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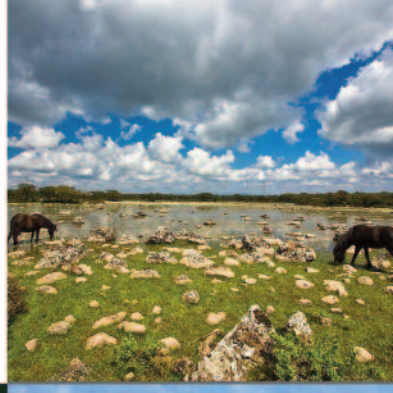



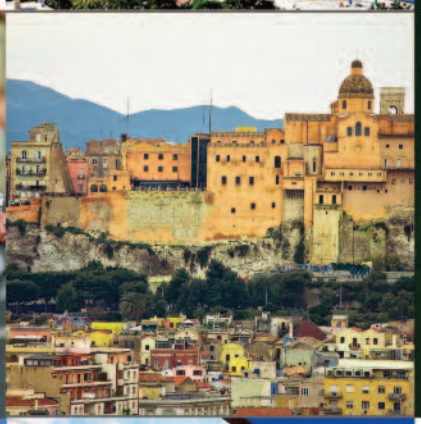


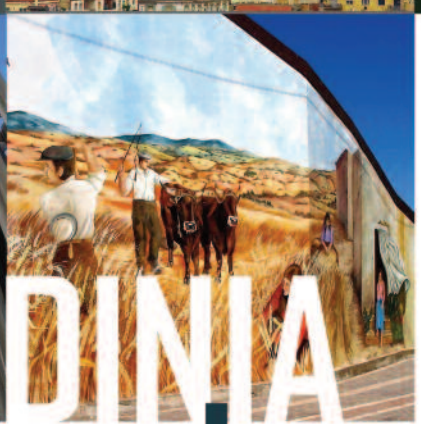


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The stark link between climate and forced migration

More than 10,000 migrants and refugees trudged into western Europe via Hungary over one weekend in September 2015. Wars, terrorism and poverty in the Middle East and beyond continue to drive this surge of humanity.

By JEZ ABBOTT

ONE

The Global Climate Index for 2018 was published in early November and – like the ones before it – the index makes grim reading. The index analyses how countries have been affected by weather extremes such as storms, floods and heat waves.

Pakistan, for example, has been blitzed in recent years by several climate and weather-related disasters. A devastating earthquake in 2005 was followed by floods in 2010 and a killer heat wave in Karachi in 2015. Climate change causes disasters and intensifies them. It kills people in their thousands and forces, even more, to flee their homes in search of less environmentally fragile areas.

Pakistan is bad. But it ranks only seventh on the index among countries the most adversely affected by climate change. Other trouble zones include Mozambique, Dominica and Malawi, Honduras, Myanmar, Haiti. And according to the International Panel on Climate Change (IPCC), the link between climate change and migration is all but proven.

Low rainfall in Pakistan's Tharparkar desert and south-eastern Sindh during the monsoon in 2016, for example, led to poor crop production, hunger, and the mass movement of people in search of less weather-beaten areas. Likewise, people in northern parts of the country during extreme winters temporarily trek towards the plains until summer. Developing nations are not the only victims.

The USA, with wealthy governments, has proved helpless against heat waves and hurricanes: Harvey, Irma, and Maria. Recent forest fires left California's government as impotent as the firemen battling to save houses. Hurricane Harvey meanwhile overwhelmed Houston's modern, effective governance, while Maria thumped US territory Puerto Rico forcing big migration to the mainland.

Closer to home, more than 10,000 migrants and refugees trudged into western Europe via Hungary over one weekend in September 2015. Wars, terrorism and poverty in the Middle East and beyond continue to drive this surge of humanity over two years later. But scientists have little doubt one additional factor will make this massive displacement of people worse: climate change.

The mass movement of people across the globe has led to calls for governments to draw up policies to deal with environmental migrants and refugees and improve humanitarian measures. Furthermore, according to Aymen Ijaz, an assistant research officer at the Islamabad Policy Research Institute think tank, the health problems caused by weather extremes must also be addressed.

The link between climate and forced migration is becoming blatant and ever-more stark. A major symposium at Harvard, USA, in September heard how climate change was a "risk factor" for forced migration as extreme as the European economic-refugee crisis.

Ashish Jha, a professor of international health and the director of the Harvard Global Health Institute, likens climate change's impact on migration to the effects of smoking on the heart

The event heard experts on health, migration and disaster relief call for "early warning systems" and more government action. The symposium also heard that the extent of climate change's contribu-

People attempt to cool off near a damaged water pipe in Karachi, Pakistan on June 25, 2015. PHOTO: EPA

tion to the 66 million people on the move globally remained hard to quantify exactly. Several experts however insisted it was important to factor in climate change in any analyses of why people emigrate, what happens to them during their journeys, and how it affects their health.

Ashish Jha, a professor of international health and the director of the Harvard Global Health Institute, likens climate change's impact on migration to the effects of smoking on the heart – though smoking is known to cause heart disease, its contribution to death is hard to quantify against other factors such as diet, he says. It does not, however, prevent warnings against cigarettes.

Scientists forecast climate change will not just warm the planet. It will whip up weather extremes, intensifying storms and floods and leading to long heat waves and drought. All of these extremes are killing crops on a terrifying scale. Before the civil war, prolonged drought in northern Syria devastated agricultural livelihoods and was exacerbated by an inadequate government response.

The result? A million Syrians migrated internally to cities already stressed by the arrival of 1.5 million refugees from neighbouring Iraq. Economic, social and organisational pressures stemming from such large numbers of new arrivals can foster local unrest and even conflict, says Jennifer Leaning, director of the FXB Center for Health and Human Rights.

"The world is awash with wars and there's quite a direct link to climate change. It's not the only link, and it's not a causal link. But there are associations between climate change, migration, entering alien spaces, conflict in those alien spaces, and then armed conflict. We're very much concerned with how you prevent these wars, which is why we're cycling back to climate change."

But often the eye of this social storm is not barren wastelands or war zones, but cities. Particularly megacities, and South America is particularly vulnerable. These are becoming focal points for climate change impacts. Rapid urbanisation and crippling demand for housing, social and health services pile on pressure to already stretched physical and social infrastructure.

If the impact of climate change on migration is not fully known, the same is true of cities, according to the International Organization for Migration (IOM). Sea level rise, land degradation and desertification, as well as changes in water availability are some of the factors in the "interplay of migration drivers and environmental change", reckons the IOM.

Additional migration to emerging metropolises in South America, Asia and Africa is likely to exacerbate vulnerabilities related to inequality and poverty. They are also likely to further hamper the ability of cities to adapt to climate change. Understanding the dynamics between migration, cities and climate change is an important priority of the IOM and others.

Michael VanRooyen, a professor of emergency medicine and of global health and population and a director at Brigham and Women's Hospital in the USA, warns that though further study is needed to understand more on climate-related risks "uncertainty is not an excuse for inaction". And "just because we can't quantify it does not mean it's not real." .

He adds: "Centuries of experience have shown where disasters are most likely to hit. We work pretty closely with the Philippines, for example, and we know, predictably, the Philippines is going to be hammered by 25 major storms a year. Two or three of these will be epic in nature. Just because we're uncertain does not mean we should not act."

Coal may be Jurassic But technology is not

Coal power is a story of improvement in the efficiency of a simple process, with a few of the best plants worldwide capable of over 47%. In November GE Power launched 'SteamH' to smash the current efficiency record.

By TOBY LOCKWOOD

ONE

Coal's unfortunate image as the dinosaur of power generation is not helped by the fact that the basic principles of a coal power plant have remained the same for over a century – heat from burning coal produces steam which drives a turbine and an electric generator. But the history of coal power also tells a story of continuous improvement in the efficiency of this simple process, with a few of the best plants worldwide now capable of over 47%.

In other words, 47% of the energy in the coal is left as electrical energy, after the electricity used for running the plant itself is taken into account. Once seen primarily as a way of cutting fuel costs, efficiency improvements now represent a powerful and urgently needed means of making significant cuts to CO2 emissions.

In November, GE Power staked a claim to the next landmark in this technological evolution as they launched 'SteamH' – their new design for coal power plant which promises to smash the current efficiency record by taking it to 49.1%. Various aspects of the design have already been chosen by the Pingshan II power plant in China and the Karaburun project in Turkey, which could vie to become the new record holders. However, the path to this point has not been plain-sailing, and SteamH represents a step back from a long-sought-after goal of 50%. The thermodynamics of power generation dictate that hotter usually means better, and the most significant leaps forward in coal power plant efficiency have come from using hotter and higher-pressure steam. State-of-the-art plants currently use steam at 600 to 620°C, but pushing beyond these temperatures has occupied researchers for almost 20 years.

The challenge is a question of finding suitable metals for the tubes, pipes, and valves which contain the steam and need to endure huge stresses and temperatures over the decades-long working life of a power plant. The most recent leap forward in efficiencies came in the early 90s, when new, high-performance steels developed in Japan enabled the latest generation of leading plants, known somewhat hyperbolically as 'ultrasupercritical'.

These plants push the limits of what is possible with any kind of steel, so researchers have long realised that making the next jump in efficiency will probably need a new type of material. The obvious choice was nickel superalloys – the precision-engineered metals developed for aerospace applications such as jet engines, where they have to endure stresses and temperatures much greater than steels could ever achieve.

As nickel superalloys are very expensive, researchers reasoned that they should get the most out of them as possible, and targeted a massive jump in steam temperature to 700°C (or even 760°C in the USA). Known variously as advanced ultrasupercritical or hypersupercritical, this would also enable efficiencies to reach the symbolic round number of 50% efficiency.

However, despite research around the world since the late 90s, coal power has yet to make this ambitious leap, and there was a setback in 2009 when cracks were found in nickel components at a German test facility. Challenges have also come not just from the superalloys, but the advanced steels which still need to play a crucial role in less-demanding sections of the plant. With the European countries which originally led the way have now mostly lost interest in coal power, the baton has been taken up by the coal giants of India and China, where there is still some prospect of a 700°C power plant being built by 2025.


The RDK8 steam power plant at the Rheinhafen-Dampfkraftwerk electrical generation facility in Karlsruhe, Germany.

Since acquiring rivals Alstom in 2015, GE holds a huge share of the market for coal power plant, and has sought to emphasise its status as a technology leader and champion of cleaner coal, with many of the most efficient plants already to its name. SteamH is essentially born of a pragmatic look at the wealth of knowledge acquired, both from operating these state-of-the-art plants and the twenty years spent striving towards 700°C steam. If 700°C is (for now) not commercially viable, what about aiming a little lower?

The new design obtains its 49.1% efficiency with steam temperatures of 650 to 670°C, using some of the nickel alloys developed while aiming for 700°C in high-stress areas of the plant, and some of the best currently used steels in less-demanding areas. GE's experience with plants and materials at the cutting edge has given them confidence in operating some of these metals at their limits, but all will be used within their established safety standards. This is an important point, as the long process of obtaining formal certificates to operate metals under new conditions has been a major hold-up in reaching 700°C.

