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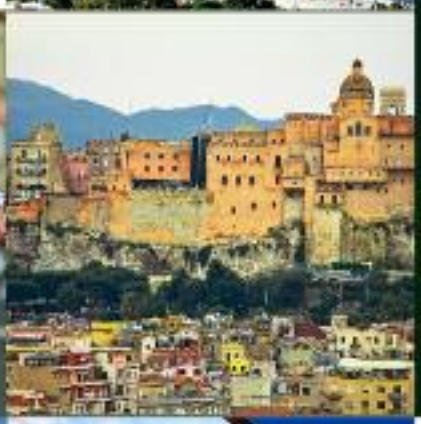


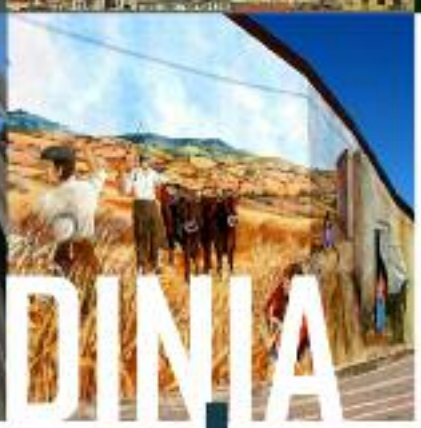


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The Green New Deal as a catalyst for smoothing out social inequality

By JEZ ABBOTT
ONE

Humanity has a decade to reduce carbon emissions or face climate change devastation, reckons the Intergovernmental Panel on Climate Change. The United Nations′ group is dedicated to providing the world with a scientific – that is to say impartial, apolitical - view of climate change, its impact and how to avoid its worst effects. If ten years sounds a bum deal, there is another one on the table.

The Green New Deal has zoomed to prominence in the USA, and it credits the influence of the Intergovernmental Panel on Climate Change for the science that underpins its radical proposals. Democratic congresswoman Alexandria Ocasio-Cortez's plan to decarbonise the American economy has been labelled by some as visionary in its scope and by others as ideologically zealous.

If the broad sweep of intent is clear, the nitty-gritty detail on implementation is less so. But the Green New Deal has given climate fresh prominence to a policy that is fast rippling beyond the USA. The UK′s New Statesman magazine, for example, believes successful implementation could transform economies around the world and ensure a liveable planet in the future.

Such ambition is hardly new. Exactly ten years ago former US president Barack Obama pushed his version of a Green New Deal into law and pumped $90 billion into ways of making electricity cleaner, fuel more renewable, and energy more efficient. But Obama has gone and Donald Trump is a notorious climate-change denier and friend of fossil fuels as well as those who mine them.

To climate cynics like Trump, the Green New Deal will throw up overwhelming costs and left-wing politics. Supporters of Ocasio-Cortez's proposed deal, who include Democratic presidential hopefuls Bernie Sanders and Elizabeth Warren, echo the New Statesman and argue the costs of not implementing the agreement will be far worse for the USA, the planet and global economies.

Ocasio-Cortez sees her version of a Green New Deal as a catalyst for not only climate-change limitation but for smoothing out social inequality and softening the harder edges of capitalism that creates that inequality. Her tone is urgent, almost reverential. The Green New Deal, she insists, is "the ′great society′, the moon shot, the civil rights movement of our generation".

Climate change, pollution, and environmental destruction, she maintains, "have exacerbated systemic racial, regional, environmental, and economic injustices". She wants the USA to be 100% renewable in electricity generation by 2030 and proposes raising marginal tax rates for the rich to 70% to pay for the ambitious new initiatives.

She also maintains the Green New Deal "should include universal health care and any other measure the committee deems appropriate for economic security". She advocates working with farmers and ranchers to reduce the carbon footprint of agriculture. And she wants to "upgrade or replace every building in the US with state-of-the-art energy efficiency".
The Green New Deal would also "build out high-speed rail at a scale where air travel stops becoming necessary." and promote electric cars: the deal wants to "totally overhaul transportation by massively expanding electric vehicle manufacturing" and "build charging stations everywhere". Ocasio-Cortez wants a new ′select committee for a Green New Deal′ made up of both political sides that will report back in 2020 on how the renewable revolution is panning out.

On the surface, this could go a long way to reducing America′s carbon footprint. Fossil-fuel combustion is America′s biggest source of greenhouse gas emissions. Currently, every kilowatt-hour generated in the US produces an average of 0.954 pounds of CO_2, according to the University of Michigan. Coal is the worst offender, releasing 2.2 pounds for every hour. Transportation meanwhile is America′s second-largest producer of emissions, producing 28% of USA′s total.

She may have captured a climate zeitgeist, while Republicans continually deny climate change, the majority of American people have come round to a viewpoint more sympathetic to Ocasio-Cortez′s. A recent study published by Yale University concluded the deal had "strong bipartisan support among registered voters" - 81% either 'strongly support' or 'somewhat support' the plan.

If the general electorate is slowly coming round, danger lurks much closer to home. Not all Democrats are convinced. House speaker Nancy Pelosi, for example, has dismissed the Green New Deal as a branding exercise: "The green dream, or whatever they call it, nobody knows what it is". Others have

criticised the omission of a key climate policy goal, the so-called carbon tax.

There is also confusion on how the Green New Deal would be rolled out and other glaring omissions. While the deal calls for achieving 100% green energy through clean, renewable, and zero-emission energy sources, it initially made no mention of nuclear power in any capacity. Some of the Green New Deal's economic plans are also deemed untenable by all sides.

Bloomberg Opinion economics writer Noah Smith praised the deal's focus on new technologies, the need to build a smart electrical grid, and the plan to retrofit buildings with renewable-energy systems. Yet other commitments in areas such as a federal job guarantee or universal basic income were "open-ended commitments" that risked "excessive budget deficits".

However, writing in the New York Times, Columbia Law School professor Jeddidiah Purdy suggested such desperate problems demanded equally drastic measures regardless of the cost. Producing "the disaster of global climate change" had involved a lot of economic policy and reversing direction would take similar significant policy initiatives.

"Since environmental policy can happen only through economic policy, there is no avoiding decisions about what sorts of

Representative Alexandria Ocasio-Cortez speaks on the Green New Deal in front of the Capitol Building in February 2019 Photo credit: Senat Democrats

work there will be, and in which industries," he wrote. "It is unsettling, but maybe a little less so when you consider that we've been doing it all along, usually without owning up to it."

Rhea Suh, president of America's Natural Resources Defense Council, agrees. In a letter to the New York Times in March, Suh spoke of the contrast between the promise of a well-crafted Green New Deal and the "folly" of doing nothing to address the central environmental challenge of our time.

Republican leaders were running out of places to hide from their "abject failure to protect our people from the rising costs and mounting dangers of climate change", she wrote.

"First, they said it was all a hoax. As the seas kept rising, the storms kept raging and the wildfires burned out of control, they threw up their hands and whined, 'We're not scientists.' Now they've got a new talking point: trying to fight climate change, they say, is socialism. Socialism! Nonsense."

Suh concluded: "Some Republicans seem hellbent on putting polluter profits first, even when it means putting the rest of us at risk. It's time to stand up and say we've had enough. It's time for assertive and comprehensive action to protect our children from climate catastrophe – while we've still got time." ONE

Generations arm wrestling for climate

While awareness of the severity of the climate change issue is undoubtedly growing worldwide, the numbers tell a strikingly different story.

By TOBY LOCKWOOD

ONE

In February, school students across the UK joined a growing international movement of school 'climate strikes', which has seen children skip their Friday lessons to protest over a perceived lack of government action against the threat of climate change.

The movement was launched last August by then 15-year-old Swede Greta Thunberg and has since spread across Europe and to the US. In October, it was given major impetus by the high-profile report released by the International Panel on Climate Change (IPCC), which warned that we have only 12 years to prevent global temperatures rising by more than 1.5°C, while detailing some of the dramatic changes to the environment should we fail. A group representing the protestors in the UK, the Student Climate Network, has laid out a series of demands which largely call on the government to wake themselves and others up to the sheer scale and urgency of this 'climate emergency'.

While the frustration of idealistic young people over the actions of their elders is a familiar sight, the climate strikes are given more poignancy by the fact that this generation may be the first to truly feel their lives will be affected by climate change. In the past, the contradiction between the population's general belief in the issue and a lack of willingness to do much about it has been attributed to the slow, imperceptible nature of the threat – it will always be somebody else's problem.

Now, as the IPCC and other high-profile voices are increasingly emphasising the immediacy of serious climate change, it is not surprising that today's school children are beginning to feel visceral concern for their futures in place of the more principled stance towards saving the planet which has characterised earlier movements.

