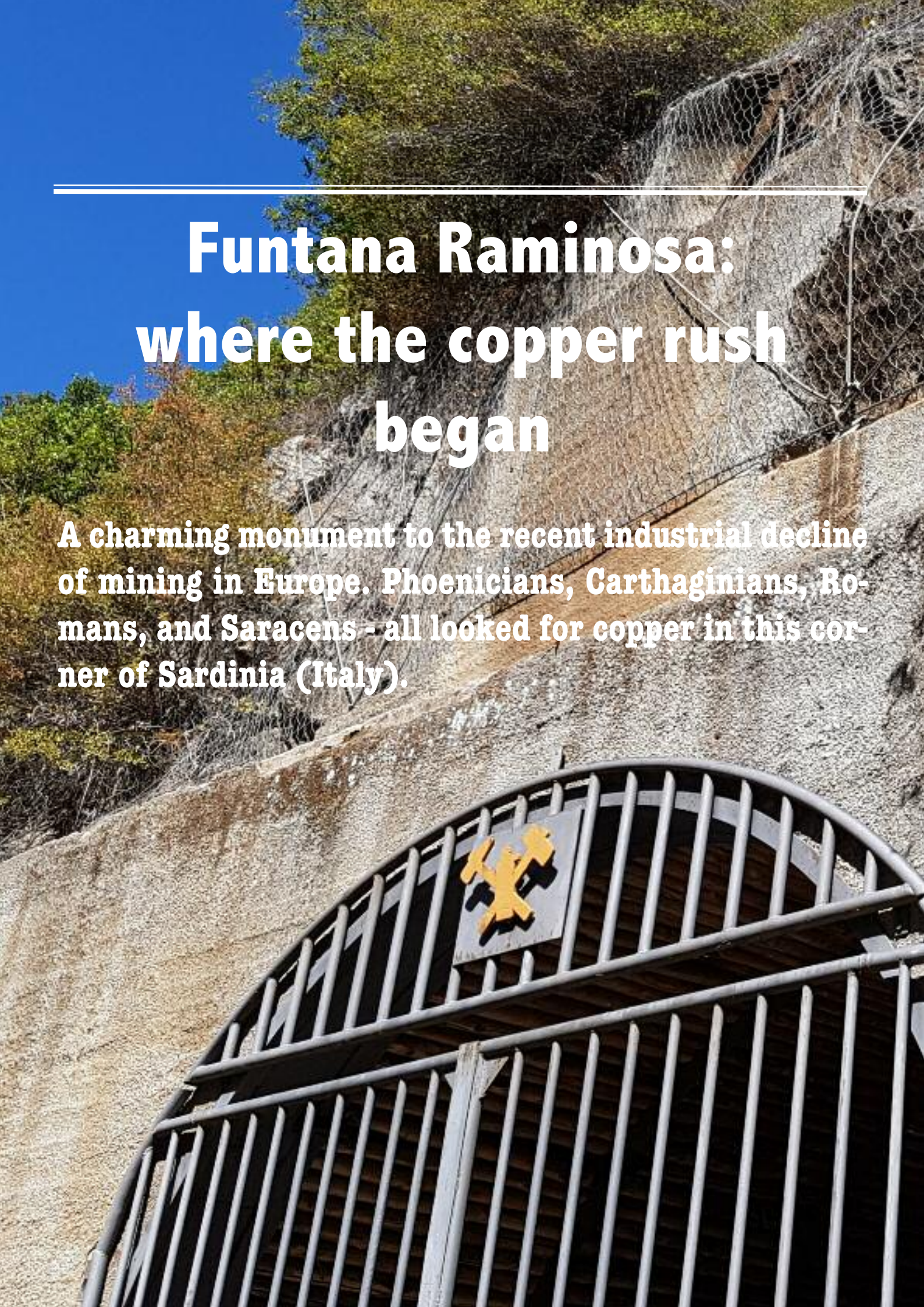
CO2 Technology Centre of Sulcis

SOTACARBO

Funtana Raminosa: where the copper rush began

A charming monument to the recent industrial decline of mining in Europe. Phoenicians, Carthaginians, Romans, and Saracens - all looked for copper in this corner of Sardinia (Italy).




