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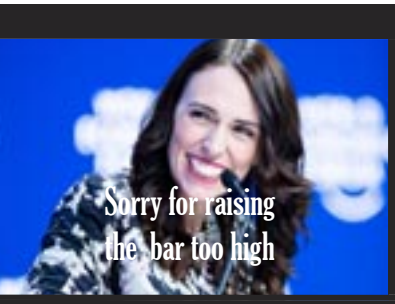

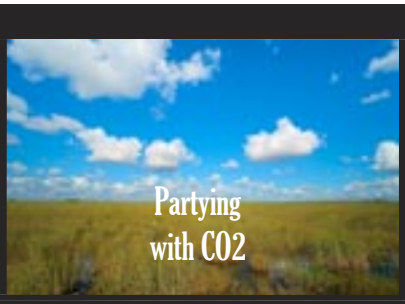

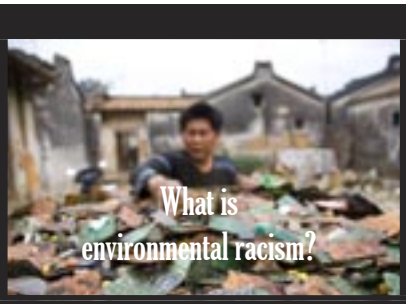

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Only Natural Energy

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Gianni Serra

Editorial team:
Jez Abbott
Lenore Hitchler
Toby Lockwood
Eusebio Loria
Alice Masili

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Nick Brooks
Joanne Clarke
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www.onlynaturalenergy.com
info@onlynaturalenergy.com

A role model. Jacinda Ardern, Prime Minister of New Zealand; Young Global Leader speaking during the Session "Safeguarding Our Planet" at the Annual Meeting 2019 of the World Economic Forum in Davos. Photo credit: World Economic Forum / Boris Baldinger

Sorry for raising the bar too high

GIANNI SERRA
ONE

"I don't think science knows" - Donald Trump's response to a scientist's suggestion that climate change had a crucial role in this August's West Coast fires.

The scheme is proven, and the 45th president of the United States of America has no exclusivity. Indeed it is quite widespread: confrontations on facts conveniently avoided to shift conversations on to opinions: you think so, I don't. The score remains nil nil. Scientific findings reduced to talk-show quips, with a range of arguments and oratorical tricks ranging from ridicule to minimizing to denial. Words and actions that heavily impact on citizens. But consequences go well beyond the external borders. And that's when a national issue becomes global. The management of the pandemic proves it: your neighbour's loose anti-Covid measures are more than enough to nullify all your efforts. If possible, with climate, which cannot be kept within administrative borders, this is even more evident.

Unless you are a model nation like New Zealand, which is remote but often ahead of its time and should represent a benchmark for the rest of the world. Not only in rugby. Recently Aotearoa became the first country to make it mandatory for banks and insurance companies to report on climate impacts and risks. Let's call it anticipating trends, not following them. James Shaw, Minister for the Environment, says that climate change is an integral part of any New Zealand government decision-making: "Decisions we take now and in the future about everything from the places we live, to how we get around, to public health, to how we relate to one another will be impacted one way or another by climate change. It's crucial, therefore that when we're making big decisions, climate change is at the forefront of our minds." No room for deniers, here.

It's the approach that makes the difference more than the subject. Whether we are talking about pandemics or anti-corruption, invariably New Zealand leads the pack of the most virtuous or of the most illuminated forerunners. The Corruption Perceptions Index is the leading global indicator of public sector corruption. More than two-thirds of countries score below 50. New Zealand and Denmark consistently top the list (87 out of 100). Such a stellar positive perception underlines trust, unity and collaboration between the governing body and the population – all essential to try something bold or unprecedented with a chance to succeed. Prime Minister Jacinda Ardern's recent suggestion that national companies could shift to a four-day working week to boost domestic tourism to counterbalance the impact of COVID-19 on tourism, could be an example of innovative thinking.

The only problem with a country like New Zealand is that it seems too good to be true, which provides an easy excuse for it to be overlooked by a large coalition of unaccountable policy makers. To mark its 75th anniversary, the United Nations has declared "The urgency for all countries to come together, to fulfil the promise of the nations united, has rarely been greater." True. Three-quarters of a century of warming up should be enough to move from words to action with the climate. And to put the right models at the forefront, not aside. ONE

Big in Japan

Japan's energy policy made headlines in July, when the Ministry of Economy, Trade and Industry announced plans to phase out older, inefficient coal plants. But closer analysis suggests that Tokyo has far from turned its back on coal.

TOBY LOCKWOOD
ONE

Japan's energy policy made headlines in July, when the Ministry of Economy, Trade and Industry announced plans to phase out older, inefficient coal plants, along with changes to its criteria for lending to overseas coal projects. These developments were seen by some observers as a significant shift for the country, whose reluctance to set an end date for coal power has brought growing attention in international climate forums. However, closer analysis of the announced changes suggests that Tokyo has far from turned its back on coal.

Japan is the birthplace of the most energy-efficient coal plant design used today – hyperbolically known as 'ultra-supercritical' power plants – and has long prided itself as a global leader in advanced coal power technologies. This status developed primarily for reasons of economy and energy security as, in the aftermath of the oil crisis of the 1970s, the rapidly growing country sought to diversify its energy mix and brought its considerable materials science and engineering expertise to bear on developing new types of coal and nuclear plant.

With no coal or other fossil reserves of its own to speak of, it was imperative that the country's transformed power sector make the most efficient use of imports, while avoiding an over-reliance on more costly gas and oil.

Today, Japan's coal fleet has the highest average efficiency in the world, and around 40% of its 45 GW of coal power uses ultra-supercritical technology. Driven by growing environmental concerns, the mood turned somewhat against coal in the 2000s, when very few new projects were given the green light. However, the 2011 disaster at Fukushima Daiichi nuclear plant quickly reversed this process, as most of the country's reactors were temporarily shut down and plans of further expansion abandoned. A 2014 policy retained a place for 26% coal power in the 2030 energy mix, alongside 27% imported natural gas, up to 22% nuclear, and up to 24% renewable energy.

Japan's coal fleet has the highest average efficiency in the world. Driven by growing environmental concerns, the mood turned somewhat against coal in the 2000s. However, the 2011 disaster at Fukushima Daiichi nuclear plant quickly reversed this process.

Early reports of the recently announced coal policies, released by the Yomiuri newspaper, suggested that up to 100 coal power units would be targeted for closure by 2030, leaving 26 units considered high efficiency, and a further 14 that are being retained for other reasons (such as grid stability in more isolated regions). It should be noted, however, that such precise numbers have not been confirmed in later statements from the Ministry regarding the phase out.

It is not straight-forward to tally the coal plans released by Yomiuri with the breakdown of Japan's fleet provided by S&P Global's World Electric Power Plant database, partly due to the fact that 'ultra-supercritical' is not a strictly defined term.

There are only 21 units given this status by the database, so it is likely that the units earmarked to be retained include a handful

Isogo Thermal Power Plant, Yokohama City (Japan).
Photo credit: Σ64

of the newest units which are merely 'supercritical' plants – probably those built since around 2000. These would amount to around 21 GW, together with an unknown capacity from the 14 less-worthy units which have also avoided the firing line.

So, while 100 units sounds like a lot of generators to close, these mainly consist of very small units – often used by heavy industry to supply on-site power – and they probably amount to only around half of Japan's existing coal capacity. Some significant heavy weights do seem to be included in the cull, including older supercritical plant from the 1980s and early 1990s, but these would be nearing the end of their design life in 2030 in any case.

Much of the recent criticism of Japan's energy policy has centred on the fact that 14 new coal plants are currently under construction in the country. Ten of these are state-of-the-art, efficient units in typical Japanese style, while two more showcase the latest incarnation of a potentially more efficient technology known as integrated gasification combined cycle (IGCC), in which coal is first converted to a combustible gas and then used to power a gas turbine. These will add a further 8.6 GW to the coal capacity remaining in 2030, bringing the total to at least 30 GW. Although this could still represent a significant reduction, such a scale-back does not seem wildly inconsistent with Japan's existing ambitions, which sees coal's contribution to the electricity mix fall from 32% to 26%.

In short, Japan's coal plans mainly seem to represent an acceleration of an existing trend towards developing a highly modern coal fleet, which will retain its role as a key part of a diversified energy mix. The possibility of adding even more ultra-supercritical or IGCC capacity has also not been ruled out. The older units pegged for closure have probably long jarred with the country's own self-image as a trend setter in coal technology. However, phasing out so many small coal plants will be far from straight-forward, especially given so many of them are associated with heavy industry – presuma-

Isogo Thermal Power Plant, Yokohama City (Japan).
Photo credit: Σ64

bly long accustomed to accessing cheaper power than available from the grid. Japan is actively exploring several options for reducing the CO2 emissions of its existing coal assets while avoiding closure of the plants.

One pathway which has already been well trodden in Europe is an either partial or complete conversion to burning biomass such as wood pellets. Another, more unusual idea, is to equip coal boilers with the capability to burn ammonia; this chemical is seen as a more manageable form for exploiting the decarbonisation potential of cleanly produced hydrogen. Japanese company Mitsubishi is a leading provider of technology for capturing CO2 from coal power plants, and there is growing interest in converting captured CO2 into useful products – known in Japan as carbon recycling.

It is informative to compare Japan's status with that of Germany, which has a similar level of CO2 emissions per capita (unlike nearly all other European nations, this is higher than China's). Despite embarking on a much-publicised energy transition since 2010, Germany boasts a coal power capacity similar to Japan's, including a wave of new, largely ultra-supercritical plants completed within the last decade.

German efforts to decarbonise have also been slowed by political reaction to the Fukushima disaster, which accelerated existing plans to phase out nuclear power with a new deadline of 2023. Chancellor Merkel has recently showed signs of a shift in the country's strong stance against carbon capture and storage, but this technology still seems unlikely to be applied to the power sector.

Unlike Japan, Germany has set a date for the complete phase out of coal power, although the choice of 2038 will allow most of the recently built plants to complete a typical 25-year economic life. While Japan seems unlikely to join Germany and many other countries in this pledge, the Asian nation's arguably more pragmatic approach to cleaning up its coal habit has by no means closed the door on decarbonisation. ONE

Only ecology-based economies can avoid future catastrophe

FAZLUN KHALID
Scidev.net

Much has been made of the brief respite in carbon emissions that coronavirus has given the world. But let's not get too excited.

The benefits are at best temporary. In fact, they are a red herring. Once the virus subsides, a race will ensue to repair the global economy — and nations and blocs will be tempted to compromise on climate targets that took decades to put in place.

Our civilisation's relentless breaching of ecological boundaries and destruction of habitats has made pandemics such as COVID-19 all but inevitable. As early as 2007, the World Health Organization warned that expanding urbanisation, anti-microbial resistance and climate change were creating a perfect storm that would drive up the threat from emerging infectious diseases.

If we are to avert a worst-case outcome of future pandemics and climate disaster, we need drastic action.

Faced with COVID-19's dire economic impacts, we may wonder whether we can afford to fight this battle on two fronts. But there is no vaccine for climate change after the planet warms beyond 2 degrees Celsius — the 'point of no return'.

So far, economic recovery programmes rushed through by lawmakers have been focused on a band-aid approach. That is necessary to protect the most vulnerable. But to guarantee that there is an economy to return to when we bring COVID-19 under control, we need to rebuild it on a footing that can create jobs and opportunities — and all within planetary boundaries.

We need to spur a clean industrial revolution.

This is a historic opportunity to ensure that 'helicopter money' is tied to real assets — helping us recover, while simultaneously averting the next great global crisis.

"In taking this approach, Western countries would find that instead of a world of competing economies where rampant protectionism drives unsustainable industrial expansion, the post-COVID-19 economy could be based on an ecological approach."

Fazlun Khalid, UN advisor on environment and faith

In some cases, this will mean leaving old industries behind. In others, it will mean transforming them. In all cases, we will need collaborative approaches to tackle the top three drivers of climate change.

Fossil fuels, agriculture and deforestation

The first priority must shift trillion-dollar fossil fuel subsidies into the renewable energy sector

The temptation, as we have seen with President Donald Trump, may be to bail out flailing oil, gas and coal sectors as demand flattens. But how long for? Societies require a resilient energy base that can sustain jobs. That means pouring trillions into solar, wind and geothermal, as well as re-

Oil Palm Concession in Riau, Sumatra. Photo credit: Hayden

search and development for other exciting technologies, such as hydrogen. Agriculture is the second biggest climate driver. While supermarket supply chains come under extraordinary strain due to panic-buying, the immediate impact of COVID-19 on reducing farm labour puts production at risk.