Aside from hotter steam, GE have also turned to a trendier technology to make efficiency gains – data analysis. Coal power stations can have over 10000 sensors monitoring things ranging from temperature to chemical composition all over the plant, but this flood of data is rarely used effectively.

GE developed a cloud-based 'digital power plant' tool which uses artificial intelligence to analyse data and work out the optimum settings for getting the most out of the plant at any given moment. This ability to rapidly respond to changes has become even more important as coal plants are expected to turn up and down as backup to wind and solar power.
So, what about the ever-elusive 50% target? The use of SteamH in China's Pingshan II project represents an interesting coming together of coal technologies that could yet see this milestone reached. Pingshan II is itself an evolution of Shanghai Shenergy's Waigaoqiao plant, which currently disputes the coal efficiency record with GE's own RDK8 plant in Karlsruhe, Germany.

Based on a holistic approach which has been likened to Chinese medicine, the operators of Waigaoqiao have managed to eke out every bit of power from the plant through a series of small optimisations such as keeping the steam thoroughly clean of solid particles. Pingshan II aims to take these principles and new ideas from Shanghai Shenergy to reach up to 49.8%. The inclusion of SteamH in the project represents a kind of supergroup of coal power design. Edging up coal plant efficiency by a few percent may not seem all that impressive in the context of the 10 billion tons of CO2 a year currently associated with coal power, and the huge carbon cuts necessary to mitigate further climate change.

However, it is precisely the enormous scale of coal exploitation which gives these advances such power. Most of the world's current coal plants perform well below these efficiency chart-toppers (at an average of around 35%), and many more poorly performing plants are being built every year. If all these plants could be converted to the current state-of-the-art, savings of over 2 billion tons of CO2 could be made annually. Not bad for a dinosaur. ONE

How some African farmers are responding to climate change - and what we can learn

By GEOFFREY KAMADI
Ensia.com

As sub-Saharan Africa's climate changes, small-scale farmers are increasingly looking to innovative ways of dealing with agricultural challenges. And in some instances, the techniques they adopt are helping to combat climate change, too.

Alternative animal feed, climate-friendly grasses and the use of fodder trees are among the examples providing farmers resilience and leading to benefits such as more productive livestock and new business opportunities — all while reducing greenhouse gas emissions and building healthy soils.

As unpredictable weather and natural disasters hamper food security across the globe, innovation will be paramount for the world's food producers, from smallholder farmers to industrial operations. Here are three novel ways African farmers are using adaptive strategies to thrive.

Brachiaria Grass

In sub-Saharan Africa, some farmers are adapting to climate change by seeding pastures with brachiaria grass. Some varieties of this forage can survive harsh conditions, such as drought and low fertile soils, while helping to reduce the environmental impacts of livestock production.

In October 2016, a study by the International Center for Tropical Agriculture, CIAT for short, found that farmers in East Africa stood to produce 15–40 percent more milk and generate tens of millions of dollars in additional revenue by using the drought-tolerant grass. Unlike Napier grass, which is forage used by many farmers in zero-grazing agricultural systems, production of brachiaria is not constrained during the dry season, according to An Notenbaert, CIAT's forage coordinator for Africa.

"Farmers like brachiaria because of its adaptability to low rainfall … and low fertility and acidic soils, and its production of green forage year round without any input of fertilizer," she says. "Brachiaria grass has [a] relatively high crude protein content due to greater leafiness and thinner stems than those of traditional Napier grass, resulting in higher nutritive quality."

One farmer who has witnessed the benefits of this grass is Albanas Nduva, who lives in Kikambuani village in eastern Kenya, an hour's drive east of Nairobi. He has 10 dairy cows on his 5-hectare (12-acre) piece of land, of which 0.8 hectares (2 acres) has been set aside for planting brachiaria grass.

"The grass grows very fast compared to others, and I have observed increased milk production from my cows," says Nduva, who uses the grass as forage instead of pasture because his animals are kept in an enclosure. "I harvest the grass every two months, which is in contrast to other types, such as Napier, which matures at between three and four months."

Nduva got 38 liters (10 gallons) of milk per cow daily before he began feeding them with the new grass. Now he gets 47 liters (12 gallons).Brachiaria is good for the environment because cows easily digest it, reducing the release of methane, a potent greenhouse gas.

In 2012, with funding from the Swedish International Development Cooperation Agency, the Biosciences eastern and central Africa – International Livestock Research Institute and a number of other research facilities and organizations began studying new brachiaria grasses in Kenya and Rwanda. They found that brachiaria is good for the environment because cows easily digest it, reducing the release of methane, a potent greenhouse gas. In addition, because these grasses are deep-rooted they are able to sequester more carbon than other grasses. More than 6,000 farmers are now growing the grass species across Kenya, according to Donald Njarui, senior principal scientist at the Kenya Agricultural and Livestock Research Organization, a corporate body that coordinates and promotes agricultural research and that's part of the Kenyan government.

However, Njarui says, for wider dissemination and more research it will be necessary to register the grass species as varieties, which will allow seeds to be imported and opened to a global market.

"This will make it possible to import the seeds from any part of the world, unlike what is happening today," Njarui says — a key step since brachiaria grass has become very important across the world, with seed production already commercialized in big cattle-producing countries like Brazil.

Nutrient Block

As droughts become more frequent and more severe, pastoralists in northern Kenya are increasingly using a multi-urea nutrient

block feed supplement for livestock as a coping mechanism when wild forage is in short supply. Marsabit County, where more than three-quarters of rural residents live below the poverty line of 1,562 Kenyan shillings (about US$15) per month, is an eight-hour drive north of Nairobi. Here, cyclical droughts are common and severely disrupt the people's livestock-dependent livelihoods, often causing massive livestock deaths due to lack of vegetation and water. However, Benson Mosor, the former food security field officer at Soliderités International, says that since the introduction of the multi-nutrient block, livestock deaths have gone down 10 percent. Solidarités International, an international humanitarian organization, helped train farmers to make and sell the blocks — which are a mixture of molasses, urea, salt, lime and other ingredients that help with bone formation, energy production and food absorption while providing necessary nutrients.

A farmer at work in Mount Kenya region. Photo: Meil Palmer (CIAT)

"It was a big challenge to work with villagers at the beginning, because they did not understand immediately what we were talking about," says Mosor. However, the nutrient block is gaining acceptance among pastoralists due to education efforts, according to Mosor. A 3- to 4-kilogram (7- to 9-pound) block costs around 100 Kenyan shillings (about US$1) to make and helps feed between four to five goats for a week, making it much cheaper than conventional feed. Andrew Abudo, a 27-year old goatherd from Galasa village, says that since he began supplementing his animal feed with the nutrient block his goats are thriving, even in the face of severe drought. The United Nations issued an alert in December 2016 advising the country to brace itself for a worsening drought in 2017.

"The animals will never die after feeding them on this block, unlike what used to happen before I started feeding it to my goats," says Abudo.

A 3- to 4-kilogram (7- to 9-pound) block costs around 100 Kenyan shillings (about US$1) to make and helps feed between four to five goats for a week, making it much cheaper than conventional feed. Corn-based feed, for instance, will cost between 2,000 to 3,300 Kenya shillings (US$20 to US$30) per week to feed the same number of animals. In addition to these benefits, a business opportunity has emerged, with villagers from Galasa making and selling the blocks. "We make these blocks to sell to outlying communities," explains Ali Elema, a member of this group. One block sells for 250 Kenya shillings (US$2.50).

The villagers have showcased their product in various forums, including the Kalacha Cultural Food and Music Festival, a popular gathering in Marsabit where pastoralists share knowledge and experience.

Planting Fodder Trees

Fodder trees are fast-growing trees that provide food for dairy cows and goats. The World Agroforestry Centre, or ICRAF, estimates that nearly a quarter-million farmers have planted these trees in Kenya, Tanzania, Uganda and Rwanda.

"[These trees] are important for helping farmers adapt to climate change because, being deep-rooted, they are resistant to drought and maintain high-protein green fodder during the dry season, when the protein level of grasses decline[s]," says Steve Franzel, principal agricultural economist at ICRAF.

In addition, "the trees are generally planted as hedges and often along field contours, helping prevent soil erosion," says Franzel.

Mary Gichuki, a farmer who lives a few minutes' drive from Nairobi in Kiambu County, not only uses fodder trees on her land, but also sells tree seeds and seedlings and educates other farmers on using them. She began planting the trees in her small plot in 2006 after receiving training from ICRAF.

"Farmers listen to me more because people have seen how the trees have lifted me from some level of poverty to where I am today," says Gichuki.

A 2-kilogram (4-pound) packet of the seeds will fetch her 6,000 Kenyan shillings (US$60), and she has between 60 and 90 customers a month during the rainy season.

Increasingly Important Innovations

Irregular and erratic weather is a big impediment for improving crop yields for smallholder farmers, especially in a region that depends on rain-fed agriculture. Meanwhile, food security will continue to be a global issue affecting much of the world's population.

Innovations that make farms less vulnerable to wide swings in conditions will become increasingly important as climate changes and population grows. Productive, affordable and accessible practices like these could make all the difference between barely surviving and thriving in an increasingly uncertain future

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How droughts have scarred Syria forever

By LENORE M. HITCHLER

ONE

What is the good, bad, and the ugly regarding climate change and Syria?

The good is that the Syrian government has finally signed the 2016 Paris Climate Agreement. The bad is the climate-induced continuous droughts between 2006-2010 and the resultant human suffering. The ugly is that these droughts were a contributing factor to the civil war that followed.

The good is Syria's record on signing climate change treaties. For example, Syria ratified the United Nations Framework Convention on Climate Change in 1995 and signed the Kyoto Protocol in 2005.

Syria signed the 2016 Paris Climate Agreement. The United Nations held a plenary session of climate talks in Bonn, Germany. The Syrian Deputy Environment Minister Wadah Katmawi, who was a delegate at the meeting, announced that Syria was planning to ratify the agreement. Katmawi spoke to the delegates of the 196 nations participating in the climate talks stating that "I would like to affirm the Syrian Arab Republic's commitment to the Paris climate change accord."

Those concerned about climate change understand that governments need to initiate policies which will lower the amount of fossil fuel emissions as the first step in slowing down climate change. Therefore, they recognize that it is necessary for governments to sign the Paris 2016 Climate Change Agreement. It now remains for the United States to renew their support of the agreement.

The bad is the consecutive droughts that occurred in Syria from 2006-2010. Climate change contributed to these droughts. Some studies based on climate models have found that there is a link between climate change and drought in the Eastern Mediterranean region including Syria. Scientists find that climate change both increases and intensifies the number of droughts in the Mediterranean region.