RAMPA BREBEGARGIU
"MUSEO MACCHINE"

Isolated among the mountains, in the middle of Sardinia (Italy), with a butte here and there that breaks the skyline that surrounds and hides the mine from sight. Funtana Raminosa is a gem for few.

A forgotten gem. As if the lush surrounding nature, which wraps the mining site in a charming silence, broken only by the birds' chirping, erases its memory too.

We are talking about a mine six miles away from the small village of Gadoni (fewer than 1,000 people), which seems to be specially designed to attract attention and interest, due to the rare beauty of the naturalistic context and the immaculate collection of still working mining tools. A charming monument to the recent industrial decline of mining in Europe.

In fact, the history of Funtana Raminosa has ancient origins. The archaeological finds of Nuragic bronzes testify the presence of copper mining activity in the area since 800 BC. Phoenicians, Carthaginians, Ro-

mans, and Saracens have crossed paths looking for copper in this corner of Sardinia. Names still recall that distant era: the Roman Gallery, the Fenicia Gallery, the Rio Saraxinus River, an explicit reference to the Saracens.

In 1517 the Spanish Pietro Xinto obtained the first research permits, and in 1882 the subterranean perlustration was carried out with innovative techniques by Vincenzo Ridi. It took four years to discover the real mining field, a result obtained almost by chance by the engineers Luigi Sanna Manunta and Emilio Jacob, engaged in tracing the Cagliari-Sorgono railway line.

In 1915, the mine went under the control of the Société Anonyme des Mines de Cuivre de Sardaigne. Nearly 63,000 tons of copper were exported to the United States. The French did not skimp on investments and provided Funtana Raminosa with modern drilling rigs and brand new machinery, but unfortunately not suitable for treating mixed sulfides

in large quantities. In 1936 a new management focused its attention on the "San Eugenio" and "Brebegargiu" construction sites and created a small mining village that included a school, an outpatient clinic, a chemist's workshop and a warehouse.

When Fascism was at its peak, entrepreneur Marcello Ravizza speculated on the planning and construction of a "copper village" at Funtana Raminosa's site. The village would have welcomed about 2200 workers and would have had a small airport. Fantasies destined to remain fantasies. Two cableways, still visible today, remind those days of great hope and ambition: one carried the mineral to the "Taccu Zippiri" height, from where the trucks moved to the Ortuabis railway station, taking the cargo to Cagliari's port; the other used to transport the rough or unrefined material.

Funtana Raminosa's property kept changing in the Sixties and the Seventies. Sardinian Cuprifera Society, EGAM, and SAMIM - all of them brought a new vision, new plans and seemed to believe in the mine future. Investments grew but based on unreal expectations.

All photos by ONE

In 1982 nearly 30 billion Italian Lire were invested in the construction of a treatment plant, which came into operation in 1982 to be closed after only eight months and never reopened. It was supposed to be the pinnacle but turned out to be the beginning of the end.

In 1983, all construction sites were shut down. In few years the mine passed into the control of the IGEA - the Geo Environmental Interventions company owned by the Sardinian Regional Government - which since then has been ensuring maintenance and protection. After having tried discreetly to embark on a touristic-educational exploitation path, the company interrupted the visits in 2014.

The new chapter is called Sardinian Geopark, which involves the local government of Gadoni. Given the budgetary constraints typical of most municipalities, the question is how will the ordinary maintenance and exploitation of such a large and complex site be ensured? When contacted by ONE, the Mayor said he could not answer. But he promised to do it on another occasion. Not arrived yet. ONE

7 Reasons We're Facing a Global Water Crisis

The world's population, now at 7.5 billion, is projected to add 2.3 billion more people by 2050. How can the planet satisfy their thirst?

By LEAH SCHLEIFER
World Resources Institute

Droughts in Somalia. Water rationing in Rome. Flooding in Jakarta and Harvey-battered Houston. It doesn't take a hydrologist to realize that there is a growing global water crisis. Each August, water experts, industry innovators, and researchers gather in Stockholm for World Water Week to tackle the planet's most pressing water issues.