Agriculture is also one of the biggest carbon emitters, with huge inputs of fossil fuels involved in manufacturing pesticides and fertiliser, plus processing, packaging and distribution. These vulnerabilities can be overcome by transitioning to more resilient, local and urban agro-ecological farming, producing food with far less energy and water, and closer to consumers. The third biggest driver of climate change is deforestation, linked to the soy, beef, palm oil industries and beyond.

New policies to avoid disaster

Prior to COVID-19, alarm about deforestation has translated into contradictory policies: the European Union banning palm oil for biodiesel while seeking deals to import soy and beef from South America, where production causes even greater levels of deforestation. Scientists warn that piecemeal action such as boycotts forces consumers to switch to other commodities that are far more land-intensive.

Instead of bans and boycotts, a post-COVID19 economic shift requires incentivising the rapid growth of sustainable production. Palm oil producer Malaysia, for instance, has introduced the world's first government-backed mandatory regulations for 100 per cent sustainable palm oil. Such efforts should be rewarded, while deals with recalcitrant actors such as Brazil should be reconsidered.

The COVID-19 pandemic might thus spur America, Europe and Asia to find common ground on an inclusive global economic programme. South American sustainable soy would contribute to sustainable European farming. Malaysian sustainable palm oil would help fuel the EU's clean transport revolution. The US and EU can supply these emerging markets with technology integrating clean energy with Big Data to speed the emergence of smart grids.

In taking this approach, Western countries would find that instead of a world of competing economies where rampant protectionism drives unsustainable industrial expansion, the post-COVID-19 economy could be based on an ecological approach to markets: free and open, while guided by the ethical purpose of contributing to civic, public and green goods and services.

Originally published by Scidev.net April 17, 2020

What is environmental racism?

Environmental racism can take many forms, from workplaces with unsound health regulations to the siting of coal-fired power stations close to predominantly non-white communities.

PETER BEECH
World Economic Forum

Poisoned tap water in Flint, Michigan. Toxic waste dumps in the Lower Rio Grande Valley. A town in China where 80% of children have been poisoned by old computer parts. What do these things have in common?

All are examples of environmental racism, a form of systemic racism whereby communities of colour are disproportionately burdened with health hazards through policies and practices that force them to live in proximity to sources of toxic waste such as sewage works, mines, landfills, power stations, major roads and emitters of airborne particulate matter. As a result, these communities suffer greater rates of health problems attendant on hazardous pollutants.

It was African American civil rights leader Benjamin Chavis who coined the term "environmental racism" in 1982, describing it as "racial discrimination in environmental policy-making, the enforcement of regulations and laws, the deliberate targeting of communities of colour for toxic waste facilities, the official sanctioning of the life-threatening presence of poisons and pollutants in our communities, and the history of excluding people of colour from leadership of the ecology movements".

In practice, environmental racism can take many forms, from workplaces with unsound health regulations to the siting of coal-fired power stations close to predominantly non-white communities. It can mean citizens drinking contaminated groundwater or being schooled in decaying buildings with asbestos problems.

Many of these problems face low-income communities as a whole, but race is often a more reliable indicator of proximity to pollution. A landmark 2007 study by academic Dr Robert Bullard – the "father of environmental justice" – found "race to be more important than socioeconomic status in predicting the location of the nation's commercial hazardous waste facilities". He proved that African American children were five times more likely to have lead poisoning from proximity to waste than Caucasian children, while even black Americans making $50-60,000 a year were more likely to live in polluted areas than their white counterparts making $10,000. In the UK meanwhile, a government report found that black British children are exposed to up to 30% more air pollution than white children.

Lead astray

The case of Flint, Michigan, is a prime example of environmental racism. In 2014, to save money, the city changed its water source to the Flint river, but failed to treat the new supply adequately, exposing the city's 100,000 majority-black inhabitants to dangerous levels of lead from ageing pipes and other contaminants such as E.coli. Between 6,000 and 12,000 children drank tap water containing high levels of lead, a neurotoxin, while 12 citizens eventually died from Legionnaires' disease. However, for 18 months, residents' complaints of foul-smelling and discoloured water, of hair loss and skin rashes, were dismissed until community pressure forced the city to reconnect to the former supply and admit wrongdoing. The Michigan Civil Rights Commission concluded that the slow official reaction was a "result of systemic racism".

Indigenous populations often suffer from environmental racism. In the US, Native Americans communities continue to be subjected to large amounts of nuclear and other hazardous waste, as corporations take advantage of weaker land laws, whereby the federal government holds land in "trust" on behalf of the tribes. Decades of uranium mining on the land of the Navajo of New Mexico have caused longstanding problems in the community. From 1951 until 1971, the US Public Health Service performed a massive human medical experiment on 4,000 Navajo uranium miners, allowing them to work without informing them of the effects of radiation. The effects were predictable: elevated levels of lung cancer and other diseases from breathing in radon.

The 2016-17 protests against the Dakota Access Pipeline were another example where the tribes came up against the power of policy and lost. The 1,172-mile oil pipeline was considered a threat to the Standing Rock Indian Reservation's water supply, as well as sites of historic importance and culturally sensitive burial grounds. Though unsuccessful, the protests caught the public imagination, drawing solidarity marches and support from Bernie Sanders. All too often however, environmental racism occurs because communities lack the resources to raise awareness or fight a costly legal battle – resources which are available to wealthier white communities, who are better able to divert airport expansions, power stations or landfills elsewhere in a process known as NIMBYism – standing for "not in my backyard".

A planet-wide problem

Globalization has increased the opportunity for environmental racism on an international scale. It refers to the dumping of pollutants such as e-waste on the global south, where safety laws and environmental practices are more lax. More than 44 million tonnes of e-waste was generated globally in 2017 – 6kg for every person on the planet – and of that, each year around 80% is exported to Asia. One e-waste hub is the town of Guiyu in China, where heaps of discarded computer parts piled by the river contaminate the water supply with cadmium, copper and lead. Water samples showed lead levels 190 times higher than WHO limits. Even a slight increase in lead levels, meanwhile, can affect IQ and academic performance in children. Other examples include the mass shipment of spent American batteries to Mexico, where illegal waste dumps from plants operated by American, European and Japanese companies have resulted in soaring rates of anencephaly (when babies are born without brains).

So what is being done? The environmental justice movement works to raise awareness of the plights of vulnerable populations through academic studies, media pressure campaigns and public activism. Grassroots movements make use of social media, along with civil disobedience and marches, to make their views heard. The European Union, where most documented cases of environmental racism affect the Romani people, has funded initiatives including the Environmental Justice Organisations, Liabilities and Trade project, which ran from 2011-2015 and brought together scientists and policymakers from 20 countries across the world to advance the case of environmental justice. As environmental laws tighten in developed countries however, many fear that dumping activities will shift towards the global south.

Combating environmental racism may risk falling down the policy in the age of COVID-19 – and yet with non-white people more likely to die from the virus, the higher instances of complicating factors such as asthma and heart disease brought about by exposure to pollution are likely to play a part. Environmental racism is part of the broader picture of systemic racism, which must be fought to bring about a fairer society.

Originally published by Weforum.org July 31, 2020

A worker sorts through stripped computer boards in Guiyu, China. Photo credit: Fortune.com

The big Muddy River's long, turbulent relationship with coal

As a proposal threatens to dump mining waste into a Mississippi River tributary, an Illinois community reassesses its coal industry ties.

SUSAN COSIER
Nrdc

Southern Illinois has been coal country for quite some time. Men first mined coal there in 1810, when they took the black rock from outcroppings along the bluffs of the Big Muddy River. They'd load it onto a flatboat and send it south to where the Muddy meets up with the Mississippi River. From there, it would head downriver to a port in New Orleans.

In 1882, the Office of Mines and Minerals reported that Illinois had more coal than any other state east of the Mississippi. The state's coal industry once employed tens of thousands of people, but as mining became increasingly mechanized, its ranks shrank. Despite being second in the country when it comes to coal reserves (behind Montana), Illinois only employed roughly 3,000 people last year.

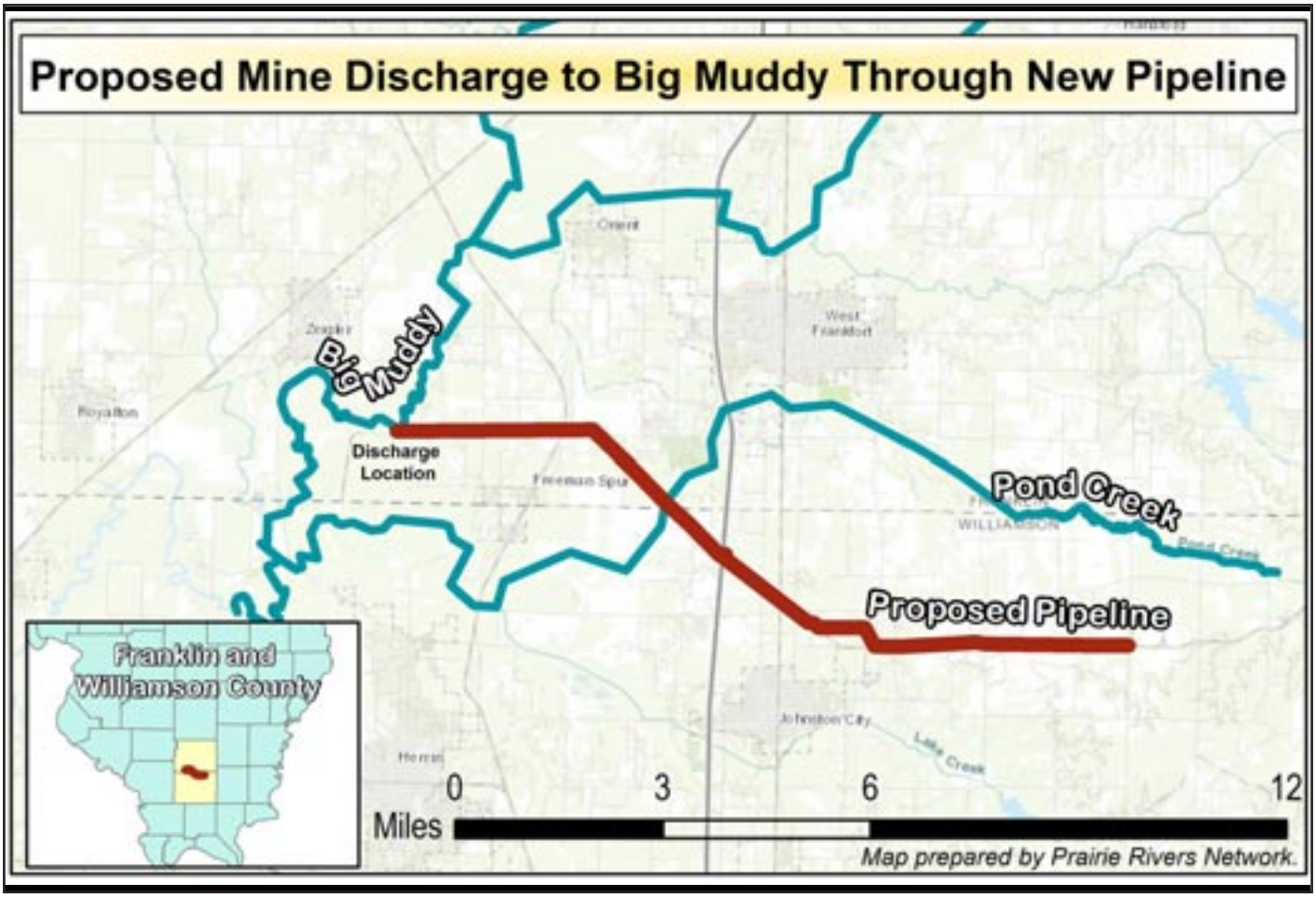
In 2005, Foresight Energy, a Murray Energy Corp. subsidiary, began developing a longwall mine in Williamson and Franklin counties near the Big Muddy River.

This type of mining involves a highly mechanized process that follows the whole coal seam and requires fewer workers than more traditional methods but yields lots of coal. Williamson Energy began operating the mine for Foresight in 2008. By 2013, the mine, called Pond Creek, was the most productive underground coal mine in the country. It yielded 6.9 million tons of coal in 2018.

Removing coal, however, can cause the land to subside and mining it came at a cost to local residents. Some homeowners entered into settlements with the company as ponds dried up and building foundations cracked. Some structures even appeared lopsided and required demolition.

And as miners bored along the coal seams over the last 12 years, groundwater from a saline aquifer began to fill the cavity. Williamson Energy proposed in 2017 to pump the water—up to 3.5 million gallons a day—from Pond Creek, through a newly constructed 12-mile pipeline, into the Big Muddy. That's when many people in the community said, "Enough's enough."

