

## Energy targets need to be bolder

The European Commission's proposal "Fit for 55" includes new targets for renewable energy and energy efficiency.

► Page 6

## Emission limits still breached

While most EU member states met their binding national emission limits in 2019, significant further action is needed to achieve the reduction commitments.

► Page 11

## Toxic threat from wood burning

The burning of wood and coal for domestic heating is a major source of air pollutant emissions, contributing to more than half of primary PM<sub>2.5</sub> emissions in the EU.

► Page 12

## Norway's future without oil

A rapid decommissioning of Norwegian gas and oil extraction is necessary to be in line with the Paris agreement.

► Page 14

## The rise of floating solar photovoltaic farms

Solar power is now the cheapest source of electricity in history. To continue its expansion many have looked to the benefits of floating solar farms.

► Page 20

## Towards climate-friendly food production

We need to reduce emissions of greenhouse gases and nitrogen from what we eat. Nordic farmers and food producers show how it can be done in practice.

► Page 22



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# Call to protect the cloud forests

Where the Andes meet the Amazon, you will find one of the earth's richest and most important biomes. Its role has been overlooked in our efforts to mitigate climate change impacts.

If there is an ecosystem that captures my imagination, it is the cloud forests, or perhaps better called, "the forests of the clouds". Walking underneath their damp and dark canopy brimming with colourful orchids and bromeliads you enter an enchanted world, as if at any minute a green dwarf could surprise you from behind a rock. Cloud forests' extraordinary colours shine in shimmering shades of

fluorescent hot pinks, dark blues, bright purples, and chilling reds. There, hummingbirds seem to be more abundant than bees, sometimes buzzing so close as if wanting to rest on your head. And best of all, there are no mosquitoes! After 40 years working in tropical forests, I chose them as my favorite type. However, these forests are facing enormous challenges, and

# Acid News

A newsletter from the Air Pollution & Climate Secretariat, the primary aim of which is to provide information on air pollution and its effects on health and the environment.

Anyone interested in these matters is invited to contact the Secretariat. All requests for information or material will be dealt with to the best of our ability. Acid News is available free of charge.

In order to fulfil the purpose of Acid News, we need information from everywhere, so if you have read or heard about something that might be of general interest, please write or send a copy to:

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Printed by Trydells Tryckeri, Laholm, Sweden.  
ISSN 0281-5087.

## The Air Pollution and Climate Secretariat

The Secretariat has a board consisting of one representative from each of the following organisations: Friends of the Earth Sweden, Nature and Youth Sweden, the Swedish Society for Nature Conservation, and the World Wide Fund for Nature (WWF) Sweden.

The essential aim of the Secretariat is to promote awareness of the problems associated with air pollution and climate change, and thus, in part as a result of public pressure, to bring about the needed reductions in the emissions of air pollutants and greenhouse gases. The aim is to have those emissions eventually brought down to levels that man and the environment can tolerate without suffering damage.

In furtherance of these aims, the Secretariat:

- \* Keeps up observation of political trends and scientific developments.
- \* Acts as an information centre, primarily for European environmentalist organisations, but also for the media, authorities, and researchers.
- \* Produces information material.
- \* Supports environmentalist bodies in other countries in their work towards common ends.
- \* Participates in the advocacy and campaigning activities of European environmentalist organisations concerning European policy relating to air quality and climate change, as well as in meetings of the Convention on Long-range Transboundary Air Pollution and the UN Framework Convention on Climate Change.

## Editorial

In August 2021, the Intergovernmental Panel on Climate Change (IPCC) – the UN body for climate science – adopted the first report of the IPCC 6th Assessment Cycle. Reports two and three will be issued in 2022 (1).

The three reports have an executive summary which is agreed word for word by 195 governments.

According to reporting from Earth Negotiations Bulletin (2) during the fourth and final approval session of report one, governments were still commenting on many sentences scientists had proposed. There were just a handful of countries that repeatedly questioned the scientists' conclusions, but as a result the final text of the summary of report one should be seen as the lowest level of agreement between 195 member countries of the IPCC. Despite this, the report issued a very strong warning about climate change already present and becoming increasingly severe as we head towards 2030, 2050, 2100 and 2300. The report also emphasises the great co-benefits of reducing GHGs for human health and the environment by reducing other air pollutants from burning fossil fuels at the same time. It confirms and reinforces many of the conclusions of the IPCC since its first assessment reports in 1990, but also builds heavily on the three IPCC special reports issued in 2018 and 2019. Climate Analytics has summarised the main conclusions of these IPCC reports on behalf of AirClim and CAN in four new science policy briefings (3). A good overview of the climate science issues discussed by the IPCC can also be found on the RealClimate web portal (4).

It is very important that the forthcoming second part of the sixth assessment report very clearly identifies the potential tipping points of regional and global ecosystems that could be destroyed by global heating. The fantastic ecosystems of the Andean cloud forests described in this issue of Acid News is an alarming example.

Since the Paris Agreement it has become increasingly clear that scientists and governments regard the 1.5 target as vitally

important if humankind is to achieve to avoid dangerous climate change. The IPCC has made it very clear that GHG emissions must be halved by 2030 and reach net-zero by 2050. The remaining carbon budget is

again presented in the new IPCC report. Climate Analytics and Constrain have published a very good analysis of the carbon budget discussions

(5), while Climate Action Tracker reports on the level of GHG reductions that have been achieved so far and the outstanding emission gap (6).

At the UN COP 26 climate conference in November 2021 the main task of governments is to decide on the pathway the world must take towards reducing emissions from now on. Every five years between 2020 and 2050 there should be clear evaluations by the IPCC concerning the newest science. The UNFCCC should analyse the remaining emission data every year and strictly ensure that the world is really on track to reach the 1.5 target. The wealthy industrialised countries must make stronger GHG reduction commitments much earlier than 2050 and increase their financial aid to countries in the global south to at least USD 200 billion annually. Governments at COP 26 should also refuse to agree new rules for the Paris Agreement that create large loopholes in reporting real reductions of emissions. CAN International has summarised the main concrete demands in an annual policy document (7). On 14 October 2021, CAN Europe and AirClim will publish a study by Climate Analytics showing how GHG reductions of at least 65% can be achieved in the EU by 2030 and net-zero by 2040 (8). These reduction targets should be agreed by the EU as its contribution to halving global GHG emissions by 2030!

Reinhold Pape

References (1) to (8) can be found on the AirClim homepage:



# Symbolic CO<sub>2</sub> threshold crossed

Carbon dioxide concentrations are now 50% higher than at the start of the industrial revolution.

**The latest measurements** released show that the atmospheric CO<sub>2</sub> concentrations at Mauna Loa Observatory, Hawaii, are now at record levels. The average for March 2021 was 417.14 parts per million (ppm).

"This is 50 per cent higher than the average for 1750–1800 which can be found with high confidence from ice core records," write Richard Betts, Met Office Hadley Centre and University of Exeter Global Systems Institute and Ralph Keeling, Scripps Institution of Oceanography, UC San Diego.