The UK government can perhaps feel aggrieved to be accused of inaction on climate change, given the country's record on the issue is pretty good relative to many other industrialised countries. With the 2008 Climate Change Act, the UK became the first country to set legally binding targets for CO_2 emissions, in the form of 'carbon budgets' which are ramped down every five years. A rather rapid phase-out of coal power – replaced by offshore wind power and natural gas – has helped meet the first two targets, and the UK is well on track to meet the third in 2022.

In comparison, despite its strong support for renewable energy, Germany has failed to reduce CO_2 emissions in the last decade, held back by a determination to phase out nuclear power and the lack of a strong carbon price signal to force a switch from coal to gas. However, the UK will also struggle to meet its carbon budget for 2027 without a significant acceleration in activity. Recent renewed interest in carbon capture and storage technology is evidence of the government's interest in reaching emissions from beyond the power sector, in heavy industry and even residential heating, but progress remains

Strike for climate in London

slow. Unfortunately, such is the scale of the climate change challenge that it dwarfs most well-intentioned efforts of this nature.

While awareness of the severity of the situation is undoubtedly growing worldwide, the numbers tell a strikingly different story. CO_2 emissions reached an all-time high in 2018, and fossil fuel's share of the global energy mix is roughly the same as in 1990. Under the international community's current obligations to the much-celebrated Paris Agreement, emissions will keep increasing for the next 20 years.

Analysis by the International Energy Agency has shown that emissions from existing energy infrastructure alone will blow 95% of the CO_2 we can emit until 2040. Contributing just over 1% of global CO_2 emissions, the actions of a country like the UK can be seen as little more than symbolic on a worldwide scale. But it may be vital symbolism, as developed countries have the power to demonstrate an alternative pathway to emerging economies in Asia and Africa, which will otherwise turn to unabated use of fossil fuels.

The climate strikers have met with a mixed, but mostly positive response. Large numbers of scientists have backed the movement, while the City of Edinburgh Council recently gave formal approval to students to miss school. The official response from the UK government acknowledged the importance of engaging with the issue, whilst disapproving of the disruptive approach. Among others, Prime Minister Theresa May made the point that education should be respected as key to solving the climate crisis. On the other hand, opposition politicians in the UK, the current UK Energy Minister Claire Perry, and even German Chancellor Angela Merkel have all expressed sympathy for the cause.

This fairly supportive reaction from most quarters is itself an indication that there may not be such a gulf between the views of the young protestors and those in power. Unfortunately, a true realisation of the scale of the problem can lead not only to the genuine alarm of the protestors but to a feeling of helplessness which may lie at the heart of the currently inadequate political efforts.

Real change will take more than raising public and political awareness, but a willingness to take dramatic steps, most likely requiring uncomfortable sacrifices to our current way of life in the developed world. For a politician to lead any democratic country into this unknown realm would take serious conviction that the population backs them in both spirits as well as words. These climate strikes may, at the very least, be the first signs of a new generation prepared to lead this charge.

Alternatives to standard grass lawns

By LENORE HITCHLER
ONE

Many people are surprised to learn that current lawn practices wreak havoc on the environment. Chemical fertilizers, pesticides, watering, and lawn equipment such as lawn mowers produce myriads of greenhouse gases that contribute to climate change. Fortunately, there are numerous alternatives that both enhance the health and biodiversity of the environment and help to mitigate against climate change. For example, both prairies and gardens store more carbon than lawns.

Standard lawns contribute to environmental damage and climate change in many ways. Large amounts of fossil fuels are used to produce chemical fertilizers which damage the environment and cause harm to the health of humans and pets. Safe and ecological ways to fertilize lawns are available. Removing grass clippings can result in a loss of 100 pounds of nitrogen per acre per year. It is better to retain them on lawns as they provide important nutrients.

Doing so will also eliminate many plastic bags made from petroleum along with the associated energy used to manufacture these bags and transport them to landfills. Instead of pesticides, attract predators of pests. Rather than applying dangerous herbicides use natural methods, such as temporarily covering ground so that the old weeds die off.

Mowing lawns also consumes a lot of fossil fuels. It is better to use an old-fashioned push mower and allow the lawn to grow taller. This causes the roots to grow deeper, which protects lawns from low rainfall levels. Moreover, taller grass shades soil which means the roots won't dry out as fast. Taller grass also retards weed growth.

Many native grass species have 70" to 140" long roots that can store 20 to 40 times more carbon than turf grass which has much shorter roots and thus stores much less carbon. Many species do not even require mowing.

Pesticide application on leaf lettuce in Yuma, Arizona (USA). Photo: Jeff Vanuga, USDA Natural Resources Conservation Service.

Watering lawns is also detrimental to the environment and contributes to climate change. Eliminate it enti-

rely or keep watering to a minimum. Landscaping has been estimated to consume 50% of US domestic water, and many homeowners apply twice as much water as lawns need. When grass turns brown, it is dormant, but not dead and will revive after rainfall.

Crop sprinklers near Rio Vista, California in the Sacramento-San Joaquin Delta region. The Delta is the hub of the State's water distribution system, and supplies irrigation to more than 1,800 agriculture users in the region. Photo: Paul Hames.

Pumping water to mow lawns requires electricity. The city of Irvine, California estimated that watering one acre of lawn every year consumes as much energy as mowing that lawn, and fossil fuels are burned to produce that electricity. Therefore, cutting down or eliminating watering will reduce climate change. Switching to native plants adapted to local precipitation rates will enable you to do so.

Connect rain barrels to downspouts and save rainwater for watering lawns and plants. Or direct water from downspouts to rain gardens, which are shallow depressions planted with water-tolerant native plants. There are numerous methods of landscaping for innovative yards. Redesigning back yards isn't controversial. However, unusual front lawn landscaping might raise objections from neighborhood organizations and local governments.

Fortunately, increasing awareness of climate change and limitations on water and energy use is gradually improving tolerance for innovations. Transition to alternative front lawns by gradually creating beautiful landscaping.

Adding such features as birdbaths and other garden ornaments can prevent the yard from appearing abandoned or neglected. A low curving path is quite attractive, as trimming or growing plants into interesting shapes. Create mazes or labyrinths, knot gardens, low hedges forming knots, or topiary, trees and shrubs shaped into interesting forms.

Creating a biodiverse mini-environment is the central principle of the new yard. Plant many different species. This will promote a healthy environment, attract wildlife, such as butterflies and birds, and attract predators of local pests.

Perennial grasses and other plants save time and money. They also will cut down on greenhouse gases because the soil will not have to be worked and resources and energy will not be used to raise new seedlings. Always choose plants that are right for soil pH and type of soil, such as clay or sand, soil moisture, sun or shade, and plant tolerance for cold and hot temperatures. Native plants are generally best, and it is important to avoid invasives. Purchase plants that have been grown no more than 100 miles from your household.

In addition to benefits for the environment, alternative lawns save money. The Owens Corning world headquarters found that the annual cost per acre for their prairie was $140 versus $6,675 for their lawn. A General Electric location spent $25 per acre for their prairie versus $1,500 for their lawn.

Once prairies are established, they don't require fertilizer or pesticides, require minimal weeding and only annual mowing. Prairie plants have evolved to thrive in drought. Some of them have roots that are more than ten feet deep. Countless beautiful prairie grass and wildflower species thrive in all sorts of colors.

Moss makes an excellent groundcover. It can be walked on and does not need mowing. Moreover, it doesn't require fertilizer or pesticides, and its density prevents weeds. Moss is found throughout the US from deserts to hot, humid areas, temperate climates, and the Arctic regions. It is tolerant of various types of soil conditions and pH ranges. Moss does not require watering, goes dormant during dry spells, and rapidly rejuvenates with rainfall. It is also excellent at sequestering carbon. Annie Martin in The Magical World of Moss Gardening references researcher Janice Glime, who states that Sphagnum moss may sequester more carbon than any other land plant.

Some species actually add nutrients to the landscape. For example, white clover is a legume that has bacteria on its root nodules which make nitrogen available to the plant. It requires little or watering or mowing as it only grows 3 to 4" tall, unless you want to eliminate the flowers. Microclover is a dwarf white clover that has an attractive dark green color and does not produce as many flowers as white clover.

If grass is the only acceptable option, grow a grass species adapted to your particular environment. For example, Buffalo grass doesn't require fertilizer or pesticides, is resistant to both extreme heat and cold, is tolerant of foot traffic, and is drought resistant. Stampede buffalo grass is a semi-dwarf variety that only grows 4". Zoysia thrives in poor soil, is drought resistant, is resistant to insects and disease, crowds out weeds, and requires less mowing than most other grasses.

There are various blends of grasses designed for different regions of the US. No-Mow Lawn Mix contains six different fescues which don't require fertilizers or herbicides as weed invasion is inhibited by its dense root system. It needs mowing only once or twice a year, is drought resistant and requires minimum watering, and tolerates moderate foot traffic. Eco-Lawn also contains a mixture of fescue grasses. It doesn't require fertilizers, is highly

drought resistant, and is slow growing, thus mowing. Another blend is Habiturf, which is a native grass mix for hot summer, low rainfall areas. It requires minimum fertilizer, water and mowing.

