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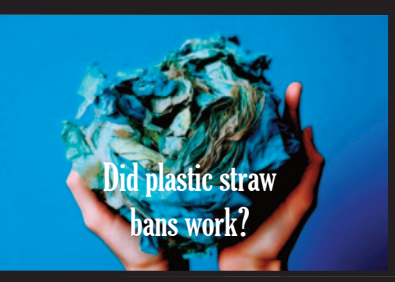
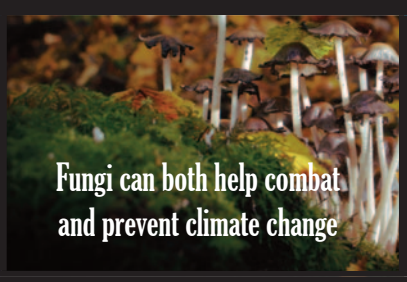
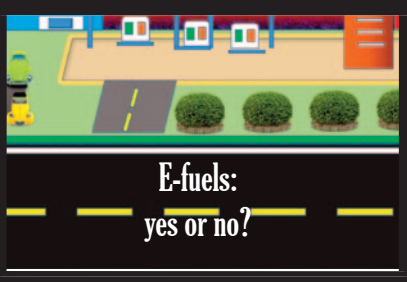
(Fossil fuels) Phasing down or out?



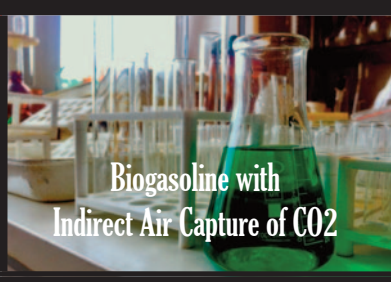
Did plastic straw bans work?



Fungi can both help combat and prevent climate change



E-fuels: yes or no?



Biogasoline with Indirect Air Capture of CO2

YEAR IX - NUMBER 4 - OCTOBER-DECEMBER 2023

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Oil sands, Fort McMurray, Alberta.
Photo credit: Eryn Rickard

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info@onlynaturalenergy.com

India's Prime Minister Narendra Modi: "We believe there is a need to move away from a purely restrictive attitude of what should not be done, to a more constructive attitude focusing on what can be done to fight climate change."
Photo credit: Stelios Misinas (Reuters)

Down and Out

GIANNI SERRA
ONE

Words matter. If appropriate, they help understanding. And even if imprecise or absent, they help, as they often reveal the underlying intention or end goal.

A few years ago, the Trump administration removed the term climate change from official communications to replace it with extreme weather. Even though the weather is what happens today, the climate is what happens over the long run. This deliberately misleading substitution served the narrative that climate change was a hoax and so were the main arguments against the exploitation of fossil fuels.

It is a mistake to equate Trump's wordplay with India's demand to talk about phasing down from fossil fuels instead of phasing out—reduction instead of elimination.

And while one might think that India is playing with words or denying reality, the opposite is true. Fossil fuels' phase-out is a mirage. The numbers cast doubt on whether one can credibly speak of phase down. India has an estimated 65.3 GW of proposed on-grid coal capacity under development—30.4 GW under construction and 34.9 GW in pre-construction. This capacity represents nearly a third of the country's operational on-grid, non-export coal capacity (212.5 GW).

The mirage of a decarbonised world is not only for India. According to Enerdata's World Energy & Climate Statistics – Yearbook 2023, in 2022, global energy demand rose, and 81 per cent of the total supply was provided by oil (30 per cent), coal (28) and gas generation (23). In the International Energy Agency's World Energy Outlook 2023 scenario, the share of fossil fuels in the global energy supply declines to 73% only in 2030. In the meantime, subsidies for fossil fuels are soaring—more than €900 billion in 2022, the highest figure ever recorded.

Fossil fuels out? Not even close. Fossil fuels down? Not yet. ONE

Fungi Can Both Help, Combat and Prevent Climate Change

LENORE HITCHLER
ONE

There are many ways to fight climate change. Using fungi to combat climate change is benign, easy, and less expensive than high-tech solutions. Industrial agriculture is a heavy contributor to climate change, and farming that uses the fungal kingdom is a good low-carbon alternative.

Raising mushrooms for their nutritional value will leave a low carbon footprint. Also, either directly or indirectly, the removal of carbon dioxide (CO2) from the environment is aided by various types of fungi including endophyte and mycorrhizal fungi.

A strand of mycorrhizal fungus can be one cell thick, but the overall scope of fungi is immense. It is estimated that there are between six and eight million species of fungi.

Fungi is the plural form of fungus and represents a distinct biological kingdom, just as plants and animals are each separate kingdoms.

The fungal kingdom includes mushrooms, molds, mildews, and yeast in addition to the fungi found both in and on plant roots, inside plant tissues, and in the soil. Some species of fungi have harmful effects on humanity. For example, consuming poisonous mushrooms can be fatal. Some molds and mildew are extremely destructive to health or property. Other fungal species can either severely damage or kill forests or food crops.

However, for the most part, fungi are necessary for plants to thrive, and some mycologists even assert that plants need fungi to survive. Mycorrhizal fungi supply plants with water and nutrients, and in turn receive carbohydrates, which contain carbon. These fungi help store carbon underground in soil organic matter. Soil organic matter contains more than two-thirds of the carbon stored on land. An article in *Current Biology* reported that worldwide, plants pump an estimated thirteen gigatons of CO2 into underground fungi every year. Each gigaton is equal to one billion metric tons. The *Food and Agriculture Organization of the United Nations* reported that "Keeping the carbon already contained in the soil is more effective than any other practice aiming at capturing atmospheric carbon."
Besides mycorrhizal fungi helping to store carbon underground in the soil, endophyte fungi help maintain plants so that they are able to store carbon above the ground. Endophyte fungi are found within the tissues of their host plants, and they live in plant roots, stems, buds, leaves, fruit, and seeds. An article in *OIKOS* reported that

Mushrooms fungi toadstool. Photo credit: Pixabay

"Growing evidence indicates that endophytes are found in all plants."

An article in the *American Journal of Biology* added that fungal endophytes are symbionts "that can affect plant physiology and growth under stressed conditions. … In very stressful thermal or saline environments, endophytes have been isolated that confer heat or salt resistance on a variety of plant hosts." According to an article in The ISME Journal, "native grass species from coastal and geothermal habitats require symbiotic fungal endophytes for salt and heat tolerance." Endophytes also help to protect plants from other forms of stress such as heavy metals, including arsenic, cadmium, lead, and chromium. According to an article in *Frontiers in Microbiology,* endophytic fungi increased their host plant's tolerance to heavy metals, thus helping their host's ability to survive in contaminated soil. Besides helping plants cope with toxic metals, endophytic fungi are important in combating plant stress due to climate change as reported in *The ISME Journal.* The article reported that "The ability of fungal endophytes to confer stress tolerance to plants may provide a novel strategy for mitigating the impacts of global climate change on agricultural and native plant communities."

One climate change-induced stress for agricultural crops is increased pest infestations. According to an article in *The Quarterly Review of Biology*, endophytes provide "pathogen immunity to their host; they can also ward off herbivores." An article in *Frontiers in Microbiology* reported that "Chemicals produced by endophytic fungi were toxic or distasteful to insects."

Unfortunately, modern agriculture threatens valuable fungi. According to Alan Gange, Ph.D., professor of microbial ecology, plant breeding and fungicides have resulted in modern crops having far fewer natural fungal partners than their counterparts in the wild. Agricultural crops are not the only types of plants that are reliant on fungi as trees also depend on fungi. Mycologist Paul Stamets reported that "Without fungi, there are no forests."

This is important as forests are extremely valuable in combating climate change. An article in *Global Change Biology* stated that "Forests represent 31% of global land surface area and currently offset around 2.4 Pg [each petagram equals 1 billion tonnes] of CO2 emissions every year by storing carbon in live plant biomass and soil."

An article in *Plant Ecology* added that "Many forests around the world would not exist in the absence of their mycorrhizal symbionts. Temperate, boreal, and Mediterranean forests harbor hundreds of different species of

"Without fungi, there are no forests."

Paul Stamets, mycologist

ectomycorrhizal fungi." Thus, to combat climate change, trees need to thrive, and therefore the fungi originally found in forests must flourish. Clear-cutting forests endangers fungi. In an article in *The Guardian*, Toby Kiers, Ph.D., professor of evolutionary biology, and microbiologist Merlin Sheldrake, Ph.D., discussed the harmful effect of logging on fungi. The article reported that "Logging wreaks havoc below ground, decreasing the abundance of mycorrhizal fungi by as much as 95%, and the diversity of fungal communities by as much as 75%."

Tree roots are extremely important in storing carbon. An article in *Scientific American* reported that 50 to 70% of the carbon found in the soil comes from tree roots and the fungi that grow on them. Unfortunately, anything that harms fungi also limits the ability of forests to combat climate change. For example, pollution damages fungi. An article in *Nature* reported that "Pollution could be starving Europe's trees of vital nutrients by damaging essential fungi. Signs of tree malnutrition, such as discolored or missing leaves, have been observed throughout European forests."

Dr. Laura Suz, of the *Royal Botanic Gardens*, a co-researcher on the study, stated that trees need mycorrhizae fungi to obtain nutrients and water from the soil. Douglas fir trees are just one example of a tree species that are reliant on fungi. An article in Whole Earth Magazine reported that throughout the lifespan of a Douglas Fir tree, nearly 200 species of mycorrhizal mushrooms may form a symbiotic relationship with the tree. Ecologist Simone Webber, Ph.D., added that "Plants used the mycorrhizal network to 'share' warnings about predation, with species such as Douglas Fir sending stress signals into the mycorrhizal network when they are attacked by predators. These signals reach neighboring trees, which can then mount a defense, and even trees of different species exhibit this response."

In addition to fungi helping trees and other plants store carbon in foliage and soil, growing mushrooms for dietary purposes will also help combat climate change. Less fossil fuels are used in their production than livestock or even growing agricultural crops. Mushrooms are produced with less water, land, and fossil fuels than otherwise would be used in the production, transportation, and application of fertilizers and pesticides. Thus, mushrooms are a low-carbon source of nutrition. There are various nutrients in mushrooms that contribute to a healthy diet.

An article in *Nutrition Journal* reported that "Our meta-analysis of prospective cohort studies found that mushroom consumption was associated with a lower risk of all-cause mortality. … A recent systematic review and meta-analysis of observational studies conducted by our research team indicated that higher mushroom consumption was associated with a lower risk of total cancer."

Robert Beelman, Ph.D., professor of food science, stated that mushrooms are good sources of antioxidants. "Oxidative stress is considered the main culprit in causing the diseases of aging such as cancer, heart disease and dementia. … A recent epidemiological study conducted with over 13,000 elderly people in Japan showed that those who ate more mushrooms had less incidence of dementia."

Thus, mushrooms may prevent various diseases, and recent research has even found that mushrooms may even help to cure various diseases, such as cancer. Therefore, consuming mushrooms is part of a healthy and nutritious diet. Dr. Beelman added that mushrooms do not contain cholesterol or gluten and are low in fat, sugars, sodium, and calories, and are also a good source of vitamin D.

An article in *Nutrition Journal* reported that mushrooms are good sources of phytochemicals, polysaccharides, and minerals, such as selenium and copper, in addition to essential vitamins, including such B-vitamins as niacin, thiamin, riboflavin, and vitamin C. As well as providing many essential nutrients, mushrooms have the potential to become a major source of protein. According to an article in *Frontiers in Sustainable Food Systems*, "Fungal-derived mycoproteins are gaining in popularity due to their healthy nutritional profile, ability to be produced at low cost, environmental benefits, and resilience to landscape limitations such as flood or drought."

An example of a high-protein mushroom is the Lactarius indigo (L. indigo) mushroom, also called the blue milk cap. It is native to the New World from Canada to southern Brazil, plus China and parts of India. It forms symbiotic relationships with trees. Therefore, to obtain protein from these mushrooms, forests would have to be retained, thus preventing deforestation, maintaining biodiversity, and storing carbon.

According to an article in *Science of the Total Environment*, L. indigo can provide around fifteen pounds of protein per 2.47 acres whereas, in extensive pastoral systems, beef provides from around 10.49 pounds to 15.1 pounds of protein per 2.47 acres. Besides preventing deforestation, no fertilizers, pesticides, irrigation, or veterinary services are necessary. Animals will not have to suffer in factory farms and produce wastes that are too concentrated for soil decomposers to easily break down. Additionally, L. indigo has various characteristics that promote good health. For example, extracts showed strong antibacterial properties and "displayed significant inhibition of carcinogenic cells."