Williamson Energy's proposal puts it in direct conflict with the area's other major industry: tourism for hunting and fishing. Fishermen now complain about sores and deformed gills on the fish they pull from the Big Muddy.



The community is caught in what environmental activist Georgia de la Garza calls a coal paradigm culture, where many of the people once supported by the industry are now seeing its long-term impacts on the environment and public health.

But their complaints, she says, don't seem to reach the state agencies responsible for protecting natural resources. The Illinois Department of Natural Resources (IDNR) issued one of the permits needed for Pond Creek Mine's pumping project in July 2019. And now, as the Illinois Environmental Protection Agency (IEPA) reviews another permit, a number of locals are fighting its approval, saying the project's waste will further contaminate the river and everything that lives in it.

The Big Muddy is by no means pristine. The state advises against eating the river's fish, such as crappie, largemouth bass, and carp, due to high levels of mercury, a potent neurotoxin, that comes from the coal industry's sewage and pollution, according to a government report published in 1999. The mining waste that Foresight proposes to pump into the river would contain sulfates and chlorides, which can be toxic to fish and other aquatic life.

The mine's owners would be required to monitor the waste and ensure that the chloride concentration is no higher than the state's limit of 500 milligrams per liter, something that those who oppose the project are not confident the company will do.

Last year, the Illinois attorney general's office cited Foresight for violating the Clean Water Act, eventually reaching an $80,000 settlement. In addition to inadequate monitoring, state inspection reports showed the mine discharged water with levels of sulfate and chloride above what's allowed.

"We don't trust the mine to monitor its waste, given its past violations and failure to report," says Andrew Rehn, a water resources engineer for the nonprofit Prairie Rivers Network, a group against the proposal.

To get to acceptable sulfate and chloride concentrations, the company plans to dilute the waste with the Big Muddy's water in a mixing zone along the river. But how well that waste is diluted depends on the amount of water flowing in the river, and the permit

The Big Muddy River.
Photo credit: David Szoke

doesn't outline how monitoring should account for that. Representatives from Williamson's parent company, Foresight, did not respond to interview requests.

It's an echo of the days when companies used to say the solution to pollution is dilution, says Cindy Skrukrud, a biochemist who serves as the clean water program director for the Sierra Club chapter in Illinois, another group opposed to the project.

If approved, the Big Muddy project could also affect threatened freshwater mussels in the river's tributaries. A survey of the basin conducted in 2012 shows that mussels may also live in Big Muddy itself, but water levels were too deep at the time to check for the mollusks. The biggest issue with the high chloride levels is that they could react with the mercury on the river bottom.

This combination of chemicals could convert the mercury to methylmercury, a more toxic form that accumulates in the tissues of animals.

As small contaminated fish become meals for larger fish, concentrations of the neurotoxin can rise dramatically as it moves up the food chain.

"That's something we've started to see improvements in because nationwide we've worked to limit the amount of mercury that comes out of smokestacks," says Skrukrud. "But by putting more chlorides into the Big Muddy, this mine could be making the mercury that's already there more available."

When de la Garza was growing up on a farm near Marion, Illinois, she had a rope swing along the banks of the Big Muddy. She learned how to swim, canoe, bird-watch, and scout mussels there. To her, the river is home. For the last 15 years, she's been fighting coal companies through her nonprofit Shawnee Hills and Hollers. She has been to every public meeting on the Pond Creek Mine proposal over the past two years.

The public reaction to the Pond Creek permit shows how the community is changing, she says. Just a couple of years ago, Foresight Energy applied for another permit to dispose of mine waste into the Big Muddy from its Sugar Camp mine, located north of Pond Creek, and the proposal got virtually zero public pushback. (As of August 2020, the company hasn't installed that project's pipeline.)

But when the IEPA held a public meeting about the Pond Creek permit this past December, just a week before Christmas, more than 150 people attended—a big turnout for a small town that included de la Garza and families with deep roots in the mining industry.

The public reaction to the Pond Creek permit shows how the community is changing. Just a couple of years ago, Foresight Energy applied for another permit to dispose of mine waste into the Big Muddy from its Sugar Camp mine, located north of Pond Creek, and the proposal got virtually zero public pushback.

"My biggest concern is that, again, we're going to be pushed aside," she says. The water is devastatingly polluted, and the communities suffer.

The company officials and the agencies that approve their requests, she says, "just don't see us here. They see what's underneath us."

The IEPA is going over all the comments from the meeting, according to an agency spokesperson, and, based on previous timelines, it could decide whether to issue a permit within the next six months. In the meantime, the Big Muddy will continue to meander through coal country, taking whatever the industry dumps in it to the Mississippi, and beyond.

Originally published by Nrdc.org August 14, 2020

Partying with CO2

Halloween, Thanksgiving, Christmas are all events that generate increased greenhouse gases. But can be improved with a few adjustments.

LENORE HITCHLER
ONE

Do you fall for fall celebrations? Do they evoke fond memories? Do you look forward to goblins and other Halloween trick-or-treaters and even gobbling up sweet treats yourself? Are you looking forward to spending Thanksgiving with your family?

On the other hand, are you a climate change activist or environmentalist who is concerned with the environmental costs of these festivities? These events generate increased greenhouse gases which contribute to climate change. However, these celebrations and traditions are important to people and can be improved with a few adjustments.

Celebrations contribute to a sense of community. They also are fun. Traditions bring families together and build strong relationships between generations.

Celebrations benefit the youngest generation in particular ways. Dimitris Xygalatas is the author of *"An Anthropologist Explains Why We Love Holiday Rituals and Traditions."* He stated: "Holiday traditions are particularly important for children. Research shows that children who participate in group rituals become more strongly affiliated with their peers. Besides, having more positive memories of family rituals seems to be associated with more positive interactions with one's children."

Children love Halloween. However, it dramatically increases the nation's carbon footprint and is also quite expensive. Between eight and nine billion dollars are spent annually on Halloween. The National Retail Federation estimates that Americans spend around $3.2 billion on costumes alone. The US Census Bureau estimates that there are approximately 41 million trick-or-treaters, and many adults also wear costumes. This adds up to a lot of outfits.

Halloween costumes are frequently made from Polyvinyl Chloride (PVC). Since petroleum, a fossil fuel, is a significant component of PVC, the production of plastics contributes to climate change by adding carbon dioxide (CO2) to the atmosphere. The manufacturing and disposal of masks, fake teeth, etc. also consume fossil fuels. Alternative methods of acquiring costumes do not generate as many greenhouse gases. Costumes can be rented, obtained at costume swaps, or purchased from thrift shops. Costumes can also be created at home easily and inexpensively, and many sites on the internet provide instructions for making them.

Many costumes reflect climate change motifs such as climate scientists, carbon footprints, sea-level rise, landfills or ocean waste, wildfires, and endangered species. Costumes that represent good alternatives include representations of solar panels, wind turbines, and trees.

Along with costumes and other Halloween accessories, plastic trick-or-treat pumpkins are manufactured from petroleum. Various alternatives include cute pillowcases designed especially for

The Everglades, Florida (USA).
Photo credit: Daniel Kraft

children, canvas bags, and shopping bags that kids can have fun decorating. Halloween is the second-biggest decorating holiday of the year. According to the US National Retail Federation (NRF), $2.7 billion is spent on decorations. Their production and disposal contribute to global warming. However, decorations can be created from non-toxic recycled items.Besides enjoying Halloween themed decorating and dressing up for trick-or-treating, candy is another primary source of Halloween joy.

Unfortunately, the production of so much candy contributes to climate change. According to the NRF, $2.6 billion is spent on candy annually. In 2018, approximately 300,000 tons of candy were sold. The average trick-or-treater receives between five to 10 pounds of candy. This amounts to a large amount of sugar.

Sugar production generates quite a bit of greenhouse gases, thereby contributing to climate change. Fossil fuel-based fertilizers are applied to sugar crops. Using fossil fuels to apply pesticides also increases CO2.

According to the World Wildlife Fund, it takes from 750 to 5,000 gallons of water to grow a single acre of sugar cane. Greenhouse gases are produced if irrigation is used and is powered by fossil fuels. Deforestation to clear land for sugar cane plantations results in the release of CO2.

Additionally, new sugar plantations are not as effective at storing CO2 as the original rainforest. Sugar consumed in the US comes from either sugar beets or sugar cane. Sugar cane that is grown in southern Florida contributes to climate change. Leonard Scinto is an environmental scientist at Florida International University. He stated that the Everglades Agricultural Area, which has been cleared for several crops, including sugar cane, has lost two-thirds of its soil. This soil is then exposed to air, resulting in the release of CO2.

Sugar cane fields are frequently burned during harvesting. The article "Greenhouse Gas Emission Associated with Sugar Production in Southern Brazil" was published in *Carbon Balance and Management.* The authors reported that 1.21 tons of CO2 equivalent were produced for each burned hectare (2.47 acres) of land.

Both sugar beets and sugar cane undergo a refining process that includes washing, crushing, heating, filtering, clarifying, crystallizing, and drying. Transporting that sugar also consumes energy. All of these processes together produce a lot of CO2. According to USA Market Data, 3.93 kilograms (approximately 8.6 pounds) of CO2 equivalent is produced for each kilogram

(approximately 2.2 pounds) of refined sugar cane. According to the Food Research Collaboration at the University of London, the carbon footprint of US beet sugar is 1040 grams (approximately 2.2 pounds) of CO2 equivalent for 1 kilogram of beet sugar. Sugar beets are a better source of sugar because they are grown in temperate areas, which means that rain forests do not have to be destroyed. Thus, sugar beet production does not cause as much climate change as sugar cane.

Sugar tastes great, and people love sweet candy. However, honey is a better alternative.
Honey can be produced in temperate climates resulting in the preservation of rain forests. Neither fertilizers nor irrigation is necessary. Thus, honey has a lower carbon footprint than table sugar.
The article "Carbon Footprint and Air Emissions Inventories for US Honey Production: Case Studies" was published in The International Journal of Life Cycle Assessment. Honey's carbon footprint was estimated to be from 0.67 kilograms (1.47 pounds) to 0.92 kilograms (approximately 2 pounds) of CO2 equivalent per kilogram of honey.

Halloween candy frequently contains chocolate, which also has a high carbon footprint. Unfortunately, statistics from different sources vary on the size of the carbon footprint of chocolate. Finding the carbon footprint of chocolate manufactured in the US is difficult. A Canadian article stated that the carbon footprint of a 49-gram (approximately 1.7 ounces) chocolate bar was 169 grams (almost 6 ounces) of CO2. Cadbury, a British company, also estimates that 169 grams of CO2 equivalent are produced for every 49 grams of their dairy milk chocolate bar.

This calculation includes cocoa, milk, sugar, packaging, and distribution, but not from land-use change. Cadbury estimated that land-use changes add 3.45 grams (0.21 ounces) of CO2 per gram (0.035 ounces) to the carbon footprint of chocolate.
The University of Manchester published a report in Food Research International in 2018. The report found that the global warming potential of milk chocolate is 3.39 kilograms (7.4 pounds) of CO2 equivalent per 1 kilogram (2.2 pounds) of chocolate.

Additional evidence of the high carbon footprint of chocolate came from a University of Oxford study published in Science. The greenhouse gas emissions per 1 kilogram of chocolate were 19 kilograms (41.8 pounds).

To put this in perspective, the production of beef was found to emit 60 kilograms (approximately

The annual Greenwich Village Halloween Parade (New York, USA).
Photo credit: Magnus Manske

132 pounds) per 1 kilogram, and one kilogram of cheese emitted 21 kilograms (approximately 46 pounds). The study also found that a chocolate bar from a deforested rainforest area resulted in more CO2 production than a serving of low-impact beef. Even though these different studies vary in actual numbers, they show that chocolate has a high carbon footprint.

In addition to the milk used in making milk chocolate, chocolate bar production itself, and transportation, deforestation to create new cocoa plantations also contributes to climate change. Additionally, replacing rain forests with palm oil plantations to provide the palm found in chocolate bars also increases deforestation.

The article "Deforestation and its Extreme Effect on Global Warming" published in Scientific American reported that deforestation is responsible for approximately 15% of global CO2 emissions. Removing trees results in increasing CO2 levels. It also eliminates the potential of those trees to absorb future CO2. According to the World Resources Institute, if tropical deforestation were a country, it would rank third in CO2 emissions, behind China and the US. Deforestation to produce paper used for candy wrappers also generates CO2. Additionally, fossil fuel energy is used in both the manufacturing and disposal of wrappers.