The new lawn is not limited to the grass family. Mat-forming plants cover the ground with a layer of foliage that ranges from flat to a height of 6" tall. The following species are suitable grass replacements. Pussytoes grow less than an inch high and tolerates some foot traffic. Veronica oltensis grows 1" tall and is tolerant of moderate foot traffic. Creeping mazus grows under two inches and can handle moderate traffic. Phedimus spurious "John Creech" grows up to 2 inches. There are various thymes that do not grow very tall. For example, red creeping thyme grows to a height of 2' to 4" and is walkable. Creeping Sedum grows 4" to 6" tall and tolerates moderate foot traffic. There are some varieties of bearberry that grow less than 6 inches. Creeping phlox grows under six inches. Sweet woodruff grows six to eight inches tall, can be mowed, and recovers from light foot traffic.

There are many low-growing plants that can be grown, such as sweet alyssum and creeping rosemary. Iris moss is not a moss and grows just one to two inches tall. Corsican mint, also known as creeping mint, only grows ½ to 1" tall. Miniature sedges grow from 1" to 2". Some rushes only grow 2" high. Yarrow is a low-growing perennial that forms a thick, carpetlike texture 2" to 4" tall and can be mowed to 2" to remove the flowers. It is drought-tolerant and stays green all summer.

Another alternative is to create an edible landscape. Less land thus needed for farming and could be used to preserve natural habitats and biodiversity.
Choose perennials such as raspberries, strawberries, and blueberries, asparagus, rhubarb, and Jerusalem artichokes, which taste similar to potatoes.

Edible landscapes are attractive as well as providing vegetables, fruit, and herbs. Both cottage gardens and potagers include vegetables, fruits, herbs, and flowers. Potagers are stylized gardens often laid out in geometric patterns. Cottage gardens are designed to look much less formal and are quite charming. Edible flowers increase the nutrient value of the garden.

Some edible plants are colourful and attractive. Examples include pink garlic, rainbow swiss chard, red or purple kohlrabi, purple basils, purple-red cabbages and kale, and red Aztec spinach and lettuces. Much food can

be grown in gardens. During WWII the US alone had 20 million victory gardens which by 1944 were producing more than 40% of the country's vegetables.

Over 80% of American households grew some of their own food. Fewer fossil fuels are used in gardens since there is less machinery usage, food waste, and transportation. Going organic eliminates even more fossil fuels used for fertilizers and pesticides. Organic matter added as compost sequesters the greenhouse gas carbon dioxide (CO_2). One estimate is that increasing the organic material in the top 1" of soil from 1% to 4% would sequester more than 50 billion pounds of CO_2.

According to a study performed by UC Santa Barbara professor David Cleveland published in Landscape and Urban Planning, every kilogram of homegrown vegetables (around 2.2 pounds), reduces greenhouse gas emissions are by 2 kilograms (around 4.4 pounds) compared with store bought vegetables.

Soil treatments and the actual physical arrangement of plants affect the environment and can even affect climate change. Since tilling oxidizes soil organic matter and releases CO_2 into the environment it should be avoided. When plants are grown densely, they reduce weeds, lower the need for energy-intensive food from many miles away, and conserve water. Vertical gardening on fences, gates, walls, etc. also increases yields.

Planting trees is beneficial and saves money on heating and cooling. Deciduous shade trees planted on the south and west sides of buildings can cool them by as much as ten degrees, while allowing the sun to warm them in winter. Moreover, planting moss under the trees will result in less grass to mow and maintain. By serving as a windbreaker, evergreen trees on the north side of buildings can lower the need for winter heating.

Forestation at Dzikunze Kilifi (Kenya). Photo: Chris Obiero

The cooling effect of a young, healthy tree is equivalent to ten room-size air conditions operating 20 hours per day. According to "A Guide to Growing Environmentally Friendly Lawns and Gardens" three well-placed trees around a home can result in a 30% reduction in home energy bills.

Windbreaks serve multiple purposes. A 12' tree sequesters half a ton of carbon each year. A dwarf fruit tree sequesters 200 pounds of carbon each year and can yield many pounds of fruit annually. Planting fruit trees such as apples, pears, or cherries will cut down on greenhouse gases because these trees store carbon dioxide, and processing and transportation of these fruits to stores will be eliminated. Windbreaks can also provide habitat for wildlife ranging from beneficial insects to birds.

Arrange them so they will direct snow where you want it to go. Forest gardening is also beneficial, and it doesn't require fertilizing, pesticides, watering or mowing. Forest gardening provides higher yields than monocropping in rows. The following statistics from Forest Farming—Towards a Solution to Problems of World Hunger and Conservation show that apple trees can yield seven tons per acre; walnuts from 10 to 15; pecans from 9 to 11; and hazelnuts from 9 to 12.

In comparison, cereal crops yield about 1½ tons per acre. Various herbs and mushrooms, especially shitakes, can also be grown. Increase yields by training grapes to grow up fruit trees. Thus, yards do not have to consume vast amounts of fossil fuels. Yards can sequester CO_2 instead of increasing global climate change. There are many attractive alternatives to current lawn practices. Instead of monocropping, a biodiverse environment can be created. Also, these visually attractive havens can add necessary nutrition to the nation.

Nuclear power - breakthrough technology or eternal promise?

By ALICE MASILI

ONE

A new-wave nuclear power that could cut down carbon emissions, according to Microsoft founder Bill Gates, is one of the 10 Breakthrough Technologies that will change the world in 2019. A bold prediction but not ungrounded.

Global greenhouse gas emissions increased in 2018, which means that the only way to prevent the worst climate change scenarios is to come up with some innovations in clean energy. Energy production and its use play a key role in achieving the ambitious 2 °C scenario - they account for almost two-thirds of the total global emissions. According to the 2018 International Atomic Energy Agency (IAEA) report, it is expected a 430-650 EJ growth in the primary energy demand by 2050. The impact on climate change will depend on the future mix of technologies for the production of electricity, which differs significantly in terms of CO_2 emissions per unit of power.

Some people may argue that it is not a massive problem as we have all the alternative sources we need, like solar and wind. Only partially correct. As those are intermittent energy sources, and we′re unlikely to have cheap batteries soon enough to store the required amount of energy when the sun does not shine, or the wind does not blow. These limitations enhanced nuclear power chances to promote itself as the most reliable solution to tackle climate change as the only carbon-free and scalable energy source available 24 hours a day.

Many good reasons but is it correct to depict nuclear energy as a solution to fight climate change? Nuclear is the only technology that the passage of time makes more complicated and expensive. The once great promise of post-war energy scenario replaced with more straightforward and cheaper techniques. The most recent World nuclear and industry status report depicts a gloomy picture: in 2017 and the first half of 2018 only seven new GW of atomic energy was installed in the world out of the 257 GW total new installed power. Nuclear power looks outclassed by wind and photovoltaics, less divisive, expensive, and dangerous.

However, it is undoubted that, as a large-scale energy source, nuclear guarantees constant energy without carbon emissions. In the context of the awareness of the necessity to ″accelerate″ the transitions, the phase-out of coal is becoming an important political goal. The United Kingdom government believes nuclear energy should be a fundamental part of its energy mix.

″Numerous independent studies have supported the British policy that identifies the need for nuclear power to play a role alongside renewable sources″, maintains a spokesperson for EDF Energy, the biggest supplier of electricity in Great Britain.

To balance the commitment of a decarbonised future with the transition towards safe and low-carbon energy, the United Kingdom ratified the Paris agreement on climate change in 2016 but still struggles to replace the old nuclear fleet and coal-fired power plants. The plans for the construction of new nuclear power plants have collapsed in recent months due to funding difficulties, while data from the Imperial College of London suggest that nuclear power plants are undergoing more interruptions, and will reduce their contribution to the national electricity system.

One step forward and two behind are so typical of the nuclear energy debate. You have Bill Gates, who believes that the risk

Three Mile Island's Unit One reactor to be closed in September 2019. Photo: Joe Ulrich/WTTF

Many good reasons but is it correct to depict nuclear energy as a solution to fight climate change?

of failure of contemporary reactors can be solved entirely with the help of innovative systems - the Terra Power project, which he founded in 2006, has been working for some time to create a new type of reactor capable of burning nuclear waste produced by existing power plants. But his optimism is not shared by everyone. His views are counterbalanced by those who highlight the difficulties and risks associated with the construction of new generation reactors.