Just as L. indigo can be used as a protein source, various other mushrooms can be processed to create an excellent protein. According to the *Potsdam Institute for Climate Impact Research*, "Microbial protein is made in specific cultures, just like beer or bread. The microbes are living on sugar and a steady temperature, and getting out a very protein-rich product that can taste like, feel like, and be as nutritious as red meat. Based on the centuries-old method of fermentation, it was developed in the 1980s. The U.S. Food and Drug Administration green-lighted a microbial protein meat alternative (mycoprotein) as safe in 2002."

Besides being an excellent source of protein, mycoprotein provides important nutrients. The article in *Frontiers in Sustainable Food Systems* reported that "Microprotein, according to European Commission standards is 'high in fiber,' i.e., providing at least 0.21 ounces of fiber per 3.53 ounces. ...When compared with the other protein food sources, mycoprotein does well for vitamin B9 (folate), vitamin B12, calcium, phosphorous, magnesium, and zinc."

In addition to providing essential nutrients, mycoprotein from mushrooms is much more climate-friendly than protein from beef. This is extremely important because raising beef uses both a lot of energy and land. An article from *Forbes* reported that "More than a quarter of the planet's ice-free land is used for cattle grazing, and a further 33% of all croplands are used to produce food for cattle. Beef production is the number one driver of deforestation globally."

Additionally, producing lamb, pork, and poultry also uses a tremendous amount of energy, natural resources, and land, thereby increasing climate change. Promyc is an example of a manufactured protein source derived from mushrooms. This is not an endorsement of the product; it is merely an example of a mycoprotein that has been produced. According to the manufacturer, "Promyc is a complete protein containing all the essential amino acids [54.4%]. Mycoprotein has a higher percentage of essential amino acids than most other plant-based and animal-based protein sources, including soy (36%), milk (41%), poultry (45%), and even whey protein (43%)."

Besides providing an excellent source of vegetarian protein, Promyc may help to fight obesity, which is a major health problem. Increasing satiety, the state of feeling full after a meal, helps lower calorie consumption. According to the Promyc manufacturer, "In a test group, individuals who had a mycoprotein lunch were compared to an identical group that had a chicken lunch. At dinner that day and the following day, individuals who had eaten the mycoprotein lunch ingested up to 24% less calories.

The reason for this is thought to be a combination of both the protein and the fiber present since both these components have been related to increased satiety in a meal."

Thus, fungi can provide high-quality nutrition in addition to storing carbon and leaving a low-carbon footprint. Growing mushrooms for their nutritional value can provide new opportunities for farmers. It also validates retaining forests as a source of food as opposed to destroying them to produce crops to feed livestock.

There are many other potential uses for the fungal kingdom in a more ecological and sustainable world. For example, mushrooms have historically been used in traditional and indigenous medicine, and researchers are confirming the medicinal value of mushrooms.

Designers are working on producing leather and other fabrics from fungi, and architects are even working on creating buildings made from it. Scientists have found ways to use mushrooms to remove toxic pollutants. In other words, employing the fungi kingdom has an amazing potential to both create a less toxic world and combat climate change. ONE

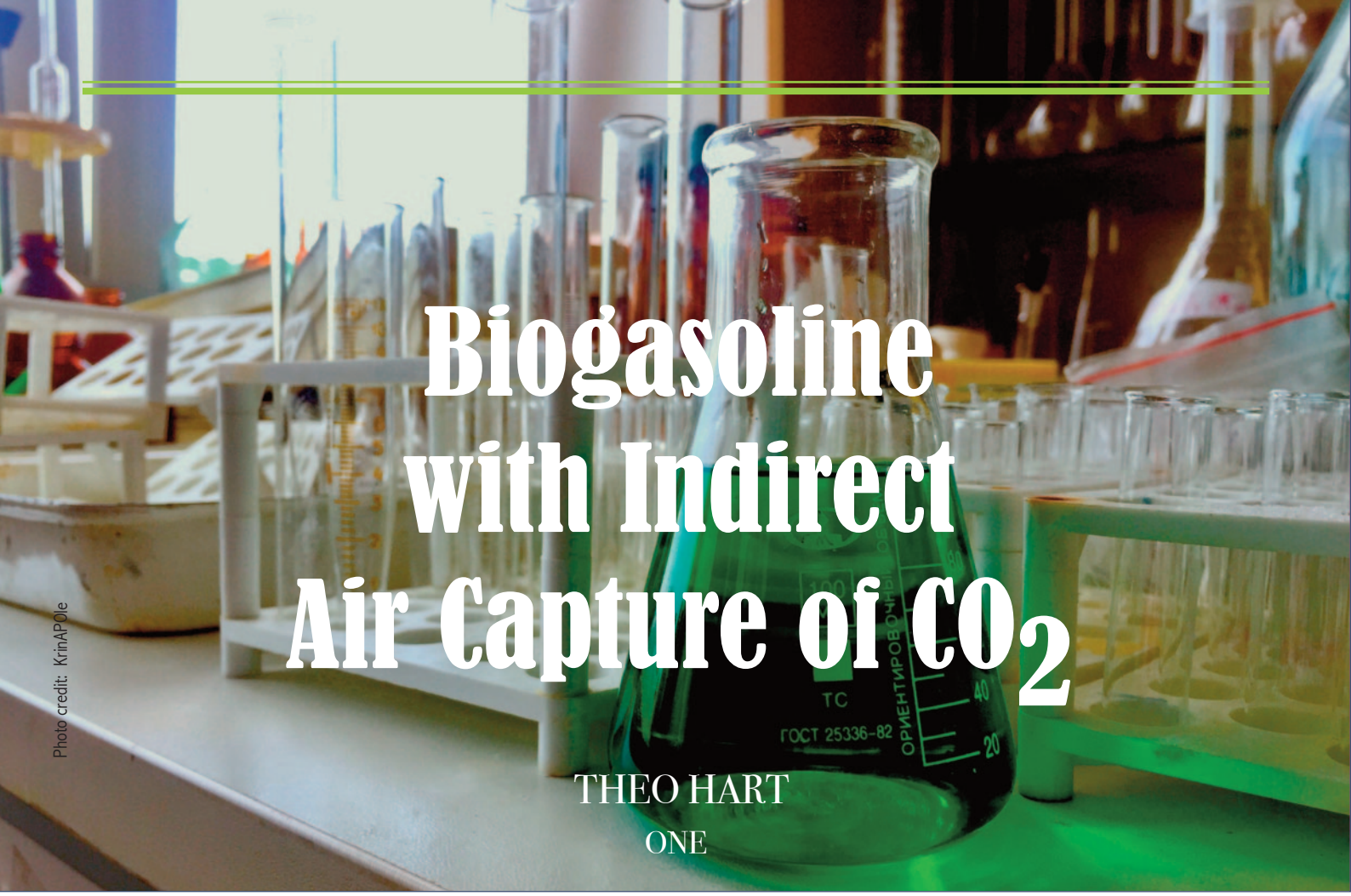

Photo credit: KrinAP0le

Biogasoline with Indirect Air Capture of CO_2

THEO HART
ONE

Several ferments yield a biofuel using wheat chaff as substrate. The focus here will be on butanoic acid. According to an old British patent [565.773], this can be a septic ferment using a mix of wild microbes plus one butanoic acid bacteria which benefits from the enzymes excreted by the others.

One which converts lactic acid directly into butanoic acid is especially suitable. Given time to develop, the endpoint will be mostly butanoic acid or its calcium salt. The ferment is shorter if much of the lignin in the material is first removed.

The butanoic acid will be isolated and made into di□ propyl ketone (PPK), a clear liquid with a pleasant odour which is almost insoluble in water. For blending in gasoline this alone makes it superior to ethanol which tends to attract moisture; plus PPK has much greater energy density as well.

A major component of chaff is cellulose, a polymer that gives glucose units, each of which can yield one butanoic molecule plus two each of CO2 and H2. These co□ products are one reason to choose this ferment.

Since all the carbon a plant uses to grow is from CO2 out of the air, when an annual plant is fermented and releases CO2, the carbon in it came weeks earlier from the air. Call this 'indirect air capture' of CO2. It could be liquified and sent underground, earning 'fermentation carbon credits'.

Clearly, this is less expensive than any 'direct air capture' scheme. And yet a major US petroleum corporation recently bought a direct air capture company for a billion $US, planning to build such facilities wherever government money makes it feasible.

Similarly, it would be much cheaper for a major user of fossil fuels to buy 'fermentation carbon credits' instead of 'capturing' CO2 from its own hot flue gases.

Who should be large buyers of these credits specifically [and not any other type] are the bitumen sands miners of Alberta, since they release large amounts of CO2 in making a very heavy petroleum. Currently, they propose capturing CO2 from their flue gases and sending it by pipeline 400 km to an area having many wells producing viscous heavy oil.

Very expensive no doubt, too much so for the companies to do it on their own, so they expect the Alberta and Canadian governments to provide much of the capital required, directly or indirectly. Most likely the gas would be sent below to enhance output of these wells.

So, while here the CO2 would indeed be 'stored', in the

sense that it goes below and stays below, it would also be increasing production of a fossil fuel. Any government support will be criticized as furthering fossil fuel production.

A recent demonstration project in North Dakota, partly funded by the US Department of Energy, liquifies the CO2 from an ethanol producer to send underground. This is indirect air capture of CO2. In the USA are several hundred such ethanol plants, nearly all using starchy grains as substrate.

But their finances are precarious at times, as these grains are much wanted both there and abroad for feeding poultry and swine. Income from selling the 'fermentation carbon credits' would improve their situation.

Saskatchewan

Wheat chaff is an inexpensive starting material for a ferment, and Saskatchewan is a very large wheat producer. Of its more than 14.5 million hectares of grains and oilseeds harvested in a typical year, spring wheat would be 3 million, durum nearly 2, barley about 1, with canola about 5 million hectares.

The frost-free period runs 115 to 120 days usually, which precludes growing maize or sunflowers for their seeds — too much risk of frost damaging these crops reducing their value. To shorten the harvest, the cereals are cut and windrows created so the crops can dry sooner.

Chaff comes from threshing wheat to obtain the grain. Current practice is to thresh in the field using a combine harvester. It is a big expensive beast of a machine divided in two. The main body is a mobile thresher which retains the grain and strews chaff and straw on the ground. A small front unit picks up the dried windrows to feed the thresher.

Periodically, grain is off-loaded into a truck or wagon. Now, if cereal chaff has value and is to be taken from the field, the harvest should change. When both grain & chaff are wanted, take the entire grain heads intact — cut when mature but far from dry — and air dry them before threshing. Barley and wheat are bearded with long awns, so much air space exists within a pile letting humid air to drain out and wind to blow in, hastening the process.

Park the combine, as only a header is needed attached to a swather style 'tractor', with a belt conveyor or thrower sending heads into a wagon — simpler equipment, smaller engine, cheaper to acquire and less expense to run. Quicker and earlier field work as well.

Being bearded, the heads interlock when lightly compacted and hold that shape. So a stack former or pendulum-type soft round baler could be used, or a 'tall' firm windrow made. The heads may then be left in the field several days before being gathered.
Thresh the heads weeks later when they are very dry and press the chaff into pellets. Adding a minor amount of lye, soda, or sodium acetate prior to compaction helps the fermentor. Both thresher and pelleter could be run by hydraulic motors, the fluid coming from a storage tank kept up in pressure by an hydraulic pump directly attached to a windmill. Wind is nearly always present on the farmlands of Saskatchewan.

Processing

Delivered to the processor are chaff pellets which contain a small amount of chemical that has reacted with the xylan to an extent, due to the heat generated in pellet formation. Also, the acetyls on the xylan will now be sodium acetate or acetic acid.

This is the fermentation substrate for the mix of wild microbes plus one producing mainly butanoic acid. At the end of the ferment, some acetic acid will also likely be there. Being in dilute amounts, concentration and isolation are required to obtain them. This step might be the most diverse among processors, as several means of doing it may be used. Freeze concentration is one.

Some processors might choose to absorb the remaining liquid on wastepaper or straw and grow fungi on it in order to obtain an organic fertiliser having quite a bit of nitrogen.

In future, engineered thermophilic bacteria which convert acetic acid into acetone will exist, its vapour escaping. Then the primary ferment of chaff may be to acetic acid rather than the butanoic.

Acetone plus H2 in a one-step process gives methyl-isobutyl ketone [MiBK] to blend with gasoline. Many petroleum refineries do that now. But it is only one biogasoline possibility, and as dozens of processors would come to exist, they won't all be using the same technology.