"The human-caused 50 per cent increase in CO<sub>2</sub> has been a major driver of the observed global temperature rise of over 1°C. It is also symbolic because a 50 per cent increase is halfway towards 'doubled CO<sub>2</sub>' which has long been an important benchmark for quantifying future global warming. For example, the long-term warming in response to a doubling of CO<sub>2</sub> concentrations relative to pre-industrial is defined with the standard metric

of Equilibrium Climate Sensitivity (ECS), with recent research suggesting that ECS is likely to be between 2.6°C and 4.1°C," Betts and Keeling say.

"The build-up of CO<sub>2</sub> in the atmosphere has also been accelerating. It took over 200 years for levels to increase by 25 per cent, but now just over 30 years later, levels are at a 50 per cent increase. If the current trend continues, doubled CO<sub>2</sub> will be reached in approximately 55 years. Reversing this trend and slowing the atmospheric CO<sub>2</sub> rise and global warming will need global emissions to reduce. Projections by the IPCC suggest that to halt global warming at 1.5°C, global emissions will need to reach net zero by approximately 2050, possibly much sooner," according to Betts and Keeling.

"Ongoing monitoring of the global carbon budget confirms that the atmospheric CO<sub>2</sub> rise is entirely caused by human activity, mainly through the burning of fossil fuels with further contributions

from deforestation. Since natural carbon sinks remove CO<sub>2</sub> from the atmosphere much more slowly than the rate of these emissions, CO<sub>2</sub> levels are continuously building up. Reducing emissions slows the rate of build-up but does not stop it altogether unless the overall input of CO<sub>2</sub> to the atmosphere reaches zero," conclude the two scientists.

Compiled by Reinhold Pape

Global Monitoring Laboratory, Recent Daily Average Mauna Loa CO<sub>2</sub>, <https://www.esrl.noaa.gov/gmd/ccgg/trends/monthly.html>

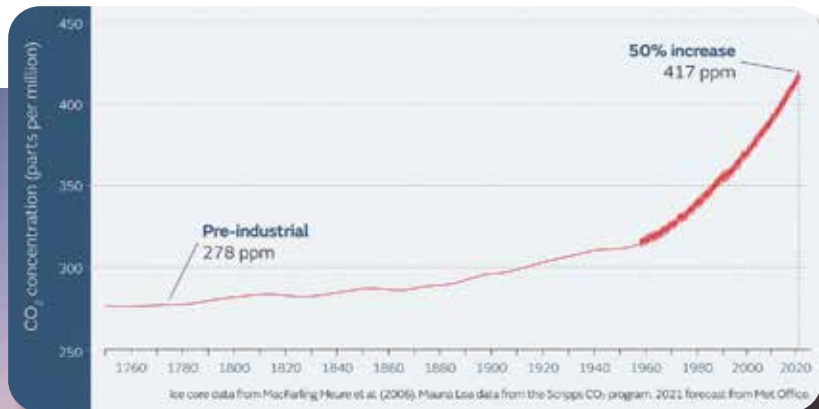
Global Monitoring Laboratory, Monthly Average Mauna Loa CO<sub>2</sub>, <https://www.esrl.noaa.gov/gmd/ccgg/trends/>

Met Office, 7 April 2021, Atmospheric carbon dioxide at record high levels despite reduced emissions in 2020, <https://www.metoffice.gov.uk/research/news/2021/record-co2-levels-despite-lower-emissions-in-2020>

Carbon Brief, 16 March 2021, Met Office: Atmospheric CO<sub>2</sub> now hitting 50% higher than pre-industrial levels, <https://www.carbonbrief.org/met-office-atmospheric-co2-now-hitting-50-higher-than-pre-industrial-levels>

Climate Energy College, More Climate Spirals, <https://www.climatecollege.unimelb.edu.au/more-climate-spirals>

Figure: Atmospheric CO<sub>2</sub> levels from 1700 to 2021. This is based on ice core data before 1958, then the instrumental record at Mauna Loa from the Scripps CO<sub>2</sub> program and, finally, the 2021 CO<sub>2</sub> forecast from the Met Office. The apparent change in 1958 is because ice core records do not capture the seasonal cycle seen in instrumental records.



# Call to protect the cloud forests

*Continued from front page*



not many are aware of their importance, nor have experienced their magic. Below is an account of what those cloud forests are, and why they matter, in the face of our changing world.

**For many the** Amazon brings to mind a vast extension of a uniform forest, a green carpet interrupted by wide meandering rivers. But at a closer look, besides its typical tall rainforests, the Amazon is a mixture of many ecosystems, including mountain forests, savannas, dry forests, single-species forests, wetlands, and many other types of vegetation. Hence, it is a mistake to treat the Amazon as a single ecological unit.

Among all, one of the most distinctive and perhaps most underappreciated forest types are those that thrive in steep mountains, closer to the snowy peaks of the Andes, the Amazonian cloud forests. Running along eastern Colombia, Ecuador, Peru, and Bolivia, those forests are ecologically very different. Fragile, endangered, and extremely biodiverse, they are only recently becoming understood and appreciated. Our efforts to mitigate climate change and prevent further major losses of biodiversity require paying particular attention to them.

Starting at 4000 metres above sea level, cloud forest trees carry a heavy load of epiphytes that, besides giving them a peculiar look, “harvest” water from the clouds. Clouds that originated thousands of kilometres away, in the Atlantic Ocean, and after several iterations of evaporation, condensation and precipitation, finally hit the giant forested wall that is the eastern

side of the Andes mountains. It is from there that the waters start their return to the ocean, flowing down the Andes through myriads of rivers converging in the mighty Amazon River.

Several studies have looked at the properties and function of the cloud forests, and water retention is a critical one. The vegetation not only acts like an active sponge, but also regulates the flow of water to defined courses. They capture more than 60 per cent of the water in the atmosphere, and without this capacity there would not only be massive tree mortality at lower elevations, but in periods when rains are abundant, severe erosion, landslides, uncontrollable floods, and a major ecological and human disaster would ensue.

Cloud forests are also an important carbon sink. Considering how slow the decay of organic matter is in these high-elevation forests, it is estimated that their dead biomass matches that of the living forests. Andean forests rank as one of the densest carbon deposits among all Amazonian ecosystems, something that is changing as climate warms.

**The cloud forests’** plant and animal species are quite unique and densely packed in narrow elevational ranges. You can find a complete replacement of species assemblages in narrow horizontal strips, as if each was living in a different floor of a building. Hence, viewing a mountain from top to bottom, an extraordinary biodiversity piles up. In the Kosñipata valley in southeastern Peru, for example, close to one thousand species of birds have been registered from the top of the mountain to its lower ranges. That is one tenth of all bird species on the planet.

These Andean forests provide a refuge and the only option for species to avoid extinction. As the climate is warming up, many life forms, including trees, need to “move up” to their optimal thermal range, i.e., to higher and colder elevations. Researchers have been measuring the rate of upward movement of different species for the last several decades and the results are perplexing. Trees, for example, are moving up at a rate of 2.5 metres a

year and modelling shows that they will move up to 9 metres a year by the end of the century. Some species of beetles have already moved up at a rate of 40 metres a year. Without an elevation gradient in an uninterrupted forest, there is no escape in the face of a warming climate. These forests are also home to spectacled bears, mountain tapirs, woolly monkeys, and many other flagship and keystone species. Other studies have documented the importance of these species and the differential impacts in tree recruitment in their absence.