However, the debate is still very open among those who support nuclear power as the primary option between renewable energy and those who exclude it. If on the one hand nuclear power seems to be the path to follow; on the other, it has negative aspects. First of all, nuclear accidents. Though limited, they caused great fear - think of the Fukushima explosions in 2011 or the sensational Chernobyl disaster in 1986. In the wake of the Fukushima accident and long-standing problems related to excessive costs and financing in the nuclear sector, several countries are implementing a progressive elimination of nuclear in their energy-mix - among them Germany, Belgium, Scotland, Switzerland, Taiwan and South Korea.

Germany position is topical. Berlin recently stated that it would come out of coal by 2038. This decision marks the second most crucial energy breakthrough in Germany since the closure of the atomic power plants eight years ago. At that time, the Merkel government ordered the closure of half of the nuclear plants and the gradual shutdown of the other half by 2022. Since then, Germany has invested heavily in renewable energy, implementing the Energiewende, the energy transition, with excellent results in wind, solar, and biomass.

According to the German Association of energy producers, in the first six months of 2018, the production of green energy exceeded coal's 118 TWh to 114 TWh. But getting out of the most polluting fossil fuel is not a cost-free process. It is quite expensive.

It is estimated that the transition will cost up to 80 billion euro. Half of the amount should be invested in the regions where the coal industry is still essential (mainly in the East) and will serve to retrain the sector's workers destined to lose their jobs. The remaining forty billion will be used to prevent the increase in the electricity price and to preserve the competitiveness of the industry.

Nevertheless, the biggest problem is related to the storage of nuclear waste and its environmental impact: radioactive dross that takes thousands of years to decay and its safe conservation presents many risks. The issue is still an open question in the United Kingdom, where the contaminated material is temporarily stored at the Sellafield site in Cumbria. After 70 years of nuclear energy, there is still no permanent landfill to accommodate the most hazardous waste. But there is more than that. When a country decides to abandon fossil fuels and to replace them with nuclear energy, the first thing to do is to build new plants. Not so easy. And not only because it should face the constant adversity of the population living in the plant area.

Putting aside, for a while, the financial risk to experience double costs (due to a long-time frame, on average about ten years), there is another one related to the passage of time: when the nuclear plants are ready, the available technologies for solar and wind could be so advanced to have made nuclear useless or already obsolete.

According to scientist Ramez Naam, one of the leading experts in the field, providing solar panels to the roofs of all the buildings that could accommodate them, would meet half of our energy needs. In Europe alone, if the energy produced by the sun and wind is efficiently combined, 70-80% of energy needs would be matched. Furthermore, the continuous progress in the batteries field makes it easier to conserve and transport the energy produced by the sun. The other energy sources' continuous technological advancement is the real challenger for nuclear power, the one that is likely to turn out Bill Gates prediction to be wrong.

Australian judge strikes down coal mine in part because of its carbon emissions

By JUAN COLE
Common Dreams

In what is likely to be the first of many such rulings, an Australian court has ruled against a coal mine in part on grounds of the environmental damage that burning coal does by contributing to the climate emergency. Burning coal releases carbon dioxide into the atmosphere, a powerful greenhouse gas that keeps the sun's heat from escaping into space once it has struck the earth. Gloucester Resources, Ltd., had proposed an open-cut coal mine near the town of Gloucester, a 3-hour drive north of Sydney along Australia's east coast. The New South Wales ministry for planning had denied the request on more conventional grounds. Open-cut mines are environmental nightmares and eyesores, and thousands of residents had written in to complain about all that and also the possibility that the proposed mine would negatively affect other land use in the vicinity. But then Gloucester Resources, Ltd., made the mistake of appealing the turn-down, and the case went to chief judge Brian Preston of the NSW Land and Environment Court. (Australia has courts for Land and Environment?)

Justice Preston upheld the denial of the permit by the ministry of planning. But he piled on reasons for so doing beyond the eyesore and land use arguments. The environmental group Gloucester Landswell was allowed to present an amicus brief against the appeal, and they played up the climate emergency argument: *Gloucester Groundswell contended that the Rocky Hill Coal Project should be refused because the greenhouse gas (GHG) emissions from the Project would adversely impact upon measures to limit dangerous anthropogenic climate change. The effects of carbon in the atmosphere arising from activities in the Project site, and the burning of the coal extracted from the mine, are inconsistent with existing carbon budget and policy intentions to keep global temperature increases to below 1.5º to 2º Celsius (C) above pre-industrial levels and would have a cumulative effect on climate change effects in the long term. Gloucester Groundswell submitted, "in light of that substantial planning harm, and the critical importance of combatting climate change now, the Project should be refused". Gloucester Groundswell developed this argument as follows.*

The Rocky Hill Coal Project will cause, directly and indirectly, emissions of greenhouse gases (GHGs). The most significant GHGs will be carbon dioxide (CO2) and methane (CH4). Different gases have different greenhouse warming effects (referred to as global warming potentials) and emission factors take into account the global warming potentials of the gases. The estimated emissions are referred to in terms of CO2 equivalent (CO2-e) emissions by applying the relevant global warming potential (Air Quality and Health Risk Assessment for the amended EIS, p 2A-158). The environmentalists also entered into the proceedings Australia's having signed on the the Paris Agreement, which aims at limiting increased global surface heat to an extra 1.5 degrees C. to 2 degrees C. at worst (2 to three degrees extra in Fahrenheit), and the way in which increasing the number of open-cut coal mines would make it impossible for Australia to meet its treaty obligations, i.e. would exceed the country's carbon budget: *Australia is a party to both the Climate Change Convention and the Paris Agreement. Under the Paris Agreement, each party commits to make its contribution to keeping the global average temperature rise to the 1.5-2ºC range by reducing their GHG emissions through their Nationally Determined Contributions (NDC). Australia's NDC is to reduce GHG emissions by 26-28% below 2005 levels by 2030. The NSW Government has endorsed the Paris Agreement and has set a more ambitious objective to achieve net zero emissions by 2050 (see NSW Climate Change Policy Framework, October 2016, pp 4, 5). A commonly used approach to determine whether the NDCs of the parties to the Paris Agreement cumulatively will be sufficient to meet the long term temperature goal of keeping the global temperature rise to between 1.5ºC and 2ºC is the carbon budget approach.*

Justice Preston reviewed the arguments for and against coal mines on climate grounds and found that the argument for keeping fossil fuels in the ground has merit: *All of the direct and indirect GHG emissions of the Rocky Hill Coal Project will impact on the environment. All anthropogenic GHG emissions contribute to climate change. As the IPCC found, most of the observed increase in global average temperatures is due to the observed increase in anthropogenic GHG concentrations in the atmosphere. The increased GHG concentrations in the atmosphere have already affected, and will continue to affect, the climate system. The current and future impacts of climate change were summarised by Professor Steffen and have been set out earlier in the judgment. The direct and indirect GHG emissions of the Rocky Hill Coal Project will contribute cumulatively to the global total GHG emissions… All emissions are important because cumulatively they constitute the global total of greenhouse gas emissions, which are destabilising the global climate system at a rapid rate. Just as many emitters are contributing to the problem, so many emission reduction activities are required to solve the problem" (Steffen report, [57]).*

Many courts have recognised this point that climate change is caused by cumulative emissions from a myriad of individual sources, each proportionally small relative to the global total of GHG emissions, and will be solved by abatement of the GHG emissions from these myriad of individual sources. Preston went further and I think may have set a crucial international precedent for common law countries (the UK, India, the US and the Commonwealth states). He pointed out that Gloucester Resources, Ltd., had neglected to provide any plan to offset the increased carbon emissions their mine would cause. That is, if you are going to increase carbon emissions with a mine, you have to specify in detail how you plan to offset those emissions so that your project does not increase the cumulative amount of CO2 in the atmosphere: *The first reason GRL gave was that the increase in GHG emissions associated with the Project would not necessarily cause the carbon budget to be exceeded, because, as Dr Fisher had argued, reductions in GHG emissions by other sources (such as in the electricity generation and transport sectors) or increases in removals of GHGs by sinks (in the oceans or terrestrial vegetation or soils) could balance the increase in GHG emissions associated with the Project. I do not accept this reason. It is speculative and hypothetical. There is no evidence before the Court of any specific and certain action to "net out" the GHG emissions of the Project.*

And thus did Justice Preston enter the history books. His ruling will certainly be seen as a path-breaking one for climate activism. The next phase will be suing companies like Exxon-Mobil, who knew they were destroying the earth but actively suppressed the evidence for it and funded vast campaigns of climate change denialism. We're not going to make our best initial deadline of 2030 to go net carbon zero, but the closer we get to that goal, the less destructing the coming changes will be.