Dr. Peter Gleick is the head author of "Water, Drought, Climate Change, and Conflict in Syria" published in Weather, Climate, and Society. He is an authority on both water and climate change. In this article, Gleick cites a study written about in the article "On the Increased Frequency of Mediterranean Drought' published in the Journal of Climate, a publication of the American Meteorological Society. Gleick states that this study suggests that winter droughts are increasingly common and human-caused climate change plays a role. Dr. Martin Hoerling, research meteorologist and one of the authors of the study, states in a National Oceanic and Atmospheric Administration [NOAA] publication that "The magnitude and frequency of the drying that has occurred are too great to be explained by natural variability alone."

The report by NOAA included a map which shows that Syria experienced the worst drying conditions in the region. The report also finds that ocean surface temperature patterns are responsible for the relationship between climate change and Mediterranean droughts. In recent decades, greenhouse-induced climate change has caused somewhat greater warming of the tropical oceans compared with other ocean regions. This acts to drive drought-conduced weather patterns throughout the Mediterranean region. The timing of ocean temperature changes coincides closely with the timing of increased droughts. NOAA has also stated that climate change from greenhouse gases explains roughly half the increased dryness which occurred from 1902-2010.

Dr. Richard Seager, climatologist, is one of the co-authors of "Climate Change in the Fertile Crescent and Implications of the Recent Syria Drought." Seager and his colleagues find that increased greenhouse gas emissions will widen the Hadley cell, which is a "band of air that envelopes the earth's tropics in a way that could further desiccate the lands of the eastern Mediterranean."

Dr. Geick's findings about the relationship between climate change and drought are confirmed by other researchers in the

Landscape around Maaloula in Syria. Photo: High Contrast

field. For example, Dr. Colin P. Kelley is a climate scientist at the University of California, Santa Barbara, and is part of the Center for Climate and security, with a specialty in climate change and drought. Dr. Kelley is the lead author of "Climate Change in the Fertile Crescent and Implications of the Recent Syrian Drought" published by the Proceedings of the National Academy of Sciences (PNAS).

The authors maintain that climate change is a reality and is causing droughts in the region that includes Syria. The article states that "our conclusion is supported by 1) climate observations of the past 80 years, which show a downward trend in rainfall and an upward trend in temperature (telltale causes of drought); 2) climate modeling, which predicts that the region dries as the greenhouse gases in the atmosphere increase; and 3) theoretical results showing that this region will be increasingly dominated by atmospheric motions that inhibit rainfall."

Thus, various scientists, doing their independent research, find that the droughts that occurred in Syria were, at least, partially caused by climate change. The article goes on to state that greenhouse gas emissions had "increased the probability of severe and persistent droughts in this region, and made the occurrence of a three-year drought as severe as that of 2007-2010 two to three times more likely than [would be predicted] by natural variability alone."

Unfortunately, there is a long history of the Syrian government promoting policies which exacerbates dwindling water resources. For instance, the administration of President Hafez al-Assad (1971-2000) enacted agricultural policies that were not appropriate for a geographic area which is prone to drought and even under normal conditions does not have suitable rainfall for western types of agriculture. He promoted such water-intensive crops as wheat and cotton. His son, Syrian President Bashar Assad, also promoted and subsidized wheat and cotton. Various scientists differ on the exact amount of precipitation that Syria receives. However, they all concur that Syria has a very limited amount of rainfall. According to one researcher, on the average, Syria receives less than 250 mm (9.84 inches) of annual rainfall. Another source states that the annual precipitation is below 350 millimeters (13.779 inches) in more than ninety percent of the country. Still another source points out that during the drought even the region that received the most rainfall only received twenty to forty centimeters (eight to fifteen inches) whereas 20 centimeters (8 inches) is considered the absolute minimum to sustain agriculture. During the drought, the national average was less than 10 centimeters (four inches). Unfortunately, areas of less than forty centimeters (15 inches) are heavily dependent on irrigation.

The Syrian government also erred by promoting irrigation which resulted in the lowering of the water table. Even before the droughts that began in 1998, natural multiyear droughts, defined as three or more consecutive years of rainfall below the long-term normal, occurred periodically during the twentieth century. From 1900 to 2005 there were six major droughts in Syria. This means that both ground and surface water did not get replenished and were overdrawn. Francesco Femia and Caitlin Werrell are both co-chairs and leaders of the Center for Climate and Security. They point out that between

2002 and 2008 Syria lost half its water resources. Data from the World Bank show that in 2009, Syria had access to just 356 cubic meters of water per capita. This is well below the scarcity level of 1,000 cubic meters of annual water per capita established by the United Nations. Water experts find that less than 1,700 cubic meters per person annually poses a significant restraint on socioeconomic development.

Considering these facts, it would have been more appropriate for the government to promote crops that are drought resistant. The United States Agency for International Development points out that barley, chickpeas, and drought resistant trees such as olive are appropriate crops for drought-prone areas. Pearl millet is also drought resistant, and there are drought resistant varieties of sorghum. Even within relatively drought-resistant crops, there are varieties that are especially drought resistant.

Various experts warned that Syria was following agricultural polices that were inappropriate for its climate and inadequate water supplies. The World Bank in 2001 stated that "The Syrian Government will need to recognize that achieving food security concerning wheat and other cereals in the short-term as well as the encouragement of water-intensive cotton appear to be undermining Syria's security over the long-term by depleting available groundwater resources."

Furthermore, the World Bank in 2008 found that climate change in the Middle East and North Africa [MENA] would result in more frequent droughts and these droughts would be more intense. The World Bank stated that "According to the latest IPCC [Intergovernmental Panel on Climate Change] assessment, the climate is predicted to become even hotter and drier in most of the MENA region. Higher temperatures and reduced precipitation will result in higher frequency and severity of droughts."

Because of the droughts of 2006-2010, farmers lost many of their crops and herders lost their livestock. Gleick states that yields of wheat dropped 47% and barley 67%. There are various estimates of how many were displaced by the drought. Gleick states that by late 2011, the United Nations estimated that between two million and three million people were affected. After losing their livelihoods, they moved to urban areas. Dr. Kelley estimates that 1.5 million people were displaced by the drought. They moved from rural areas to cities and camps on the outskirts of such major cities as Aleppo and Damascus.

Similarly, the United Nations found that over a million Syrians left their villages and that the drought pushed two to three million people into extreme poverty. The migration caused by the droughts combined with an inadequate political and social infrastructure resulted in overcrowding, unemployment, and crime. It is estimated that between 2002 and 2010 the population of Syrian cities grew by fifty percent. The population growth included refugees from other countries. According to the United Nations Relief and Works Agency for Palestine Refugees in the Near East, 560,000 Palestinian refugees entered Syria. In early 2007, the United Nations High Commission for Refugees estimated that there were 1.2 million Iraqi refugees in Syria. The number of refugees significantly increased the number of people reliant on Syria's dwindling water supply.

Returning to the theme of the good, the bad, and the ugly, the ugly is that the Syrian droughts were a major contributing factor in the civil war. Recent research has found a statistical link between climate and conflict. The article written by Kelley et al. quoted a Syrian farmer's response when she was questioned if she thought the Syrian conflict was about the drought. She responded by saying "Of course, the drought and unemployment were important in pushing people toward revolution. When the drought happened, we could handle it for two years, and then we said, 'It's enough.'" Mustafa Abdul Hamid is another Syrian farmer and is from Azaz, near Aleppo. Hamid said that "The start of the revolution was water and land."

There is a historical precedent of climate change causing massive social upheaval. The Little Ice Age occurred roughly between 1300 to 1870 A.D. The Bubonic Plague and witchcraft trials were only some of the cataclysms that occurred. Global Crisis War; Climate Change and Catastrophe in the 17th Century was written by University professor Dr. Geoffrey Parker. In it he states that "the experience of the 17th century shows that long-term turbulence and unreliability of the weather inevitably produces calamitous outcomes for humanity." The social turmoil caused by the Little Ice Age shows how much damage can be done by just a two-degree change in climate, and summer temperatures in Syria have risen about 2.2 degrees Fahrenheit.

Abdullah bin Yehia, Syria's representative to the United Nations Food and Agriculture Organization, stated in 2008 that drought impacts were a "perfect storm" when combined with other economic and social pressure. He predicted mass migration from the northeast and that this "social destruction" would lead to political instability in Syria's major western cities of Damascus and Aleppo.

Various United States sources have recognized the relationship between the climate change and social turmoil. For example, the United States Department of Defense [DOD] recognizes the detrimental political affects of climate change. The DOD has found that "assessments conducted by the intelligence community indicate that climate change could have significant geopolitical impacts around the world, contributing to poverty, environmental degradation, and the further weakening of fra-

A line of Syrian refugees crossing the border of Hungary and Austria on their way to Germany. Hungary, Central Europe, 6 September 2015. Photo: Mstyslav Chernov

gile governments. Climate change will contribute to food and water scarcity will increase the spread of disease, and may spur or exacerbate mass migration."

The United States Department of Defense is not the only source of warnings of climate change initiating warfare. Dan Smith, from the Stockholm International Peace Research Institute, understands the "linkage between the drought and the political instability, which lay behind the [Syrian] civil war, I think is pretty clear." He goes on to discuss how the drought led to agricultural failures, which in turn led to migration and social upheavals. Smith states "And so this was part of the background behind the increasing feelings of dissatisfaction, resentment, and grievance. Which fed the first round of political mobilization against the Assad regime in early 2100. And it's off the back of that the civil war started."

Shortly after the drought began, the American embassy in Damascus sent a cable to the United States State Department regarding the situation in Syria. The cable warned about the "unraveling social and economic fabric of Syria's rural farming due to the drought. It noted that the mass migration 'could act as a multiplier on social and economic pressures already at plan and undermine stability in Syria.'"

The United Kingdom-United States Task Force on Extreme Weather and Global Food System Resilience is also concerned about the relationships between climate change, food shortages, and civil unrest. They report that climate change will make global food shortages three times more likely. Thus low-income countries could experience civil unrest as a result of expected increases in food prices. In 2016, the Food and Agriculture Organization of the United Nations stated that "A total of 8.7 million people—around half of the people remaining in Syria—are unable to meet their basic food needs."

Various high-level United States government officials have spoken about the relationship between the drought and the following civil war. President Barack Obama said that climate change-related drought "helped fuel the early unrest in Syria, which descended into civil war." Secretary of State John Kerry said that "It's not a coincidence that immediately prior to the civil war in Syria, the country experienced its worst drought on record."

Even the Syrian government acknowledges the relationship of the climate change-induced drought and the following civil strife. It assembled a climate change report in 2010, which took five years to complete.

The report affirmed that Syria's climate was indeed changing. Temperatures increased "abnormally" between 2000 and 2005. The amount of available water had decreased. The report stated that "Most Syrian cities currently have a water supply deficit. Damascus, once an oasis with pure and ample hydrological resources, is today one of the thirstiest cities in the Middle East."

The report also found that "A major shift in long-term annual rainfall patterns and a rise in temperatures are projected over most areas of Syria by the year 2100. … This will predominantly have negative impacts on the agricultural sector, which currently employs 25—30% of the total workforce and contributes an equal percentage of the country's total GDP."