As instance, in making MiBK, the H2 is only there to saturate a created double bond, for which instead an alcohol will do. Or instead of acetone as the ketone, butanone works, it being arrived at readily from a 2-3, butanediol ferment [which also produces much CO2]. There are, of course, other possibilities. ONE

Who decides what ESG is and how to make investments greener – new research

JOHANNES PETRY, JAN FICHTNER AND ROBIN JASPERT
The Conversation

More than 30 US states have proposed or implemented legislation in recent years to stop the government and its pension funds from investing in environmental social and governance (ESG) funds.

These products integrate ESG issues into their investment strategies, which mainly involve buying stocks but also bonds.

US conservatives claim that ESG has an overly large impact on corporations and the whole economy – hence recent moves to ban the strategy for government investments. But critics in Europe argue that ESG funds are not doing enough to have a positive impact in the real world.

Both cannot be right. So, who is?

Our recently published research explores this question by looking at the actual sustainability impact that these funds have. Although financial industry groups claim that one-third of all investment assets are already sustainable, our research shows most ESG investing actually does not create any meaningful sustainability impact.

Most ESG funds take conventional mutual funds as their baseline and tweak their capital allocation according to ESG criteria. Those that stay closest to their conventional peers are called "broad ESG" or "ESG integration" funds. Broad funds are prone to accusations of greenwashing because their capital allocation only slightly deviates from conventional funds.

For example, these funds usually exclude producers of thermal coal from their portfolio and assign slightly less weight to oil firms.

As a result, large tech firms such as Amazon, Micro-


Coin on wooden table. Photo credit: jcomp (Freepik)

soft and Alphabet often make up a bigger share of these funds' portfolios due to their huge market capitalisation and their relatively small emissions footprint (compared with fossil fuel producers, anyway).

Overall, however, changes to their portfolios are more cosmetic than anything else.
Our market analysis of ESG funds showed that, out of all index-tracking ESG funds, 88% are broad ESG funds. But there are also "light green" and "dark green" ESG funds, which do not track conventional or benchmark stock indices as closely.

Light green funds comprise 7% and dark green funds make up 5% of the market.
When it comes to firms that offer these ESG funds, our research shows Blackrock is the largest provider, but its market share is only 15%, followed by Fidelity with 12% and Pictet with 8% of the pie.

This indicates ESG asset management is a rather fragmented market, and so asset managers themselves are less likely to be able to set the standard for ESG.

Who really sets ESG standards?

Instead, we found that asset managers such as Blackrock, which are passive investors, essentially delegate their investment decisions to ESG indices. And most large active managers such as Fidelity hardly deviate from their non-ESG index benchmarks. So, what ultimately matters when it comes to defining ESG capital allocation are indices.

Indices are basically a basket of particular stocks that aim to represent a specific economic entity. There are many but, for example, the S&P 500 represents the US stock market, while the MSCI ESG Leaders USA Index supposedly represents the leading US

companies with respect to ESG criteria. These index providers play a key role in this age of passive asset management. We found that ESG funds tend to merely track existing stock indices these days, essentially delegating investment decisions to the firms that create these indices. As a result, this is where ESG standards are actually set.

One firm in particular dominates the development and provision of ESG indices: MSCI has a stunning global market share of 57%, compared to only 12% each for its closest competitors, S&P Dow Jones and FTSE Russell.

This is largely because MSCI is one of the very few firms that not only provides ESG ratings, but also data and indices. Offering a number of related products in this way creates a strong "network" effect.

Further, most ESG funds are based on the ESG ratings of companies, which do not seek to measure a corporation's sustainability impact on the environment or society. In fact, they measure the exact opposite: the potential impact of ESG on the corporation and its shareholders.

Broad ESG investing based on MSCI and other rating and index providers is therefore really only a risk management tool for investors. Rather than monitoring how a company is affecting or helping with the escalating climate crisis and other ESG issues, it actually tracks how ESG factors are affecting companies.

This means that broad ESG funds, which constitute the lion's share of the market, often only make a rather feeble attempt to manage ESG. Their typical capital allocation – the amount of money invested in a fund – hardly deviates from conventional funds.

How ESG funds could boost sustainability

Capital allocation is only one of the potential ways ESG investing can boost sustainability, however. Shareholder engagement could be even more powerful. This can either be pursued by investors via their proxy voting behaviour at the annual general meetings of the firms that are part of their portfolio, or through other forms of interactions (such as private engagements) with the management of these companies.

Research has shown that funds are able to create significant impact via these routes. But at the moment, shareholder engagement is neither a standard part of ESG methodologies nor of ESG indices. Our research shows this could be a crucial factor in ensuring ESG funds have maximum impact, but there is a need for significant changes in the regulation of the industry. This should include clear criteria for broad ESG funds to dictate how capital allocation should deviate from conventional funds, plus favourable taxation or regulatory arrangements to boost the market share of light and dark green funds. International regulators should also develop minimum standards for ESG funds' proxy voting behaviour and private engagements.

In its current form, ESG will not decarbonise our economies. The volume of "true" ESG funds is still so small that they cannot possibly change contemporary capitalism, indicating the US conservatives' "war" on ESG is just electioneering. Instead, EU discussions about ESG greenwashing seem a much more fitting description of what is going on in the world of (allegedly) sustainable finance.

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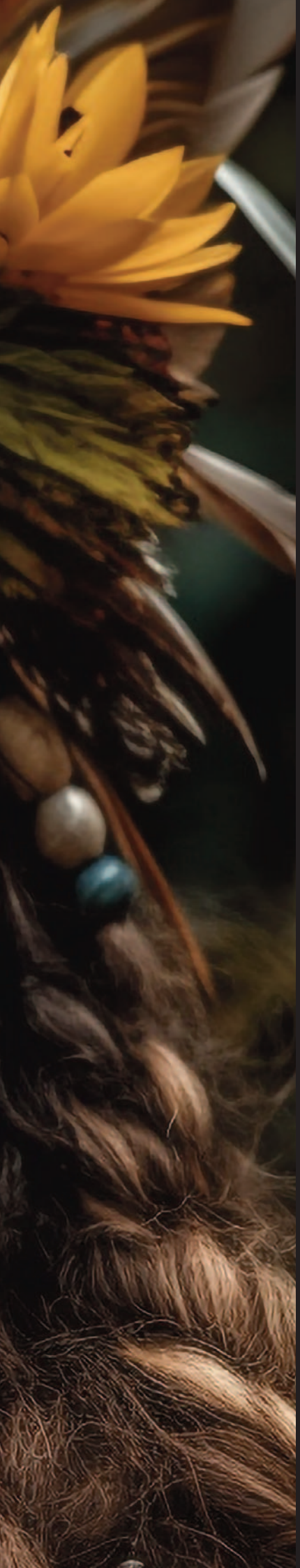
Challenges, Solutions & Opportunities for Industrial Transformation

SPONSORSHIP PROSPECTUS

Smiling young women in traditional clothing outdoors. Photo credit: Freepik



Ecuador faces economic dilemma after vote to ban oil drilling in the Amazon

How will the new president reconcile the ban on oil with the country's economic dependence on extractivism?

FRANCESC BADIA I DALMASES
Open Democracy

Ecuador's historic vote to leave the Amazon rainforest's oil reserves underground contrasts sharply with the results of the presidential elections held on the same day, and leaves the troubled country facing an economic dilemma.

On 20 August, the country voted by a significant margin – 58% to 41% – in favour of leaving the oil reserves of the Amazon's Yasuní National Park "unearthed".

The victory of 'yes to Yasuní' was a major triumph for environmental campaigners – and a major problem for the state. It means Ecuador's state oil company Petroecuador will no longer be able to exploit oil reserves, costing the country an estimated $600m a year in revenue.

The two presidential candidates who will now compete in the run-off on 15 October have both favoured extractivism in the past, specifically metallic mining and the oil industry, key sectors of the Ecuadorian economy. There are few differences between the two candidates.

Left-wing populist Luisa González, who came first with more than 34% of the vote, is the hand-picked candidate of ex-president Rafael Correa, who was convicted of corruption in 2020 and is now

self-exiled in Brussels.

Right-wing businessman Daniel Noboa, the son of a banana tycoon, came second on 23%. Noboa's success was a surprise – his support hadn't topped 10% in pre-election polls, but he gained popularity after an eloquent performance in the final electoral debate.

History of the Yasuní referendum

The idea of voting to leave oil in the ground in Yasuní National Park – one of the most biodiverse areas in the world and home to at least two uncontacted Indigenous peoples, the Tagaeri and the Taromenane, who live in voluntary isolation in the Ecuadorian Amazon – was born in 2006.

That was a year before Rafael Correa's first electoral victory in 2007, and two years before the country became the first in the world to grant "rights of nature" as part of its new constitution.

The original proposal was to leave the Yasuní oil reserves untouched, in exchange for $3bn compensation paid by the world's major economies, which would have to assume responsibility for a climate debt acquired over decades of greenhouse gas emissions from the burning of fossil fuels.

This idea was criticised as an attempt to commodify nature, so Correa's government insisted on promoting carbon credit markets in exchange for keeping the oil under Yasuní, thus making the protection of nature conditional on the income it could receive in return.

In 2013, when this goal was not achieved, Correa licensed the state oil company Petroecuador to drill the three oil fields of Ishpingo, Tambococha, Tiputini (ITT, also known as Block 43), located at the eastern edge of the park.

The state began to receive $148m dollars a year from ITT's exploitation, while the opposition movement, including youth groups, Indigenous peoples and environmental NGOs, grew in size and strength. Despite active government repression, they spent ten years in the struggle, collecting tens of thousands of signatures in favour of a public vote on the exploitation of Yasuní.

Finally, in May this year, Ecuador's constitutional court recognised the right to a referendum. The court agreed that if the 'yes' vote – yes to keeping oil in the ground – wins, the state will keep the oil reserves of Block 43 underground indefinitely and will be responsible for "a progressive and orderly withdrawal of all activities related to oil extraction within a period of no more than one year".

After the overwhelming 17-point margin of victory for 'yes' in the 20 August referendum, this is what the new president and government will have to deal with.

Another referendum was also held in the district of the capital, Quito, this time on banning gold mining in the Chocó Andino highlands. The ban was approved by an even larger majority than in the case of Yasuní: 68% to 31%.

Uncontrolled violence

But these historic victories against the extractivism that dominates Ecuador's economy stand in stark contrast to a political environment riven with endemic corruption, and an exponential increase in violence in a country once known in the region for its lack of violence.

Under the last president, Guillermo Lasso, violence rose from 5.8 to 26.7 homicides per 100,000 people. If it continues along the same trajectory, the country will end 2023 with a rate of 40 homicides per 100,000, making it the most violent in South America.

The rise is largely attributed to changes in drug trafficking in the region as a result of va-

rious factors including: peace agreements with the FARC guerrillas in Colombia; movements in the cocaine market, especially in the US, where demand is decreasing while demand for fentanyl is increasing; the booming European cocaine market; and the fact that Ecuador went from being a drug transit country to a distribution centre, especially through its ports on the Pacific.

However, the emergence of political violence during the election campaign was a shock. The murder of several local leaders culminated in the assassination of presidential candidate Fernando Villavicencio, an investigative journalist turned corruption scourge and vocal opponent of drug trafficking leaders. He was shot outside a Quito election rally on 9 August, just 11 days before the vote was due.

The political shock of the assassination significantly changed the dynamics of the candidates and the focus of the campaign, and saw Daniel Noboa, then ranked seventh, unexpectedly come second.

Analysts have pointed out Luisa González may have reached the electoral ceiling of 35% that correísmo – the political movement founded by Rafael Correa, which combines state developmentalism with social policies – has in Ecuador.

Noboa's potential for growth is much greater. But eight weeks is a long time in politics, especially in such a violent and volatile climate.

A key question for both candidates will be how they address the results of the Yasuní and Chocó referendums, as both are a long way from supporting a moratorium on extractivism.

Both correísmo and the forces of the right depend on the extraction industry (mainly oil, gold and copper) to raise funds to finance their policies.

Whoever is elected president will only have a year and a half – this was a snap election called in the middle of a four-year mandate – to try to deal with an economy in crisis, significant emigration, uncontrolled violence, and pressure from drug trafficking barons.

At the same time, they will have to implement the Yasuní agreement and restore the significant environmental damage already caused by the exploitation of Block 43.

The challenge for Ecuador's embattled economy will be significant without the incomes from the Yasuní oil fields, which are responsible for about 12% of the country's fossil fuel production. But if the country manages to resolve its internal disputes, it would be wise to join – wholeheartedly – the burgeoning coalition of Amazon nations trying to protect nature.

The coalition, led by Colombia and Brazil, does face difficulties. The final declaration from the Amazon Summit held in Brazil in early August failed to mention the Colombian government's proposal to ban oil extraction in the Amazon.