What are they up against this year? Here's a quick rundown on the growing global water crisis.

1) We're Changing the Climate, Making Dry Areas Drier and Precipitation More Variable and Extreme

Climate change is warming the planet, making the world's hottest geographies even more scorching. At the same time, clouds are moving away from the equator toward the poles, due to a climate-change driven phenomenon called Hadley Cell expansion. This deprives equatorial regions like sub-Saharan Africa, the Middle East and Central America of life-giving rainwater. Paradoxically, climate change is also increasing precipitation in other areas, and people who live near rivers and streams have the most to lose. Currently, at least 21 million people worldwide are at risk of river flooding each year. That number could increase to 54 million by 2030. All countries with the greatest exposure to river floods are least developed or developing countries – which makes them even more vulnerable to climate change and natural disasters. This summer, extreme flooding submerged over a third of Bangladesh, claiming over 115 lives and affecting 5.7 million citizens.

2) More People + More Money = More Water Demand

It's a simple equation: As populations increase and incomes grow, so does water demand. The world's population, now at 7.5 billion, is projected to add 2.3 billion more people by 2050. How can the planet satisfy their thirst? Growing incomes also exacerbate the water problem, because of the water-intensive products—like meat and energy from fossil fuels—that richer populations demand.

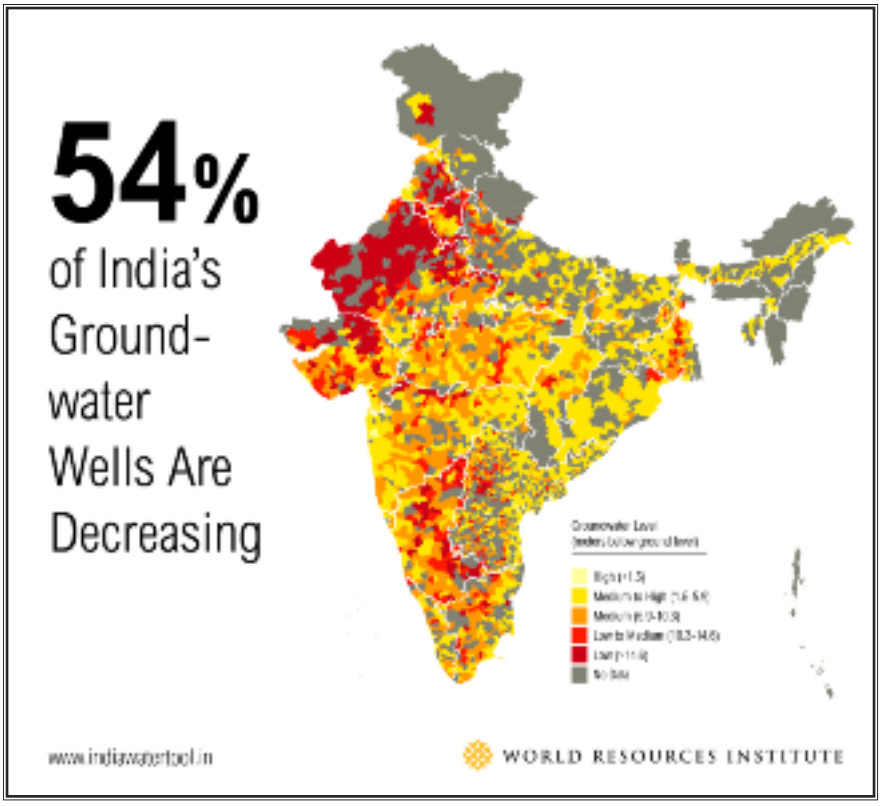
3) Groundwater Is Being Depleted

About 30 percent of Earth's fresh water lies deep underground in aquifers. And it's extracted daily for farming, drinking and industrial processes – often at dangerously unsustainable rates. Nowhere is this more evident than India, which guzzles more groundwater than any other country. 54 percent of India's groundwater wells are decreasing, meaning that water is used faster than it's replenished. Unless patterns shift, in 20 years, 60 percent of India's aquifers will be in critical condition.