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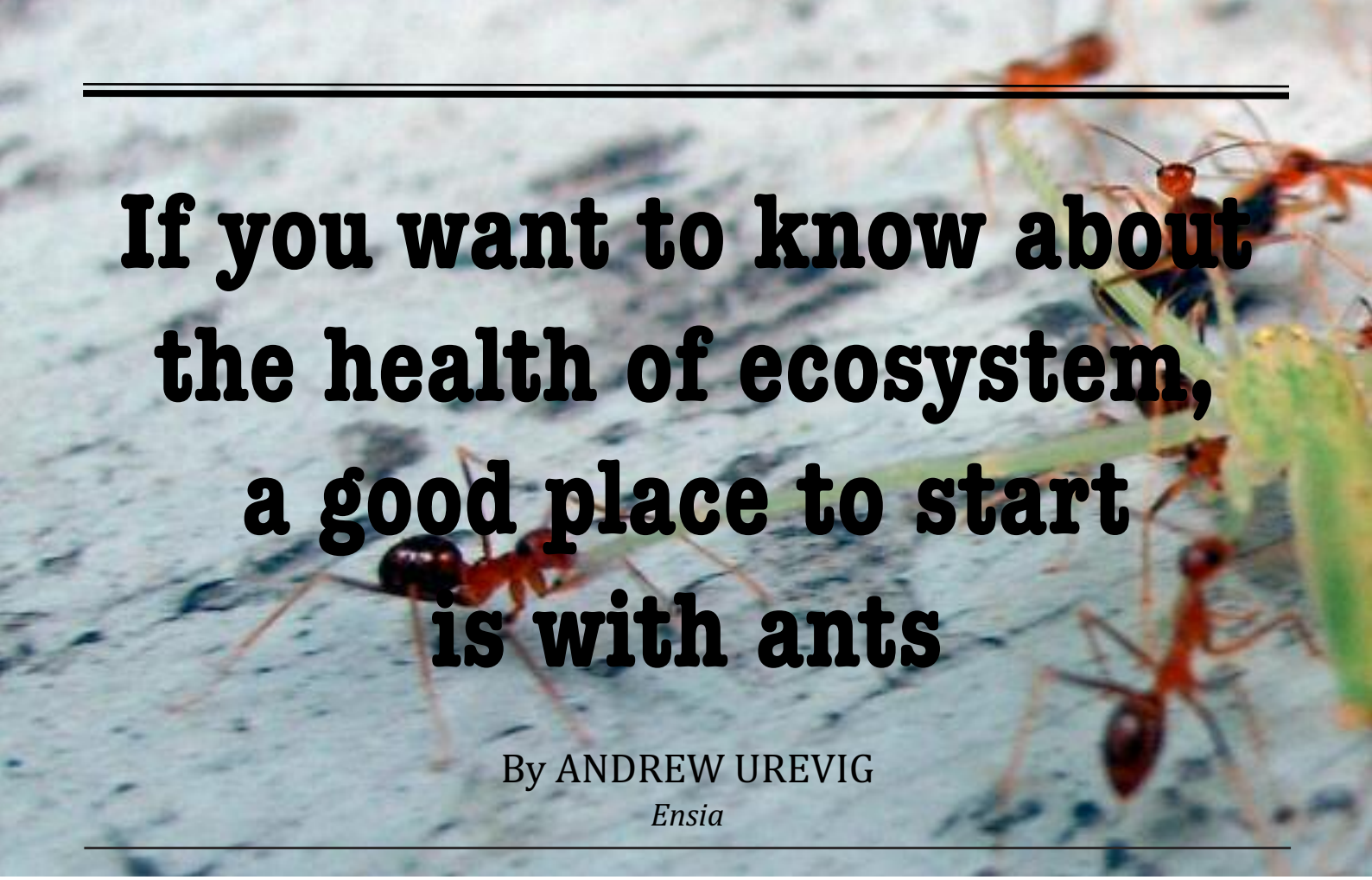

If you want to know about the health of ecosystem, a good place to start is with ants

By ANDREW UREVIG
Ensia

The ghost ant is aptly named. All six of its legs, not to mention the ant's antennae and abdomen, sport a spectral yellow — a pale hue that often fades into the background, leaving the ant's tiny brown head and torso to bob along, barely visible, like a spirit in the breeze.
Except the ghost ant is hardly a heavenly specter. It's an earth-bound creature common across much of the globe, adapted so well to human habitats that it's seen as a pest.

In an abandoned field in Brazil, many ghost ants have made their home. A team of biologists, there as part of research on how old farmland for sugarcane — a tropical grass used to make sugar, rum and ethanol fuel — has recovered once it's reforested with native plants, spotted these insects, and other ant species. In the plot, retired from sugarcane production just five years earlier, common denizens included ghost ants and fungus-farming Atta species, both of which also live in cities.

The presence of these ants in that field tells scientists one part of a story about how the area's environment is recovering from intensive agriculture. As stakeholders around the world look to rehabilitate ecosystems damaged by farming, mining and other activities, scientists are turning to ants — which play pivotal roles in most environments — to see exactly how effective restoration efforts are.

Telling Ecological Secrets

Ants make good ecosystem indicators because they interact with many other species — for example by eating spiders or making nests that double as homes for microorganisms — and influence important processes like nutrient cycling and seed dispersal. They live just about everywhere except the polar regions.

And their numbers are staggering. If you found a sufficiently large scale and weighed all the animals on Earth, ants would account for between 15 and 20 percent of that total biomass.

Like other insects, ants reproduce quickly, cycling through generation after generation much faster than do mammals and other vertebrates. "Ants in general respond quite easily to changes in their environment, and in that sense they can be used as indicators for many other species groups as well," says Pekka Punttila, a senior researcher at the Finnish Environment Institute.

In Brazil, the team that observed ghost ants published their findings in a study a little over a year ago. To learn more about projects to revitalize landscapes altered by sugarcane production, the researchers identified four plots of land: abandoned fields that had been reforested with native plant species five, ten, and twenty years prior, plus an undisturbed section of forest.

Then they had to catch ants. For that task, the team used pitfall traps. The traps are simple: small containers, about 2.4 inches (6 centimeters) in diameter, filled with water and detergent placed in the ground with the rim level with the surface. Ants of all sizes get caught by falling in. The other sampling method involved removing sections of soil.
Back in the lab, the scientists sorted through their finds and identified the genus of every ant specimen.

After running the numbers, the team found that each fragment of land supported ant communities that looked quite different. In the field reforested just five years prior, the most common ants were species also routine in urban areas.

In the areas left to nature for longer, especially the site undisturbed for 20 years, different ants proved dominant, for example the wood- and twig-nesting Pachycondyla. In the oldest native forest, one important genus was Crematogaster, composed of tree-dwelling predator ants.

As restoration plods on, the living things that settle an area alter its soil, its food sources, its entire environment, creating conditions that open the door for new species to take their place. Those new species revamp the ecosystem again, continuing the cycle of change biologists call ecological succession, a phenomenon most studied in plants. What's striking about the Brazil study is how clearly this change over time held for ants.

"Seeing this process occurring also with ants, seeing the succession theory working with animals, is very interesting," says Daniel de Paiva Silva, an ecologist at Brazil's Goiano Federal Institute of Education, Science and Technology who contributed to the research.

The study also analyzed what these various ant groups indicated about their environments, finding a strong association between ants and environmental attributes such as the humidity of leaf litter on the ground.

Key Indicators

A 2009 study found that ants are more diverse across the Southern Hemisphere, in places like Brazil, than they are north of the equator. It's no surprise, then, that the hotspot for research using ants to gauge ecosystems lies in the southern latitudes: Australia.

Home to many ant species, Australia is also home to a massive mining industry, which means thousands of retired or ready-to-retire mines. At some of these sites, ants are helping guide ecological restoration. Take the Ranger uranium mine. After more than three decades of operation by the Darwin-based Energy Resources of Australia Ltd. (ERA), the Ranger mine — located on land traditionally owned by the Mirarr Aboriginal people — ended uranium extraction in 2012, leaving workers to process what's left of the ore stockpiles.

Now the hard part begins. The Ranger site sits within the World Heritage–listed Kakadu National Park, and government regulations require ERA to rehabilitate the mine area — an important priority for the Mirarr people, too.

"The goal of the rehabilitation is to produce ecosystems similar to that surrounding park, so the land can be incorporated into the park," says Alan Andersen, a professorial fellow at the Research Institute for the Environment and Livelihoods at Charles Darwin University in Darwin, Australia. He's been tasked with establishing criteria to determine when ERA has met its obligations.

Setting standards for when the Ranger site can be absorbed into Kakadu means addressing a key issue: How can researchers measure whether two areas have similar ecosystems? Andersen's answer is ants. With his team, he ventures into Kakadu to discover which of the small social insects live in the area — knowledge he's using to write guidelines for how officials should assess the ecological restoration back at the mine site.

This entails catching ants by the tens of thousands, which he does using pitfall traps, just like the Brazilian research team. Though Andersen's traps are a bit smaller, they're the same sort of setup: small containers dug into the ground.