And there were no targets for a green energy transition, showing the Brazilian government wants to continue investing in Petrobras, the Brazilian oil behemoth – a policy that has caused tension within president Lula's cabinet.

It's not clear how Ecuador's new president could honour the country's pioneering constitution guaranteeing the rights of nature and the clear will of its citizens not to pursue the destructive path of extractivism while also boosting economic growth.

But if she or he manages to do so, they will make a crucial contribution to decarbonisation and also send a message to the world that leaving fossil fuels in the ground is possible.

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Climate Education Suffers from Partisan Culture Wars

But teachers in many states are stepping up to the challenge and providing students with knowledge and tools for resilience.

EDUARDO GARCIA
The Revelator

Climate change education has been caught in the crossfire of the culture wars. While some U.S. states are boosting climate literacy, others are effectively miseducating children by depriving them of the skills they'll need to face the biggest challenge of their generation.

Studies show that climate education can help inspire kids to become more resilient, teach them about climate solutions, and prepare them to take jobs in the flourishing clean energy economy - all while reducing climate anxiety and the carbon footprint of schools. Perhaps more importantly, advocates say that climate education has a positive ripple effect in local communities and across generations.

However, despite the rapid increase in heatwaves, droughts and climate-induced wildfires, K-12 teachers in most states typically devote just a couple of class hours per school year to climate change. And in recent years, several bills supporting climate education have failed in the U.S. Congress. But behind the scenes, there's a major push by advocates striving to improve climate education in two major ways: by training teachers, and by doing advocacy work at the state, city and district levels to ensure that climate education is included in the curriculum.

Thanks to these grassroots efforts, climate education is improving in many states. In 2020 New Jersey became the first state to pass a bill adding climate change to its K-12 education standards. Connecticut has passed a similar bill, while California and New York are also considering legislation to support climate education. Maine, Oregon and Minnesota are also taking steps toward boosting climate education. Despite these advances, a 2020 study found, the education standards of at least 20 states failed to include the basics of human-caused climate change. In addition, advocates tell The Revelator that conservative-leaning states trying to limit LGBTQ rights and outlaw women's rights to choose, like Florida and Texas, are also censoring climate education. This partisan divide, coupled with the complex bureaucracy of the education system and a systemic lack of urgency, is undermining climate education, says

Photo Credit: Sasin Tipchai(Pixabay)

Elissa Teles Muñoz, coordinator of the Climate & Resilience Education Task Force at the National Wildlife Federation. "Our youth frankly don't care about all the bureaucracy that's going on at the state level," she says.

"They want climate education in their classrooms right now. Those who have received this education feel grateful to their teachers, who have sometimes gone out of their way to teach them about climate. But those who haven't received it feel slighted. They're anxious. Some of them are depressed. They feel grief. Climate education is a key solution to these feelings because we need to channel that into solutions."

Grassroots Movement

Although 20 states have adopted the K-12 Next Generation Science Standards, which cover many climate change topics, climate education tends to be patchy across the United States because educators haven't been trained to teach about the intricacies of the climate crisis, especially when it comes to attribution and solutions. "Climate change needs to be taught at all different levels and subjects," says Katie Boyd, program manager for the Climate Literacy and Energy Awareness Network (CLEAN), which has 800 members.

"It's not just the science — children also need to understand the policy, health, and justice implications. Teachers need tools and resources to dig into climate in a holistic way."

Boyd says "scores" of nonprofits provide teachers with the skills they need to teach about the climate crisis by organizing workshops and designing courses for educators. Some of these groups receive funding from progressive states. "California, New Jersey and Washington are great examples," Boyd says. "They're doing good work to make climate

education more robust by not only adopting the standards but also funding professional development and creating curriculum."

Washington is spearheading this effort through Clime Time, an initiative sponsored by Governor Jay Inslee that has provided grant money for climate education projects across the state since the 2018-19 school year. One of the leading recipients is EarthGen, a climate education nonprofit that works with approximately 750 teachers and 50,000 students in Washington every year. EarthGen aims to provide kids with the skillsets to be changemakers within their communities and has a strong focus on the intersection of climate change and social justice. "This is especially important in a state like Washington, where we have a pretty robust fire season during which kids can't even go outside," says EarthGen program manager Becky Bronstein. "Certain communities, usually communities of color, are unfairly and unjustly impacted."

But BIPOC communities aren't helpless victims — they are also agents of change that often use traditional knowledge to safeguard the environment. "For our professional development, we try to showcase and raise the voice of native Tribes in the Pacific Northwest because they're doing great climate action work," Bronstein says. Her team is currently developing a course that highlights how Tribes are restoring the wild salmon population in the Columbia River watershed.

Culture Wars

A survey published in April by the Center for Sustainable Futures at Columbia University found that 80% of Americans think that elementary and secondary schools should teach climate education. But the poll's data shows that liberals are more likely than conservatives to support climate education and efforts to reduce the carbon footprint of schools. Climate change advocates say this gap is widening amid the culture wars being waged by predominantly red states. The Texas State Board of Education is actively trying to undermine climate education in the state in a bid to include more "positive" messages about the fossil fuel industry. Florida, meanwhile, is waging a culture war against "woke ideology," including sexual and gender freedoms, as well as the climate crisis. In Florida, there isn't much opposition to teaching the underlying science of climate change, says Karolyn Burns, Education and Curriculum Manager at the CLEO Institute, a woman-led nonprofit dedicated to climate education in the Sunshine State. "But you see opposition when you try to talk about causes or solutions," Burns tells The Revelator. "And of course, the disparate impact that climate change has in certain communities. Bringing up the justice angle is not allowed in Florida."

There isn't an outright ban against teaching climate justice, but teachers feel "censored and scared" because they fear that some students may record them and report them to their parents or the media, Burns says. This hostility is fueled by extremist organizations like Moms for Liberty, a Florida-based far-right group that campaigns against what its members call "woke indoctrination," and which has supporters at local school board meetings in many states. These groups represent a minority, but they're "very loud and very hostile," says Burns.

Although Burns describes Florida as "ground zero for these kind of attacks on education," the impact of this pushback is being felt across the United States, even in liberal-leaning states like Washington. "All the time we're hearing about parents calling and saying, 'I don't want my kid learning about global warming,'" Bronstein says.

"Or some parents don't want their kids to learn about critical race theory and how that's connected with climate justice." But, she adds, educators show "a lot of bravery" when they teach about the climate crisis in conservative areas.

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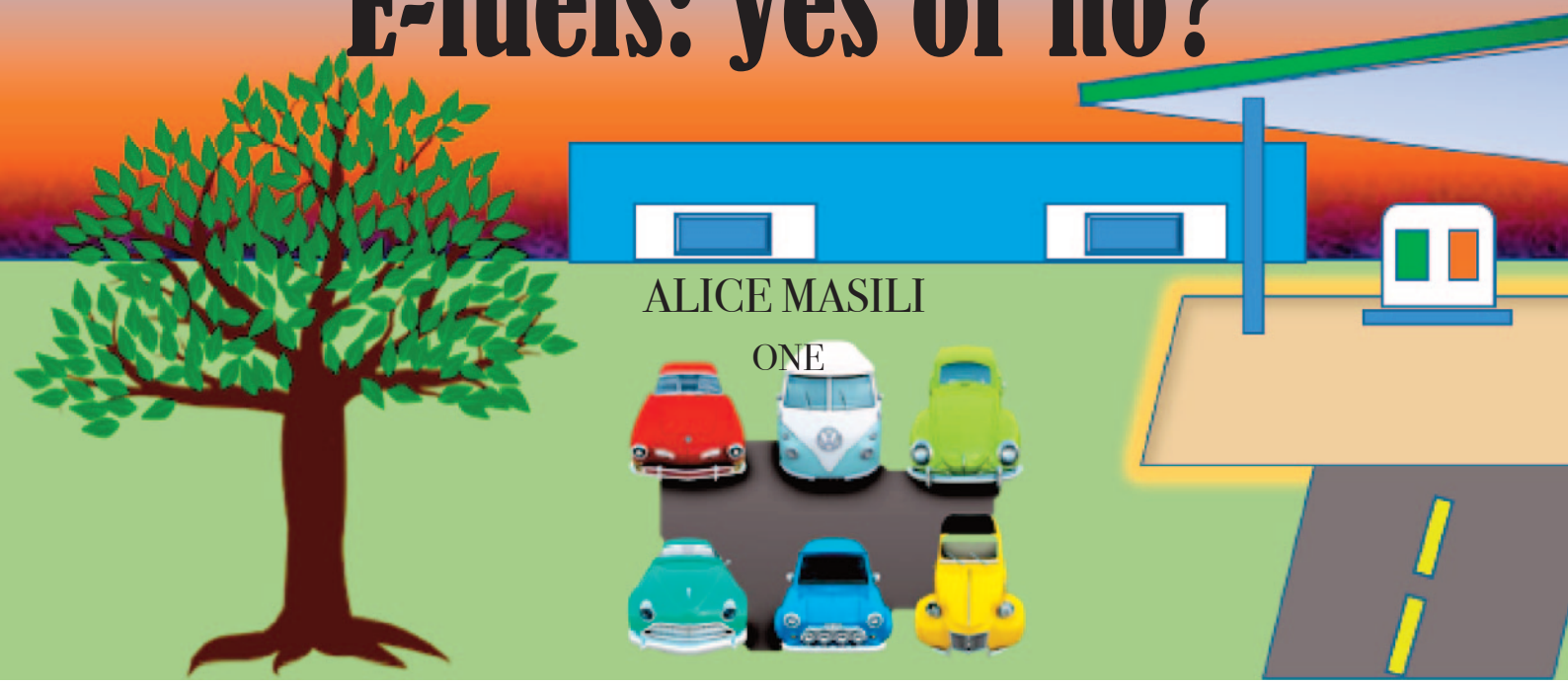
E-fuels: yes or no?



In the coming years, we will witness a transformation in the mobility sector: diesel and gasoline will give way to alternative solutions such as electric fuels ("e-fuels").

Will they be able to decarbonize the transport system?

The European Commission has banned the sale of internal combustion engines from 2035, drawing a line between the old and the new. Goodbye to gasoline and diesel cars; welcome to electric motors and batteries. This boundary needs to be clarified.

Like Germany and other countries, including Italy, the EU has allowed the sale of vehicles with internal combustion engines beyond 2035, provided they run on e-fuels.

E-fuels are synthetic fuels from renewable energy sources (such as solar or wind power) produced through chemical synthesis. They contain only two raw materials: water (H_2O) and carbon dioxide (CO_2). The necessary hydrogen is obtained from water by electrolysis.

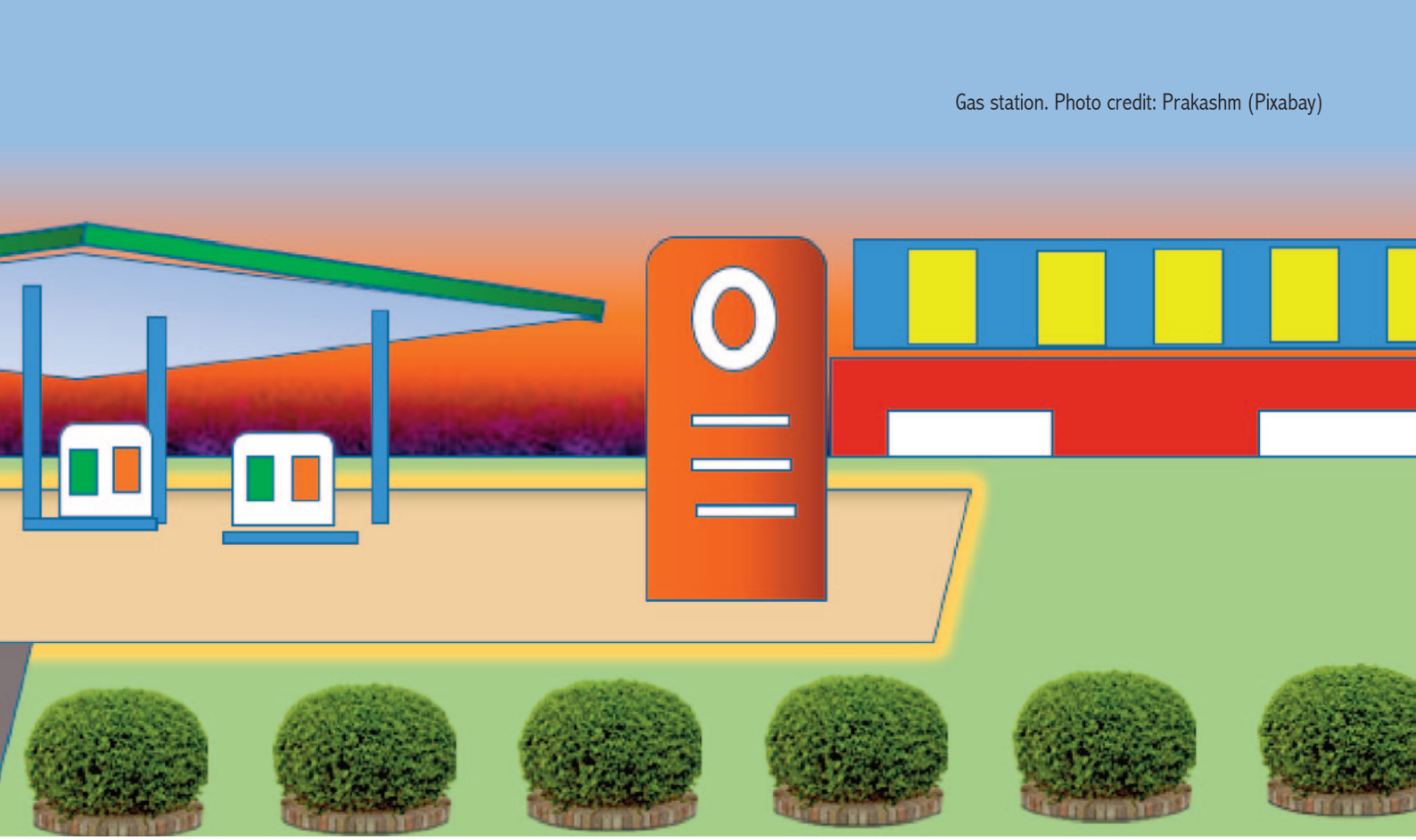
The carbon dioxide is extracted from the air by passing it through some filters with the help of large fans. Synthetic methanol (CH_3OH) is obtained at the end of the process, which is converted by refining into e-petrol, e-diesel, e-gas or e-kerosene, depending on the intended use. However, all that glitters is not gold.