Thus, Halloween candy contributes to climate change. Fortunately, there are better ways to give out sweet treats during Halloween. How about a Hallo-green party with friends and neighbours? Serve homemade goodies, eliminating packaging and its contributions to climate change. Honey makes an excellent sweetener. Fudges that are not made with chocolates are a delicious and environmentally friendly alternative. These fudges include both peanut butter and honey fudge and fruit fudge made with frozen locally grown fruits and honey.

If you want to provide treats that are not sweet, distribute such items as pages from colouring books or children's activities books. Hand out pretty dyed chicken feathers for art projects. Doling out coins is quite ecological since coins are recycled continuously.

Halloween pumpkins are an additional source of CO2. According to the US Department of Energy (DOE), nearly two billion pounds of pumpkins were grown in 2014. The manufacturing of both pesticides and fertilizers used on the crop pro-

duce greenhouse gases. Also, fertilizers applied to crops produce the greenhouse gas nitrous oxide, which is around 300 times more potent than CO2. An estimated 1.3 billion pounds of pumpkins are thrown out after Halloween. When they end up in landfills, they emit methane, which has 20 times the warming effect of CO2. Instead of wasting pumpkins, they can be used to make soup, bread, pudding, and pies. Roast the seeds. Feed pumpkins to chickens or other farm animals. Compost the remains.

Thanksgiving also results in high production of CO2 with its associated travel being particularly egregious. In 2019, the American Automobile Association (AAA) stated that for the Thanksgiving holiday, 55 million travellers planned trips of more than 50 miles.

AAA reported that 49.3 million would travel by car, and 4.45 million Americans planned on flying. To put this into perspective, Climate Central said that the carbon footprint of automobiles equals .802 pounds of CO2 per passenger mile. Air travel produces .505 pounds of CO2 per passenger mile, trains have .408 pounds of CO2, and bus travel produces .236 pounds of CO2. This adds up to quite a lot of CO2.

The traditional turkey roast is the centerpiece of Thanksgiving dinner. According to the National Turkey Federation, around 46 million turkeys are consumed every Thanksgiving. Research at Carnegie Mellon University found that the carbon footprint of a 16-pound turkey was 34.2 pounds of CO2. Side dishes of roasted Brussels sprouts, cranberry sauce, mashed potatoes, gravy, biscuits, and apple pie together generated another 34.2 pounds of CO2.

There are various methods to measure the amount of Thanksgiving turkey that gets discarded. The US Department of Agriculture estimates that 35% of turkey meat gets thrown out. An article in MarketWatch published in 2016 estimated that Americans tossed out $293 million worth of uneaten turkey. In 2018, Stefanie Feldstein, Population and Sustainability Director of the Center for Biological Diversity, wrote "Those Thanksgiving Leftovers?—They're Killing the Planet." She stated that about 200 million pounds of turkey are thrown away.

In other words, lots of turkey meat, costing a lot of money, and adding a lot of mass, end up in landfills where they emit lots of methane. Feldstein went on to say that more than 150 million pounds of potatoes, green beans and other vegetable side dishes are discarded. She added that an estimated 14 million pounds of dinner rolls would also be thrown out.

Thanksgiving pumpkin pies also add to climate change. Approximately 50 million of Thanksgiving pies are consumed yearly. Fertilizers and pesticides are applied to the crop. Additionally, making the pies, transportation, and packaging and disposal of packaging generate CO2.

Fortunately, there are ways to make Thanksgiving dinner more climate-friendly. Give leftovers to guests, freeze them, or make soup. Compost anything not consumed. Start a new tradition of making Thanksgiving more like the original one. Linda Poppenheiner is the author of "The First Thanksgiving was a Green Event."

She wrote: *Traditionally, the 1621 harvest feast celebrated by Plymouth Colony, is known as 'The First Thanksgiving.' By today's standards, it was a green and low carbon event. It was a local affair. People walked to hunt, harvest, and between their homes and the harvest feast. … All the food was seasonal, local, and organic. … Fortunately, throw away packaging did not exist. … Nothing would have been thrown out or wasted. Written accounts by Edward Winslow and William Bradford provide the little information we have about the actual food eaten at the harvest feast. [These include] venison, waterfowl, wild turkeys, cod, bass, wheat, corn, and barley.*

Thus, it is evident that our ways of celebrating Halloween and Thanksgiving contribute to climate change. However, it is not difficult to make the necessary improvements needed to lower the carbon footprint of these holidays. Fortunately, we can still have fun and enjoy these festivities in an environmentally friendly way. ONE

"The First Thanksgiving at Plymouth" (1914) By Jennie A. Brownscomb
Photo credit: Stedelijk Museum De Lakenhal

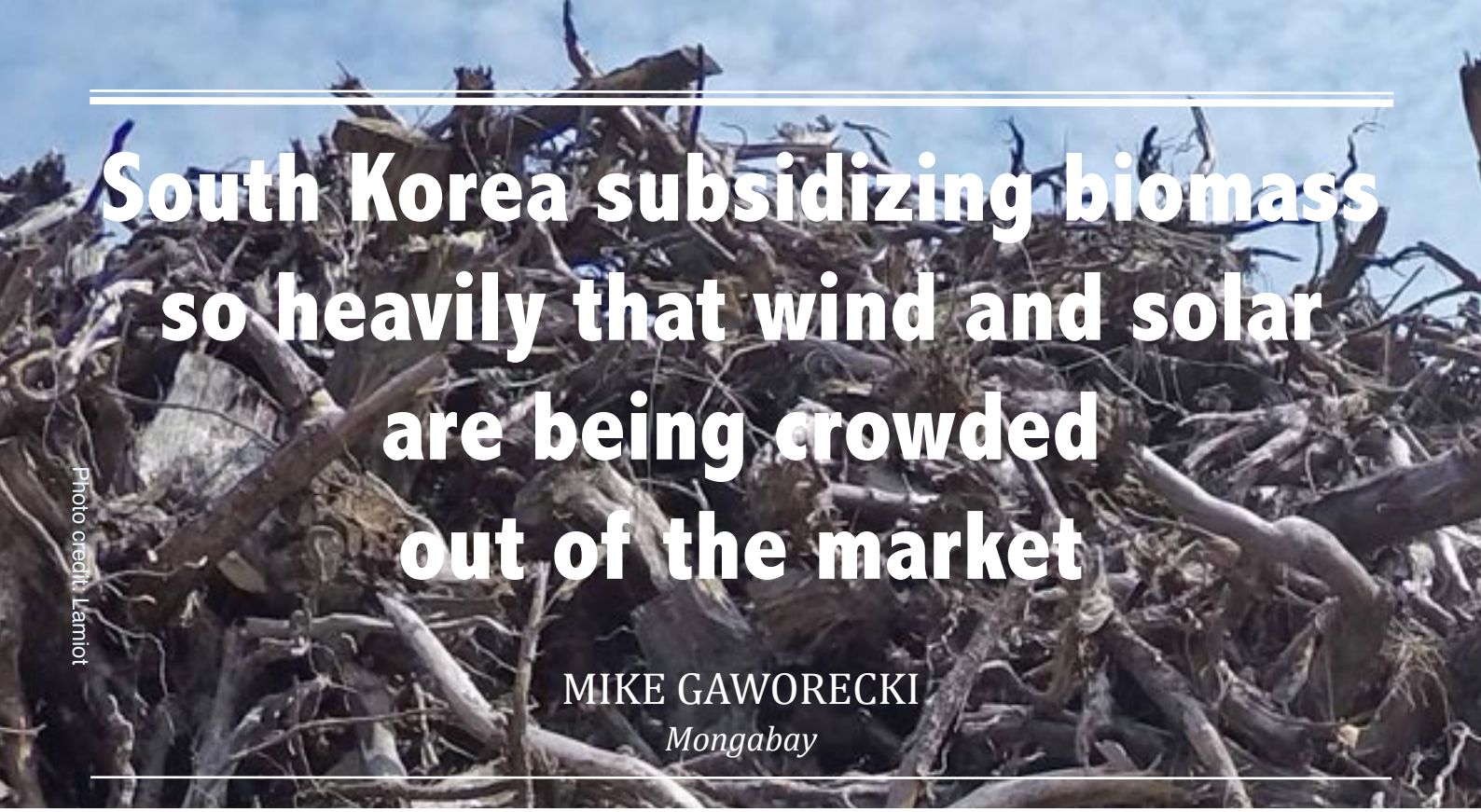


Photo credit: Lamiot

South Korea subsidizing biomass so heavily that wind and solar are being crowded out of the market

MIKE GAWORECKI
Mongabay

The government of South Korea is subsidizing the development of biomass power so heavily that it's hindering the adoption of renewable energy technologies like solar and wind, new research finds.

South Korea adopted a Renewable Portfolio Standard (RPS) policy in 2012 in order to increase the market share of renewable energy. But according to a report issued by Seoul-based NGO Solutions For Our Climate (SFOC), forest biomass is considered a carbon-neutral alternative to fossil fuels under Korean law, and the country's government has so aggressively supported the growth of biomass-fueled energy production that it has become one of the most subsidized renewable energy sources in South Korea. Due to the direct subsidies and other forms of financial assistance directed to biomass projects, electricity generation from biomass in South Korea rose 160 percent every year between 2012 and 2018, per the report.

Soojin Kim, a senior researcher at SFOC and an author of the report, told Mongabay that biomass projects have been so overcompensated by the government that it is causing serious disruption and uncertainties in the Korean renewable energy market, including steep declines in the price of Renewable Energy Credits (RECs). These uncertainties, in turn, are discouraging utilities from investing in renewable energy technologies such as solar and wind, she said. "Korea has this market-based system where any utilities of more than 500MW have to supply some renewable energy in their portfolio, and biomass is one of the eligible sources of renewables they can do," Kim said. "Once they produce renewable energy through biomass, the government issues them renewable energy certificates, and [biomass projects] were receiving about twice as much certificates because of the REC schedule that grants them higher RECs than other sources."

Biomass projects received as much as 40 percent of total RECs on average between 2014-2018, the report states. These subsidies are meant to help offset the operating and construction costs of converting coal-fired power plants into biomass plants, but those costs are overestimated, Kim said, "in some cases 15-times higher than actual cost." About 75% of the biomass used in Korea is burned together with coal in what's known as a "co-firing" plant, Kim noted, and whether utilities want to turn old power plants into biomass plants or simply try to improve the environmental performance of their plants by adding some biomass to the existing coal, they can count on government support.

"It's been a pretty profitable business for them in the biomass industry," Kim said. As Kim pointed out in a blog post co-authored with the Natural Resources Defense Council's Debbie Hammel, the expansion of biomass energy in Korea is not only crowding out truly green forms of renewable energy, it's also undermining the government's own attempts to rein in emissions in response to global cli-

mate change. "Korean utilities have boasted about the positive climate outcomes of their coal-to-biomass conversions, some reporting up to a 90% decrease in greenhouse gas emissions," Kim and Hammel write. "This is misleading because the emissions from burning biomass were simply omitted under the erroneous assumption of biomass 'carbon neutrality.' In reality, scientists have warned for years of the disastrous outcomes of burning biomass for power. Years of research has shown that even under best-case scenarios, burning biomass for electricity makes climate change worse for decades."

Growing biomass industry threatens the world's forests

Burning forest biomass is something of a double-jeopardy scenario for the global climate, as it both increases greenhouse gas emissions and threatens forest ecosystems around the world that are important carbon sinks.

Some 98% of the wood pellets used to produce energy in Korea are imported, mainly from Southeast Asian countries like Vietnam, the number one exporter of biomass, as well as Indonesia, Malaysia, and Thailand. Russia and the United States are also important sources of wood pellet exports to South Korea, which has become the third-largest importer of biomass in the world.

Kim and Hammel note in their blog post that "When forests are logged, the amount of carbon stored in that forest is reduced, even under a best-case scenario in which harvested trees are immediately replanted or naturally regrow. A recently published study showed that the same holds true even when biomass energy is generated by burning forestry residues — the leftovers from logging operations, like treetops and limbs."

Thanks to a similar push in Japan to develop biomass-fueled electricity production capacity, East Asia has become a major driver of global biomass growth, according to Roger Smith, Japan Project Manager for the NGO Mighty Earth. "Forest biomass is a false climate solution unworthy of public subsidy. Solutions for Our Climate highlighted the major problems with wood biomass — it increases near-term greenhouse gas emissions over the coming decades, and has the potential to harm forests in exporting countries," Smith told Mongabay.

He added: "Ironically, while Korea and Japan are turning to biomass to meet global warming and renewable energy goals, neither country has greenhouse gas standards to ensure any actual pollution reductions. This leads to an absurd situation where trees can be cut down, dried and processed into pellets, shipped across the ocean, and burned in Japanese or Korean power plants with none of the carbon pollution counted. Both nations need to close this loophole and set a stringent greenhouse gas emissions standard for all biomass fuels."