Because of the introduction of cattle from the old world, the upper limit of these forests today, the tree line, is in most places almost one thousand metres in elevation below where it was 500 years ago. Restoration of that vegetation is of most critical importance if we want to allow species to adapt to our changing world.

**Burning of the** upper elevation grasslands and the opening of new previously forested areas for both animal husbandry and expansion of the agricultural frontier, are by far the main threat to these Andean forests. Suitable land for agriculture is largely scarce and the booming of illegal crops has further complicated the scenario. Add to it mining, road development, and a proliferation of commercial crops at the lower end of these mountains. Altogether these make cloud forests perhaps the most endangered forest type in the Amazon.

But there is progress and hope. Iconic protected areas like Madidi National Park in Bolivia, Manu National Park in Peru, and scores of other protected areas along the Andes Amazon range are effectively protecting large swaths of forests, even entire watersheds. But assuring the connectivity of these areas is critical and remains a challenge. Andean nations and most notably, local communities, are making great efforts to protect as much forest as possible. And more importantly, there is a growing sense of pride and ownership in the cultural values of Andean Amazonian ecosystems for local peoples.

Much more is needed to be done as we cannot afford to lose a square metre more. The recent IPCC report has once





View of the Wayqecha forest in the Andes.

again reminded us how important it is to act immediately to reduce emissions, including by protecting forests, while there is a chance. Ancient cultures that built Machu Picchu and the Gran Pajatén cities thrived in those environments without altering it. Why not us? Cloud forest protection needs more attention, scientific research, funding, and technical support. But everyone is starting to realize what their status is and that they truly matter.

There may not be green dwarfs jumping from behind rocks, but there are perfectly translucent Glass Frogs calling for the

clouds, bright orange Cock of the Rocks dancing in groups and competing for the attention of a female, miniature orchids as little as a headpin, moths as big as your hand, and armadillos that are as hairy as a Rolling Stone. To me, besides the climate reasons, that is the magic we need to preserve.

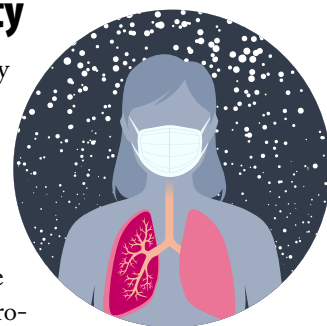
Enrique G. Ortiz  
Peruvian Tropical Ecologist

## WHO tightens guidelines for air quality

WHO has recently released the new Air Quality Guidelines. New scientific evidence has led to lowering of the air quality guideline level for annual nitrogen dioxide (NO<sub>2</sub>) by 75%

to 10 µg/m<sup>3</sup>. Levels of fine particulate matter (PM<sub>2.5</sub>) have been halved to 5 µg/m<sup>3</sup> and levels for particulate matter (PM<sub>10</sub>) have been adjusted to 15 µg/m<sup>3</sup>. For the first time WHO includes a peak season level for ozone, which is set to 60 µg/m<sup>3</sup>. More than 15 years of research have been conducted since the old guidelines. Scientific knowledge has improved with more precise methods in measurements, modelling and exposure assessment methods.

Source: WHO press release, 22 September 2021



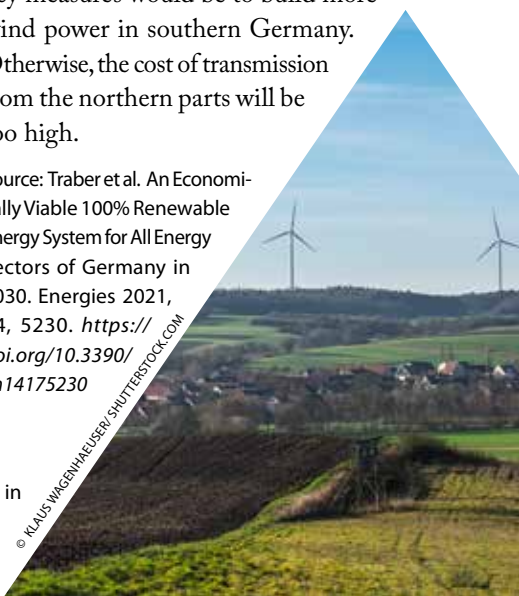
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## 100% renewable energy system in Germany 2030

An economically viable 100% renewable energy system for all energy sectors in Germany is possible by 2030 according to a new study by Energy Watch Group and Department of Physics, Technical University Munich. To be able to fulfil the Paris Climate Agreement, Germany must set an end to all greenhouse gas emissions by 2030. At the core of this task is the switch to 100% renewables across all sectors on the same time horizon. It is shown that the necessary transition of the energy sector is possible at low cost with a steady expansion. One of the key measures would be to build more wind power in southern Germany. Otherwise, the cost of transmission from the northern parts will be too high.

Source: Traber et al. An Economically Viable 100% Renewable Energy System for All Energy Sectors of Germany in 2030. *Energies* 2021, 14, 5230. <https://doi.org/10.3390/en14175230>

More wind farms needed in southern Germany.



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## Greece goes to court for breaching NO<sub>2</sub> limit

The European Commission has taken Greece to the EU Court of Justice for poor air quality caused by high levels of nitrogen dioxide (NO<sub>2</sub>). Greece has continually and persistently exceeded the annual NO<sub>2</sub> limit value in Athens and failed to adopt appropriate measures to keep the exceedance period as short as possible.

Source: European Commission press release, 15 July 2021. [https://ec.europa.eu/commission/presscorner/detail/en/ip\\_21\\_3402](https://ec.europa.eu/commission/presscorner/detail/en/ip_21_3402)

Too high nitrogen dioxide levels in Athens.

## Court fines French state over air pollution levels

France's highest administrative court, the Council of State, has fined the state €10 million for failing to improve air quality in several areas of the country. Last year, the court ruled that the government had failed to implement a court order dating from 2017 to curb air pollution levels and gave it six months to take corrective action or face a €10 million fine every six months until air quality improves.

The court said that NO<sub>2</sub> pollution was still excessive in five urban areas: Paris, Lyon, Marseille-Aix, Toulouse, and Grenoble. It also singled out Paris for persistently high levels of PM<sub>10</sub> pollution. Environmental group Les Amis de la Terre, which filed the initial complaint, welcomed the fine and said it was the result of years of pressure on the state by activists and the public.

Source: AECC Newsletter, August 2021.

# Energy targets need to be bolder

The European Commission's proposal "Fit for 55" includes new targets for renewable energy and energy efficiency. They have to go further to be in line with the 1.5°C goal.

The European Union is getting ready for a major update of its climate and energy legislation to make the EU "Fit for 55" – its new 55 per cent greenhouse gas reduction target for 2030. On 14 July the European Commission presented its package of proposals including the Renewable Energy Directive (RED) and the Energy Efficiency Directive (EED).

Reducing greenhouse gas emissions entails a significant increase in the share of renewable energy production as well as improvements in energy efficiency.