Another factor in Syria's dwindling water supply is the loss of the Golan Heights, a range of hills that was formerly part of Syria. Since 1967 Israel has occupied this territory. The Golan Heights formerly supplied 30% of Damascus' water.

Another factor in Syria's dwindling water supply is the loss of the Golan Heights, a range of hills that was formerly part of Syria. Since 1967 Israel has occupied this territory. The preceding report pointed out that the Golan Heights formerly supplied 30% of Damascus' water. Syrian officials insist that Israel is responsible for the "looting" of this water resource.

Unfortunately, Syria's water problems are not over. Climate-induced droughts are expected to continue into the foreseeable future. A report from the International Food Policy Research Institute forecasts that at the current rates of greenhouse gas emissions, yields of rain-fed crops in Syria may decline between twenty-nine to fifty-seven percent between now and 2050.

It has been estimated the Syrian conflict has resulted in the deaths of 400,000 people. This represents a horrific amount of human suffering. Four hundred thousand deaths means that a lot of grandparents, parents, children, and other family members mourn their losses. Widows and widowers now have to struggle alone. Besides family losses, places of worship and neighborhoods suffered losses. Entire communities are bereft of valued members.

The Syrian conflict has also produced many refugees. In 2016, the United Nations found that there were five million refugees living outside of Syria, and more than six million displaced Syrians within Syria itself. This statistic represents tremendous amounts of human suffering. Families were torn asunder, many not even knowing if their family members are alive, or who they should mourn. The extent of the pain and suffering of the Syrian people is impossible to quantify.

The theory of climate-induced drought that led to migration, which in turn led to social conflict is controversial. However, it can not be denied that Syria is located in a drought-prone region which means that water resources are frequently inadequate. Climate change increases the frequency and intensity of droughts. Also, the Syrian government made many mistakes which intensified the magnitude of drought-induced problems. These mistakes amplified the extent of social disruption. However, even taking into consideration poor governmental policies, drought-induced hardships contributed to the breakdown of the social structure which led to military conflict in Syria.

Therefore, even though it is good that Syria has signed the Paris Climate Agreement, there is a high amount of the bad and the ugly caused by climate change in Syria. It is bad that climate-induced droughts wreaked a lot of havoc. Droughts caused both crops to fail and a loss of livestock. Farmers and herders escaped to urban areas where they faced even more misery. Failed government policies increased suffering and unrest. The ugly is the social turmoil caused by the drought. The warfare increased the sufferings of an already besieged people. ONE

The Golani brigade training at the Golan Heights. Photo: Israel Defense Forces

The desperate but effective attempts to silence climate scientists

Buckland (Alaska). Photo: Chris Lott

By JEREMY DEATON
Nexusmedianews.com

People play dirty when they can't win by playing fair. This is, more or less, the story of climate change denial in the United States.

Scientists overwhelmingly agree that humans are altering the climate, reaping changes with potentially catastrophic consequences. Climate deniers can't dispute the data. They can't win on facts. Instead, they impugn the credibility of scientists, a tactic which has proved both ugly and effective.

Right-wing groups are using open records laws to obtain scientists' emails, and then misrepresenting the content of those emails to question the integrity of researchers and cast doubt on their findings, all of which has a chilling effect on scientific inquiry. But scientists have earned powerful allies in the fight to protect their research—including, by a strange set of circumstances, the Trump administration.

"Climategate" led to a wave of harassment.

The current spate of invasive records requests back to "Climategate," a 2009 controversy that erupted when a hacker obtained more than 1,000 emails sent and received by climatologists at East Anglia university in the United Kingdom. Parts of some emails, taken out of context, suggested scientists had manipulated data to exaggerate the warming trend.

Climate deniers harped on the leaks to paint climate scientists as ideologically motivated and dishonest. Though an official inquiry into the matter exonerated scientists, the damage was already done. Their calls for universities to investigate climate scientists prompted institutional probes that hampered research efforts. Today, conservative advocacy groups point to "Climategate" when making open records requests.

"I think anyone who looks at the whole 'Climategate' manufactured controversy understands now that it's bogus, but that's the rationale that they've used," said Lauren Kurtz, executive director of the Climate Science Legal Defense Fund, a nonprofit working to protect researchers threatened by legal attacks.

The Energy & Environment Legal Institute (E&E), a conservative think tank with ties to coal and oil companies, cited "Climategate" as the impetus for its "transparency project." In 2011, the group sued to obtain more than 10,000 emails written or received by Michael Mann, a researcher at the University of Virginia and one of the scientists implicated in "Climategate." The Virginia Supreme Court sided with Mann, who lamented the "coordinated assault against the scientific community by powerful vested interests."

That same year, E&E requested more than a decade of emails from University of Arizona climate scientists Jonathan Overpeck and Malcolm Hughes, another researcher ensnared by "Climategate." E&E's legal brief alleged there is a "climate scientific-technological elite" which has "behaved badly" in the past, a reference to "Climategate." In a gesture of surprising candor, E&E acknowledged that it was searching for emails to "embarrass both Professors Hughes and Overpeck," whom it characterized as "academic climate alarmists." That suit continues to this day.

The University of Arizona case volleyed back and forth between the trial court and the appellate court, which recently determined the trial court had failed to consider a statute that protects "unpublished research data, manuscripts, preliminary analyses, drafts of scientific papers" and other documents produced by researchers at Arizona public universities.

Now the case will go back to the trial court, which will reevaluate the records request in light of this statute. The ruling is a pyrrhic victory for researchers and the university, who

must dedicate even more time and money to fighting off E&E. "That's basically as good as we could have hoped for," Kurtz said. Even when scientists win, they lose.

The lawsuit has taken a hefty toll on Overpeck and Hughes. Overpeck said he spent six weeks of his sabbatical sorting through 90,000 pages of emails, explaining the case was a "grave distraction" from his work and family. Hughes spent an entire summer collecting emails, failed to attend to his work and lost a research grant as a result.

These injuries are temporary. More worrisome is the long-term effect that records requests have on research. Hughes noted that, due to his involvement in the case, other scientists have been reluctant to email him. While Hughes is nearing the end of this career, he said that, were he a young man, he would "consider a different line of work or another institution."

Even if E&E loses in the trial court—and it most likely will—the group will have nonetheless succeeded in bullying climate scientists. This, rather transparently, was the point. If E&E had concerns about the empirical rigor of climate research, it could have scrutinized the findings of specific studies. Instead of interrogating the final product, it went after the hastily scribed emails exchanged between colleagues.

"I have taught, researched and administered in academia for more than 40 years and have not seen a time in which freedom of inquiry has been more needed, or more imperiled than it is now," Hughes wrote in a letter to University of Virginia president Teresa Sullivan when E&E was working to obtain Mann's emails. "Nothing is more likely to quash the creativity of America's scientists than the ever-present ear of a hostile listener intent on finding, at all costs, the appearance of malfeasance. Nothing is more calculated to discourage research into topics that may challenge power interests."

Today, some states are enacting policies to protect scientists. Rhode Island and North Dakota recently passed laws guarding academic freedom. The Rhode Island statute specifically shields "drafts, notes, impressions, memoranda, working papers and work products" from open records requests. Kurtz hopes more states follow suit.

Climate scientists have an unlikely ally in the Trump administration.

At the federal level, the issue becomes more complicated. The legal protections that guard the emails of federally-funded climate scientists also shield government employees, including those working for the president. As a result, climate scientists have an unlikely ally in the Trump administration.

In 2015, the conservative nonprofit Judicial Watch made a FOIA request to obtain the emails of climate scientists at the National Oceanic and Atmospheric Administration (NOAA). Judicial Watch has a history of harassing opponents with records requests—most notably Hillary Clinton. Its president, Tom Fitton, claimed the NOAA documents requested would show "the Obama administration put politics before science to advance global warming alarmism."

"This case is interesting because it was actually started under the Obama administration, but the Trump administration continued it, I think, because the Trump administration recognizes that it's important to maintain these open-records protections," Climate Science Legal Defense Fund's Kurtz said.

There is little reason to believe that President Trump is interested in protecting researchers. His EPA transition team included lawyers David Schnare and Christopher Horner, both of whom have a history of harassing climate scientists with open-records requests. Rather, the Trump administration is committed to secrecy. EPA chief Scott Pruitt offers a prime example. Pruitt, who recently installed a $25,000 soundproof booth in his office, has been sparing in his use of email, partly as a response to a 2014 open-records request that revealed his close ties with the fossil fuel industry. "The Trump administration, I don't think, is eager to be turning things over under open-record laws," Kurtz said.

The rationale for protecting scientists' emails from public disclosure is simple. FOIA was enacted to make government more transparent, but it also threatened to discourage open conversations among federal employees. Judges have interpreted the law to exclude these conversations from records requests—what's known as deliberative process privilege.

The rationale for protecting scientists' emails from public disclosure is simple: FOIA was enacted to make government more transparent, but it also threatened to discourage open conversations among federal employees. Judges have interpreted the law to exclude these conversations from records requests—what's known as deliberative process privilege.

"The deliberative process privilege was designed to allow agency employees to have freedom to communicate with each other and toss around ideas and engage in devil's advocate debates and what-if arguments and really feel like they can be candid with each other," Kurtz said. "In addition, there's the rationale that people might toss out ideas that are later determined to be bad ideas and never implemented, and if you produce all those emails, it's really going to confuse the public."

The NOAA suit was settled in August. "The trial court judge agreed that the emails in the NOAA case were exactly the sort of emails that this deliberative process privilege was designed to protect," Kurtz said. Judicial Watch declined to appeal to the ruling. As with the University of Arizona case, the damage was already done. If Judicial Watch had concerns about the empirical rigor of the NOAA study, it could have scrutinized the data, the method or the results - all of which were publicly available. But, the group didn't want to debate the merits of the science. Its goal was more specific.

Invasive records requests undermine scientific inquiry.

A 2015 report from the Union of Concerned Scientists found that researchers in numerous fields - public health, environmental science, genetic engineering - face attacks from groups on both sides of the ideological spectrum. The report explains that "individuals and well-heeled special interests across the political spectrum are increasingly using broad open records requests to attack and harass scientists." It warned that such tactics can "can curb the ability of researchers to pursue their work, chill their speech and discourage them from tackling contentious topics."

With climate change, there is evidence that this is already happening. A 2015 study found that climate scientists frequently downplay the gravity of their findings in response to harassment. Authors wrote that, "in response to constant, and sometimes toxic, public challenges, scientists have overemphasized scientific uncertainty, and have inadvertently allowed contrarian claims to affect how they themselves speak, and perhaps even think, about their own research." This erodes public understanding of science.

"We all lose when scientists self-censor due to continued harassment. We have a poorer understanding of the science and are less able to make good personal and policy decisions," said Michael Halpern, head of the Center for Science and Democracy at the Union of Concerned Scientists. "Scientists will be more likely to keep their heads down and refuse to publicly engage or ask contentious research questions if they don't feel that their peers who are attacked are adequately protected."