Of course, the European Union's renewable energy policies also recognize biomass as carbon neutral, and Europe is a major growth region for biomass energy, as well. "In fact, 65% of EU renewable energy comes from burning biomass, and so we are now seeing countries like South Korea and Japan following that same path," NRDC's Hammel told Mongabay.

The carbon neutrality of biomass is predicated on the idea that any trees cut down to be burned for electricity can be replanted, thus canceling out the carbon emissions of burning that biomass in power plants. But these are "erroneous" assumptions, Hammel argued, saying: "There's no guarantee, first of all, that trees will be replanted, or that they will regrow. That's not a safe assumption. And then, secondly, if they are replanted and allowed to regrow, it's going to take decades. And we don't have the time to wait."

Forests are going to be under increasing pressure if the biomass industry keeps expanding, Hammel warned. "The EU imports for woody biomass are expected to climb to 30 million tons by 2020, and these new markets in South Korea and Japan are going to expand that demand. So I think that this is a huge threat to the world's forests," she told Mongabay. "It's also a huge threat in terms of addressing climate change. Scientists have said we need to reduce our emissions over the next decade in order to avert the worst consequences of climate change and keep temperature rise to 1.5 to 2 degrees."

But burning biomass from forests will make reaching those climate targets impossible, she said: "It's going to worsen the effects of climate change and it's going to degrade the world's forests, which are some of the best tools to mitigate climate change."

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Are European cities delivering on their climate commitments?

At the time of writing, more than have committed to some form of climate action. These efforts range from setting emission reduction targets to adopting clean energy and sustainable transport projects, as well as energy efficiency policies.

ANGEL HSU, NIHIT GOYAL and AMY WEINFURTER
CarbonBrief

While some city-level climate initiatives fulfill national requirements, many are more ambitious and extend beyond their respective national governments' efforts. Subnational climate efforts may play a critical role in closing the widening emissions gap between current policies and global climate goals.

A key question, however, is whether and to what extent cities are meeting their climate commitments. Our new analysis, published in Nature Climate Change, provides one of the most comprehensive assessments of cities' progress towards their climate goals.

Our findings show that over 60% of the more than 1,000 European cities that have monitored their performance are on track to meeting their climate target.

We investigate what factors – such as the type of climate action cities pursue and the ambition of their targets – influence progress in reducing greenhouse gas emissions and what lessons these results hold for subnational climate governance.

Tracking climate performance

Determining the impact of subnational climate actions has been challenging for several reasons. In its fifth assessment report, published in 2013-14, the Intergovernmental Panel on Climate Change (IPCC) concluded that although "thousands of cities are undertaking climate action plans, their aggregate impact remains unknown". This was due to the fact that there "are few evaluations of urban climate action plans and their effectiveness".

The lack of data on city-level greenhouse gas emissions, limited information on policy implementation and inconsistent methodologies for monitoring progress are all cited as reasons for this research gap. To address these issues, we compiled available data for more than 1,000 cities that participate in the EU Covenant of Mayors for Climate and Energy – one of the world's largest subnational climate action networks. These 1,066 cities are home to almost 50 million people – approximately 11% of the EU's population.

Founded in 2008, the covenant includes more than 10,000 local and regional governments pledging to go further than the EU's 2020 target of reducing emissions 20% below 1990 levels, or to meet the EU's 2030 target of reducing emissions by at least 40% by 2030. Participating cities are required to provide emission inventories and progress reports every two years. We then used an automated system to analyse the text of these reports to identify key themes in their climate actions and used modelling to identify their greenhouse gas emission (GHG) reductions.

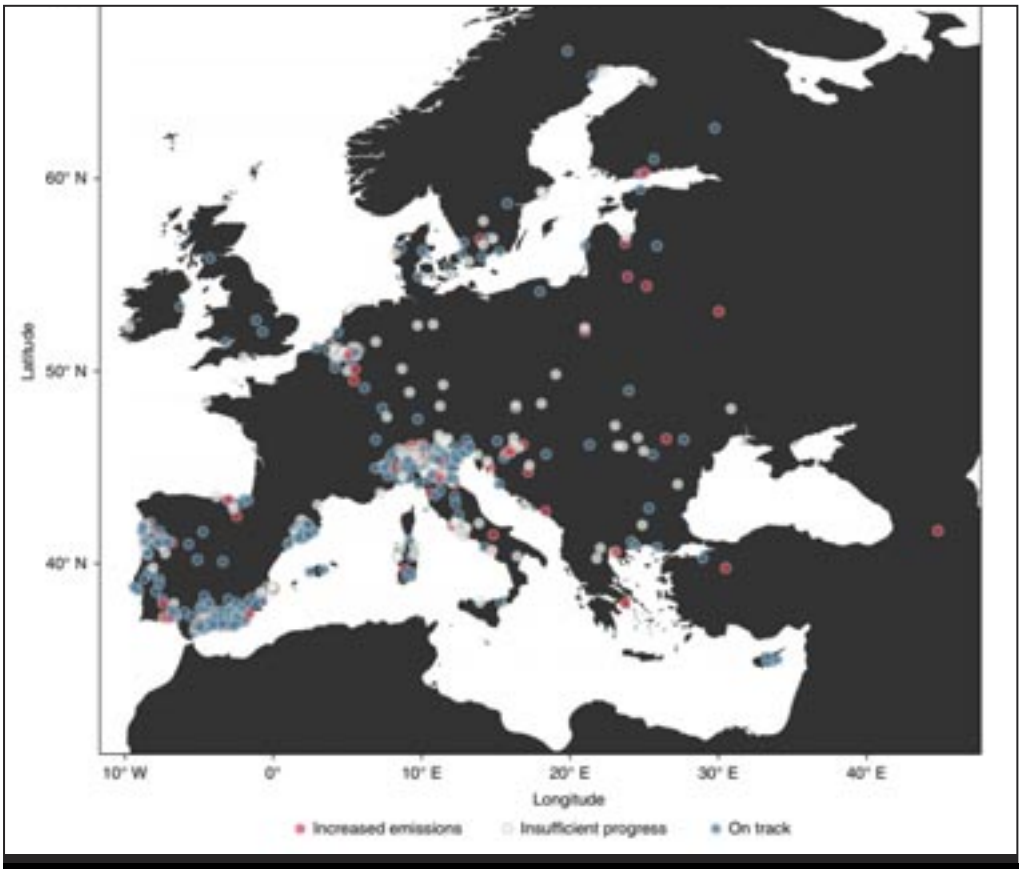
Are cities on track to meet their targets?

We find that cities in this dataset have, on average, committed to reduce emissions by 24% compared to their baselines. Cities that monitor their progress and reported inventory data have already achieved about a 15% reduction in emissions, totalling 51m tonnes of CO2 between 2008 and 2019.

Assuming that they have maintained the same rate of emissions reduction, nearly 60% of the cities in the dataset are, therefore, likely to meet their climate target for 2020.

The map below shows cities that are on track with their targets (blue dots), along with those that are lagging behind (white) and those whose emissions have actually increased (red).

Several characteristics distinguish cities that are on track to meet their climate target from those that are not. For instance, on-track cities tend to have higher baseline emissions – approximately 5.9 tonnes of CO2 per capita compared to 4.6 tonnes for cities that are not on track – and, therefore, possibly have more scope for climate mitigation. On-track cities also had a lower climate mitigation target in comparison to cities that were not on track (approximately 23% versus 25%), suggesting that they were less ambitious.



Map of emissions reduction performance calculated for 1,066 cities in Europe, where sufficient data is available. Cities are considered "on track" if they have achieved a ρ value of 1 or higher; a value of $\rho = 0$ indicates insufficient achievement; a negative value ($\rho < 0$) describes cities that have increased emissions.
Credit: Hsu et al. (2020)

City-level climate performance also varies significantly by country. For example, while cities in Cyprus and Turkey achieved average per-capita emissions reduction exceeding 5% per year, cities in eastern Europe in fact increased their average per-capita emissions. And, as might be expected, countries with higher national emissions reductions are more likely to be home to on-track cities (3% per year) than off-track (2.4% per year).

In our dataset, Spain has the highest share of on-track cities (81%), followed closely by the UK (80%), Denmark (71%), Austria (67%) and Portugal (63%). Glasgow in Scotland, which is set to be the host of the COP26 next year, for example, is among one of the UK cities on track, having already achieved a 3.6% annual per-capita emissions reduction from 2006 to 2012. Spain, whose participating cities in our dataset only have an average of 22,658 people, boasts actors like 72km2 Murtas, a municipality in Granada, that achieved around 11% annual per-capita emission reductions between 2007 and 2012.

Countries with a moderate share of on-track cities span many geographic regions. Italy, for instance, has 48%, while Finland, Ireland, Turkey, Slovenia and Ukraine all hover around 50%. However, countries such as Belgium, Germany and those in eastern Europe – Bosnia and Herzegovina, Lithuania, Belarus, Georgia and Slovakia – have few on-track cities (less than 10%).

What determines climate performance?

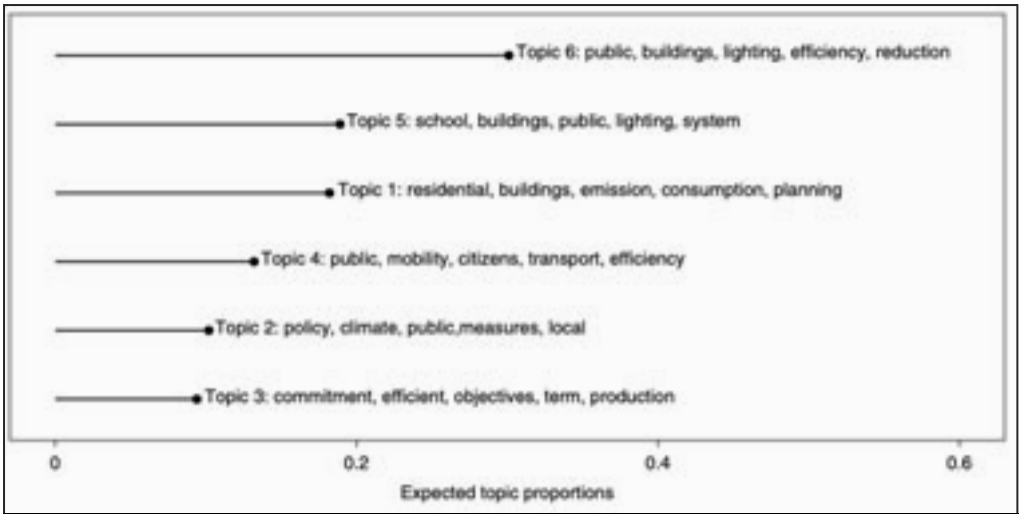
We find that climate performance is determined by a combination of plan-level, city-level and country-level characteristics.

Perhaps surprisingly, our results suggest that higher ambition might not lead to better performance. "Ambitious" cities – those that set targets to cut emissions by more than 21% by 2020 (the median figure across all 1,066 cities) – tend to reduce annual per-capita emissions by approximately half a percentage point less than other cities.

Our text analysis reveals six themes on which urban climate policy strategies tend to focus. The chart below illustrates their prevalence, with the longer lines indicating that the topic features in a greater number of city climate policies.

In decreasing order of prevalence, these topics include:
Municipal administration (30%)
Public buildings and lighting (19%)
Residential buildings and urban planning measures (18%)
Mobility and public transport (13%)
Cross-sectoral integration (10%)
Energy efficiency interventions (10%)
In comparison to any other theme, the prevalence of energy efficiency in the action plan – usually prioritised by cities that are less dense and less wealthy – is associated with higher per-capita emissions reduction.

In terms of other characteristics of a city that might explain



Topics and keywords identified in European cities' climate actions. The longer lines indicate the topics that feature in the most city climate policies. Credit: Hsu et al. (2020)

its climate performance, we find none of per-capita GDP, population or population density to be important. However, higher per-capita baseline emissions typically lead to higher per-capita emissions reduction.

Higher emissions reduction at the national level also translates into higher emissions reduction at the local level. While more national climate policies do not necessarily improve urban climate performance, they appear to result in higher ambition at the city level.

Implications for climate governance and research

Our findings show that the majority of the cities participating in the EUCoM, which requires cities to commit to efforts that exceed or are additional to national requirements, are delivering on their climate commitments.

While our analysis shows that national emission reduction trends do relate to cities' achievement, about 40% (432 cities) of the cities in our dataset demonstrate emission reduction trends that are steeper than what their respective national governments have achieved. This finding provides evidence of urban climate action to reduce greenhouse gas emissions beyond the scope of national governments to narrow the emissions gap.