"And you sort of think … 'Who would just walk past and drop in?' But you will be amazed," Andersen says. He once collected 27 different ant species in a single trap over just two days. Back in the lab, Andersen and his team pour their collected ants onto a tray, sort them by species and tally the numbers. This process tells him about ant communities in Kakadu, and thus what ant communities at the Ranger site should look like once the area has been rehabilitated.

Back to the Beginning

This research stretches back decades in Australia. The story starts with Jonathan Majer, a recently retired Curtin University conservation professor whom Andersen describes as the father of using ants as indicators for ecosystem health.

In the 1970s, a young Majer — newly granted doctoral degree in hand — approached Alcoa, a Pittsburgh, Pennsylvania-based multinational that mined (and still mines) bauxite, the ore processed to make aluminum, in Western Australia. He says he told Alcoa he wanted to inspect revegetation efforts at some of the company's retired mine pits to see how ants and other invertebrates related to ecological restoration.

After Majer wrote a report on his observations, he partnered with Alcoa to study dozens more sites and publish a scientific paper looking at what factors encouraged ants to repopulate rehabilitated mines. "We wrote this up, and then it occurred to me … perhaps you could turn this around and look at the ant fauna as an indication of all these environmental conditions that they respond to," he says. "In other words, ask the ants, 'How well is the revegetation going?'"

By surveying what kinds of ants inhabit recovering biomes, and how common each species is, scientists can assess the success of tactics used to re-establish ecological communities. The idea aimed to make assessments of rehabilitation more rigorous. Routine approaches, Majer says, assumed that restoring plant life to an area equaled success. But simply planting an area with lush greenery isn't necessarily enough to entice the diverse crowd of insects and other invertebrates that a functioning ecosystem needs.

The immense variety of ants means a detailed sketch of the environment. "Some ants [are] cryptic species that require a thick, moist leaf litter layer," Majer explains. "Some ants require good sunlight to warm their nest up. Some ants are nesting in twigs or tree trunks. Some nest in the soil, and some nest in shaded soil, some nest in sunny soil."

Over the ensuing years, Majer has kept this work going — and going global. Ants have taught him about the status of ecosystems in Australia, but also in Brazil and South Africa. He even founded BioMonitoring International, a consulting company that employs many of the techniques he developed.

A Crucial Conversation

Where these techniques have seen less application is north of the equator, where fewer ants live. But the Northern Hemisphere isn't totally devoid of scientists who've chronicled ant life to learn more about ecosystems.

In southern Finland, people engaged in farming and forestry have drained nearly 80 percent of peatlands, swampy environments marked by partially decomposed plant matter. Dozens of Finnish species associated with these boggy mires have become more threatened, even as scientists increasingly realize the importance of such environments worldwide for storing carbon dioxide and thus mitigating climate change.

Metsähallitus, the organization that manages land and water areas owned by the Finnish government, aims to address the problem by filling ditches and removing trees, with the goal of recreating the sparse pine stands that mark Finland's natural mire habitats.

To get an idea of whether this restoration strategy works, Pekka Punttila partnered with a team of other scientists. They analyzed both plants and ants in pristine, drained and recently restored mires. Even though ants are less numerous in colder, more northern regions like Finland, at least a third of the country's 55 native ant species count mires as crucial habitat.

The team published their findings in a 2016 journal article. After sampling ants with pitfall traps, the researchers found that mires restored a mere one to three years prior had already attracted many new species. "This surprisingly rapid reaction by the ants is the most important message in our paper," Punttila says.

Since the study tracked mire ants for just three years, Punttila cautions, future research should include longer term monitoring. It's a point echoed by Andersen in Australia.

A clear picture of what ants look like in Kakadu National Park will set the benchmark Alcoa, the mining company, must meet before the Ranger site can be incorporated into the park, but achieving those goals will likely prove difficult. The restoration, after all, is starting with bare rock. "How long is it going to take to be successful?" Andersen asks. "A long time."

Yet no matter how long it takes to rehabilitate environments maimed by mining or farming, something is certain: Ants of one kind or another will be there marching, eating and reshaping the ecosystem — ready to speak up, if only people have the good sense to ask them how things are going.

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One Earth Climate Model

The result of the modeling effort shows that not only is it possible to switch to 100% renewables for all energy uses, but it will cost much less to operate than today's energy system.

By KARL BURKART

Leonardodicaprio.org

A state-of-the-art climate model, funded by the Leonardo DiCaprio Foundation and released by the prestigious scientific publisher Springer Nature, offers a roadmap for meeting -- and surpassing -- the targets set by the Paris Climate Agreement, showing that we can solve the global climate crisis with currently available technologies and natural climate solutions.

The book, entitled *Achieving the Paris Climate Agreement*, was the culmination of a two-year collaboration with 17 leading scientists at the University of Technology Sydney (UTS), two institutes at the German Aerospace Center (DLR), and the University of Melbourne's Climate & Energy College.

As the Intergovernmental Panel on Climate Change (IPCC) warned in its Special Report on Global Warming of 1.5°C (SR1.5) released October 2018, the Earth must be kept below the dangerous threshold of 1.5°C in global average temperature rise above pre-industrial levels if we are to avoid a worsening of climate-related impacts. We are already seeing the devastating consequences of the current 1°C global temperature increase, including rising sea levels in many coastal cities, extreme storms, prolonged droughts, and intensified wildfires.

The impacts resulting from a higher 2°C level are almost unimaginable -- the death of the coral reefs in every ocean, the collapse of nearly one-quarter of the world's agricultural land, dramatically increased heat waves and wildfires, 100 million people driven to extreme poverty sparking multiple refugee crises, 1 meter of sea level rise in some regions, and more than $11 trillion per year in damages from extreme storms and flooding. Stacked upon each other, these impacts and many more, could undermine the very fabric of life on our planet, greatly challenging the continuation of human civilization as we currently know it.

Up until now, it was assumed to be difficult, if not impossible, to achieve the carbon budget required to stay below 1.5˚C – a maximum of 400 billion tonnes of cumulative carbon dioxide emissions (GtCO2) from January 2018 on. Humans today release approximately 39 GtCO2 per year, mostly from the burning of fossil fuels -- coal, oil, and natural gas. At our current level of emissions, we would only have 7 years to completely cease the use of all fossil fuels, which is clearly not feasible. While many scientists have modeled 1.5°C climate mitigation pathways, to make the math work almost all of them require the use of unproven and potentially dangerous geoengineering strategies like Solar Radiation Management (SRM) or Bio-energy with Carbon Capture & Storage (BECCS).

The One Earth climate model is groundbreaking in that it shows the 1.5°C target can be achieved through a rapid transition to 100% renewables by 2050 (65% by 2030), alongside a major conservation effort to increase the resilience of natural ecosystems and help ensure greater food security. This includes a moratorium on land conversions by 2030 and 400 GtCO2 of 'negative emissions' from forest and land restoration (shown in gold below the zero line), which pulls carbon dioxide out of atmosphere and stores it in trees and soil.

Co-author and editor Dr. Sven Teske, Research Director of the Institute for Sustainable Futures at the University of Technology Sydney (UTS) said, "Scientists cannot fully predict the future, but advanced modeling allows us to map the best scenarios for creating a global energy system fit for the 21st century. And with momentum around the Paris Agreement lagging, it's crucial that decisionmakers around the world can see that we can, in fact, meet global energy demand at a lower cost with clean renewables."

Six components are needed to achieve the 1.5˚C climate target.
Image copyright: Springer Nature.

Some have doubted that a transition to 100% renewables is even possible. To explore the potential, the scientists at UTS created a sophisticated computer model of the world's electrical grids to date -- with 10 regional and 72 sub-regional energy grids modeled in hourly increments to the year 2050 along with a comprehensive assessment of available renewable resources like wind and solar, minerals required for manufacturing of components, and configurations for meeting projected energy demand and storage most efficiently for all sectors over the next 30 years.

The result of the modeling effort shows that not only is it possible to switch to 100% renewables for all energy uses, but it will cost much less to operate than today's energy system. Moreover, it will eliminate the toxic pollution associated with the burning of fossil fuels, estimated to be the primary cause of 9 million premature deaths per year. The renewable energy transition will not only improve public health worldwide, it will also drive economic development, providing the 30 million people currently working in the energy sector with permanent, well-paying jobs and creating an additional 12 million new jobs.

The proposed energy transition outlined in the One Earth climate model will require an investment globally of approximately $1.7 trillion per year. This sounds like a lot, but it pales in comparison to the vast subsidies governments currently provide to prop up the ailing fossil fuel industry, estimated at more than $5 trillion per yearby the International Monetary Fund (IMF). Taxpayers are unwittingly funding the climate crisis, and that needs to stop.