Investing in energy savings and renewable energy clearly brings about benefits for people and the environment. The costs of the required transformation are far outweighed by the costs of inaction or delayed action. The avoided costs of environmental damage in the EU, e.g. from weather extremes, amount to €10,000 billion by 2050. The continued use of fossil fuels would only increase the bill for our economies. One of the world's biggest insurance groups estimates that a 2.5°C temperature increase will cause 8.0% GDP loss in Europe by 2050. With the revamped EU budget and the Recovery and Resilience Facility, member states have a once-in-a-life-time opportunity to ensure funding for a sustainable and inclusive investment process that promotes a just and clean transformation.

The Renewable Energy Directive (RED) was originally set up in 2001 to promote renewable energy use in electricity generation and was amended in 2018.

The new RED proposal increases the overall renewable energy share from at least 32% to at least 40% by 2030. However, as action in the next ten years will be vital in reaching the 1.5°C objective, the revised RED should propose an EU binding renewable energy target of at least 50% by 2030.

The RED revision does not reintroduce

binding national targets, which would provide certainty and push governments to bolder climate action. Furthermore, even though no fundamental changes are proposed for permit granting and administrative procedures, according to a new provision the Commission will review these procedures one year after the entry into force of the Directive. This is a positive development, but the date or the review might come too late. Moreover, the review should also look into ensuring that citizens and communities are engaged in the energy transition. With a cross-cutting approach, it also needs to be ensured that the increased use of renewable energy potentials really mobilises synergies with biodiversity protection.

The proposal also tries to incentivise system integration of renewable electricity. Despite some positive additions, there is too narrow a focus on the transport sector. A general approach to encourage the direct use of renewable electricity in heating and cooling and in industry is missing. The proposed provisions for hydrogen currently promote hydrogen produced with renewable electricity and not with fossil fuels (if the upcoming Delegated Act confirms this principle). However, provisions that already exist in the current RED and leave the door open to fossil-based fuels (e.g. so-called 'recycled carbon fuels') have not been deleted. Finally, even though some changes are being proposed, the bioenergy criteria are not sufficiently strengthened.

The Energy Efficiency Directive (EED) aims to promote energy efficiency measures to improve energy savings throughout Europe. The European Green Deal together with the commitment to climate neutrality and to a higher climate ambition for 2030 require the EU to update its energy efficiency target. The revision includes a higher and EU binding energy

Too high nitrogen dioxide levels in Paris.

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A binding renewable energy target of at least 50 per cent by 2030 is needed to be in line with the Paris Agreement.

efficiency target of 36% for final and 39% for primary energy consumption for 2030 (9% if compared to the new 2020 Reference Scenario projections).

This level of ambition is in line with the 55% greenhouse gas emission reduction target for 2030 but is not enough to help bring the EU in line with the 1.5°C goal. The NGO coalition CAN Europe calls for an EU binding energy efficiency target of 45%. Furthermore, the proposal does not include national binding targets. However, it introduces a delivery mechanism in case there is insufficient progress to achieve the national contributions, which is similar to the Renewable Energy Directive. This is an improvement compared to the current situation where no corrective action is foreseen.

In terms of measures, the proposal foresees a higher annual savings rate of 1.5% for the Energy Savings Obligation from 2024 onwards and more stringent provisions for the renovation of buildings owned by public bodies. Furthermore, there is a new obligation to reduce the energy demand in the public sector by at least 1.7% annually, and new rules that are relevant to tackling energy poverty are set. A new overarching provision introduces a stronger legal basis for the

implementation of the Energy Efficiency First principle.

Finally, the heating and cooling provisions related to planning, highly efficient cogeneration and efficient district heating are updated. Unfortunately, they still fail to trigger a quick and extensive shift away from fossil fuels and towards an energy system based on renewable energy.

In its response to the “Fit for 55” package, CAN Europe calls for the EU to increase the level of ambition of climate and energy legislation well beyond the current proposals, if the EU is to fulfil its Paris Agreement commitment to limit global temperature rise to 1.5°C.

“While we keep witnessing the devastating impacts of climate change on people’s lives, the environment and our economy, we expect the EU to recognise the urgency to act and live up to the commitments made in the Paris Agreement. To limit temperature rise to 1.5°C, the EU would need to reduce its greenhouse gas emissions by at least 65%. The Commission proposal does increase the target to -58% which is good but this increase is not even halfway what is needed to make the package fit for 1.5 and in line with the Paris Agreement,” commented Wendel Trio, Director of CAN Europe.

“It’s now Member States’ and the European Parliament’s roles to improve the different pieces of law and enable the EU to further overshoot the 55% emission reductions target towards -65%. Only with further ambition will the package be turned into a policy framework that will bring us all to the 1.5°C target,” added Wendel Trio.

A welcomed proposal by the Commission’s proposal to keep national emission reduction targets in the Effort Sharing Regulation (ESR) to tackle emissions from road transport, buildings, agriculture and waste, but regrets the absence of similar targets in the proposed energy legislation such as the RED and EED. Some additional energy and climate laws are expected to be revised in the coming months: Revision of the Energy Performance of Buildings Directive (EPBD); Revision of the Third Energy Package for gas (Directive 2009/73/EU and Regulation 715/2009/EU) to regulate competitive decarbonised gas markets, scheduled for December 2021.

By Emilia Samuelsson

Vased on CAN Europe’s rapid assessment of the ‘Fit for 55’ main files, 20 July 2021, <https://caneurope.org/can-europes-rapid-assessment-fit-for-55-main-files-climate-energy/>



# Emission limits still breached

While most EU member states met their binding national emission limits in 2019, significant further action is needed to achieve the reduction commitments set for the period 2020–29 and for 2030 onwards.

**As of 2010**, the EU's National Emission Ceilings (NEC) directive requires member states to meet national emission limits for their total emissions of four harmful air pollutants: nitrogen oxides (NO<sub>x</sub>), ammonia (NH<sub>3</sub>), sulphur dioxide (SO<sub>2</sub>) and non-methane volatile organic compounds (NMVOCs).

The emission limits were set in the 2001 NEC directive and are applicable from 2010 until 2019. In 2016, a revised NEC directive was adopted that sets new national emission reduction commitments that are applicable in two steps, from 2020 and 2030, respectively (see AN 1/2017, p.7). Moreover, a fifth pollutant (particulate matter, PM<sub>2.5</sub>) was included in the revised directive.

Official emissions data for 2010–2019 reported to the European Environment Agency (EEA) shows that over these years there were numerous breaches of the emissions limits by several member states. Despite this, the European Commission has so far brought no country to court for their illegal emissions.

Specifically for 2019, four countries – Croatia, Czechia, Ireland and Spain – were still in breach of their limits for NH<sub>3</sub>. Of these, Spain and Czechia have now been in breach of their NH<sub>3</sub> ceilings for ten consecutive years.

Emissions from agriculture – mainly from the use of fertilisers and the handling of animal manure – are responsible for the excessive NH<sub>3</sub> emissions. Emissions of ammonia reduce air quality by increasing the levels of health-damaging secondary particulate matter (PM<sub>2.5</sub>). Ammonia also disrupts land and water ecosystems through eutrophication – the oversupply of nitrogen nutrients with resulting impacts on biodiversity – which currently

affects more than two-thirds of the total ecosystem area in the EU.