Our work also identifies areas that might require further attention. For instance, the ambition level and targeted sectors of climate action plans strongly influence emissions reductions. Therefore, networks and cities may want to explore the mechanisms behind this and the ways cities could reflect this finding in their planning approach.

The fact that ambition does not translate directly into performance suggests that more attention should be paid to setting "science-based" mitigation targets – that is, targets that translate global emissions reductions goals for an actor's specific emissions profile.

The relatively poor performance of cities with lower baseline emissions suggests that a blanket approach to setting targets for emissions reduction might need a rethink, as it might be more challenging and, potentially, demotivating for cities that are already less carbon intensive.

In the short-term, cities could reduce emissions further by focusing more on enhancing energy efficiency. "High-performing" cities in our dataset have implemented energy and emissions savings by adopting strategies for behavioural change, such as the promotion of pedestrian mobility and cycling and the implementation of public awareness campaigns.

They have also replaced inefficient technologies, for example, by installing high-efficiency glass in buildings, replacing heating systems and using biomass boilers instead of diesel or propane boilers. Drawing relevant lessons from successful cities can help improve overall performance and contribute to bridging the global emissions gap. International cooperative initiatives such as the EUCoM are well-positioned to continue facilitating this kind of experimentation and learning.

This analysis represents a small step towards filling the data gap around the progress towards voluntary climate commitment. There is still an urgent need to track climate performance more comprehensively, but our study shows that it can be done.

As a next step, researchers – including ourselves – should build on this work by extending climate performance tracking to cities outside of Europe. This could include examining the achievement of cities in other initiatives – such as the Race to Zero campaign – and shedding light on corporate climate performance.

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Breaking down the Amazon: how deforestation could drive the next pandemic

At a new biobank in the Amazon, scientists are working to identify the risks of a new infectious diseases. It's part of an growing field of science looking at the interactions between human health and environmental change.

LUCY JORDAN and EMMA HOWARD
Unearthed

When veterinarian Prof Alessandra Nava first learnt of a new respiratory disease killing people in China, the initial cases linked to a Wuhan wet market, she felt a chill of inevitability. "It gave me that cold feeling in my stomach," she said. "It was the realization that what we had been expecting had actually happened."

As a part of a team set up by Fiocruz Amazônia to create a "Biobank", she spends most of her days, when she is not self-isolating, sampling and studying bodily fluids from bats, rats, and primates. Her team, which also includes more vets, biologists and a geneticist, is trying to build up a library of viruses circulating in the Amazon in a bid to forestall a similar outbreak here. As it became clear the virus was something new, and rippling effortlessly across international borders, chatter started up between the web of scientists – epidemiologists, ecologists, biologists, geneticists, vets – who work on the intersection between human and animal health, "We said, 'look at it ... it's arrived,'" she said. "We saw it coming. We expected a pandemic like this."

A growing body of research suggests that, rather than deadly pathogens lying in wait for an opportune encounter with humans, the spillover of zoonotic viruses – like Nipah, Swine 'Flu, Ebola and, now, Covid-19, amongst many others – are often triggered by human destruction and exploitation of wildlife-rich habitats.

Where you have a huge biodiverse zone and an encroaching human footprint, you have all the ingredients for a virus spillover recipe

And as a tropical forest with high mammalian diversity facing rapid deforestation, some experts say the Amazon is particularly at risk. "In a forest, you have natural reservoirs, you have hosts for viruses, for these kinds of pathogens. When we disrupt that, you can see the emergence of new infectious diseases," said Nava, who lives in Manaus, a city at the heart of the Amazon rainforest.

Various outbreaks of diseases have been linked to deforestation, some of which bear a troubling likeness to the Amazon today. Take the first known outbreak of the Nipah virus in Malaysia in 1998: smog from Indonesian forest fires had reached Malaysia and forced fruit bats, the virus's natural host, to seek food in mango farms. Nipah crossed over to the pigs that also ate the mangos, probably in bat saliva or urine. Next, it made the leap to farmers, causing hundreds of deaths from rapid encephalitis, with a terrifying mortality rate of 40 per cent.

Amazon River. Photo credit: Jorge Kike Medina

Deforestation in the Amazon reached its highest rate in a decade last year, as fires set to clear land burnt so fiercely that at one point they turned the 1,000-mile distant skies of São Paulo as dark as night. Loggers and encroaching cattle ranchers burn up pristine forest, overgraze the pasture, then sell the land to monoculture soy farmers and move on, penetrating deeper into the jungle. On the Amazon river's snaking tributaries, gold miners fell trees for landing strips and roads, dredge river beds and hunt bushmeat. They throw up informal settlements without sanitation or plumbing, where rain barrels and abandoned tyres provide breeding grounds for disease-carrying mosquitoes.

Growing cities are attracting migrants from the countryside and swallowing up more jungle too. In 2018 informal settlements expanded into previously uninhabited land around Manaus roughly every 11 days. Diseases originating in animals go by the name "zoonotic" and Brazil already has many. Chikungunya, dengue fever, yellow fever, Zika, hantavirus, leptospirosis, leishmaniasis – to name only a few – already cause hundreds of deaths a year and pose a huge burden to the public health system. In Manaus, it is threatening to buckle under the additional strain of Covid-19 cases.

"Where you have a huge biodiverse zone, the Amazon, and then you have an encroaching human footprint, through urbanisation, road networks, deforestation, extractive industries like logging and mining, you have all of the ingredients for a virus spillover recipe," said David Wolking, Senior Manager of the One Health Institute at the University of California, Davis and an expert on the interface of human and animal health.

Wolking was also global operations manager for USAID's PREDICT project, which, between 2009 and 2019 performed a similar function to the Biobank, but on a global scale. Wolking and his team collected samples from over 164,000 animals and people and found more than 1,000 new viruses. These included a new Ebola virus, Bombali, in West Africa, and the lethal Marburg virus in bats in Sierra Leone, far further west than it had ever been detected before. The project completed field-based surveillance and lab activities around the world last autumn, a couple of months before the first case of Covid-19 emerged in Wuhan, though PREDICT did receive a six month extension in March 2020 to provide emergency support for Covid-19 response efforts.

Ecology of disease

The crux of the theory known as the "ecology of disease" holds that increasing encroachment into biodiverse ecosystems creates situations where species interact with humans in novel, intimate and ultimately dangerous ways. According to Dr Thomas Gillespie, disease ecologist at Emory University's Global Health Institute, there is now scientific consensus that these human-induced changes are making the situation worse. "Zoonotic diseases are hard to predict and many ecological and evolutionary factors play a role," he said. "Nevertheless, scientists agree that human-induced land-use changes and wildlife hunting/trade are key drivers."

"The clearance of forests for crops and livestock, including but not limited to industrialized production, and extractive industry actions like mining and logging can negatively impact the environment, creating a cascade of factors that facilitates the emergence and spread of diseases."

We are breaking down the forest into small pockets, we are pushing species in different ways

The data supports this too: scientists studying the zoonotic infectious diseases that have emerged since 1940, found that land use change was the most important primary driver. It was linked to 31% of the viral spillover events studied, with agricultural industry changes linked to a further 15%.But Gillespie adds that: "human alterations do not always have negative health impacts. It is usually a combination of factors that lead to the emergence of infectious diseases. For example, deforestation in combination with hunting for bushmeat or converting deforested lands into human settlements."

Much of the analysis around the emergence of Covid-19 has focused on the wet market in Wuhan – with animals that might never meet in the wild packed tightly together in unsanitary conditions and subsequently eaten, it may have

An aerial view of the edge of Manaus, where the city meets the forest.
Photo credit: Greenpeace

provided the perfect crucible for viruses to multiply, shed and jump species. But more broadly, land-use change, particularly of tropical, biodiverse forests, is key, said Dr Carlos Zambrana-Torrelio, associated vice president for conservation at EcoHealth Alliance, a non-profit studying what they believe to be an increasingly porous relationship between human and ecosystem health. "If you imagine continuous forests like the Amazon basin, the process of development, of changing them into croplands, produces fragments across the landscape," he told Unearthed. "We are breaking down the forest into small pockets, we are pushing species in different ways."

Fragmentation allows some wild animals with a history of passing on disease, like rodents and some bat and primate species, to thrive and multiply; others, like the Malaysian fruit bats, might be forced closer to humans in search of food. Others might find that their new neighbours offer an easy meal: Nipah outbreaks in Bangladesh have been caused by bats drinking from containers collecting date palm sap. "If we are offering them food, the numbers will increase, but also there are more humans working there, so we have more exposure to wildlife," said Zambrana-Torrelio, adding that EcoHealth Alliance was currently exploring this link in Liberia, where the fruit from palm oil plantations is thought to attract rats responsible for Lassa fever outbreaks.

Bats and rats

A study released this month by the One Health Institute showed that the species – rodents, some primates and bats – that flourish in these conditions are more likely to host diseases that spill over to humans. It also showed that, at the other end of the spectrum, so are animals whose population declines were directly connected to hunting, wildlife trade and habitat encroachment. They host twice as many zoonotic viruses compared to species that are in decline for other reasons.

However the notion that particular species – such as bats, rats and primates which have donated the most pathogens to humans in the past – are naturally more suitable as pathogen reservoirs than others is controversial in the scientific community. "Bats and primates are disproportionately likely sources of viral spillover to humans," said Gillespie, "due to their phylogenetic similarity and unique immune-metabolic dynamic respectively". That's the similarities in the evolutionary histories of their relationships with other organisms, and the relationship between their immune and metabolic systems. But Dr Kris Murray, an ecologist at Imperial College's School of Public Health and MRC Global Infectious Disease Unit the Gambia, said that: "A lot of people believe bats and rats and primates are a particular risk of spillover to people but actually I think that's probably wrong. If you look more closely at the association between pathogens and hosts you don't see a particular role for bats or rodents – it's simply a function of the number of species."

That is to say, there are many many different types of bats – and many bats – so more diseases are likely to come from that family. And when it comes to primates, their association with zoonotic spillover events may be more to do with their vulnerability to hunting and land-use change than it is to do with genetics and immunity.

Mosquitos and mammals

Deforestation also benefits some disease vectors – an animal that can act as an intermediary host – like mosquitoes. "There are two easy ways for a pathogen to get into a human, one is by a biting insect, because it breaches the skin, and the other is by eating it," said Bennett. Working in the Peruvian Amazon in the late 1990s, epidemiologist

Dr Amy Vittor at the University of Florida's Emerging Pathogens Institute showed that the larvae of the Amazon's main malaria vector Anopheles darlingi flourish in the dappled water pools found along the edges of roads penetrating forests and the patchy deforestation that springs up alongside them.

In Borneo, a 2016 study linked a spike in cases of a type of malaria normally found in macaques (monkeys) with rapid deforestation in the region. Researchers determined that monkeys were huddling with increasing density in the remaining fragments of forest. Mosquitoes were proliferating on the margins, feeding on the macaques, then passing the disease to people working on adjacent new palm plantations. In Brazil, increased urbanisation and deforestation have been linked to higher rates of hantavirus, leptospirosis, Zika and yellow fever. There are other effects too, said Zambrana-Torrelio, including some we don't fully understand yet. Skittish predators that ordinarily keep reservoir species in check, like jaguars, might flee entirely. Large herbivores like capybaras which usually affect the structure of vegetation, crushing plants and eating seeds, might be hunted to the point of local extinction, causing further ripples of unpredictable change. "Around these fragments are livestock, or croplands, or some other kind of human activity, and humans get more exposed," Zambrana-Torrelio added. "It becomes a different forest, with different resources."

It's a catastrophe. I think five or ten years from now, we can expect a new disease coming from our mistakes

Climate change can also affect the spread of both disease vectors and hosts, enabling them to expand into new areas. A paper published in 2013 predicts that by 2050, there will be a significant increase in the range of the potential habitat for the bat species known to host henipaviruses in western Africa, India and northern Australia. Zoonotic diseases are increasing in impact – a 2017 paper co-authored by Zambrana-Torrelio and Murray states that emerging infectious diseases (EIDs) "of wildlife origin, which are responsible for nearly all recent pandemics (e.g., Ebola, MERS), constitute the majority of the high impact EIDs from the last few decades, and are a significantly growing proportion of all EIDs combined."

But scientists admit it can be difficult to parse a perceived increase from improved diagnostics and the exponential growth in our interconnectedness; new diseases can spread far faster and further than they could before. "Certainly [new diseases] are becoming ever increasingly important because we're so joined up," said Professor Malcom Bennett, an expert in zoonotic and emerging disease at the University of Nottingham. We can assume, Bennett said, that "things used to jump across from a nonhuman animal into a human animal and then... peter out. Now, because everyone is joined up not just locally and regionally but nationally and internationally, if something can infect people and can be passed from one person to another there are far more opportunities for that to happen."