Unlike an incoming hurricane or a drained lake, the naked eye cannot see when groundwater reserves in aquifers are declining. Global water supplies are susceptible to this hidden and growing threat.

4) Water Infrastructure Is in a Dismal State of Disrepair

Having enough water to go around is only the beginning. That water also needs to be transported, treated, and discharged. Around the world, water infrastructure - treatment plants, pipes, and sewer



systems - is in a state of disrepair. In the United States, 6 billion gallons of treated water are lost per day from leaky pipes alone. Built infrastructure is notoriously expensive to install and repair, meaning that many localities ignore growing infrastructure issues until disaster strikes, as it did in California earlier this year.

5) And Natural Infrastructure Is Being Ignored

Healthy ecosystems are " natural infrastructure" and vital to clean, plentiful water. They filter pollutants, buffer against floods and storms, and regulate water supply. Plants and trees are essential for replenishing groundwater; without them, rainfall will slide across dry land, instead of seeping into the soil. Loss of vegetation from deforestation, overgrazing and urbanization is limiting our natural infrastructure and the benefits that it provides. Forested watersheds around the world are under threat: watersheds have lost up to 22 percent of their forests in the past 14 years.

6) Water Is Wasted

Although it's true that water is a renewable resource, it's often wasted. Inefficient practices like flood irrigation and water-intensive wet cooling at thermal power plants use more water than necessary. What's more, as we pollute our available water at an alarming rate, we also fail to treat it. About 80 percent of the world's wastewater is discharged back into nature without further treatment or reuse. In many countries, it's cheaper to receive clean drinking water than to treat and dispose of wastewater, which encourages water waste. This brings us to the next issue:

7) The Price Is Wrong

Globally, water is seriously undervalued. Its price does not reflect the true, total cost of service, from its transport via infrastructure to its treatment and disposal. This has led to misallocation of water, and a lack of investments in infrastructure and new water technologies that use water more efficiently. After all, why would a company or government invest in expensive water-saving technologies, when water is cheaper than the technology in question? When the price of receiving clean water is closer to its actual service cost, efficient water use will be incentivized. And on the flip side, the poor often end up paying disproportionately high prices for water, stunting development.

It's Not Too Late

Amidst these seven deadly water sins, there is good news: governments, businesses, universities and citizens around the world are waking up to water challenges, and beginning to take action. Each year brings more solutions – like using wastewater for energy, using restoration to bring water back to dry topographies, and monitoring groundwater levels more closely. However, even the best solutions will not implement themselves. Along with fresh water, political will and public pressure are critical resources in ensuring a sustainable future for all.

Originally published
by WRI
August 24, 2017

Photo: Brian M. Powell

NUTTALLBURG

Nuttallburg, West Virginia, USA, owes its name to English entrepreneur John Nuttall, who saw a golden opportunity in the coal-rich New River gorge and began buying land and building infrastructure in 1870.

The area started to flourish after the completion of the Chesapeake & Ohio railroad line. In 1888, it was producing 1.5 million tons of coal.

In the 1920's automobile industrialist Henry Ford leased Nuttallburg's mines to provide coal mineral for his steel mills. Ford's plan for "vertical integration" failed and mines passed through three owners after Ford and production ceased in 1958.

In 1998 Nuttallburg became a National Park Service property. Today it is one of the most intact and complete coal-related industrial sites in the United States. ONE

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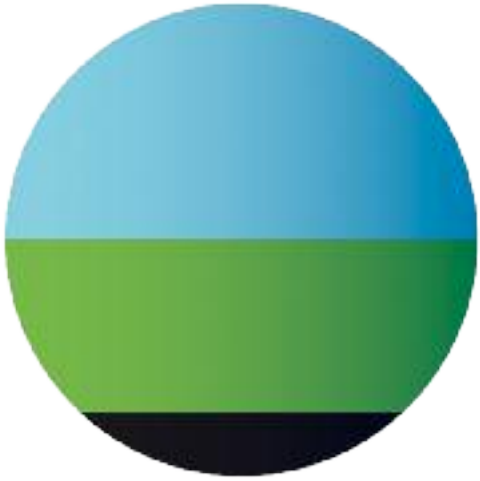

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