How then do scientists balance privacy with transparency? Where is the line between confidentiality and obfuscation?

"We think it's totally appropriate to FOIA for funding information and conflict of interest information," Kurtz said. "When you're getting into research emails and candid communication, I think that's really harmful." She added, "Short of something where you have actual evidence of criminal fraud, I think those things should be protected."

FOIA is designed to give a window into the policymaking process, but science is already transparent. "When you're doing a peer-reviewed study, your peers are looking at your research and giving you feedback on it, and they are determining whether or not it is appropriate for publication," said Kurtz. Scientists must publish their data, their methods, their results, and they must disclose their source of funding .

"That sort of transparency is actually what you need to replicate the research, evaluate the research," said Kurtz. "That is not happening in the policymaking field where FOIA was originally designed to operate."

Because science is transparent, it is also self-correcting. Researchers can interrogate, criticize and improve upon each others' work. In 2013, Thomas Herndon, a graduate student at the University of Massachusetts made headlines when he found a number errors in an influential study authored by two Harvard economists. The paper showed that economic growth slows down in countries with high national debt, and it was used to justify austerity measures following the Great Recession. Herndon, 28, published a paper which called attention to the errors and refuted its conclusions about national debt.

This is how research works. Researchers evaluate and attempt to replicate the findings of their peers. They have every incentive to prove each other wrong. Herndon's work earned him the acclaim of serious economists, weeks of fawning press coverage and a star turn on The Colbert Report. Any person who could do the same for climate research would be similarly celebrated. If E&E, Judicial Watch or any other groups were to find and publicize flaws in peer-reviewed climate research, they would be doing a public service. But, overwhelmingly, the data show that humans are driving the warming trend. So instead, right-wing groups go after emails, looking to defame scientists.

"Scientific transparency is obviously important," Kurtz said. "What we want to preclude is scientists having to live in a fish bowl."

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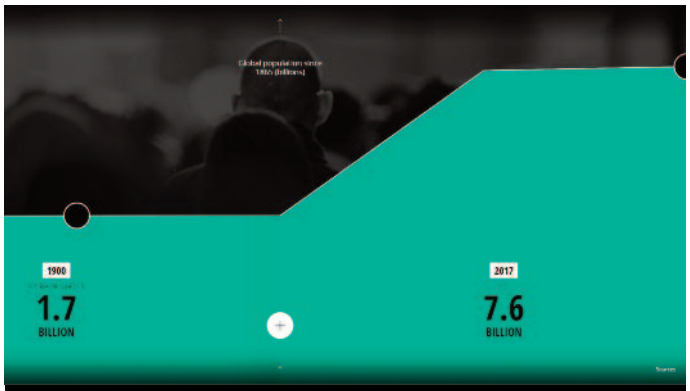
Father and (Grand)son

Exploring how life has changed over the years.

By EUSEBIO LORIA

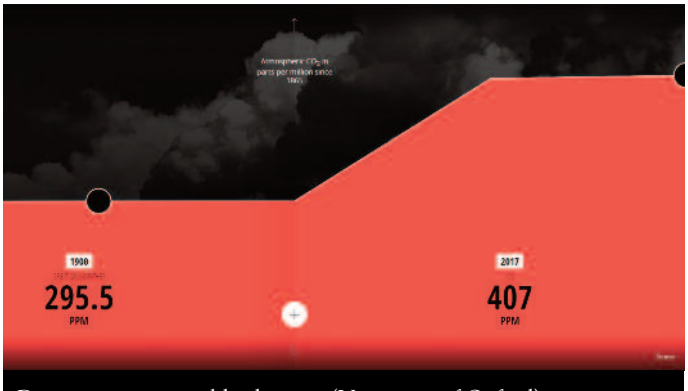
ONE

Let the record play. The sound of an old vinyl is music to my ears. it comes from an ancient record player.
"It's not time to make a change".



Data source: ourworldindata.org (University of Oxford)
Courtesy of BBC

"Hi Grandpa, the time has come! Today BBC News declared that global warming would cause further changes within world living memory. For example, 2016 average concentrations of CO2 hit 403.3 parts per million, up from 400 ppm in 2015. It is the largest increase we have ever seen in the last 30 years and will cause faster temperature rising."



Data source: ourworldindata.org (University of Oxford)
Courtesy of BBC

"Before the Industrial Revolution, there were around 280 parts per million of CO2 in the air. That amount had varied very little for 8.000 years. After industrialization, greenhouse gas emissions rose, and now the world needs to cut down to around half of today's levels to constrain the global mean temperature increase to 2°C"

"Why are CO2 levels so high today?"

"Because of industrialization. There are more people alive today than ever before, and the global population is expected to grow from 7 billion to 10 billion by 2050."

Not only are there more people; they live longer too.

Lethal diseases that frightened me when I was a child, can now only be found in history books. A healthy population lives longer using more energy, producing pollution and breaking the natural balance.

Image from the Global Change Calculator
Courtesy of BBC

Extinction is a natural part of evolution and is being accelerated by human activity. As habitats change, plant and animal extinctions are predicted to occur faster than species adaptation.

Significant steps forward in the understanding of our wor have come from scientific discoveries. In the past, our view of the world was very different. Scientific research, engineering, and technology have not just changed our understanding of the universe, they've changed our societies."

"Damn it! How much the world has changed from the past!". And the song goes on... *"Just relax, take it easy! Look at me, I am old, but I'm happy."* ONE

The Bitcoin never ending rise: a model of unsustainability?

By ALICE MASILI
ONE

A currency that keeps growing and democratizes the digital economy but looks far from being ecological. Maybe it is the right time to ask questions about the sustainability of the cryptocurrency. A bubble about to burst? The apparently inexplicable and irresistible Bitcoin dancer's progress led many market observers that the electronic money (or cryptocurrency) is just the latest giant speculation. Time will tell.

What we can already say is that the Bitcoin is growing in popularity due to its financial exploits, but few have figured out what such a growth implies for the environment.The bitcoin's effects not only touch the economy and finance, but they have consequences on our lives too. They do not use presses or filigree paper, but this does not cancel the cost of issuing.

Bitcoin is an electronic currency and a digital transactional mean created in 2009. Transactions from one virtual portfolio to another are based on the so-called blockchain: a user, who owns the coins, transmits transaction details to a connected computer network, where they are then duplicated in thousands of identical documents. The blockchain, the database introduced by bitcoin, is a sort of transaction log: because it is always intact so that no computers that are part of the network can be tampered with.

Essentially, a computer should not be able to automatically add new entries to the transaction log (otherwise, anyone could coin money at will and get away with it). To prevent a fraud, the transaction authentication process has been made very long and complex.

Every transaction is only approved when all network computers get to the bottom of a computational problem that requires vast and prolonged computing power. These issues become increasingly complicated as the register expands and it requires more and more energy to be solved. The incredible rise of the Bitcoin currency has increased everywhere the energy consumption of the e-currency network to epic proportions because more and more people use computers to "mine" crypto value. The "mining" is a method used by the Bitcoin system and in general by digi-

tal currency to issue money. The system does not print money; it discovers money. The miners make available their computers' computing power to perform these calculations. In return for each successful check, they receive free BitCoins.

As estimated by the analyst Alex de Vries on Digiconomist (www.digiconomist.net) through the Bitcoin Energy Consumption Index, Bitcoin miners will use more than 24 terawatt-hours (TWh) of electricity per year. This number gives an idea of how nature plans to carry on with the Bitcoin: that amount of energy corresponds to the annual consumption of the whole of Nigeria, a country of 186 million inhabitants.

In a report published by the International Energy Agency, De Vries sustains that the entire Bitcoin network now consumes more energy than countries like Oman and the Netherlands. A recent research on the energy consumption of the bitcoin network, carried out by the Hamilton Institute and the University of Maynooth in Ireland, points out that the energy used by Bitcoin mining is “comparable to Irish energy consumption.”

The need for energy consumption corresponds to a more prominent demand and a more considerable resource utilisation: this is the real environmental impact of the digital money.The American magazine Motherboard (www.motherboard.com) calculated that each Bitcoin transaction consumes about 215 kilowatts per hour. An average US household consumes approximately 900 kilowatts per month, if we multiply that figure for the 300,000 daily transactions occurring all over the world, it is easy to get dizzying numbers. It is clear that Bitcoin miners could use enough electricity to maintain about 2.26 million US homes. These figures make us realize that Bitcoins have a high environmental impact due to their extreme high-energy consumption. They would even contradict the objectives of the Paris Agreement. In today's world, where the attention to energy consumption and climate change is becoming an integral part of everyday life, is there any need for such a power-consuming currency?

It is not the first time we have to face with an energy crisis, and certainly, it will not be the last. However, the mining community is working to fix the problem, proposing cheaper and more eco-friendly alternatives for generating electricity to power their miners and to make the monetary withdrawal more sustainable from an energy point of view.

Several ideas have recently been proposed to improve the sustainability of crypto-money (newscientist.com). A Russian startup, Comino, offers, for example, radiators able to transform this heat into useful heat.

Another idea is OgNasty, a Bitcoin mining company, which launched in 2012 the Green Energy Bitcoin Mining Project, which uses renewable energy (mainly solar and wind power) to extract currency. An Australian company, HydroMiner, uses hydropower to operate its mining farms, lowering the electricity cost of 85 percent compared to the European average. Genesis Mining, arguably the largest Bitcoin mining company in the world, uses the green electricity generated in the country’s geothermal power plants to power its mining farms in Iceland.

It may not be enough. It might be time to rethink the architecture of the digital currency. A more energy-efficient, cheaper and greener extraction method will keep the bubble intact. And its surroundings too. ONE

Why China is no climate leader

By ELIZABETH ECONOMY
Politico.com

When President Donald Trump yanked America's support for the Paris Climate Accords, pundits were quick to hail China as the world's new environmental leader. Two veteran journalists wrote that the decision was "the greatest strategic gift to the Chinese, who are eager to fill the void that Washington is leaving around the world."

But is leadership on climate change really a strategic gift? Do the Chinese want it? And above all, do they merit it? The quick answer is no, no and no.

True global leadership is costly: It requires vision, creativity, perseverance, deft diplomacy and often cold, hard cash. It also demands a willingness on the part of political leaders to align, and in some cases subordinate, their own narrow interests to those of the larger international community. The Chinese, including President Xi Jinping, understand this. That is why any number of Chinese analysts have been quick to reject the idea that Chinese leadership on climate change is realistic, arguing as one did, "Taking on global leadership is too much, too soon for China."

Xi Jinping, himself, is somewhat less willing to reject the idea out of hand. China as a global power shaping norms and institutions is a central element of his rejuvenation narrative. He therefore flirts with the prospect, proclaiming China ready to defend globalization and to protect the Paris climate agreement. But nowhere does Xi say that China will actually lead; that is left to others.