Indeed, Murray pointed out, "One hundred years ago, because there was no airline network to speak of, Covid could have just affected a much smaller community because there was much less ability to facilitate the spread of that around the world – although we know from past influenza pandemics it is still possible."

The Biobank was set up in Manaus in 2015. The team targets different parts of Amazonas – the largest state in the Amazon – with different degrees of degradation. They trap rodents, bats and primates, take anal and oral swabs, and samples of feces, blood and urine, then release the animals back into the wild. The programme is already producing interesting results: The team have been studying corona viruses in Amazonian bats and found that bats in pristine areas of the forest had fewer viruses than those in areas with human development. "We found less viral diversity and fewer "positive" bats for viruses in pristine areas compared to anthropized areas," Nava said. "In the anthropized areas, [where the bats had] greater contact with domestic animals and people, the bats sampled had greater viral diversity and a greater number of positives for some viruses."

Similarly, Wolking said that some of the data gathered during the PREDICT project appeared to suggest that viral spillover events may potentially happen with less frequency from wildlife communities within forests, because virus

shedding is less in healthy animals in their natural habitat when they are not stressed. "In the forest when animals are living the way they live, they are healthy...maybe they are not shedding viruses in the same way as they are once they are trapped, and put in a cage and transported and thrown into a market, where an animal is obviously freaked out and stressed and its biology can go into hyperdrive," Wolking said.

A forest under siege

Brazil was already at risk, but the stakes have become significantly higher since the election of Bolsonaro, Nava said. The right-wing populist, who speaks openly of his desire to open up the Amazon to mining and agribusiness interests, has made no secret of his contempt for conservation efforts, which he sees as a needless brake on GDP growth. Deforestation alerts for the first three months of the year were fifty percent higher than last year, and at their highest levels since the monitoring programme began five years ago. An area roughly the size of New York City was lost in those three months alone. "It's a catastrophe," Nava said. "I think soon – five years or ten years from now – we can expect a new disease coming from our mistakes... We have an environmental politics that is allowing the forest to be destroyed."

Sources within ICMBio and IBAMA, Brazil's environmental protection agencies, told Unearthed last year that the Bolsonaro administration was deliberately weakening and defunding their agencies, while land-grabbers, ranchers and miners pushed into protected areas with impunity. The fires that blazed through the Amazon last year will only contribute to this dangerous phenomenon. As with the Nipah virus, these fires destroy the habitat and food sources of wild animals, driving them into greater contact with human settlements and farms.

The fires also cause feedback loops, setting in motion destructive cycles that produce conditions conducive to more fires. When the rainforest's protective canopy is lost, the forest floor is exposed to intense tropical sun, drying out and losing resilience to blazes. Smoke hanging in the atmosphere can suppress rainfall, while trees lost in the fires no longer help water condense and produce more rain. A study released earlier this year showed how wildfires like last year's inhibit the forest's capacity to pull carbon-dioxide from the atmosphere, exacerbating climate change and in turn making droughts and fires even more likely. It's a really complex social issue.

Developing some kind of way of doing sustainable business is really essential

Meanwhile, fire smoke has caused respiratory disease spikes in indigenous communities, weakening resistance to some viruses. Recent research suggests this may well include COVID 19. Climate change can itself trigger disease flare-ups – droughts in Brazil cause Chikungunya virus to spread because mosquito larvae breed in barrels used to store water – or make populations vulnerable to existing diseases.

Last year Georgetown University researchers estimated that, thanks to a warming world, as many as a billion people could be newly exposed to disease-carrying mosquitoes by the end of the century. Biodiversity loss is inevitable with this deforestation, creating further risk through something ecologists call the dilution effect. The theory, according to Bennett, posits that where some species are more vulnerable to infection than others, higher biodiversity means there's a lower chance of a susceptible host being infected. "In North America you are much more likely to get infected with West Nile Virus if you live in the suburbs than in the forest," he said. Some ecologists think this is "because there are fewer bird species, so a greater proportion of them are able to maintain the virus."

Forest farming

Agriculture and live-stock farming in deforested regions also plays a key role. Most of the livestock in the Amazon are cattle, not pigs, which have a biochemistry and DNA that is singularly similar to ours. But that doesn't mean cows pose no risk. Researchers believe that the measles virus probably jumped into humans from cattle thousands of years ago, when they were first domesticated, and Rift Valley Fever in Africa is predominantly found in cattle but can be passed to humans via mosquitoes.

The scale of agriculture makes a difference, too – monocultures, be they soy or swine, are always more vulnerable to disease. Nipah had probably been in pigs before; but in the 80s and 90s an economic boom in Asia had created high

demand for pork. Smallholdings transformed into crowded, industrial-scale piggeries. Viruses thrived in these conditions, proliferating easily, amplifying and then jumping to humans with terrifying lethality. The way we assess the risks of big industry in biodiverse environments has to change, Gillespie argued.

A cattle ranch in the Marabá municipality, southern Pará state. Photo credit: Greenpeace

"Far too often, commercial activities that require large-scale land-use change levy tremendous costs that are not considered in cost:benefit analyses because the costs are not shouldered by those profiting. For a future with lower risks of disease spillover, we need to incorporate such negative externalities into the decision-making process. The paradox is that we're very risk averse but irrational in risk assessment. We prize gross domestic product (GDP) and ever-growing economies without acknowledging that unsustainable exploitation of natural resources has become the norm and that natural capital dwarfs our human economies."

Even so, the risk from big commerce doesn't negate the risk from smallholdings in some areas, said Dr Pranav Pandit, co-author of the One Health Institute study.

We are completely dependent on nature and have made our future vulnerable

"Backyard livestock farming in the rural areas of [developing] countries are also important interfaces. Generally, these are pastoral people having their animals – poultry, a few goats, cows – just in the backyard of their houses. These are the people who tend to interact more with animals."

"It's a really complex social issue. Any change we need to really involve stakeholders including the community itself. Any industry or any development is going to bring in some kind of economic development to the community people. Developing some kind of way of doing sustainable business is really essential."

Either way, it is a mistake to think of viruses or bacteria as having agency; no matter how aggressive and malign their effects may appear to us, they are dependent on a host, Wolking pointed out. "Viruses don't really look for new hosts to infect," Wolking said. "They just look for the ability to enter a cell to replicate."

A virus may have evolved within the microbiome of a single host species and existed there peacefully for millenia, without necessarily causing its host any problems. A truly successful virus won't kill its host, because then it can no longer successfully replicate inside that host. But when we transform a habitat within which the animal has adapted over millennia, we are accelerating evolution.

"We are completely dependent on nature and have made our future vulnerable", said Gillespie. "However, this process continues unfettered because the consequences are far in the future and we tend to discount the risk.

"Four months ago, pandemics did not feel like an urgent issue, people did not feel vulnerable. Now the COVID-19 pandemic is affecting people – it's affecting the stock market, their quality of life, their health, and their loved ones – now this feels urgent, now they feel vulnerable.

"It's in moments like this that real change can happen. The key is ensuring that this crisis catalyzes societal and environmental solutions instead of reinforcing entrenched irrationality."

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These African World Heritage Sites are under threat from climate change

JOANNE CLARKE, ELIZABETH EDNA WANQUI, GRACE W. NGARUIYA and NICK BROOKS
The Conversation

Very few academics or policy makers are talking about the impact of climate change on heritage. Yet heritage is essential for social wellbeing, for identity creation, for safeguarding traditional knowledge and livelihoods and for sustainable development. The conversations taking place are mainly on the effects of climate change in wealthier countries. One recent study estimates that only 1% of research on the impacts of climate change on heritage is related to Africa. Yet climate change has already resulted in loss and damage to African heritage.

Three of us are contributing authors to the Africa chapter of the Intergovernmental Panel for Climate Change's sixth assessment report. Our research for the report has drawn our attention to the total lack of quantifiable data on the impacts of climate change on heritage in sub-Saharan Africa. So we teamed up with a climate scientist with years of experience working on the continent and set about highlighting the threat of different kinds of climate change and climate variability to heritage in Africa.

Our research is conclusive. Without significant intervention some of Africa's most important heritage will be lost as a result of the direct and indirect impacts of climate change over the coming decades. There is a need for research into the impacts of climate change on different forms of cultural heritage in Africa, and to highlight the possible harmful effects these losses will have on society more generally. The next ten years will be a critical period in which research agendas can be developed that will have a practical application for the management of African heritage in the face of climate change.

The bad news

Coastal erosion and sea-level rise have damaged African World Heritage Sites. The Roman city of Sabratha on the Libyan coast and the colonial forts along the coastline of Ghana are slipping into the sea. Natural sites are also under threat. Relict Guinean coastal forests have largely disappeared, partly through coastal erosion.

By 2050, Guinea, The Gambia, Nigeria, Togo, Bénin, Congo, Tunisia, Tanzania (including Zanzibar) and the Comoros will all be at significant risk from coastal erosion and sea-level rise. Villages and towns associated with the historic Swahili Indian Ocean trading networks are all forecast to suffer significant loss from sea-level rise and coastal erosion in the coming decades. These are almost all located on the coasts of Mozambique, mainland Tanzania, Kenya, the Comoro Islands, Zanzibar and Madagascar.

A host of unique heritage locations are built on coral, sand or mud – all at elevations less than 10 metres above sea level. These include Ibo Island in the Quirimbas Archipelago in northern Mozambique, Shanga and Pate islands in Kenya, Pemba and the ruins of Kaole in Tanzania, Mahilaka in Madagascar and Suakin in Sudan. A combination of underlying geology and low elevation make these sites extremely vulnerable to coastal erosion. In addition, low-lying World Heritage Sites that are densely populated, such as Lamu Old Town and the Stone Town of Zanzibar, are located in regions of Africa predicted to be most severely impacted by shoreline retreat.

Inland of the coast, the World Heritage mud-built town of Djenné, on the Inland Niger Delta, is suffering multiple threats, exacerbated by climate change. Rock art sites in the Golden Gate Highlands National Park in South Africa are experiencing biodeterioration due to microbial activity arising from increased humidity.

The facade of the Djenné mosque needs repairing every year. The climate change has definitely worsened the process of loss.
Photo credit: Ralf Steinberger

But African heritage is predominantly lived heritage, which presents unique opportunities for heritage conservation.

Why a site like Djenné matters

Take Djenné in Mali, a town composed almost entirely of earthen buildings. Because of its unique vernacular architecture and its iconic mosque, it was inscribed on the World Heritage List in 1988. There has been a conspicuous degradation of its mud architecture. The reasons are complex but climate change has definitely worsened the process of loss. The lowering of the high water stand of the Inland Niger Delta has meant high quality mud has become scarcer. Mud bricks must be sourced further afield at greater cost, which locals simply can't afford. The result is buildings being repaired in cheaper materials such as concrete and fired clay bricks.

Traditional building methods are often perceived as being at odds with modernity and globalisation. But earthen buildings such as those at Djenné emit fewer greenhouse gases, consume less energy and maintain a high level of internal thermal comfort. They are more sustainable against climate change than brick and breeze block construction.

Some hope

Heritage has unseen potential. Traditional custodianship and community engagement will be at the forefront of a sustainable future. The good news is that five years ago the World Heritage Convention adopted Unesco's World Heritage and Sustainable Development Policy. The policy is built on the principles of human rights, equality and long-term sustainability. It's potentially groundbreaking for African heritage, which has been beset by a colonial legacy of centralised heritage management. It represents an opportunity for the restoration of traditional custodianship and local community engagement in heritage management. As heritage is reinserted into local lifeways, communities are able to reengage with traditional ways of doing things, which are often much more in tune with the environment. In this, African countries have the opportunity to be at the forefront of sustainable development.

And in our intergovernmental climate report, the Africa chapter has for the first time included heritage in its assessment. It identifies heritage as critical for a sustainable future.

Resetting the research agenda towards a sustainable heritage in the face of climate change will not only enable re-engagement with the past, but will help mitigate the impacts of climate change beyond heritage.

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Why green energy finally makes economic sense

Solar and wind generators have suddenly become just as cheap as other ways to produce electric power.

BOB HOLMES
Knowable Magazine

Karoo Windmill - Central Karoo, South Africa. Photo credit: SA Tourism

Renewable energy experts have long hoped that solar and wind power would someday become the cheapest way to generate electricity, allowing the world to shift away from fossil fuel. That day has now arrived, much sooner than expected, says **Faaiqa Hartley, an energy economist at the Energy Research Centre of the University of Cape Town, South Africa**. It could pave the way for renewables to eventually account for the lion's share of global electricity production, far beyond today's . *Knowable Magazine* spoke with Hartley, who coauthored a review on the subject in the 2019 , about what crossing this threshold means, particularly for developing countries, and about some of the new challenges that are likely to arise as the world transitions to a renewable future.