You need a lot of water, about two litres to produce one litre of e-fuel, and energy. To avoid using precious drinking water, desalinated seawater should be used instead. To ensure that the process is also sustainable from an energy point of view, the electricity used must come from renewable sources.

In theory, the CO_2 produced by an e-fuel-powered engine is the same as that used to create synthetic fuel. A closed loop that makes the whole process CO_2 neutral. According to the Transport & Environment Association, cars that run on synthetic fuels emit the same amount of nitrogen oxides (NO_x) as cars that run on fossil fuels.

Particulate emissions decrease significantly compared to fossil fuels, but carbon monoxide and ammonia NH_3 emissions increase during startup.

Not to be underestimated is that e-fuels can be used in current internal combustion engine vehicles without requiring any special modifications to the existing infrastructure, and, like current liquid fuels, they can be easily stored, transported and used safely.



Gas station. Photo credit: Prakashm (Pixabay)

They can completely replace gasoline and diesel with no problems for the engine. No other technology currently allows CO2 emissions to be neutralized, even from existing cars with internal combustion engines. However, some problems need to be resolved. For example, there is the production factor.

According to a study published in the Nature Climate Change Journal, the energy consumption for the same distance with an e-fuel vehicle is five times higher than with an electric car. So far, this fuel type has not been produced on a large scale.

The first plant was opened in 2021 in Punta Arenas, Chile, by Porsche (which will initially use it in motorsports), together with Siemens and ExxonMobil, with a target of 550 million litres per year. More factories are planned for 2024 in Norway.

Yet, sourcing e-fuels is expensive. But price estimates need to be revised. According to the Potsdam Institute for Climate Impact Research in non-commercial settings, the price would be around 50 euros per litre.

However, the price will decrease with production in larger quantities due to economies of scale.

The German eFuel Alliance estimates that the production cost of a litre of synthetic fuel will be between 1.61 and 1.99 euros in 2025 (and then between 0.70 and 1.33 in 2050), while a study by the Icct (International Council on Clean Transportation) assumes 2.8 euros per litre.

Controversial opinions are also in the auto industry. Major automakers are focusing on electric car production. In contrast, some luxury car makers, notably Porsche and Ferrari, strongly support e-fuels. The superior performance of these liquid fuels compared to electric vehicle batteries would ensure that they can continue to produce sports cars with roaring engines, regardless of the cost of e-fuels.

Likely, e-fuels will only represent a small niche in the automotive sector. Still, they could play a role in decarbonizing sectors without a viable electric alternative, such as aviation with synthetic jet fuel and maritime transport. On this front, especially for aviation, the Norwegian company Norsk is working very hard.

If, on the one hand, it is true that research is being done along these lines - especially for the development of electric and/or hydrogen fuel cell trucks (think of Tesla and Tevva) - on the other, it is undeniably a difficult, long and complex road. In these sectors, which are as crucial to our economy and well-being as our cars (if not more so), e-fuels not only have a reason to be but are an absolute necessity, at least in the medium to long term.

Finding Climate Solutions in Fairy Tales

What can stories of witches tell us about solving the plastics problem?

KATHERINE ELLSWORTH-KREBS & BECKY TIPPER
YES! Media

Can traditional tales help us think productively about contemporary environmental issues? We have been exploring how fairy-tale tropes and archetypal characters offer new ways to articulate important questions. So sit back and let us tell you a story...

Fever: An Old-fashioned Tale About Modern Problems
In that town, the people know all kinds of spells. There are spells for protection, spells for assistance, spells for small wonders.

Those who tend the sick know the magic words which will keep you safe from fever. The traveling merchants know the incantation to shield you from the poxes that swirl in other towns. One spell lightens the load in your cart so your horse trots along as if he were pulling nothing at all.

Here, a little cantrip that conjures a basket to carry home your bread. There, a charm to preserve the herbs you carry to market; when you arrive they're as crisp and fresh as when you picked them that morning. And simply murmur the right words, and the water in your cup will flow to your lips, bubbling upward like a waterfall being reeled in.

The children giggle as they drink, and others find relief in being able to drink so effortlessly. What a world it is: magic to salve, to ease your path through life, to dazzle and delight.

"'People will accept almost anything if it's just the way things have always been."

No one in the town remembers asking for such marvels, and none of them can explain quite how they came to have all this ordinary magic. It's been around so long, handed down and shared around, that it's woven into

Photo credit: Vecstock/Freepik

their lives now.
They only know that the witch who lives on the hill, or some other witch, once gave them these spells and charms, drawing her power from wherever witches find it. (And no one could quite tell you where that is.

Although some do say that the witches' magic comes from deep in the earth, that it's the breath of the first living things. That if you were to see the magic, it would be dark like peat. Black with uncountable years.)

Everyone knows, of course, that there's a price to pay for these small wonders. The witches have always been clear about this. Nothing comes for free in this world. Just like life, magic is a balance, and the universe needs to settle its ledger.
Meet a need today, savor a small luxury, and you might encounter some little misfortune tomorrow. It sounds unpleasant, but it's not hard to understand how the people accept it.

Oftentimes, the price comes due so long afterward that it doesn't seem related at all. Or perhaps it pops up elsewhere, far away, causing some other person to stumble or trip instead.

True, it's a haphazard sort of accounting, but people will accept almost anything if it's just the way things have always been.

In this way life proceeds unquestioned, until who knows what it is that finally cracks and starts the dam bursting. Because, lately, the discomforts have begun to trouble the people. The small misfortunes seem to mount; they

feel bothersome and close by.

Take the stream, for instance: Once it flowed cleanly, but now it overflows its banks, and foul water floods the paths. Sometimes, the people find their own animals have been swept away by the currents and drowned.

The people always knew the magic came with a price, but the small misfortunes don't seem so small anymore. And what else are they to conclude but that it's the fault of the witch and the silly magic she gave them?

When the people meet in the marketplace, they mutter about the spells of convenience: those devilishly crisp herbs, the bewitched bread baskets, the sorcery of that up-tumbling water.

Why, they grumble, did the witch ever offer them such absurdities? They curse her wicked, sticky magic. It should have stayed where it belonged, they say, deep in the earth's hot belly.

The witch knows what is brewing. When she passes the townspeople in the woods or in the market, she hears them muttering and seething. She's seen their eyes flash with fiery resentment. And she knows it won't be long before they confront her, fueled with righteousness, ready with their hot words.

"'She knows that bargains can sometimes be struck with the cosmic ledger, that nothing is set in stone."

They're angry about the spells that seem so frivolous, so extravagant. They forget, for now, all the others that heal and ease. Even so, she knows that something has to change.

The people could use fewer spells, but there's more to it than that. Perhaps, after all, the old magic has run its course. Perhaps it's time to craft new spells that don't carry so steep a price.

She's heard of one incantation that could protect 40 people from fever before any harms would be incurred. And she might be able to make a charm to shield not just one person but the whole town from poxes.

The healing spells have always come with a cost, but it doesn't have to be that way. She knows that bargains can sometimes be struck with the cosmic ledger, that nothing is set in stone.

From her window, she can see the people's faces flickering in the torchlight as they climb the hill to her little house. Soon they will hammer on her door, feverish with indignation, demanding she account for herself. But who knows if they will want to hear what she has to say.
In the white heat of rage, people don't always want to sit and talk. It can seem like the only answer is to burn things down.

Although, sometimes, it's also right there in the heat of the crucible that the world might be reimagined. Where we can dismantle the old ways and forge something brand new.

We know that when it comes to the wicked problems of climate change, biodiversity loss, and pollution we need to shift worldviews. "And the most advanced tool we have to change worldviews—to transform people's attitudes, values, and structures of perception—is called the story," writes Marek Oziewicz, professor of children's and young adult literature.

As Will Storr, author of The Science of Storytelling, reminds us, folktales have been used to communicate social codes and establish moral norms since humans first formed societies. Whoever tells the stories defines the agenda: the framing of our common issues and enemies.

"Fever," the story that opens this piece, is about the magic of plastics, which we take for granted today. IV bags, tubes, and personal protective equipment (PPE) have revolutionized medical procedures and saved lives through reduced contamination risks.

Plastic packaging has also transformed our ability to keep

food from spoiling and thereby wasting the resources involved in planting, fertilizing, harvesting, and transporting those goods.

Yet we can no longer look away from the accumulated impacts of plastic pollution. And as a result, we often blame consumers for choosing plastic bags or plastic straws. Instead of individualizing responsibility, in "Fever" we articulate a tale that gets us wondering about broader systemic changes required of manufacturers and petrochemical companies.

There is no singular, standardized account of plastic's history. Some point to the seeking of alternatives to ivory and elephants' tusks for billiard balls, others to a repurposing of military materials fueling a postwar boom. Either way, plastics were not initially designed for single use. Yet, as a result of their explosion onto the scene in the 1960s, plastics have become a driver of global oil demand and a market for expanded growth by fossil fuel companies.

One of the major issues with plastics is that there is inadequate research on their health impacts, and a lack of labeling on the more than 10,000 different chemical substances used in plastic production.

We know occupational disease affecting generations of workers as well as waste pickers, sorters, and recyclers is cause for concern. And, thankfully, these chemicals' toxic bearing on human health remains part of the global plastics treaty currently being negotiated.

This sort of collective, upstream regulation is what is actually required to balance the cosmic ledger. Recent modeling shows that even with a massive expansion of waste infrastructure, we cannot keep pace with the increasing speed and volume of plastic production.

We have to look at how to stem the flow upstream. As such, another key systemic intervention we need to implement, and without delay, is making the polluter pay through Extended Producer Responsibility.

For example, in the U.K., businesses pay only 10% of the disposal cost of plastic packaging, with the remainder subsidized by council tax. That's U.K. residents paying so that businesses can save money by delivering their products in inexpensive, disposable containers.

If businesses were paying the additional 90% through Extended Producer Responsibility, it's not hard to imagine that companies would be motivated to innovate different products and services with less waste.

Because, as Max Liboiron, author of Pollution Is Colonialism, eloquently argues, the concept of disposability—including recycling—is dependent on the idea that we can send unwanted materials away. Indeed, there is continued violent enactment of this colonialist approach when one considers landfills and dumps being sited in or near Indigenous communities and communities of color.

It's time the polluters pay for the creation of systems that maximize the value of this magical family of materials. We don't need to burn all plastics at the stake to make meaningful change; instead we need to look at the broader systems around how we manufacture, use, and dispose of plastics. In this way we can find ways to live with them (perhaps happily ever after).

Stories can help us create universal climate literacy and find united agendas. We need tales of collective action and of finding well-being in doing less. We need tales that inspire activism and mobilize visions of joyful, low-impact lifestyles. It's time to rewrite some traditional tales in service of the people and the planet.

Note: The fairy tale, Fever, was written by Becky Tipper based on the academic research by Katherine Ellsworth-Krebs and her colleagues.