With the adoption of the new NEC directive in 2016 came a so-called flexibility mechanism that allows member states under certain circumstances to “adjust” downwards their reported emissions for compliance assessment with the national ceilings. This also includes retroactive adjustment for the 2010–2019 period. Following a review and possible approval of member states’ applications by the European Commission, the number of countries currently deemed to exceed one or more emission ceilings could decrease.

The lack of ambition of the 2016 NEC directive, especially regarding the 2020 reduction commitments, has been strongly criticised by environmental organisations. The new EEA analysis now shows that in 2019, the aggregated EU-27 emissions for all five pollutants were already below their respective targets for 2020.

**Looking at individual** countries, the 2019 emission levels suggest that nine countries have already attained the emission reduction commitments for the 2020–2029 period for all five pollutants. But more effort will clearly be needed in some countries, especially on NO<sub>x</sub>, PM<sub>2.5</sub> and NH<sub>3</sub> emissions.

The slowdown in economic activity in 2020 associated with the Covid-19 lockdowns resulted in temporarily lower emissions of several pollutants and may therefore help countries to meet their 2020 commitments. But without additional efforts, these Covid-19 related reductions will most likely be reversed as the economy recovers.

Moving on to the targets for 2030, more action is clearly needed for all pollutants if the EU is to achieve its 2030 emission

reduction commitments. The EEA concludes that to achieve the 2030 limits, all member states need to lower their 2019 emissions by more than ten per cent for at least one pollutant. In summary:

All countries except Estonia need to reduce NO<sub>x</sub> emissions, and ten of these must cut emissions by more than 30 per cent.

Most countries need additional action to cut PM<sub>2.5</sub> emissions – Czechia, Hungary and Romania must more than halve their emissions, while an additional seven countries will need to cut PM<sub>2.5</sub> emissions by more than 30 per cent.

Reducing NH<sub>3</sub> emissions will continue to be a major challenge for almost all member states, and nine countries will need to lower emissions by more than ten per cent.

Significant action will be needed in 15 member states to reduce emissions of NMVOCs. Czechia, Hungary and Lithuania need to cut emission levels by more than 30 per cent.

Under the NEC directive, member states have to produce national air pollution control programmes (NAPCP) that set out the additional emission abatement measures needed to achieve their emission reduction commitments for 2020 and 2030. A review of the 2019 NAPCPs carried out by the European Commission indicated that many countries are not on track to meet their 2030 emission reduction commitments (see AN 3/2020, pp 24–25), and a more recent analysis by the European Environmental Bureau (EEB) concluded that virtually all (26 out of 27) member states have failed to show how they will cut air pollution to comply with the 2030 limits (see AN 1/2021, pp 12–13).

The EEA points out that changes in the energy sector are crucial to meet

Czechia has been in breach of its ammonia ceiling for ten consecutive years.





Table 1: EU member state progress toward meeting 2010 NEC directive emission ceilings.

Country	NH <sub>3</sub>										NMVOCs										NOx										SO <sub>2</sub>										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Austria	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Belgium	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bulgaria	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Croatia					✗	✗	✗	✗	✗	✗					✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓	
Cyprus	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Czechia	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Denmark	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Estonia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Finland	✗	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
France	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Germany	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Greece	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hungary	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ireland	✓	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Italy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Latvia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lithuania	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Luxembourg	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Malta	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Netherlands	✗	✗	✓	✓	✓	✗	✗	✓	✓	✓	✗	✗	✓	✗	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Poland	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Portugal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Romania	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Slovakia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Slovenia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Spain	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sweden	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
EU-27	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes: '✓' indicates that the emission ceiling has been met. '✗' indicates that the emission ceiling has not been met.

the emission reduction commitments for PM<sub>2.5</sub>, especially cutting the use of biomass and coal in residential heating. Reducing NH<sub>3</sub> and NOx emissions will require action in the agricultural and road transport sectors, respectively.

Moreover, ensuring consistency between the NAPCPs and the National Energy and Climate Plans can increase the reduction in emissions of both air pollutants and greenhouse gases across the energy, industrial, transport and agricultural sectors.

Christer Ågren

Source: EEA briefing on "The National Emission Ceilings Directive Reporting Status 2021" (26 August 2020).

Link: <https://www.eea.europa.eu/publications/national-emission-reduction-commitments-directive-2021>

Note: More detailed emissions data are published by the EEA in the report "European Union emission inventory report 1990–2019 under the UNECE Convention on Long-range Transboundary Air Pollution (Air Convention)", EEA Report No. 5/2021, which is available at: <https://www.eea.europa.eu/publications/Irtap-1990-2019>

Table 2: Percentage emission reductions compared with 2019 levels required to meet the national emission reduction commitments for 2020–2029 and 2030 onwards.

Country	2020					2030				
	NH <sub>3</sub>	NMVOC	NOx	PM <sub>2.5</sub>	SO <sub>2</sub>	NH <sub>3</sub>	NMVOC	NOx	PM <sub>2.5</sub>	SO <sub>2</sub>
Austria	●	✓	✓	✓	✓	●	✓	●	●	✓
Belgium	✓	✓	✓	✓	✓	✓	✓	●	✓	✓
Bulgaria	✓	●	✓	●	✓	✓	●	●	●	✓
Croatia	✓	✓	✓	✓	✓	●	●	●	●	✓
Cyprus	✓	✓	●	✓	●	✓	●	●	●	●
Czechia	✓	✓	✓	✓	✓	●	●	●	●	●
Denmark	●	✓	✓	✓	✓	●	✓	●	●	✓
Estonia	●	✓	✓	✓	✓	●	✓	✓	✓	✓
Finland	●	✓	✓	✓	✓	●	●	●	✓	✓
France	✓	✓	✓	✓	✓	●	✓	●	●	✓
Germany	●	✓	●	✓	✓	●	✓	●	●	●
Greece	✓	✓	✓	✓	✓	✓	●	●	●	●
Hungary	●	✓	✓	●	✓	●	●	●	●	●
Ireland	●	●	✓	✓	✓	●	●	●	●	✓
Italy	✓	✓	✓	✓	✓	●	●	✓	●	✓
Latvia	●	✓	●	✓	✓	●	●	●	●	✓
Lithuania	●	●	●	✓	✓	●	●	●	✓	●
Luxembourg	●	✓	✓	✓	✓	●	●	●	✓	✓
Malta	✓	●	✓	✓	✓	✓	●	●	●	✓
Netherlands	✓	✓	✓	✓	✓	●	✓	●	✓	✓
Poland	✓	●	●	✓	✓	●	●	●	●	●
Portugal	✓	✓	✓	✓	✓	●	●	●	●	●
Romania	✓	✓	●	●	✓	●	●	●	●	●
Slovakia	●	✓	✓	✓	✓	●	✓	●	✓	●
Slovenia	✓	✓	✓	✓	✓	●	●	●	●	●
Spain	●	✓	✓	●	✓	●	●	●	●	●
Sweden	●	✓	●	✓	✓	●	✓	●	✓	✓
EU-27	✓	✓	✓	✓	✓	●	●	●	●	●

Notes: '✓' indicates current emissions levels below the emissions reductions commitment.