The research tells us that we could be creating the clean energy future we so desperately need for less than one-third of what we're spending now, and in so doing improve energy access in the developing world. Leonardo DiCaprio, Founder of LDF, said, "With the pace of urgent climate warnings now increasing, it's clear that our planet cannot wait for meaningful action. This ambitious and necessary pathway shows that a transition to 100% renewable energy and strong measures to protect and restore our natural ecosystems, taken together, can deliver a more stable climate within a single generation."

There are five major components to the renewable energy transition. First is increased capacity to generate electricity mostly through solar and wind power, enabling the electrification of all energy uses including power, heating, transportation, and even industrial uses. Second is increased storage capacity in the form of battery arrays and pumped hydroelectric (which uses excess generation to pump water up to a reservoir releasing the energy when needed). Third is energy efficiency – decreasing overall energy consumption, especially in the developed world, by making buildings, cities, and vehicles more efficient. Fourth involves repurposing the existing gas pipeline and storage infrastructure to deliver hydrogen produced by renewable sources. And fifth is a gradual retraining of the energy workforce to participate in the burgeoning green economy.

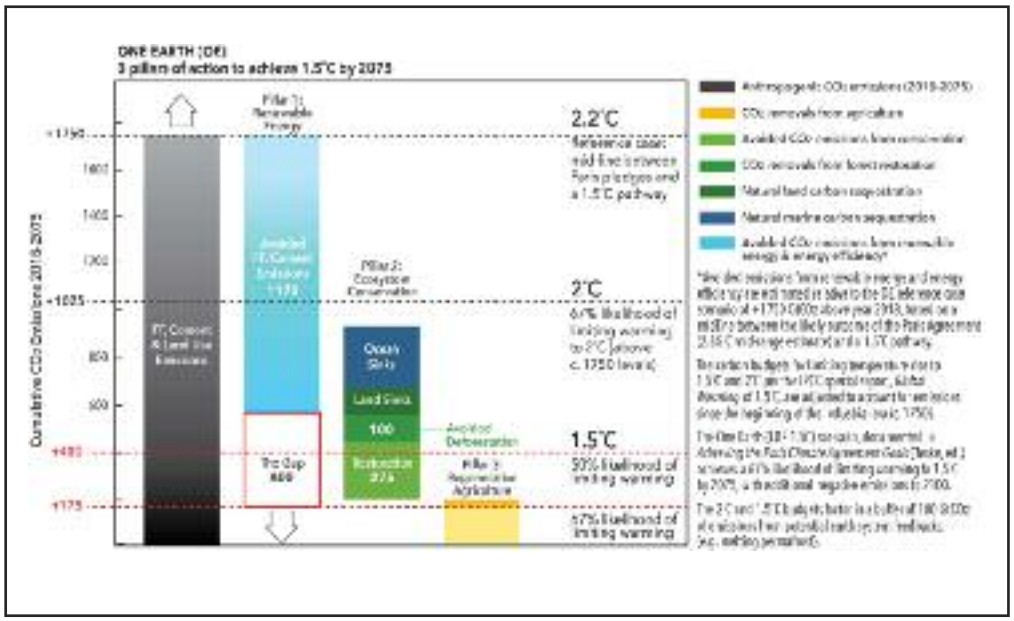
The sixth major component of the climate model is land restoration. "Citing a growing body of research, we show that using land restoration efforts to meet negative emissions requirements, along with a transition to 100% renewable energy by 2050, give the world a good chance of staying below the 1.5°C target," said Malte Meinshausen, co-author, Founding Director of the Climate and Energy College at the University of Melbourne and Potsdam Institute Fellow.

Natural Climate Solutions (NCS) include everything from restoring natural forests, grasslands, and wetlands to improving soil fertility through regenerative agricultural practices like agroforestry, silvopasture, and cover crops. These solutions not only absorb carbon, they also dramatically increase sustainable livelihoods in the developing world, offering improved water supplies, reduced soil erosion, and higher quality crop yields.

The One Earth model shows just how important our natural ecosystems are. Justin Winters, Executive Director of the Leonardo DiCaprio Foundation, said, "Nature is the missing key. While the renewable energy transition is imperative to solving the climate crisis, it isn't enough. Currently wildlands and oceans absorb one-half

of all our CO2 emissions. As this climate model shows, in order to keep global temperature rise to no more than 1.5°C, we have to keep our natural carbon sinks intact, scale up restoration efforts and shift to regenerative agriculture. Without them we have no future."

The land use sector should be a big part of the climate solution. Unfortunately, because of rampant deforestation and unsustainable industrial agriculture and livestock practices, it is a net emitter of greenhouse gas pollution. Many efforts, like the New York Declaration on Forests, is working to halt deforestation, and UN Sustainable Development Goal 15 calls for an end to this destructive practice by 2030. The climate model shows that by protecting natural ecosystems and completely phasing out deforestation in the 2030's, we can maintain the integrity of the carbon sinks that are so vital to rebalancing our global climate system.



The newly released climate model is part of the larger One Earth initiative, launched by the Leonardo DiCaprio Foundation in 2017. The initiative builds upon the latest science to create a vision for the world that is possible in 2050, a world in which humanity and nature can coexist and thrive together.

The vision is based upon three pillars of action – 100% renewable energy, protection and restoration of 50% of the world's lands and oceans, and a transition to regenerative agriculture, all by 2050. Together, these pillars of action give us a global roadmap to tackle the climate crisis and to ensure a sustainable future for all of Earth's inhabitants.

The One Earth Reference Case

After 20 years of negotiations, the world's governments came together under the United Nations Framework Convention on Climate Change (UNFCC) and established the Paris Climate Agreement in 2015 (COP25). They created a structure in which countries could submit pledges, called Nationally Determined Commitments (NDCs), that would be added together to achieve the target of staying "well below 2˚C" in global average temperature rise, with the goal of gradually increasing commitments over time.

Despite Trump's move to increase fossil fuel production in the United States and his stated "pull-out" from the Paris Agreement, current global emissions are actually leveling off. In 2017 emissions were about 39 GtCO2 per year, and emissions could peak by 2020 according to many experts.

While the Paris Climate Agreement was a success in many ways, it's very clear that it will not deliver what is needed to achieve reductions sufficient to avoid a climate crisis. The latest analysis of government commitments by Climate Action Tracker estimates the current pledges would result in about 2.85˚C of global temperature rise.

There is hope, however, in the next commitment period that pledges will increase, as the world wakes up to the disastrous impacts of our current level of warming. So for the purposes of an optimistic "reference case" scenario, One Earth uses the midline between current pledges and what is needed to achieve 1.5˚C.

The reference case factors in a plateau period between 2018-2020 of an average of 39 GtCO2 per year, and then a linear reduction in CO2 at approximately 1% per year between 2021-2075. The resulting cumulative emissions of the OE reference case are approximately 1750 GtCO2 emissions total, less 1175 GtCO2 from avoided FF emissions, with approximately 100 GtCO2 in avoided land use emissions and 275 GtCO2 in negative emissions from reforestation & 25 GtCO2 negative emissions from agroforestry. Another 175 GtCO2 is possible in negative emissions from the agricultural sector could bring us back to 2018 levels by end of century.

It's clear that all 3 pillars of action are required to achieve the goal of limiting warming below 1.5˚C. A transition to 100% renewables by 2050, while incredibly aggressive, is not sufficient to get to a low (50%) likelihood of the target, much less a strong (67%) likelihood.

Environmental conservation, which avoids approximately 100 GtCO2 of emissions from land use change relative to the reference case, plus 275 GtCO2 in negative emissions from environmental restoration gets us very close to the goal, but it takes an additional 25 GtCO2 in negative emissions from the agriculture sector to actually get to a strong likelihood of staying below 1.5˚C.

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Water: underground source for billions could take more than a century to respond fully to climate change

By MARK CUTHBERT, KEVIN BEFUS, TOM GLEESON
The Conversation

Groundwater is the biggest store of accessible freshwater in the world, providing billions of people with water for drinking and crop irrigation. That's all despite the fact that most will never see groundwater at its source – it's stored naturally below ground within the Earth's pores and cracks.

While climate change makes dramatic changes to weather and ecosystems on the surface, the impact on the world's groundwater is likely to be delayed, representing a challenge for future generations.

Groundwater stores are replenished by rainfall at the surface in a process known as "recharge". Unless intercepted by human-made pumps, this water eventually flows by gravity to "discharge" in streams, lakes, springs, wetlands and the ocean. A balance is naturally maintained between rates of groundwater recharge and discharge, and the amount of water stored underground.

Groundwater discharge provides consistent flows of freshwater to ecosystems, providing a reliable water source which helped early human societies survive and evolve.

When changes in climate or land use affect the rate of groundwater recharge, the depths of water tables and rates of groundwater discharge must also change to find a new balance. The time it takes for this new equilibrium to be found – known as the groundwater response time – ranges from months to tens of thousands of years, depending on the hydraulic properties of the subsurface and how connected groundwater is to changes at the land surface.