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Colombia's offshore wind power plans spark hope and caution

Government seeks to accelerate offshore projects with upcoming auction, as experts say regulations and safeguards still need fine tuning

DANIELA QUINTERO DÍAZ
Dialogo Chino

The wind and the strength of our seas place us in a privileged area for the installation of wind power generation projects, and this will allow us to be the first country in Latin America to produce this type of energy offshore," said Colombia's Minister of Mines and Energy, Irene Vélez, in late May, as she announced the country's first ever auction for offshore wind power projects.

A few days later, the Colombian government launched its first information portal on the deployment of offshore wind power, which will report on the progress of the country's efforts to boost its capacity, and take advantage of the consistency and strength of the wind at sea.

According to Vélez, the final details of the tender will be ready in August. Companies who obtain permits will be able to carry out studies, apply for licences for activities and access maritime concessions to build and operate offshore wind farms.
However, a number of challenges remain for offshore wind development in Colombia.

Stagnant renewables

A recent report by SER Colombia, a renewable energy sector association, stated that of the 80 non-conventional renewable energy projects – that is, wind and solar facilities – that were scheduled to enter operation in Colombia in 2023 and 2024, only 35% are progressing smoothly. The rest are delayed due to social, environmental or legal conflicts.

Among these is the Windpeshi wind project, owned by Enel Colombia and located in the department of La Guajira in the country's far north. On 24 May, the company announced the indefinite suspension of the project's construction after difficulties in reaching

Spinning blades generate wind power for sustainable energy. Photo credit: Vecstock / Freepik

agreements with some Wayuu Indigenous communities, the ancestral inhabitants of the territory.

Meanwhile, Colectora, a transmission project planned to transport energy from seven wind farms in La Guajira to the rest of the country, has been delayed for three years. Elsewhere, other renewable energy projects have been unable to connect and deliver power to the grid, the National Interconnected System.

Potential on the oceans

Around the world, offshore wind energy has shown itself to be a promising alternative source of power. In 2021 alone, the global installed capacity of offshore wind plants tripled, reaching record figures, as 21.1 gigawatts of new capacity was added, up from 6.1 GW of additions in 2020.

Colombia is among the world's nations with some of the greatest wind power potential. "We are the only country in South America that has two oceans and a huge extension of territorial sea, equivalent to almost 50% of the country," says Andrea Devis-Morales, an oceanographer with extensive experience in offshore energy.

"We are the only country in South America that has two oceans and a huge extension of territorial sea, equivalent to almost 50% of the country".

Andrea Devis-Morales, *oceanographer*

Devis-Morales is working on a project at the National University in Medellín to determine the potential of renewable energy within Colombia's seas. Her research focuses not only on wind, but also on wave- and current-powered sources, ocean temperature energy conversion and saline gradient energy.

However, the researcher stresses that wind has an advantage over other forms of energy generation: "Potential sources such as thermal or saline gradient are not yet sufficiently technologically advanced. On the other hand, the technology to extract energy from wind has advanced a lot, as well as the technology to keep platforms afloat despite variations in climate and intense weather."

Unresolved issues

Although the Colombian government has stated that it is looking to conclude the first round of temporary occupancy permit allocations for offshore wind in the near future, the rules of the game are still not so clear.

A specific regulatory framework for offshore wind has been under construction in the country since 2020. A national offshore wind power roadmap was published in May 2022, detailing its potential and challenges in the medium and long term.

In August 2022, the government released Resolution 40284, which aims to establish the rules and requirements for granting temporary occupancy permits to companies as a first step in the development of projects.

The Colombian Caribbean coast, where the country's greatest potential for offshore wind energy is concentrated, is also home to protected areas, areas of biological and ecological importance, and critical habitats and ecosystems for the conservation of species.

Its waters are used by artisanal and commercial fisheries, and areas of the coastal land are ancestral territories of Indigenous communities.

It is also an area of high maritime traffic, for fishing, cargo and tourism, close to the Panama Canal, and with areas allocated for offshore hydrocarbon exploration and extraction.

Dimar, the maritime authority in charge of controlling and authorising maritime and coastal activities in Colombia, oversaw the delineation of areas it considered to have "low levels of conflict", where offshore wind projects would be allowed to develop and coexist with other marine activities.

As the roadmap points out, the larger the scale of a project, the greater the risks of social and environmental impacts, so "data, participation and careful marine spatial planning will be required to minimise them".

This was echoed in a recent report by CLEANaction, a platform comprising more than 10 international organisations, which focused on the potential impacts of different renewable energy sources.

"We know that renewable energy is our best option to meet future energy needs without irreparably damaging our climate and nature, but even renewables will be disruptive to the environment when they are installed and maintained," its foreword cautioned.

"We know that renewable energy is our best option to meet energy needs without irreparably damaging our climate and nature, but even renewables can be disruptive"
CLEANaction's Nature-safe Energy report

According to researcher Juan Gabriel Rueda, a civil engineer and expert in offshore wind energy, Colombia still lacks sufficient information around its potential offshore developments.

"There is not a clear legal context [in Colombia] to regulate sustainable and safe exploitation of the offshore wind energy," he wrote as lead author of a 2019 research paper.

His perceptions have not changed. "The roadmap, which is what is guiding the discussions today, did not take into account the research that had been done here in Colombia on the subject," Rueda told *Climate Tracker.*

"Decisions were made without consulting the country's academics, and the state lacks a lot of information, justifying the hiring of foreign consultants who, although they have experience, do not have in their countries the social, environmental and cultural conditions and particularities that we have."

Among other challenges are the impacts on migratory birds, as highlighted by the country's roadmap itself: "The dangers posed to birds by the construction of offshore wind farms continue to be mainly: the barrier to movement, loss of habitat and the risk of collision."

A similar concern exists for marine mammals, such as dolphins and manatees. In Colombia's Caribbean waters, 29 species – 83% of the species recorded in the country – have been identified as potentially sensitive to construction activities, underwater noise and the risk of collision with vessels.

"There is currently no marine acoustics map of current noise levels, and we don't know how [offshore wind developments] may impact marine species," Rueda said.

Colombia has a mechanism of environmental licensing to reduce or compensate for these impacts. National legislation establishes that those who want to carry out this type of project must present an environmental impact assessment (EIA), the starting point for whether a licence is granted.

The National Environmental Licensing Authority (ANLA) and the Ministry of Environment and Sustainable Development, which are in charge of publishing terms for the development of EIAs for offshore wind projects, were approached for comment on the progress of these systems, but at the time of publishing no response had been received.

On 8 June, World Oceans Day, a study was published that indicated global greenhouse gas emissions had reached an all-time high of 54 gigatonnes of CO2 equivalent per year, on average, in the last decade.

In order to limit global warming to 1.5C by the end of the century, renewables need to account for more than 90% of electricity generation by 2050 – a challenge that will need more than just targets and good intentions.

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Did plastic straw bans work? Yes, but not in the way you'd think

Plastic straws used to be "environment enemy number one"

HARVIN BHATHAL
Grist

This story is part of the Grist arts and culture series Remember When, a weeklong exploration of what happened to the climate solutions that once clogged our social feeds. This story was co-published with Popular Science. It was the face that launched a thousand plastic straw bans.

The video begins with a close up of the turtle's head, its dark green, pebbled skin out of place against the stark-white boat deck. Robinson's hands approach, moving the pliers toward the turtle's nostril. The tool clamps down on the edge of something — A barnacle? A worm? — barely visible within the dark tunnel.

The creature squirms and dribbles blood as the pulling begins. A long, thin object begins to emerge, inch by excruciating inch. It was August 10, 2015, and marine conservation biologist Christine Figgener was collecting data for her Ph.D. a few miles off the coast of Guanacaste, Costa Rica.

She and a colleague, Nathan Robinson, were researching olive ridley sea turtles when they noticed a male had something encrusted in its nose. The pair decided to try to extract the object. Robinson flipped open his Swiss army knife's pliers and Figgener grabbed her phone and began to film. "We had no idea what we were frigging looking at," Figgener said in a newer, annotated version of the video.

It wasn't until one of the researchers cut off a piece of the object that they realized what it was:

a four-inch piece of plastic straw. "We couldn't believe that such a mundane object that we really use on a daily basis … that we found it in the turtle's nose," she said — "that a tiny object caused so much suffering."

When Figgener uploaded the turtle straw video to her YouTube account eight years ago, it went viral. For a few years, plastic straws were the trendy rallying cry for sustainability. In many ways, the campaign was a success story — one that elevated our awareness of single-use plastics to the point where it resulted in actual policy change. But upon reflection, not all the solutions that spun out of the anti-straw movement actually held water. In recent years, many environmental pundits have focused on the movement's shortcomings. To many environmentalists fighting plastic pollution, anti-straw advocacy now feels passé — out of touch with the broader need to address all forms of single-use plastic. But the movement's rise and fall still holds lessons for the activists of today. From soda bottles to yogurt containers, there is a lot of plastic pollution out there. So how did we end up so obsessed with straws?

The anti-plastic straw movement didn't actually originate with Figgener's turtle video. Back in 2011, a 9-year-old named Milo Cress found it odd that the restaurants he would go to with his mom in Burlington, Vermont, would automatically serve drinks with a straw, whether or not their customer wanted one. He approached the owner of Leunig's Bistro and Café in Burlington, and eventually, Leunig's became one of the first establishments in the country to ask customers whether they wanted a straw or not. Eventually, Cress and his mom made some calls to straw manufacturers and esti-

mated that 500 million straws are used and discarded by people in the U.S. every day.
The environmental advocacy group Eco-Cycle published Cress's findings, which in the years since have been cited by nearly every major news media outlet that has covered the plastic straw beat, including *CNN, the New York Times,* and *the Washington Post*. (The credibility of that figure has since been questioned, with market research firms determining the figure to be between 170 million and 390 million a day.)

But the turtle video added just the right amount of injury to plastic insult. Figgener's viral footage helped stir single-use plastic outrage into a frenzy. Celebrities called on their followers to *#stopsucking*, a social media campaign that aimed to "turn the plastic straw into environment enemy number one."

Thousands of restaurants joined the pledge and the idea took off, reaching the rare environmental threshold of actual policy change.

In 2018, Seattle became the first big city in the United States to ban plastic straws. It was followed shortly by other major municipalities in California, New Jersey, Florida, and other states.

That same year, companies including Starbucks and American Airlines jumped on the anti-straw bandwagon, the former announcing it would launch a new "sippy" lid for its cold beverages starting in 2020, allegedly diverting more than 1 billion straws per year. But for all its success in getting people riled up about plastic pollution, much of that outrage seemed limited to, well, straws, which only make up a small part of the single-use problem.

National Geographic calculated that of the 8 million tons of plastic deposited into the world's oceans each year, only 0.025 percent is comprised of plastic straws. Some anti-plastic advocates began denouncing the straw bans as "slacktivism," a type of activism characterized by a lack of commitment or effort. They said the bans gave people an overblown sense that they were making a difference in combating the plastics crisis.

For example, anti-straw pledges didn't seem as concerned with other types of plastic waste or the fossil fuels associated with every part of their life cycle. Even the anti-straw Starbucks sippy lids were actually made from polypropylene, a type of plastic that has a 3 percent recycling rate in the U.S. (The company claimed it was still an improvement, as the new lids could potentially be recycled. Plastic straws are too lightweight and thin to make it through the mechanical recycling sorting process.)

The anti-plastic straw movement also started getting pushback from disability advocates, who pointed out that some people need flexible straws to be able to drink liquids. Paper straws get soggy and fall apart more quickly, reusable straws made of metal are not easy to bend, and silicone straws are difficult to clean.

For the average consumer, functionality is often more important than sustainability, said Leslie Davenport, a climate psychology educator and consultant. "Our brains favor habits because they conserve energy. So if we are going against the current — a BYO straw for example — it's hard for most people to do so unless highly motivated."

For restaurants that chose to continue to provide disposable straws, there were options beyond paper or plastic. Straws made with natural materials such as sugarcane and wheat are 100 percent biodegradable, but are inflexible and cost more

to manufacture. As a result, many businesses looked to straws made from bioplastics — allegedly compostable plastics made from corn, sugarcane, agave, and other nonpetroleum sources. But according to Brandon Leeds, co-founder of SOFi Paper Products, bioplastics require specific disposal and processing methods, many of which aren't always followed or clearly outlined, in order for them to decompose effectively. "Many businesses desire to adopt sustainable practices, and when they encounter these plastic-like alternatives, they may mistakenly believe that they can be environmentally conscious without truly moving away from the plastic aesthetic," Leeds said.

"The absence of stricter governmental regulations allows companies to take advantage of greenwashing tactics, making it difficult to differentiate genuinely sustainable options from those that are not."