'●' indicates emission reductions needed by less than 10% from current levels.

'●' indicates emission reductions needed by 10% to 30% from current levels.

'●' indicates emission reductions needed by 30% to 50% from current levels.

'●' indicates emission reductions needed by more than 50% from current levels.

# Material recovery opportunities from the clean energy sector

The exponential increase in renewable energy sources is vital, and it is important to enable the vast circularity potential of these technologies.

Many industries have pushed for the need for strategies and legislation to support recycling and recovery in the clean energy sector. Waste generation in renewable infrastructures is currently rather low, since the installations are relatively new and, generally, have not yet reached their end-of-life span. However, waste generation in this sector will undergo a dramatic increase in future. This creates a unique opportunity for the EU to anticipate the change and prepare a policy framework to apply circular economy principles to this new sector from an early stage.

The policy gap is analysed in a new report from the European Environmental Agency (EEA). It identifies key drivers and framework conditions necessary to realise opportunities and solutions for improving the circularity of renewable energy. The focus lies on the waste aspect of three main renewable energy infrastructure types: batteries for energy storage and mobility, solar PV cells and wind turbines (see figure).

When it comes to energy storage all metals used in batteries can be recycled. Cobalt and nickel could be valuable enough to make recycling profitable, depending on

price levels and the amounts recoverable from batteries. Increased circularity can be supported through modular/standardised design to promote remanufacturing, and enhanced information about the content of high-impact materials.

Currently, solar panels at their end-of-life stage are processed in existing recycling plants for glass or metals. Mechanical processes are used to separate the materials. Recycling yields of up to 95% of the materials in solar panels are possible. The recycling of solar panels in the EU is regulated by the Waste Electrical and Electronic Equipment (WEEE) Directive. Solar panel waste management is therefore regulated and bound to fulfil specific recycling standards, with an 85% recovery target, 80% of which consists of reuse and recycling. This legislation is based on the extended producer responsibility (EPR) principle.

When it comes to wind turbines, 90% of the total mass of a wind turbine can be recycled. Most of the components have established recycling processes. However, wind turbine blades are more challenging to recycle. They contain complex composite materials, a combination of reinforced

fibres and a polymer matrix, which boost the performance of wind turbines.

There are technologies available to recycle the composite materials in blades, and an increasing number of companies offer composite recycling services. For example, reusing composite materials for the production of concrete, a major source of greenhouse gas emissions, can improve each installation's ecological life cycle balance, help save resources and decrease emissions. However, making these technologies commercially viable will require commitment from policy makers, other composite users and the recycling industry.

Policy options and approaches that can support this are;

- Set mandatory targets for specific products, components, materials or types of waste. Targets could relate to various aspects, including material composition, recycling or collection. Targets may be set by legislation (as is the case in the EU WEEE and End-of-Life Vehicles directives), through EPR (with each EPR scheme setting specific targets) or on a voluntary basis (with industry making its own commitments).
- Place a formal ban on certain waste operations for categories such as products, components, materials or types of waste. This should be done through legislation to enable a coherent approach and a level playing field.
- Specify end-of-waste criteria and requirements for the treatment of emerging waste streams. This would facilitate recycling and the supply of secondary resources, thereby increasing circularity. This could most effectively be done at EU level.
- Introduce ecodesign criteria for specific products or components. This could be done effectively via

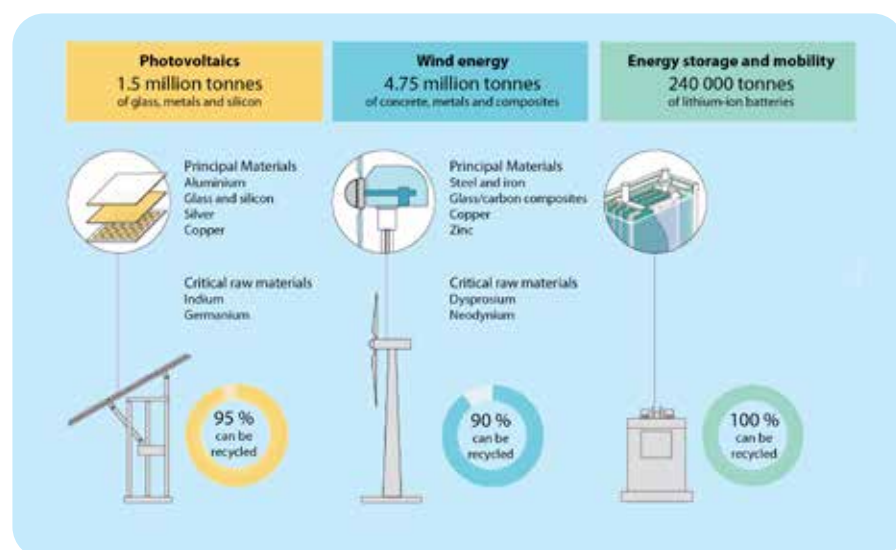


Figure: Material recovery opportunities arising annually from the clean energy sector by 2030.





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Wind energy farm turbine destroyed by fire after a lightning strike. Ninety per cent of the total mass can be recycled.

the development of product-specific regulations, for example in the context of the EU Ecodesign Directive or other regulatory framework, to ensure common criteria and a level playing field.

- Formal design standards for specific products or components to encourage design that maximises the potential for circularity. This could include elements related to materials used, reducing hazardous content, repairability, ease of disassembly etc.
- Extended producer responsibility (EPR) for specific products, components or materials. This could be led by new or amended EU level legislation or industry could be encouraged to develop EPR on a voluntary basis. EPR would help to finance the costs of proper waste management.
- Provide fiscal incentives for measures that lead to greater circularity. Examples could include product or material taxes, tax cuts for recyclable or repairable products, reduced VAT for repair services etc. Similarly providing financial support for measures that lead to greater circularity. Examples could include grants or loans for transport, storage and treatment infrastructure.
- Support for research & development (R&D) on measures that would lead to greater circularity, such as product design, repair options, recycling technologies, infrastructure, development of markets for recycled materials etc. This would also facilitate future planning for waste, since many technologies have lifespans of many years and waste has not always been considered during their design.
- Technical training could be provided to individuals involved with the relevant technologies, to teach them how to work towards greater circularity. This could include training on repair, maintenance and disassembly of the technologies, health and safety etc.
- Finally, attention should be paid to the potential risk of externalising the high costs for recycling in Europe by exporting aged, near end-of-life batteries or electric vehicles, solar power systems or wind turbines to non-EU countries with no stringent enforcement of environmental regulations;

**The CEO of WindEurope**, Giles Dickson, highlighted the need for stronger recycling EU policies this summer: “Wind energy is a green technology. Sustainability is part of our DNA. That’s why we are

constantly striving to further reduce our impact on the environment. A ban on landfilling wind turbine blades will help accelerate the development of sustainable recycling technologies.” He added: “We’ve already started developing cross-industry collaborations with other sectors that are working on composite recycling technologies. The right legislation will help support the creation of viable recycling value chains and to incentivise a market for recycled materials.”<sup>1</sup>

A systematic circular approach can further contribute to a sustainable future for the clean energy sector and this will both increase the efficiency of the decarbonisation and reduce the reliance on material imports. In the next few years, recycling waste materials and second-life manufacturing will become a stand-alone business model, driving job creation in the EU.