This conversation has been edited for length and clarity.

Prices for renewable electricity have been falling for many years. What's surprising about what's happening now?

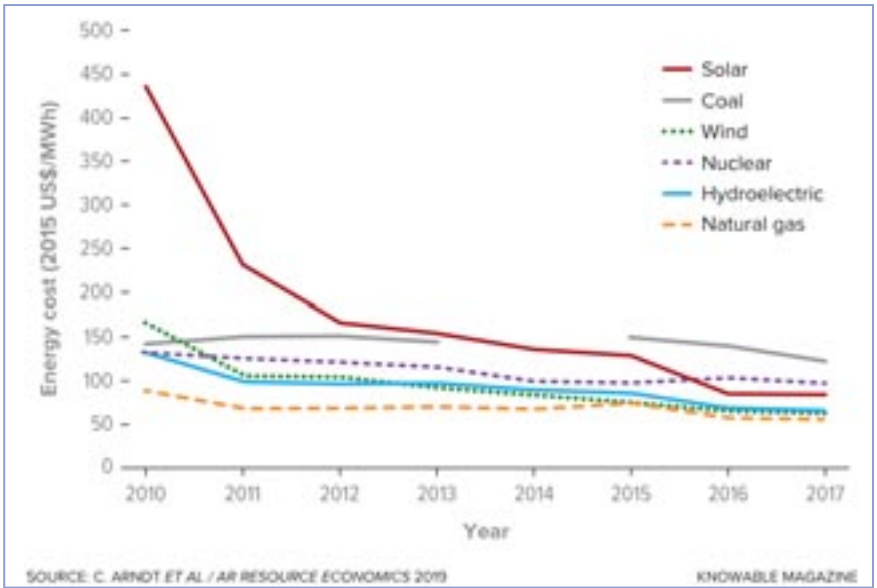
Experts have been expecting a decline in prices, yes. But what has been such a game changer is the rate at which these prices have fallen. Every year for the last decade, electricity from solar and wind has ended up costing less than experts predicted it would. Renewable energy is now comparable with the cost of building new coal and nuclear capacity. Existing, older power plants already have the capital investment sunk, so they are cheaper — but, in the case of South Africa at least, many of these plants are reaching retirement ages.
This has changed the landscape. There is now a cheap, clean alternative for power generation. There's no longer this problem of do we decarbonize our power sector and have more expensive electricity — in which case it negatively affects our economy. We're now finding that because it's cheaper, it's actually beneficial to produce greener electricity.

How does that affect the wider economy?

Switching to renewables requires far less investment into your power sector than if you were to build new coal or nuclear power plants. That means a lower electricity price, and that has impacts on everything in the economy. A lower electricity price reduces the cost of production, and increases profit. At the same time, it helps households, because spending less on

In South Africa, which is considered to be one of the leading countries on the continent in terms of infrastructure development, around 20 percent of people living in rural areas don't have electricity. Photo credit: AFDB/Shutterstock

power means you can spend more on other things. From that perspective, you're actually stimulating the economy when you're building renewable energy. In South Africa you're looking at the potential for if we move to renewable energy.



Solar and wind power used to be the most expensive ways to generate electricity. Now they are among the cheapest. (Some data for coal not shown.)

You've suggested that a surge in renewable sources of electricity will be especially beneficial for the world's poorest people. Why is that?

In many developing countries, not everyone has access to electricity, because the infrastructure required to connect them to the system is not available. Renewable technologies can allow countries to skip the need of having extensive power grids, as energy production can be developed closer to centers of demand and, in the case of solar, can even be placed on people's roofs. This is very powerful if one considers that these households currently do not have electricity. Even in South Africa, which is considered to be one of the leading countries on the continent in terms of infrastructure development, around 20 percent of people living in rural areas don't have electricity.

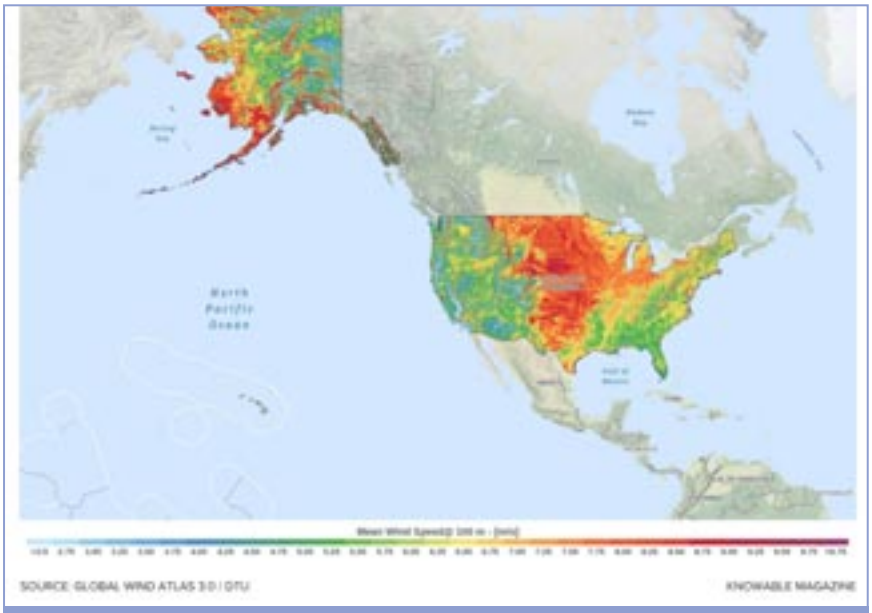
Does the lower cost of renewables mean there is no longer a good reason to build fossil-fuel electric generating plants?

It depends on where in the world you are. Different countries have access to different types of resources. Here in South Africa, it makes sense for us to build renewables. We've got a very well-developed grid, and if we're generating solar or wind power it's just a matter of connecting those sources to the grid. South Africa has sufficient land to build these power plants. And I think more importantly, because the resource, the solar and wind, is so good in South Africa we can basically build it anywhere in the country without making it significantly less efficient. But some other countries, such as Bangladesh, don't have as much land suitable for building renewables on a large scale.

How long would it take a country like South Africa to make the transition? It gets only about 10 percent of its electricity from renewables today.

South Africa is actually at the perfect place to be switching to renewable energy. A lot of our coal power plants will be decommissioned by 2030 to 2040, so we need to start building new capacity.

The question is, do we build new coal capacity, new nuclear capacity, or do we build renewables? According to predictions we've done, South Africa could have 70 percent to 80 percent from renewables by 2050.



Much of the United States is routinely breezy, as highlighted on this map of average wind speeds, making wind a rich potential source of electricity.

Is that happening?

There are plans, but they're very much in their infancy. If you spoke to me about this two or three years ago, or even maybe at the start of last year, there was really nothing suggesting a move to renewable energy. Whereas now, there's far stronger support for shifting to renewables. It's just about getting the policies in place.

Will that happen automatically, or will policy changes be required?

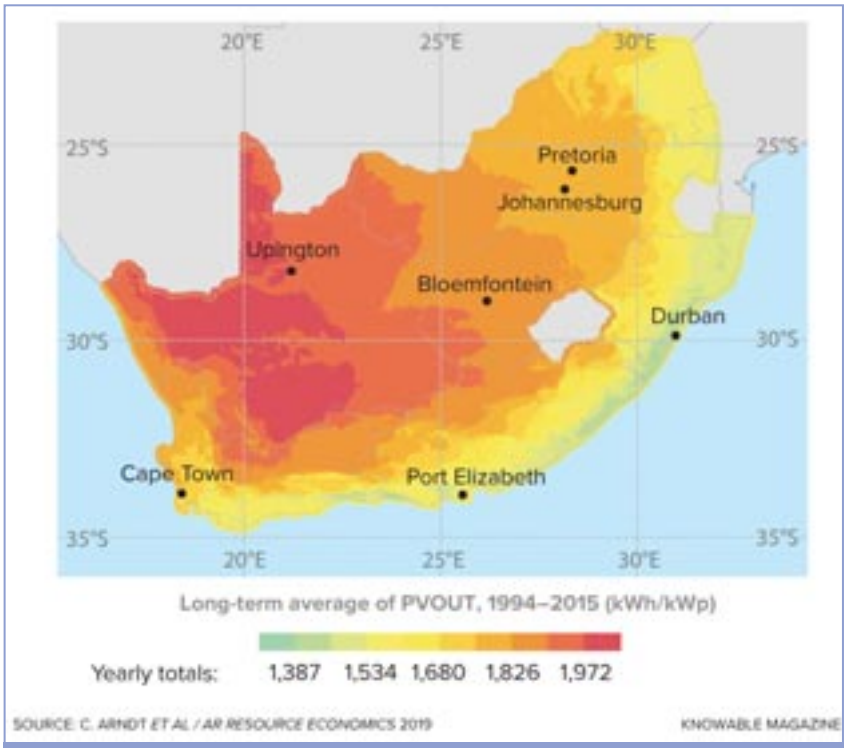
In South Africa, we do need policy intervention because the current policy is not to shift to renewable energy at the pace that's needed. Numerous studies, including ours, have shown that it's the least-cost path for the country. But current policy still plans the building of new coal plants to 2050. The government's reason is that there's no transition plan in place for the coal-mining sector. You've got lobbying groups who benefit from coal-mining production. You've got unions whose workers are in the coal industry.

The government needs to find a balance. While you are creating more jobs throughout the economy with renewable energy, coal miners are losing their jobs, so you do need a plan in place that either helps to reskill these workers or, if they are near retirement age, looks at alternative financial arrangements. You need policies in place that think about how to maybe put more manufacturing in coal-mining regions, or wind farms or solar farms there. So those are things that need to be planned.

You've noted that energy systems that rely heavily on renewables face what's called the "systems integration challenge." Can you explain what that is?

Sure. The systems integration challenge is the complexity of always ensuring that there is enough power in the system. The sun does not always shine and the wind does not always blow, so there may be periods of time in which a highly renewable-dependent energy system may not be able to produce enough electricity. During this time, one would have to have other technologies to fill the gap. The challenge is being able to maintain this shifting between technologies in an efficient manner, so that people don't experience blackouts or brownouts. With a renewable system, one needs to consider where and when it will be windy or sunny, how far into the future we can actually predict this and how the endowment will change over time, particularly in light of climate change. These questions are quite different from the ones of before. This only becomes a challenge when wind and solar contributes more than 20 percent of electricity production.

Current levels are quite low in many countries. although there are examples of countries such as Denmark where they are managing a high share quite well. South Africa, along with much of Africa actually, is very well-endowed with solar and wind resources. It is therefore highly likely that renewables will always be producing power because when the sun sets we still have wind. For South Africa, estimates show full coverage of demand for about 70 percent of the year, with the remaining 30 percent of the year having coverage of around 70 percent to 90 percent.



South Africa has enormous potential for generating solar electricity nationwide, as highlighted in this map showing possible photovoltaic power output over one year.

How can the system cover those shortfalls?

There is the option to use gas, and with the technological advancement in batteries, storing solar- or wind-produced energy for later is increasingly becoming an option as well. And we have in the past been able to create agreements with industry in which they would shift their use of electricity to times when there is less demand in the system. You can also shift households' demand for electricity by having a tariff structure where the price is higher when demand normally peaks. That's been done in other countries, as well.

Will clean electricity bring other environmental benefits?

We do need to find ways of further reducing carbon emissions — but that doesn't necessarily have to come from the power sector. For example, in the transport sector, you can now switch away from fossil fuels to electric vehicles, because you're using a clean source of electricity. That will reduce emissions. If the transport sector is no longer using fossil fuels, there is no need to produce high volumes of petrol and diesel, so you reduce emissions in the fossil fuel production sector as well. But all this does need government support for all of these things to align.

Are you optimistic that society will manage the transition to renewables?

I am. I'm actually very optimistic about it. I think it's something that will help significantly in a country like South Africa, where you've got the bulk of emissions being produced by the electricity sector. You've got industry that is so electricity-intensive, and a lot of that industry is also producing for the export market. To have competitively priced green electricity is definitely exciting.

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LAST STAND


Photo credit: Andreas Swane

KELENFÖLD

Hidden in Budapest's 9th district lies the Kelenföld Power Station. Built in 1912, after few years it became Hungary's largest coal power plant and one the most advanced in Central Europe.

The plant experienced several extensions and additions. The most impressive was its unique art-deco control room, completed in 1929, which became a providential bunker during World War II. By some miracle, the power station survived unscathed all the bombing. Still, it could not avoid the inevitable decline, which led to the main plant shut down in 2006.

Kálmán Reichl and Virgil Borbíro's design masterpiece is now a protected industrial heritage site, occasionally opened to tourists. ONE

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