Buying into greenwashing, a term that refers to environmental "solutions" whose appeal is based on appearing environmentally friendly rather than actually being so, "can be an unconscious psychological defense in individuals to shield them from the fear and overwhelming [feeling] of climate change," Davenport said. "There can be an unexamined story of 'I'm doing my part' because it is more soothing than feeling out of control with the harmful and terrifying trajectory we are on with climate change."

Plastic straw bans are alive and well today, with new proposals still cropping up at the state and city levels. But eliminating plastic straws is no longer the go-to goal of the anti-plastic movement. Part of that is the result of the existing bans' success: For many consumers, the absence of plastic straws has become normal, even mundane. Now, anti-plastic advocates hope to harness in new ways the outrage they once inspired. According to Jackie Nuñez, the Plastic Pollution Coalition's advocacy and engagement manager and the founder of The Last Plastic Straw, the anti-plastic straw movement helped advance awareness and understanding of other single-use products. California, Delaware, Hawaii, Maine, New York, Oregon, and Vermont have all placed some form of ban on plastic bags. The U.S. Interior Department stated that single-use plastic products will be phased out of national parks and around 480 million acres of federal land by 2032.

In 2022, the Canadian federal government implemented a single-use plastics ban that included bags, cutlery, food service ware, and stir sticks. It's not really the item, it's the material that's the problem, Nuñez said. "All plastic is pollution by design."

Some activists have attempted to call attention to the scourge of single-use plastics by staging 'plastic attacks,' in which protesters head to the grocery store and proceed to remove the plastic wrapping from the food in their carts and return the waste to the store.

Since they began in 2018, the strategy has gone global. Plastic attacks have been reported in places including in Hong Kong, South Korea, Canada, Peru, and the United States. Some of the biggest demonstrations have drawn hundreds of participants. The anti-plastic straw movement "triggered a lightbulb moment for a lot of people," Nuñez said. "It ended up becoming a thing I call a gateway issue."

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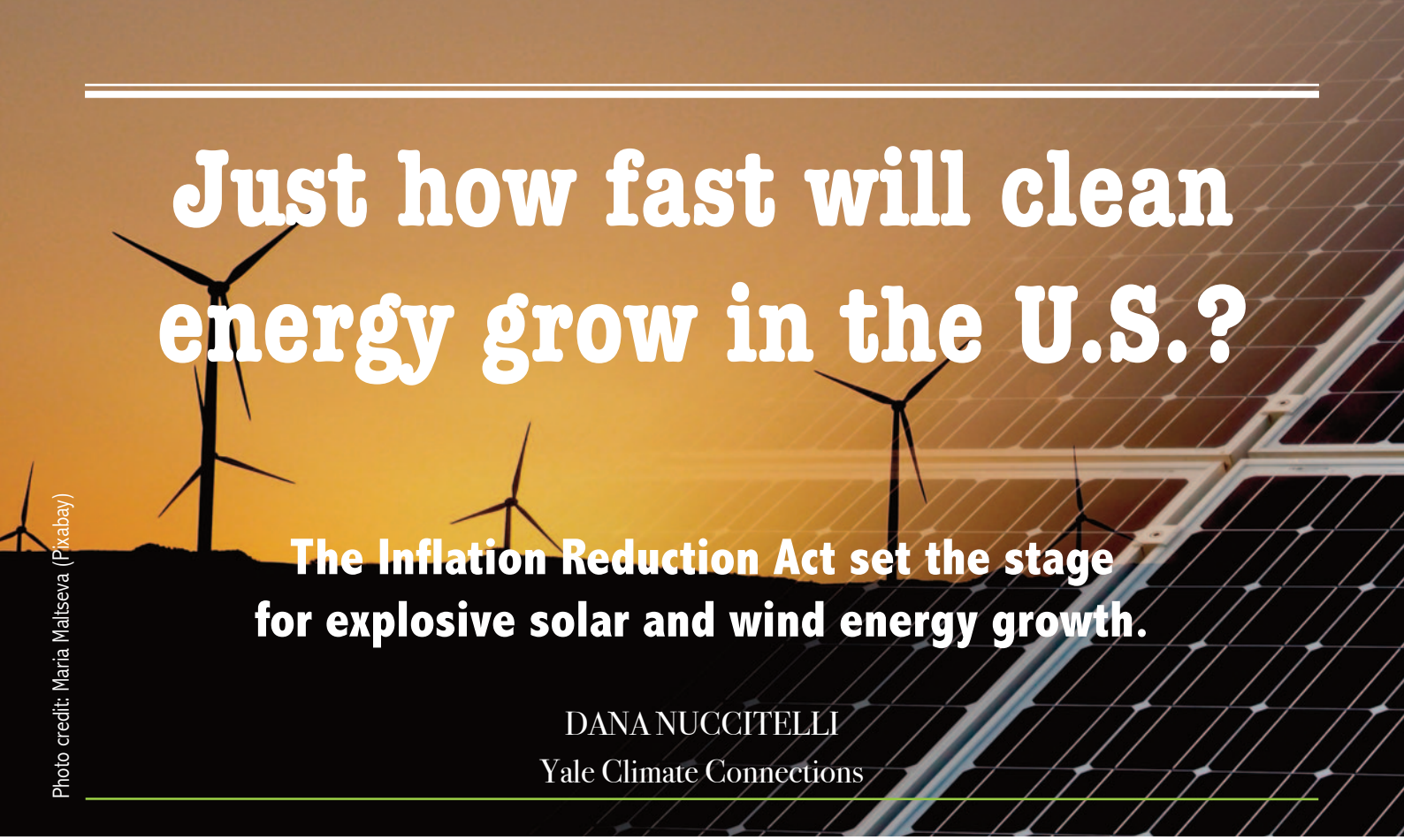

Just how fast will clean energy grow in the U.S.?

Photo credit: Maria Maltseva (Pixabay)

The Inflation Reduction Act set the stage for explosive solar and wind energy growth.

DANA NUCCITELLI
Yale Climate Connections

To slash U.S. emissions of climate-warming carbon pollution, many experts have settled on a plan that can be largely described in two steps: Clean up the power grid and electrify everything.

If electric vehicles, heat pumps, induction stoves, and some industrial processes can be powered by clean electricity and replace fossil-fueled alternatives, that transition will do most of the work toward decarbonizing the economy and helping the U.S. meet its commitments under the Paris climate agreement.

Carbon pollution from the U.S. power sector had already been declining, albeit too slowly to meet the country's Paris commitments. Then in 2022, President Biden signed into law the Inflation Reduction Act, which includes over a decade's-worth of tax credits for clean electricity sources.

That financial certainty along with the rapidly falling costs of solar and wind power and energy storage are set to unleash an explosion of clean-energy deployment in the coming years.

A plethora of energy modelers and renewables and financial experts have published reports and studies projecting just how quickly this transition will occur. The consensus is that the amount of solar and wind generation in the U.S. will nearly double between now and 2025 — and then nearly double again by 2030, supplying about half the country's power by the turn of the decade. But a variety of complicating factors create uncertainty around that precise number, and it's still not enough to meet the U.S. Paris commitment to reduce its carbon pollution to net zero by 2050.

Breaking clean energy records every year from now on

2021 was a record year for clean energy installations in the U.S., with about 13 gigawatts of wind and nearly 24 gigawatts of solar power capacity installed. Those numbers dipped a bit in 2022 due largely to supply chain issues but have begun to rebound in 2023.

Experts expect their growth to continue, with supply chain issues largely resolved and the Inflation Reduction Act's clean energy tax credits now available.

A recent study published in the prestigious journal Science looked at the clean energy growth forecasts from nine energy systems models, including those from groups at Princeton, Energy Innovation, Rhodium, and the National Renewable Energy Laboratory.

To gauge the Inflation Reduction Act's impact, the models were run with scenarios in which the bill did not become law, then compared to the model forecasts of a post-Inflation-Reduction-Act world. The U.S. currently generates about 40% of its electricity from low-carbon sources, in-

cluding 18% from nuclear power, 10% from wind, 6% from hydropower, and 5% from solar.

The models projected that even in the absence of the Inflation Reduction Act, those numbers would grow to about 50% clean electricity in 2025, 55% in 2030, and almost 60% in 2035 simply due to the growth of cheap solar and wind. But when the Inflation Reduction Act's clean energy tax credits are factored in, solar and wind energy growth are supercharged. In this new reality, the models forecast that the U.S. low-carbon electricity numbers will grow to 54% in 2030, 73% in 2030, and over 80% in 2050. That includes a near-doubling of solar and wind generation from 15% of U.S. electricity to about 28% in 2025, 50% in 2030, and 60% in 2035.

Most of that growth will likely come from new utility-scale solar farms, thanks to their plummeting costs. Forecasts from the Energy Information Administration, Morgan Stanley, and a joint analysis by Wood Mackenzie and the Solar Energy Industries Association all project that the U.S. will install about 63 gigawatts of new solar capacity by the end of 2024.

The Federal Energy Regulatory Commission similarly identified 78 gigawatts of solar and 20 gigawatts of wind power with a high probability of being built by mid-2026, with the potential for much more. The commission projects that nearly 90% of new energy capacity added during the next three years will be low-carbon and that more fossil fuels may be retired than are added to the grid during that time. In short, the record 24 gigawatts of solar capacity added in 2021 will likely be broken in 2023 — and in every subsequent year for the foreseeable future.

Factors that could slow the clean energy transition

But some roadblocks remain that create uncertainty about just how fast the U.S. will build all of this new clean power. Inadequate electrical transmission infrastructure is chief among them and the subject of ongoing permitting reform negotiations in Congress.

As of this writing, there's more power stuck in the "interconnection queue" than exists on the entire power grid. These are projects awaiting an assessment regarding whether the grid can handle their added power, or whether the developers would need to pay to build more grid capacity. Under today's conditions, it takes a decade on average to build a new electrical transmission line in the U.S.

An analysis by energy modelers at Princeton found that if the U.S. continues to build out transmission infrastructure at the recent slow rate of 1% to 1.5% expansion per year, 50% to 80% of the Inflation Reduction Act's potential climate pollution cuts could be squandered because of the inability to connect new clean energy to the grid.

Doubling that rate from 1% to 2% per year would more than double the solar and wind energy that could be built. Congress and the Federal Energy Regulatory Commission are working on measures to speed up that transmission infrastructure build-out, but it remains to be seen how successful these efforts will be.

Changes in net-metering policy in California that will reduce the payback by 75% for sending extra solar energy back to the grid are also expected to slow the deployment of residential installations in the state, which ranks No. 1 for installed rooftop solar. And the Biden administration's temporary suspension of tariffs on solar panels imported from China and Southeast Asia is set to expire in June 2024, which could result in higher solar panel prices and thus could somewhat hinder their deployment.

A bright future for clean energy

Although these factors create some uncertainty around exactly how fast U.S. solar and wind energy will grow, there is nevertheless a consensus among experts that their deployment will proceed at a record-breaking pace. Solar and wind power are forecast to generate between about 35% and 55% of domestic electricity by 2030 and 45-65% by 2035. Other low-carbon sources like nuclear power and hydroelectricity will likely account for a further 25% of power generation.

But without additional policy measures, energy models project that this progress will only reduce U.S. climate pollution by 33% to 40% below 2005 levels by 2030, reaching 43% to 48% emissions cuts by 2035. That's about 10 percentage points closer to meeting the U.S.'s Paris commitment to curb climate pollution 50% below 2005 levels by 2030 than the country's pre-Inflation Reduction Act path, but additional action will be needed to meet that target.

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‘How’s the Air?’ Using AI to Track Coal Train Dust

Scientists in California are working with communities — and a suite of AI tools — to better understand air pollution.

EMMA FOEHRINGER MERCHANT
Undark

In a sloping backyard in Vallejo, California, Nicholas Spada adjusted a piece of equipment that looked like a cross between a tripod, a briefcase, and a weather vane. The sleek machine, now positioned near a weathered gazebo and a clawfoot bathtub filled with sun-bleached wood, is meant for inconspicuous sites like this, where it can gather long-term information about local air quality.

Spada, an aerosol scientist and engineer at the University of California, Davis, originally designed the machine for a project based about 16 miles south, in Richmond. For six months, researchers pointed the equipment — which includes a camera, an air sensor, a weather station, and an artificial intelligence processor — at railroad tracks transporting coal through the city, and trained an AI model to recognize trains and record how they affected air quality. Now Spada is scouting potential locations for the sensors in Vallejo, where he collaborates with residents concerned about what’s in their air.