Emilia Samuelsson

Reference: EEA, Emerging waste streams: Opportunities and challenges of the clean-energy transition from a circular economy perspective, <https://www.eea.europa.eu/publications/emerging-waste-streams-opportunities-and/emerging-waste-streams-opportunities-and>

<sup>1</sup>Wind Europe, Press release 16 June 2021, <https://windeurope.org/newsroom/press-releases/wind-industry-calls-for-europe-wide-ban-on-landfilling-turbine-blades/>

# Toxic threat from wood burning

The burning of wood and coal for domestic heating is a major source of air pollutant emissions, contributing to more than half of primary PM<sub>2.5</sub> emissions in the EU. A new study compares the emissions from various types of heating options.

**Although wood burning** is perceived by many as being natural and therefore environmentally benign, it is in fact a significant source of several harmful air pollutants, including fine particulate matter (PM<sub>2.5</sub>), black carbon (BC), dioxins, and polycyclic aromatic hydrocarbons (PAHs).

Small-scale combustion of fuels for domestic heating is reported in the European emission inventories under a sector called “residential, commercial & institutional”. According to emission data for 2019 from the European Environment Agency (EEA), fuel combustion in this sector in the EU28 was the major emission source of primary PM<sub>2.5</sub>, contributing 53 per cent of total emissions, as well as PM<sub>10</sub> (40%), black carbon (39%), dioxins (42%) and the carcinogenic PAH compound benzo(a) pyrene (87%).

These emissions contribute significantly to premature mortality and morbidity, and black carbon also contributes to Arctic warming and global climate change. Moreover, the share of emissions in the EU from residential solid fuel burning has increased over the last 20 years and is expected to continue increasing, as other important emission sources gradually become more efficiently regulated.

A new study by the European Environmental Bureau (EEB) and Green Transition Denmark has compared the emissions of air and climate pollutants from wood burning to those from several other heating sources, such as oil, gas, electric, heat pumps, and district heating. The expressed purpose of the study, which is referred to as a pre-study, is to raise awareness about pollution from wood burning.

Expressed as grams of pollutant per unit of energy, the emission levels of PM<sub>2.5</sub>, BC, PAH, volatile organic compounds (NM-VOC), and methane (CH<sub>4</sub>) from residential wood burning are many times higher than those from other heat sources (see Table). It should be noted that emissions of PM<sub>2.5</sub> from wood burning may increase significantly if the stove/boiler is not operated properly and therefore can be much higher in real-life conditions.

Moreover, wood burning in stoves can give rise to very high levels of indoor air pollution – a recent study in the UK showed a threefold increase in harmful PM levels in homes using wood stoves.

The climate impacts of different heating options are also compared, summarising the net global warming potential (GWP) over 20 and 100 years respectively, using

the IPCC GWP factors for each of the climate pollutants CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O and BC. This calculation shows two options for the CO<sub>2</sub> emissions from wood burning, where these are either accounted for or not.

If the CO<sub>2</sub> emissions from wood combustion are included, it was found that wood-burning results in the highest global warming impact, and if these emissions are ignored (i.e. assuming that trees from sustainable forestry grow as fast as they are burned) wood-burning would be a better option for the climate than fossil fuels (coal, oil, gas) for heating. Even better would be to use the wood to replace fossil fuels burned by district heating or power plants, and then use the resulting district heating or electricity (e.g. in heat pumps) to heat homes. The best climate option would be to use green electricity or solar heating.

**The health impacts** of air pollution depend on both the toxicity of the individual pollutants and on the location of the emission. To illustrate the air pollution health costs of different heating options, the study used average Danish health cost data for four key air pollutants (PM<sub>2.5</sub>, NO<sub>x</sub>, SO<sub>2</sub> and NH<sub>3</sub>), and assumed that

	Energy <sup>1)</sup>	PM <sub>2.5</sub>	BC	NOx	SO <sub>2</sub>	CH <sub>4</sub>	CO	PAHs <sup>2)</sup>	NM VOC
Wood stove/ boiler	Wood	375	22	90	14	140	3,440	0.08	465
Oil boiler	Fuel oil	6	0.25	65	8	0.9	4.5	0.0001	25
Gas boiler	Natural gas	< 0.1	< 0.1	22	0.5	1	22	< 0.0001	4
District heating (Plant < 50 MW)	Coal	6.5	0.15	125	584	1.2	13	< 0.0001	1.3
	Fuel oil	6.6	0.26	173	9	1.2	21	< 0.0001	1
	Natural gas	0.1	< 0.1	43	0.6	1.3	37	< 0.0001	2.6
	Wood	13	0.44	120	15	14.5	320	< 0.0001	9.7
Electric heating (Plant > 50 MW)	Coal	2.3	< 0.1	28	11	1	11	< 0.0001	1
	Fuel oil	5.5	0.2	126	7.4	1	16.5	< 0.0001	0.9
	Natural gas	< 0.1	<0.1	31	0.5	1.1	16.5	< 0.0001	2.2
	Wood	5.3	0.18	90	2	3.4	100	< 0.0001	5.6
Electric heating + direct solar heat	Wind, sun, and hydro	0							
Heat pumps <sup>3)</sup>		One third of the emissions from electric heating depending on primary energy (see above)							

Table: Emissions of air pollutants from different heat sources, expressed as grams of pollutant per gigajoule house heating.

<sup>1)</sup> Primary energy: For electric heating the fuel used for producing the electricity.

<sup>2)</sup> Measured as Benzo[a]pyrene.

<sup>3)</sup> Small new heat pumps including air to air, air to water and soil to water, all having average efficiencies around 3.





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the emissions take place in Denmark. It was found that wood-burning is the most expensive heat source, resulting in the highest health damage, both domestically and internationally.

In conclusion, residential solid fuel burning is the most polluting and costly option for domestic heating, and it contributes significantly to global warming. Although new wood-burning appliances are more efficient and emit less particles than the old ones, they still pollute much more than other available heating options. Replacing wood burning with better insulation and alternative clean heat will provide big health benefits.

The study ends with three recommendations:

- Carry out a more detailed study on air and climate pollution from domestic heating;
- Set much stricter emission limit values in the EU EcoDesign directive for wood-fired stoves and boilers;
- Start a Europe-wide campaign for better insulation and cleaner domestic heating, including i.e. local/national actions to ban or limit domestic solid fuel combustion.

Christer Ågren

Source: "Emissions from domestic heating". By Kåre Press-Kristensen. Published by the European Environmental Bureau (EEB) and Green Transition Denmark (September 2021). Available at: <https://eeb.org>

# Global PM pollution cuts life short

Across the world, 6.3 billion people – 82 per cent of the global population – live in areas where levels of PM<sub>2.5</sub> exceed the World Health Organization's guideline<sup>1</sup> of 10 µg/m<sup>3</sup>. The average global citizen is exposed to concentrations of 32 µg/m<sup>3</sup>, i.e. over 3 times the WHO's guideline. If this level of particulate pollution persists, the health consequences of air pollution could shave 2.2 years off global life expectancy compared to a world in which all countries met the WHO guideline. In other words, permanently reducing air pollution to the WHO guideline could increase global average life expectancy and the world's population could gain 17 billion life-years.