Amazon River. Photo: Lubasi

Estimates of response times for individual aquifers – the valuable stores of groundwater which humans exploit with pumps – have been made previously, but the global picture of how quickly or directly Earth's groundwater will respond to climate change in the coming years and decades has been uncertain. To investigate this, we mapped the connection between groundwater and the land surface and how groundwater response time varies

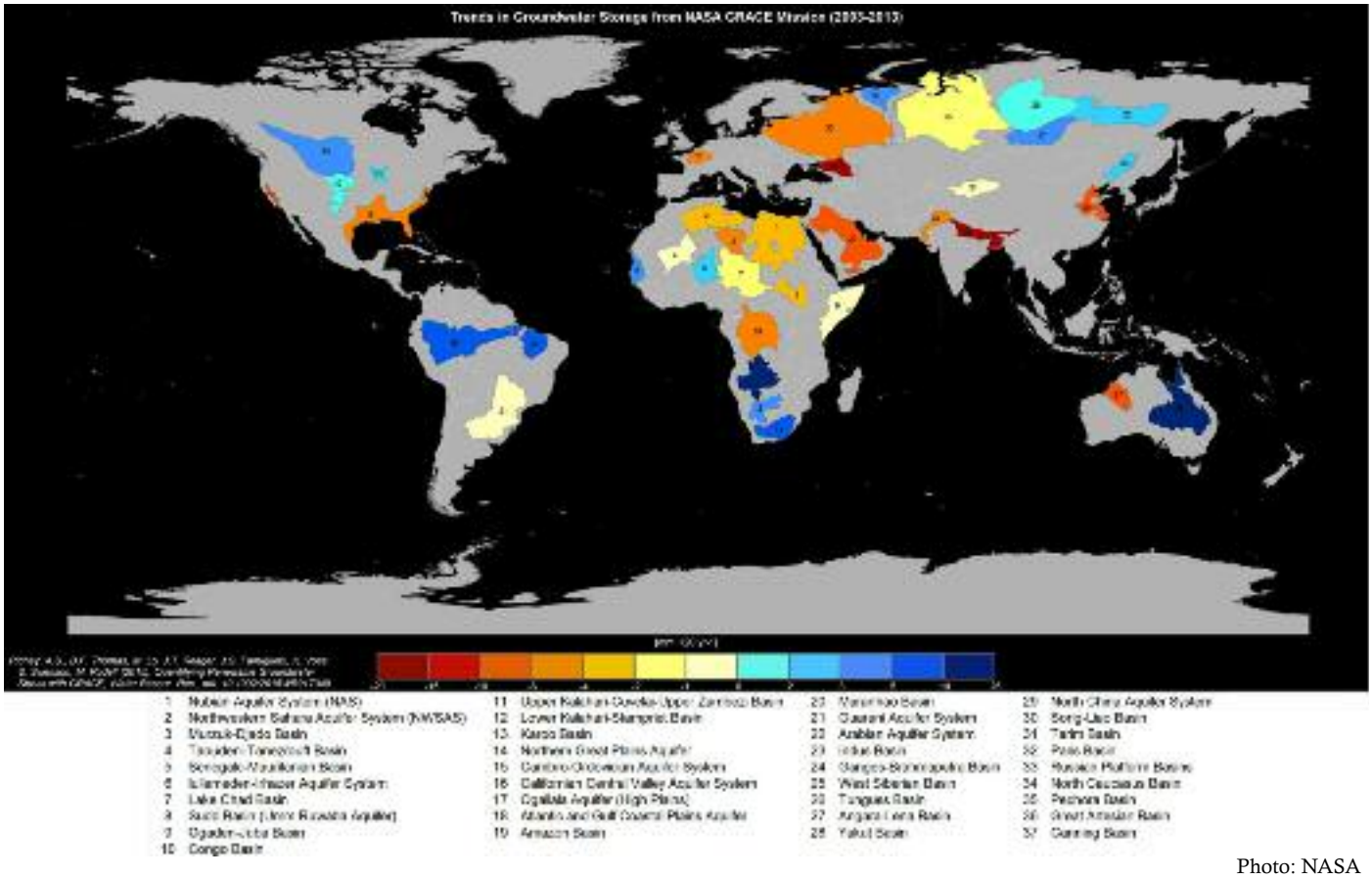

Photo: NASA

across the world.

The long memory of groundwater

We found that below approximately three quarters of the Earth's surface, groundwater response times last over 100 years. Recharge happens unevenly around the world so this actually represents around half of the active groundwater flow on Earth.

This means that in these areas, any changes to recharge currently occurring due to climate change will only be fully realised in changes to groundwater levels and discharge to surface ecosystems more than 100 years in the future. We also found that, in general, the driest places on Earth have longer groundwater response times than more humid areas, meaning that groundwater stores beneath deserts take longer to fully respond to changes in recharge.

In wetter areas where the water table is closer to the surface, groundwater tends to intersect the land surface more frequently, discharging to streams or lakes.This means there are shorter distances between recharge and discharge areas helping groundwater stores come to equilibrium more quickly in wetter landscapes. Hence, some groundwater systems in desert regions like the Sahara have response times of more than 10,000 years.

Groundwater there is still responding to changes in the climate which occurred at the end of the last glacial period, when that region was much wetter. In contrast, many low lying equatorial regions, such as the Amazon and Congo basins, have very short response times and will re-equilibrate on timescales of less than a decade, largely keeping pace with climate changes to the water cycle.

Geology also plays an important role in governing groundwater responses to climate variability. For example, the two most economically important aquifers in the UK are the limestone chalk and the Permo-Triassic sandstone.

Despite both being in the UK and existing in the same climate, they have distinctly different hydraulic properties and, therefore, groundwater response times. Chalk responds in months to years while the sandstone aquifers take years to centuries. In comparison to surface water bodies such as rivers and lakes which respond very quickly and visibly to changes in climate, the hidden nature of groundwater means that these vast lag times are easily forgotten. Nevertheless, the slow pace of groundwater is very important for managing freshwater supplies.

The long response time of the UK's Permo-Triassic sandstone aquifers means that they may provide excellent buffers during drought in the short term. Relying on groundwater from these aquifers may seem to have little impact on their associated streams and wetlands, but diminishing flows and less water could become more prevalent as time goes on.

This is important to remember when making decisions about what rates of groundwater abstraction are sustainable. Groundwater response times may be much longer than human lifetimes, let alone political and electoral cycles.

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Photo credit: Discovod

HARLAN COUNTY

A defining date that will reshape the local economy of Harlan County: 25 August 1911. The day of the first commercial coal shipment by rail in the area. The coal came from the land owned by a local businessman, Jesse M. Blanton. A story recalled by the Herald Leader to celebrate a century of coal mining in the county, said that the future president of the United States Franklin Delano Roosevelt went to Harlan County in the 1910s and "asked Blanton what he thought of a steep mountain in the distance as an investment for Roosevelt. Blanton dismissed it, and Roosevelt rode off, but the local entrepreneur actually realized the potential value of the land. He sold other property to buy part of the mountain and later leased it to a coal company to mine because he knew the railroad was coming".

Farming was soon replaced by the coal industry. Coal production went from 25,814 tons in 1910 to more than 15 million tons by the late 1920s. The population tripled as the coal industry provided jobs at an unprecedented rate. The miners included African and European immigrants. The social change was immense with people who used to be independent farmers suddenly living in crowded camps owned by someone else. The new reality was working for a wage now. Harlan County was no different than many others, and after the growth, there was the decline. The coal boom had stalled well before the 1929 Great Depression strangled the county's coal industry. According to the book A New History of Kentucky by Lowell Harrison and James Klotter, by 1932, a third of the county's mines had closed. During World War II the demand for coal increased but dropped again after the railroads stopped using coal to fuel locomotives. Jobs and population followed the same curve, returning in 2010 to the low-level pre-1920. The Kentucky Coal Museum brings back those golden days for tourists, whereas Blanton descendants still own the land their Jesse bought. ONE

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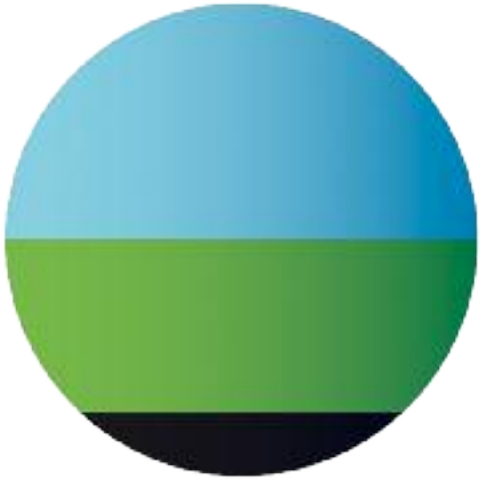

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