The project in Richmond was Spada’s first using AI. The corresponding paper, which published in March 2023, arrived amid proliferating interest — and concern — about AI. Technology leaders have expressed concern about AI’s potential to displace human intelligence; critics have questioned the technology’s potential bias and harvest of public data; and numerous studies and articles have pointed to the significant energy use and greenhouse gas emissions associated with processing data for its algorithms.

But as concern has sharpened, so has scientific interest in AI’s potential uses — including in environmental monitoring. From 2017 to 2021, the number of studies published each year on AI and air pollution jumped from 50 to 505, which an analysis published in the journal Frontiers in Public Health attributed, in part, to an uptick of AI in more scientific fields. And according to researchers like Spada, applying AI tools could empower locals who have long experienced pollution, but had little data to explicitly prove its direct source.

In Richmond, deep learning technology — a type of machine learning — allowed scientists to identify and record trains remotely and around the clock, rather than relying on the traditional method of in-person observations. The team’s data showed that, as they passed, trains full of coal traveling through the city significantly increased ambient PM2.5, a type of particulate matter that has been linked to respiratory and cardiovascular diseases, along with early death. Even short-term exposure to PM2.5 can harm health.

The paper’s authors were initially unsure how well the technology would suit their work. “I’m not an AI fan,” said Bart Ostro, an environmental epidemiologist at

UC Davis and the lead author of the paper. "But this thing worked amazingly well, and we couldn't have done it without it."

Ostro said the team's results could help answer a question few researchers have examined: How do coal facilities, and the trains that travel between them, impact air in urban areas? That question is particularly relevant in nearby Oakland, which has debated a proposed coal export terminal for nearly a decade. After Oakland passed a resolution to stop the project in 2016, a judge ruled that the city hadn't adequately proved that shipping coal would significantly endanger public health. Ostro and Spada designed their research in part to provide data relevant to the development. "Now we have a study that provides us with new evidence," said Lora Jo Foo, a longtime Bay Area activist and a member of No Coal in Oakland, a grassroots volunteer group organized to oppose the terminal project.

The research techniques could also prove useful far beyond the Bay Area. The AI-based methodology, Foo said, can be adapted by other communities looking to better understand local pollution.

"That's pretty earth shattering," she said.

ACROSS THE UNITED STATES, around 70 percent of coal travels by rail, transiting from dozens of mines to power plants and shipping terminals. Last year, the U.S. — which holds the world's largest supplies of coal — used about 513 million tons of coal and exported about another 85 million tons to countries including India and the Netherlands.

Before coal is burned in the U.S. or shipped overseas, it travels in open-top trains, which can release billowing dust in high winds and as the trains speed along the tracks. In the past, when scientists have researched how much dust these coal trains release, their research has relied on humans to identify train passings, before matching it with data collected by air sensors.

About a decade ago, as domestically-produced natural gas put pressure on U.S. coal facilities, fossil fuel and shipping companies proposed a handful of export terminals in Oregon and Washington to ship coal mined in Wyoming and Montana to other countries. Community opposition was swift. Dan Jaffe, an atmospheric scientist at the University of Washington, set out to determine the implications for air quality.

In two published studies, Jaffe recorded trains in Seattle and the rural Columbia River Gorge with motion

sensing cameras, identified coal trains, and matched them with air data. The research suggested that coal dust released from trains increased particulate matter exposure in the gorge, an area that hugs the boundary of Oregon and Washington. The dust, combined with diesel pollution, also affected air quality in urban Seattle. (Ultimately, none of the planned terminals were built. Jaffe said he'd like to think his research played at least some role in those decisions.)

"I'm not an AI fan," said Ostro. "But this thing worked amazingly well, and we couldn't have done it without it."

Studies at other export locations, notably in Australia and Canada, also used visual identification and showed increases in particulate matter related to coal trains. Wherever there are coal facilities, there will be communities nearby organizing to express their concern about the associated pollution, according to James Whelan, a former strategist at Climate Action Network Australia who contributed to research there. "Generally, what follows is some degree of scientific investigation, some mitigation measures," he said. "But it seems it's very rarely adequate."

Some experts say that the AI revolution has the potential to make scientific results significantly more robust. Scientists have long used algorithms and advanced computation for research. But advancements in data processing and computer vision have made AI tools more accessible. With AI, "all knowledge management becomes immensely more powerful and efficient and effective," said Luciano Floridi, a philosopher who directs the Digital Ethics Center at Yale University. The technique used in Richmond could also help monitor other sources of pollution that have historically been difficult to track. Vallejo, a waterfront city about 30 miles northeast of San Francisco, has five oil refineries and a shipyard within a 20 mile radius, making it hard to discern a pollutant's origin. Some residents hope more data may help attract regulatory attention where their own concerns have not.

"We have to have data first, before we can do anything," said Ken Szutu, a retired computer engineer and a founding member of the Vallejo Citizen Air Monitoring Network, sitting next to Spada at a downtown cafe. "Environmental justice — from my point of view, monitoring is the foundation."

Air scientists like Spada have relied on residents to assist with that monitoring — opening up backyards for their equipment, suggesting sites that may be effective locations, and, in Richmond, even calling in tips when coal cars sat at the nearby train holding yard.

Spada and Ostro didn't originally envision using AI in Richmond. They planned their study around ordinary, motion-detecting security cameras with humans — some community volunteers — manually identifying whether recordings showed a train and what cargo they carried, a process that likely would have taken as much time as data collection, Spada said. But the camera system wasn't sensitive enough to pick up all the trains, and the data they did gather was too voluminous and overloaded their server. After a couple of months, the researchers pivoted. Spada had noticed the AI hype and decided to try it out.

The team planted new cameras and programmed them to take a photo each minute. After months of collecting enough images of the tracks, UC Davis students categorized them into groups — train or no train, day or night — using Playstation controllers. The team created software designed to play like a video game, which sped up the process, Spada said, by allowing the students to filter through more images than if they simply used a mouse or trackpad to click through pictures on a computer. The team used those photos and open-source image classifier files from Google to train the model and the custom camera system to sense and record trains passing. Then the team identified the type of trains in the captured recordings (a task that would have required more complex and expensive computing power if done with AI) and matched the information with live air and weather measurements.

The process was a departure from traditional environmental monitoring. "When I was a student, I would sit on a street corner and count how many trucks went by," said Spada. Employing AI was a "game changer" Spada added. The previous three studies on North American coal trains combined gathered data on less than 1,000 trains. The Davis researchers were able to collect data from more than 2,800.

IN EARLY JULY 2023, lawyers for the city of Oakland and the proposed developer of the city's coal terminal presented opening arguments in a trial regarding the project's future. Oakland has alleged that the project's developer missed deadlines, violating the terms of the lease agreement. The developer has said any delays are due to the city throwing up obstructions.

If Oakland prevails, it will have finally defeated the terminal. But if the city loses, it can still pursue other routes to stop the project, including demonstrating that it represents a substantial public health risk. The city cited that risk — particularly related to air pollution — when it passed a 2016 resolution to keep the development from proceeding. But in 2018, a judge said the

city hadn't shown enough evidence to support its conclusion. The ruling said Jaffe's research didn't apply to the city because the results were specific to the study location and the composition of the coal being shipped there was unlikely to be the same because Oakland is slated to receive coal from Utah. The judge also said the city ignored the terminal developer's plans to require companies to use rail car covers to reduce coal dust. (Such covers are rare in the U.S., where companies instead coat coal in a sticky liquid meant to tamp down dust.)

Environmental groups point to research from scientists like Spada and Ostro as evidence that more regulation is needed, and some believe AI techniques could help buttress lawmaking efforts. Despite its potential for research, AI may also cause its own environmental damage. A 2018 analysis from OpenAI, the company behind the buzzy bot ChatGPT, showed that computations used for deep learning were doubling every 3.4 months, growing by more than 300,000 times since 2012. Processing large quantities of data requires significant energy. In 2019, based on new research from the University of Massachusetts, Amherst, headlines warned that training one AI language processing model releases emissions equivalent to the manufacture and use of five gas-powered cars over their entire lifetime. Researchers are only beginning to weigh an algorithm's potential benefits with its environmental impacts. Floridi at Yale, who said AI is underutilized, was quick to note that the "amazing technology" can also be overused.

"It is a great tool, but it comes with a cost," he said. "The question becomes, is the tradeoff good enough?"

A team at the University of Cambridge in the U.K. and La Trobe University in Australia has devised a way to quantify that tradeoff. Their Green Algorithms project allows researchers to plug in an algorithm's properties, like run time and location. Loïc Lannelongue, a computational biologist who helped build the tool, told Undark that scientists are trained to avoid wasting limited financial resources in their research, and believes environmental costs could be considered similarly. He proposed requiring environmental disclosures in research papers much like those required for ethics.

In response to a query from *Undark,* Spada said he did not consider potential environmental downsides to using AI in Richmond, but he thinks the project's small scale would mean the energy used to run the model, and its associated emissions, would be relatively insignificant. "It is a great tool, but it comes with a cost," Floridi said. "The question becomes, is the tradeoff good enough?"

For residents experiencing pollution, though, the outcome of the work could be consequential. Some activists in the Bay Area are hopeful that the study will serve as a model for the many communities where coal trains travel. Other communities are already weighing the potential of AI. In Baltimore, Christopher Heaney, an environmental epidemiologist at Johns Hopkins University, has collaborated with residents in the waterfront neighborhood of Curtis Bay, which is home to numerous industrial facilities including a coal terminal.

Heaney worked with residents to install air monitors after a 2021 explosion at a coal silo, and is considering using AI for "high dimensional data reduction and processing" that could help the community attribute pollutants to specific sources.

Szutu's citizen air monitoring group also began installing air sensors after an acute event; in 2016 an oil spill at a nearby refinery sent fumes wafting towards Vallejo, prompting a shelter-in-place order and sending more than 100 people to the hospital. Szutu said he tried to work with local air regulators to set up monitors, but after the procedures proved slow, decided to reach out to the Air Quality Research Center at UC Davis, where Spada works. The two have been working together since.

On Spada's recent visit to Vallejo, he and an undergraduate student met Szutu to scout potential monitoring locations. In the backyard, after Spada demonstrated how the equipment worked by aiming it at an adjacent shipyard, the team deconstructed the setup and lugged it back to Spada's Prius. As Spada opened the trunk, a neighbor, leaning against a car in his driveway, recognized the group.

"How's the air?" he called out.

Emma Foehringer Merchant is a journalist who covers climate change, energy, and the environment. Her work has appeared in the Boston Globe Magazine, Inside Climate News, Greentech Media, Grist, and other outlets.

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LAST STAND

Mount Lyell Mining and Railway Company was an Australian mining company formed on 29 March 1893, based in Queenstown, Tasmania. In the early 1890s, the Mount Lyell mining operations produced more than a million tonnes of copper, 750 tonnes of silver and 45 tonnes of gold.

On 12 October 1912, somebody reported the pump house on the mine's 700-foot (210 m) level was on fire. As the mine lacked an emergency warning system, of the 170 miners working there, 73 managed to escape that first day. However, many others were trapped, and 42 miners died. One of the miners, Albert Gadd, who escaped death and then re-entered the mine to rescue his colleagues, was hospitalised in Launceston and died on 20 February 1913 from carbon monoxide poisoning. Gadd was regarded as the 43rd victim of the mining tragedy. He was posthumously awarded the Clarke Gold Medal from the Royal Humane Society in Melbourne.

Twelve months after the tragedy, Gold Mines of Australia took over Mount Lyell. Still, low copper prices made the operation unsustainable–the first of many that led to the closure. In 2022, Guy Barnett, Minister for State Development, Construction and Housing announced that "the Mt Lyell copper mine was back to life after an eight-year hiatus. To help get the mine going again, we will now provide almost $2.3 million in grant funding to Copper Mines of Tasmania, the owner of the Mt Lyell Mine, to help protect and improve the mine's valuable infrastructure and help pave the way for a re-start". ONE

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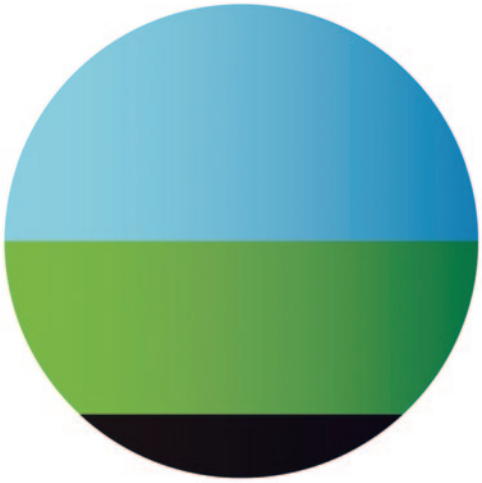

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RESEARCH CENTRE

www.onlynaturalenergy.com
info@onlynaturalenergy.com