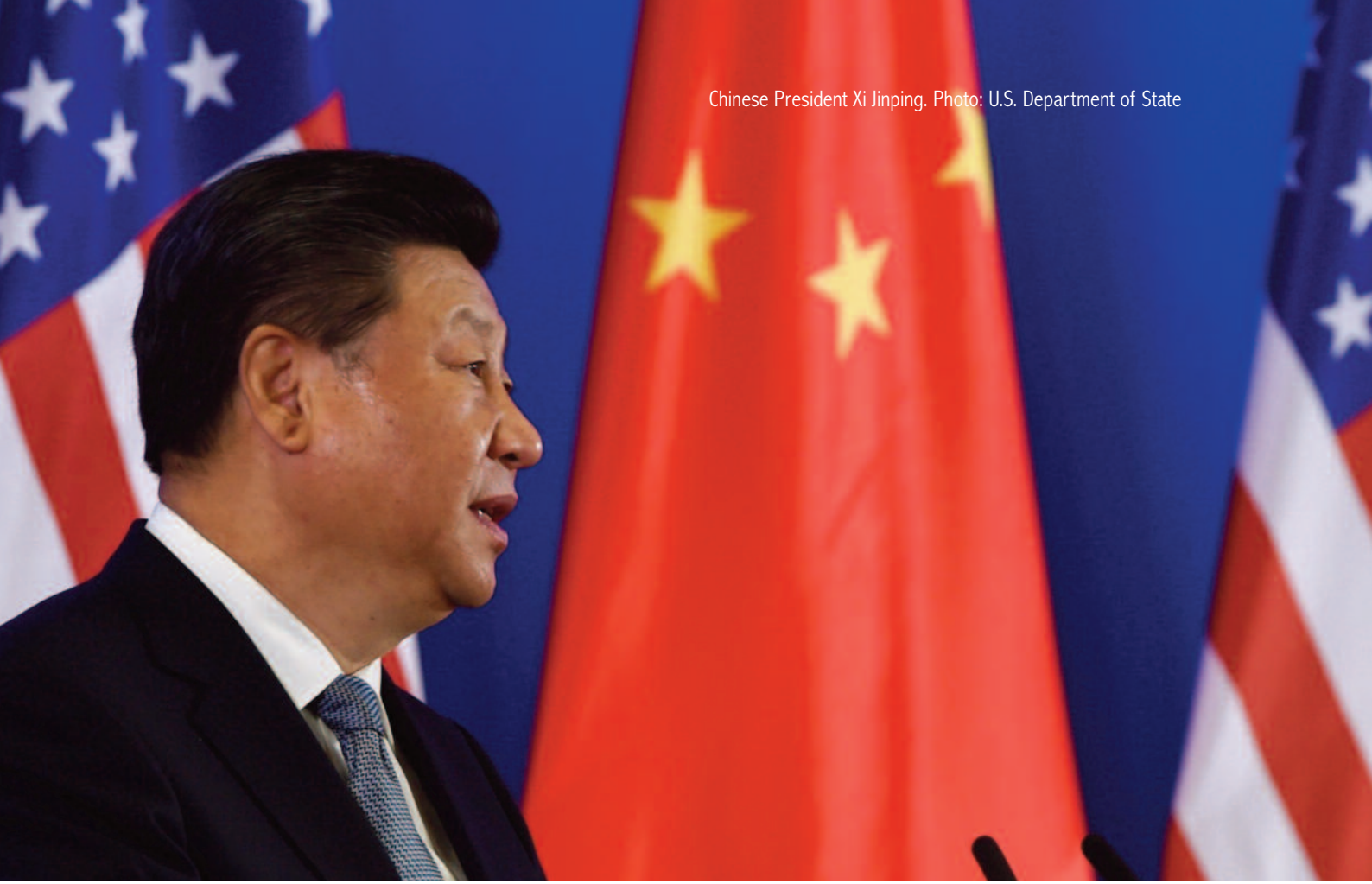
So where does China stand on the climate leadership spectrum? First, the good. It will meet its Paris commitment: By 2030, China's CO2 emissions will peak and its energy intensity (the amount of energy consumed per unit of GDP) will be reduced by 60-65 percent.

In addition, Beijing is making strides toward rebalancing its energy mix. This year it cancelled 85 new coal fired power plants on top of the 18 that it cancelled last year; if brought on line, these 103 new plants would have exceeded China's 2020 targets of 1100GW of coal-fired power capacity by 150 GW. (By way of comparison, total U.S. energy produced from coal is 350GW.) Moreover, China has pledged not to approve new coal-fired power plants in as many as 13 provinces and regions until 2018. (Of course, one might reasonably ask what is happening in the other 18 provinces and regions, and what 2018 might bring.) China has also stepped up its commitment to renewable energy. In 2016 China invested $78.3 billion in renewable energy—topping both Europe ($59.8 billion) and the United States ($46.4 billion). China also ranks first in terms of total installed renewable electric capacity. Much of this capacity, however, remains idle. In 2016, in three of the most wind power-rich provinces and regions—Gansu, Xinjiang and Inner Mongolia—for example, levels of curtailment (capacity not utilized) reached 43 percent, 38 percent and 21 percent respectively.

The curtailment rate for solar energy was similarly high. In contrast, curtailment rates in the United States and Europe are generally between 0-5 percent. In the wait and see category, China is reportedly set to launch a nationwide CO2 cap and trade system sometime this year. This system could be spectacular, or it could be spectacularly embarrassing.

Now the bad. China is still the largest emitter of CO2 on the planet by a substantial margin, contributing 29 percent of the world's total CO2 emissions in 2015. The United States comes in a distant second at 14 percent. In addition, while Beijing is cutting back on coal-fired power plants—particularly in its wealthy and pollution-conscious coastal provinces—it is upping its count of CO2 emitting coal-to-chemical (including coal-to-gas) plants. There are 46 coal-to-chemical plants in operation and another 22 under construction that will add another 193 million tons of carbon emissions annually. A conservative estimate suggests that by 2020, such plants will contribute as much CO2 as all of Poland's contribution to global carbon emissions, while the extreme scenario—if China builds all the coal-to-chemical plants outlined in its 13th Five Year Plan—will lead to a contribution of almost 800 million tons per year, more than German's total carbon emissions in 2015, and equal to roughly 10 percent of China's current CO2 contribution.

China also falls short in the eyes of some independent monitoring groups that assess countries' climate commitments. The 2017 annual report by German Watch and the Climate



Chinese President Xi Jinping. Photo: U.S. Department of State

Action Network ranks China 48th—just a few places behind the United States at 43rd—in terms of how much it has done to avoid climate change and how much it plans to do. True climate leadership belongs to the Europeans—France, Sweden and the United Kingdom, in particular—although even these climate leaders come in for some criticism. Moreover, the Climate Action Tracker, produced by three international research institutions, indicates that China's current emission reduction targets are not consistent with ensuring that the earth's warming remains below 2 degrees C.

And finally the ugly. Whatever positive steps China is taking at home are not being replicated in its behavior abroad. China is the world's largest exporter of coal-fired power plant finance and technology. Even as Xi is calling for an "international coalition for green development on the Belt and Road" (his comprehensive new trade and development initiative involving 65 countries), Beijing is backing more than 100 new coal-fired power projects in the Belt and Road countries. China's much-touted Belt and Road deals in Pakistan, for example, include plans for as many as 12 coal-fired power plants—even in areas recognized for their superior solar energy potential. In addition, China is actively pushing coal-to-chemical plants abroad. The Paris accords don't account for countries' actions outside their own borders, so China is not breaking the letter of its Paris commitments, but these Belt and Road investments are certainly not in keeping with the spirit of the agreement.

Beyond the clear limitations of China's climate policies at home and abroad, there remains the larger question of diplomatic leadership. Will China rally other countries to adopt another round of more ambitious greenhouse gas reduction targets? Will it stop the overseas financing and sale of coal-fired power plants and coal-to-chemical plants? Will it push forward to limit other harmful greenhouse gas emissions, such as methane? Will it accede to international monitoring and verification of its emissions, an important measure it continues to reject? Thus far, there is no indication that China has plans to adopt any of these leadership-worthy measures.

When Trump, in the midst of withdrawing the United States from the Paris agreement, offered up the possibility of renegotiating the climate pact, the rest of the world in effect said, "not going to happen." Undoubtedly other countries are becoming accustomed to the idea of a world without American leadership. But filling the void left by the United States must be earned, not simply granted by overeager officials and pundits. China may one day earn that right, but not today.mans, and Saracens.

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How much fuel does it take to power the world?

By ETHAN SIEGEL

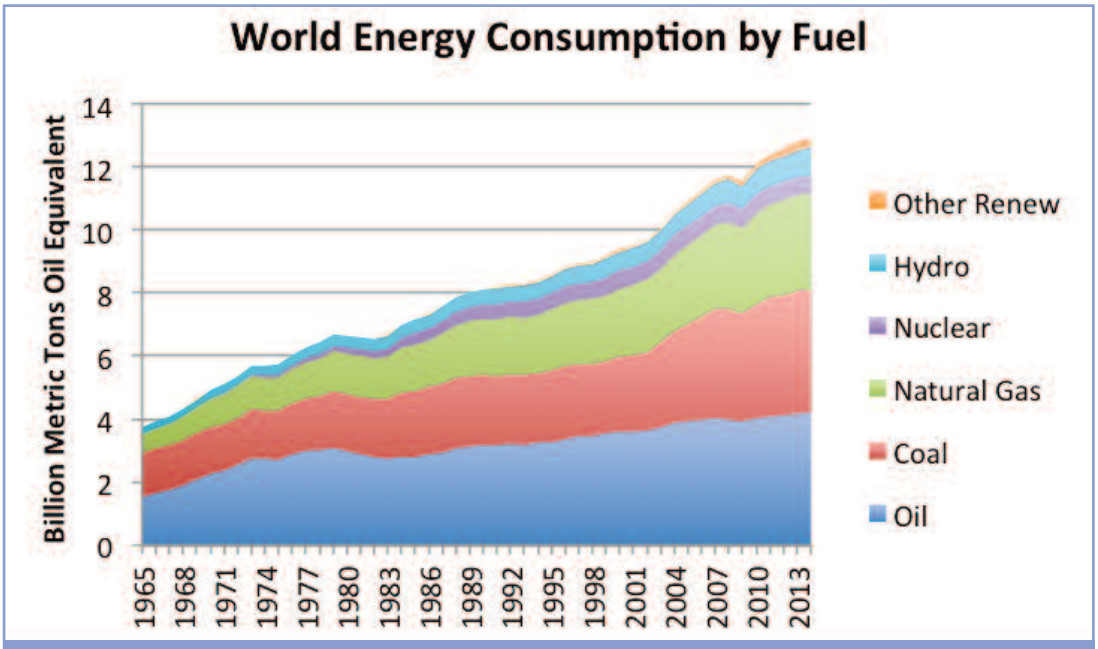
Medium.com

"In terms of weapons, the best disarmament tool so far is nuclear energy. We have been taking down the Russian warheads, turning it into electricity. 10 percent of American electricity comes from decommissioned warheads."
-Stewart Brand

Over the past few centuries, the quality of life for the overwhelming majority of the world has increased precipitously. Amenities brought by the widespread availability and distribution of electricity have brought us into the industrial and then the information age. Every day, billions of people access computers, lighting, rapid transportation, phones and innumerable other technologies and conveniences made possible only by using energy. Yet at its core, the energy we access and use simply arises from the conversion of some sort of potential energy. While there are renewable sources such as hydroelectric, wind, and solar, most of our energy comes about by burning fuel. There are many different sources available for this—some practical, some possible, some only theoretical—that illustrate just how much, or how little, the world actually needs.

According to the United States' Energy Information Administration, one of the major world sources that gathers information about the world's energy use, the amount of energy supplied by all the sources of energy across the world is tremendous: 155,481 Tera-Watt-hours as of 2014, the latest year on record.

Different fuel sources have different efficiencies for conversion into power and for long-and-short-range transport, so the total amount of energy consumed by households, industries, and businesses is a bit less: only about 70% of that. But the amount of energy the world needs to generate—the equivalent of 5.60×10^{20} Joules—is pretty hard to fathom. So let's break it down a little differently, and look at the amount of



World energy consumption by fuel, based on BP Statistical Review of World Energy 2015. Image credit: Gail Tverberg / Our Finite World.

The KEPCO Tanagawa No2 Oil-fired power plant, one of many oil-fired power plants in the world. Much of the oil used, however, goes to mobile sources rather than stationary ones, as depicted here. Image credit: Kyoyaku / Wikimedia Commons.

fuel needed to provide that much power.

Coal: First used as a heat source due to its compact nature, coal is a form of carbon which can be burned, in the presence of oxygen, to release energy. This is how all fossil fuels, or any carbon-based fuel, works on Earth, where oxygen is abundant in our atmosphere. For every kilogram of coal that gets burned, a total of 2.312×10^7 Joules of energy gets released, meaning we need to burn a total of 24 billion tonnes of coal in order to meet Earth's energy needs. As it is, coal is responsible for about a third of our world's current energy production, which means that 8 billion tonnes of highly-polluting coal gets burned every single year.

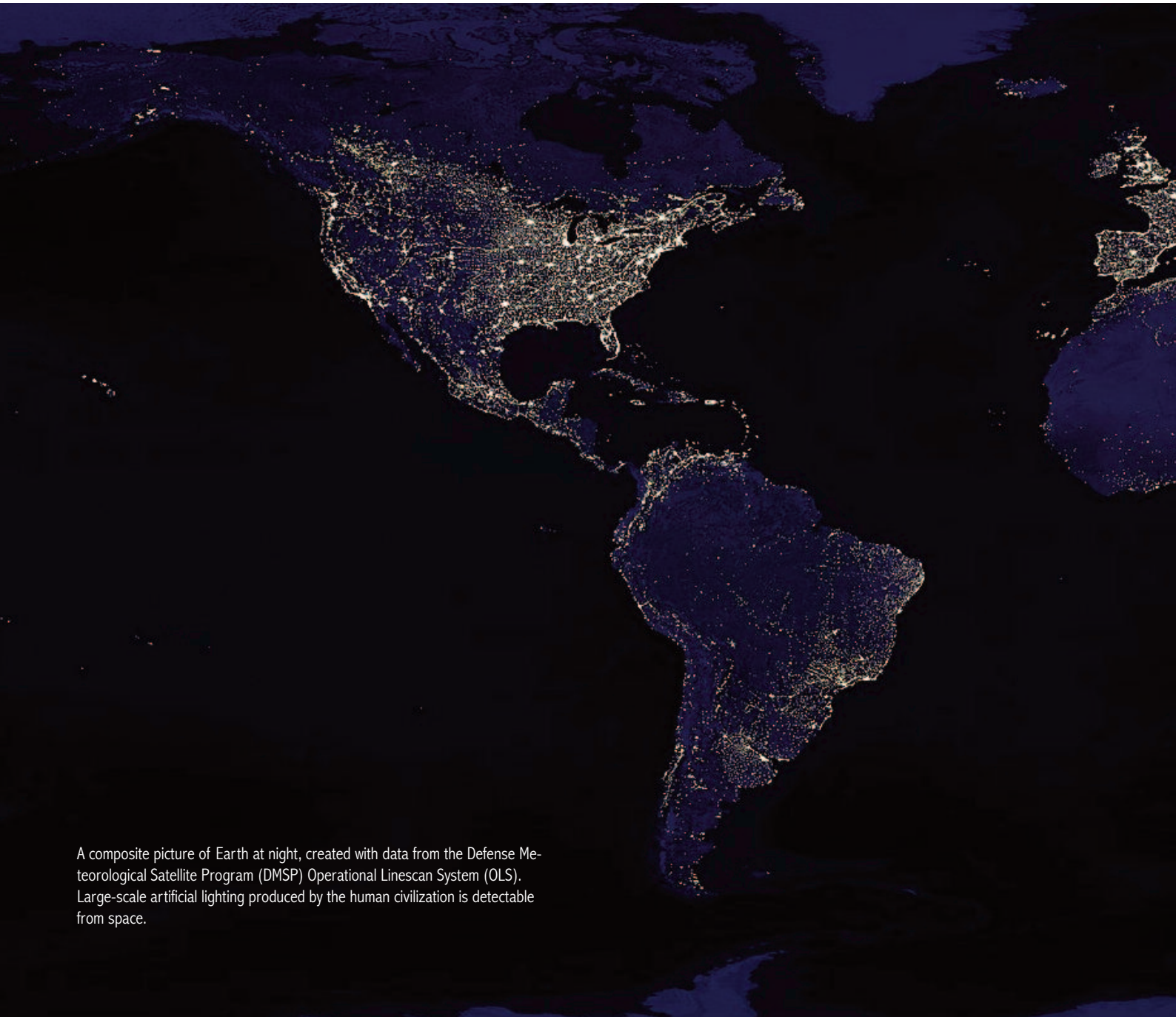
Oil: This includes diesel, gasoline, heavy fuel oil, and liquified petroleum, among others. While coal was the dominant fuel of the 18th and 19th centuries, oil rose to prominence in the 20th century with the advent of the automobile and the airplane. Like coal, oil relies on combustion; unlike coal, oil will net you more energy for the same mass of fuel. For every kilogram of oil (in the form of gasoline) that gets burned, a total of 4.64×10^7 Joules of energy is liberated, which would mean 12 billion tonnes of oil are needed to power the planet in a given year. Since oil first entered widespread use in the 1850s, it's estimated we've burned somewhere between 100 and 135 billion tonnes of oil, with another 4 billion tonnes burned every year at the present rate.

Gas: You've likely heard that replacing other fossil fuel sources with liquid natural gas (LNG) has brought about the greatest reduction in environmental pollution in recent years. It's true; LNG now supplies over 20% of the world's energy needs, is more fuel-efficient than both coal and oil, and has fewer toxic pollutants in it than either one. For every kilogram of LNG that undergoes combustion, 5.36×10^7 Joules of energy can be gained, meaning it would take a mere 10.4 billion tonnes of gas to power the world. These are still huge numbers, though, and there is no reduction in terms of one important pollutant—Carbon Dioxide—to be gained by choosing gas over coal or oil. To achieve that goal, we need to look away from carbon-based fossil fuels.

Nuclear: Instead of using carbon-based fuel, we could instead look to the heavy, fissionable elements present on Earth: elements like uranium or thorium. Uranium breeder-reactors take advantage of the fact that when U-235, the second-most common isotope of uranium, is hit with a slowly-moving neutron, it ab-

sorbs it and splits apart into lighter elements, releasing further neutrons and enabling a chain reaction to be set off. Nuclear reactors successfully control the rate of reaction, allowing the rate of energy production to be tuned as well. Although U-235 is far less abundant than coal, oil, or gas, and requires heavy refining to produce reactor-grade fuel, nuclear power is far more efficient, with 8.06×10^{13} Joules of energy released for every kilogram of uranium in a breeder reactor. To power the world, it would only take 7,000 tonnes of uranium fuel each year. Nuclear power currently provides only a few percent of the world's energy, with 444 reactors currently operating and another 62 presently under construction.

Nuclear fusion: We don't presently have this technology as a viable power source on Earth, but nuclear fusion is one of the holy grails of the energy world. Abundant, light elements (like hydrogen and its isotopes) can be fused together into heavier elements, releasing a tremendous amount of energy in the process. This is the energy process that powers the Sun, where the heavier elements actually have less mass than the lighter elements that went into creating them; the release of energy via Einstein's $E = mc^2$ is where nuclear energy comes from. Even more efficient than fission, nuclear fusion would liberate 6.46×10^{14} Joules of energy per kilogram of hydrogen fuel, meaning it would take a mere 867 tonnes of hydrogen to power the world. The abundance of hydrogen, the lack of atmospheric pollution, and the controllable nature of radioactive products to come out of fusion makes it the most promising energy source of the future.



A composite picture of Earth at night, created with data from the Defense Meteorological Satellite Program (DMSP) Operational Linescan System (OLS). Large-scale artificial lighting produced by the human civilization is detectable from space.

Antimatter: Why not dream of the ultimate energy source: antimatter! If nuclear fission and fusion reactions both enable the release of a substantial fraction of a particle's mass in the form of energy, why not simply convert the whole thing? When you collide an antimatter particle with its matter counterpart, that's exactly what you get. A perfect conversion of antimatter-and-matter into energy releases 8.99×10^{16} Joules of energy per kilogram of combined matter/antimatter, which means you only need 3.1 tonnes of antimatter (and another 3.1 tonnes of matter) to power the whole world for a year. On a daily basis, that would be a meager 8.5 kilograms of antimatter; too bad that even the largest production facilities of antimatter—particle accelerators—can only produce about a microgram's worth per year.

On Earth, we're currently burning more than ten billion tonnes of fossil fuels per year worldwide, supplying some 80% of our energy needs through those methods. Unfortunately, air-and-water pollution, along with vast atmospheric changes, have arisen from this. Renewable sources of energy are one potential (although, arguably only a partial) solution, but nuclear power—if it can be done safely—could solve our fossil fuel problem today, with current technology alone. With the amount of fuel it presently takes to power the world, the cost of doing nothing is not only far too high, but will be borne by humanity for generations to come.

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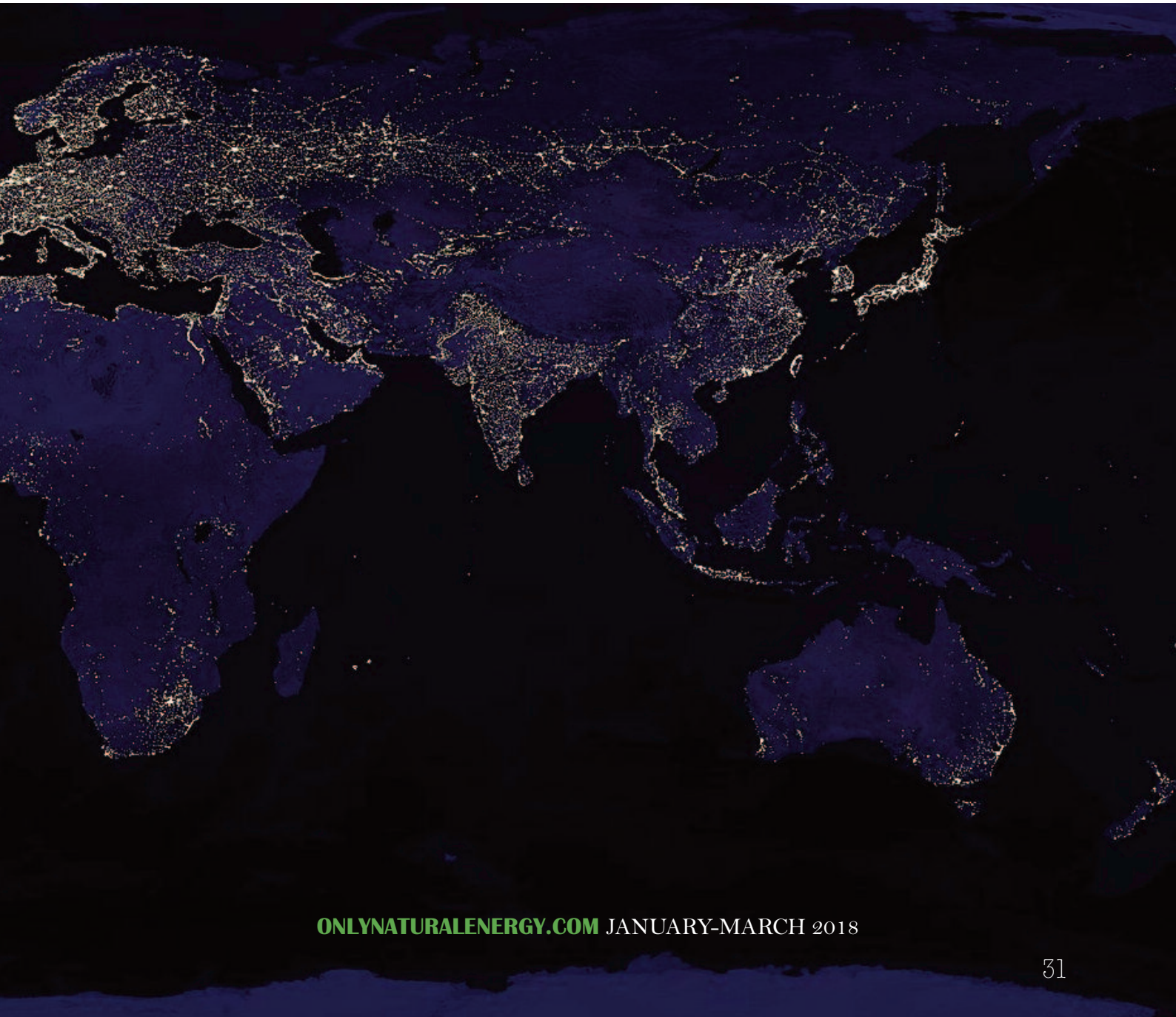

The Death of 'Alternative Energy'

The definition of what's "alternative" has changed dramatically in the last decade.

By ANDREW BEEBE
Greentechmedia.com

Fifteen years ago, when I joined the early ranks of clean energy entrepreneurs, we were nearly dead in the water on climate. Oil was $15 per barrel, Al Gore's groundbreaking movie An Inconvenient Truth hadn't come out, and a solar panel was something that powered a calculator.

In 2005, I went to my first "alternative energy conference" in Aspen, Colorado. I was asked to speak at the event, and hadn't paid much attention to the agenda. Upon arrival I found the audience consisted of coal, oil and gas executives.

It turns out that "alternatives" in the energy space in 2005 actually meant new methods for extracting old fossil fuels: tar sands, "clean coal" and a new thing called fracking. This, according to all of the other speakers, was the future.

I didn't walk away optimistic about our coming transition. Forecasters weren't wearing their rose-colored glasses either.

What a difference a decade makes

In the first quarter of 2017, renewable energy accounted for 20 percent of all U.S. electricity, while fracking has gone mainstream. On the flip side, six publicly traded coal companies declared bankruptcy from April 2015 to 2016, while coal production had its steepest annual decline since 1958. And after much hype, the number of operational clean coal power plants in the U.S. remains firmly stuck at…zero.

A coal plant built today would not be competitive with a combination of wind and solar in virtually any location in the country. And nowhere would it be competitive with natural gas.

In the end, these fossil sources, particularly coal, look increasingly like the new "alternative energy sources," since there's simply no economic justification for them.

The speed of this transformation may surprise some readers. That's understandable. For years, traditional energy analysts have completely mis-forecast the transformation.
Why were these analysts so wrong? What drove this profound shift with such speed? This did not happen because of Paris. This didn't even happen because of Kyoto before it. It didn't happen because of something Trump did or undid. It didn't happen because of President Obama's Climate Action Plan.

The real change agents of the energy transformation

Three drivers of change set us on this course. It started first with the growing chorus of concerned citizens, scientists and activists coming together to seek out solutions -- often at a local level. This was catalyzed by inflection points like An Inconvenient Truth, but the sources of inspiration were everywhere as the evidence of change mounted.

Second, local and state leaders in the U.S. started to listen. Across party lines, real leadership showed up to pass renewable portfolio standards, enhanced automotive standards, and air quality improvement plans.

Third, in reaction to the first two, businesses started playing an increasingly important role.

Broadly speaking, businesses have played two key roles in cementing our direction on climate. First, large companies have finally started to internalize the will of their customers. Five out of the top six most valuable public companies in the world are U.S.-based technology companies: Google (Alphabet), Apple, Microsoft, Amazon and Facebook. They are also the source of the greatest amount of electricity demand growth in world. All of them have now committed to 100 percent clean energy in the near future -- Google is there today. The others behind them will follow suit.

Leading companies have committed to 100 percent clean energy to save money, show leadership and meet the growing cries from their customers and employees to be part of the solution. The magnitude of this commitment cannot be overstated. These companies have a combined market capitalization of nearly $2.3 trillion -- exceeding the size of nearly every economy that signed the Paris accord.

The second way business has played a key role is innovation and entrepreneurship. The impact of buying power is the domain of the large multinationals. The impact of innovation is the domain of startups. From SunPower and First Solar to Tesla and Nest, we have continually seen the unbounded creativity of startups and founders prove the impossible. And we're just getting warmed up. Electric buses, large-scale

energy storage, autonomous cars, electric planes, and the myriad software solutions to help make our energy more efficient and effective are launching daily.

Trump and Paris: Both irrelevant?

Last year, diplomats and world leaders gathered in France to sign the Paris climate accord. It was the culmination of over a decade's worth of work, and it was heralded as an historic agreement.

The accord was historic. Virtually all climate scientists agree the commitments were in fact necessary first steps. Most would also agree they were not sufficient, but at least they showed an alignment and a willingness to stand together in this time of global crisis.


Pumpjacks on Lost Hills Oil Field in California on Route 46 at sunset.

In June of this year, our new president began the work of removing the U.S. from the Paris commitments. But interestingly, it would appear the U.S. commitment, or lack thereof, has had no material impact on the movement to address climate change. Like so many of the solutions to our climate challenges, the movement is now distributed and highly effective.

An unstoppable force

As has been pointed out many times, all of the stakeholders addressing climate change were moving on their own before Paris, and virtually all of them already had plans in place which would result in exceeding the Paris goals. This is true of the U.S. as well. The real value of Paris was simply coming together to collectively acknowledge the challenge and show unity around a future engagement for the next steps after Paris.

Today, leadership is everywhere, distributed in its origins, rationale and actions. China is investing hundreds of billions into renewables over the next three years while slowing plans for coal-fired power plants. The same is happening across India. Germany is now sourcing as much as 85 percent of all its energy from renewables at any given time, with Chile and the Nordic countries pushing ahead as well.

The story of transformation here in the U.S. is, typically, much more diverse and creative than some of the top-down transformations listed above. The U.S. shift didn't happen because of a global accord, or really with much support at the federal level at all. It happened because of local leadership, consumer demands and entrepreneurship.

The road ahead has no U-turns

The efforts of brave local political leaders, individual consumers and "prosumers" (those who are both using and selling back their solar or storage), and, most importantly, of businesses around the globe have coalesced into an irreversible movement. No one global leader nor one global accord is going to make or break this effort. This is a decentralized transformation, and no one in their right mind wants to go backward. The road to safer, cleaner future has not been straight, but it is one-way.

No one in Delhi wants more soot in the air once they realize the connection to coal. No one in Guangzhou wants toxic rivers once they've seen clean water again. No one in Dallas or New York wants dirty streets and diesel buses once they've seen the improvement of all-electric.

President Trump's attempted reversals on climate are pathetic. There is no clearer an example of political manipulation than his rhetoric on Paris. While he's in office, he clearly weakens our global standing, and we must stand up to show he doesn't represent the majority of Americans -- he represents less than one-third, to be precise.

Thankfully, the president is decreasingly relevant. We're doing this with or without him, and there's nothing he can do to stop it. America's leading corporations are exceeding the Paris targets. States representing the majority of the country are exceeding the goals of the accord. While Trump plays petty payback politics that embarrass us on the world stage, we're getting the job done here at home.

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PYRAMIDEN

Pyramiden was a coalmining town located in the Svalbard achipelago in the Arctic Ocean. In 1925 Norway took formal possession of the islands under the international Svalbard Treaty that allowed existing natural resources exploitation to continue with visa free travel. Despite being Norwegian territory it was actually a Soviet community in a NATO country. It was bought by the Soviet Union in 1927 and abandoned in 1998 after the mine's closure. Once 1,000 Russian miners worked in Pyramiden, one of the most isolated settlements on the planet. ONE

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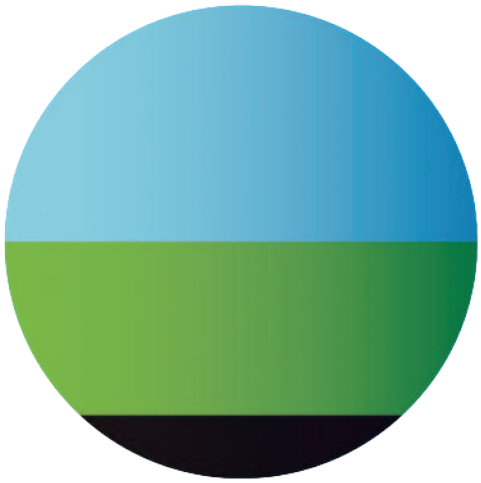

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