According to the annual update of the Air Quality Life Index (AQLI), in terms of life expectancy, particulate pollution is the world's greatest threat to human health. South Asia is consistently the most polluted region, with people there living 5 years less on average than they would if the region met the WHO guideline – and even more in the most polluted parts of the region like northern India.

Nearly three-quarters of Europeans, including the entire populations of Poland, Belarus, Slovakia, Hungary, Lithuania, Armenia, Moldova, Cyprus, Bosnia and Herzegovina, live in areas where particulate pollution exceeds the maximum recommended by the WHO. In 2019 the average European was exposed to a particulate pollution concentration of 12.2 µg/m<sup>3</sup>. If the WHO guideline was to be met, average life expectancy across Europe would improve by 4 months.



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People of Warsaw could on average live another year if WHO guidelines were met.

Poland is the most polluted country in Europe, and people in Warsaw and Silesia would gain 1.2–1.3 years from better air quality below the WHO guideline. Outside of Eastern Europe, high pollution persists in areas such as Italy's Po Valley, including the city of Milan, as well as the industrial centre of Bursa in Turkey. In Milan and Bursa, residents would gain 10 months and 1.4 years, respectively, if pollution levels met the WHO recommendation.

Source: Air Quality Life Index Annual Update (September 2021). [https://aqli.epic.uchicago.edu/wp-content/uploads/2021/08/AQLI\\_2021-Report.EnglishGlobal.pdf](https://aqli.epic.uchicago.edu/wp-content/uploads/2021/08/AQLI_2021-Report.EnglishGlobal.pdf)

<sup>1</sup>This text refers to the old WHO guidelines

## Fireplaces and stoves greatest PM source in UK

Fireplaces and stoves are now the largest single source of primary particle pollution in the UK, greater than traffic and industry. About 40 per cent of the UK's primary particle pollution comes from just 7 per cent of homes that burn solid

fuel. Government estimates suggest increases in wood burning since 2005 have offset gains from other sectors, including cleaning up traffic exhausts.

Source: The Guardian, 7 May 2021.



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# Norway's future without oil

A rapid decommissioning of Norwegian gas and oil extraction is necessary to be in line with the Paris agreement. The loss of GDP may only be 1% in 2050 compared to business as usual.

**The Norwegian environmental** movement and an increasing number of political parties and organisations in Norway are advocating a forced shutdown of the Norwegian petroleum industry. The warnings from the oil industry and their allies have consistently been that this might lead to an economic and social catastrophe, with a loss of vital income for society, loss of revenue for the government and loss of employment for a large number of people.

Those in favour of an early shutdown of the oil and gas fields argue that this will reduce the total amount of CO<sub>2</sub> released to the atmosphere, and it is necessary if Norway wants to fulfil its obligations under the Paris Agreement. If the average global temperature increase due to the greenhouse effect is to be limited to well below 2 °C, and ideally below 1.5 °C, Norway cannot continue exploiting the oil and gas reserves at the same rate as before. The International Energy Agency (IAE) has traditionally been a solid supporter of the oil industry. But the IEA recently published a scenario showing that if the world as a whole is to honour the Paris Agreement, there is no need for any new oil and gas fields. This means that active oil and gas exploration should stop immediately, including in Norway. This was a shock for the Norwegian oil industry, and for the majority of the political parties. So far, the majority refuses to face the inevitable.

Politicians shy away from doing the necessary, fearing the loss of votes. This includes the present Prime Minister, Erna Solberg, and the majority of the political parties in the Norwegian Parliament. New leases for oil exploration has until recently been issued in the most vulnerable sectors of the Norwegian off-shore areas in the Barents Sea in the far north. It is reasonably certain that Norway, after the recent Parliamentary elections, will form a new coalition government between the Labour Party and one or two smaller parties. The Labour Party has so far said

that oil exploration and production will continue as before, and so has one of the two possible coalition partners, the Centre Party. The other possible coalition partner, the Socialist Left Party, wants to phase out oil production and exploration. How the programme of the new government will turn out, is still not clear at the time of writing (mid-September 2021).

The economic arguments and the consequences for employment in the Norwegian economy weigh heavily in the debate about a forced shutdown of the oil sector. Around 100,000 jobs depend on the present level of oil and gas exploitation. This is a significant number in a country of no more than 5.4 million people. The oil price collapsed around 2014. This caused a loss of 36,000 jobs in the oil sector alone because of cut-backs in the industry. Similar consequences are easy to envision with a rapid shutdown of the oil industry to protect the world's climate.

It is obvious that the forced shutdown of the oil and gas industry cannot take place without an active strategy to stimulate the creation of employment and absorb the loss of jobs in the oil sector. The oil industry chooses to either ignore these possibilities, or argue that no employment in other sectors will be able to compensate for the loss of the oil jobs. A coalition of environmental NGOs, trade unions, church organisations and others have therefore established something called "Broen til framtiden" – or "The Bridge to the Future". The coalition organises a yearly conference where the alternatives to the oil business are explored. It has also sponsored several reports with the same theme. The aim is to foster a just transition to the new economy without the present heavy dependence on the petroleum sector.

**The "Bridge to the Future"** coalition wanted to study the consequences of a forced shutdown for the economy and for the employment. So it sponsored a report from the Norwegian Central Bureau of

Statistics – SSB. The report<sup>1</sup> looked at two different scenarios: in the first scenario the government stopped giving out new permits for exploration and stopped the issue of new leases for areas of exploration. In the other scenario a reduction of new leases for exploration was combined with changes in the tax regime for the oil companies. The conclusion was that both would have very modest economic consequences. In the least-severe alternative, the GDP of onshore Norway would be reduced by 0.5 per cent, compared to the business-as-usual reference development. This is only one third of the expected yearly growth in GDP. The impact on public spending would also be very small, because the money used in the government budget comes from the so-called Oil Fund (the Norwegian Pension Fund Global), and not directly from oil revenues. The number of people unemployed would increase by 6,500 at most, which is 0.2 per cent of the workforce.

In the other scenario, a reduction in exploration areas combined with changes in the tax regime would reduce the oil companies' incentives. This would mean a full stop in the issuing of new licenses from 2022. From 2025 several tax incentives will be removed. The CO<sub>2</sub> tax and the cost for emission trading quotas are gradually increased. The combination of measures in this alternative may also cause a faster phasing-out of petroleum activity from existing fields already in production. The economic consequences would be more severe, but it would also give faster transitional effects and ensure that more oil and gas will remain in the ground. The loss of GDP will still only be 1 per cent in 2050 compared to the business-as-usual scenario. This is still less than the expected annual growth of the economy. The unemployment rate will be clearly higher, by 0.5 percentage points. So there will be a greater need for active investments and job creation to compensate for the job losses in the petroleum sector. Right before the recent





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Norwegian fishermen protesting against new oilfields close to the Lofoten islands.

Parliamentary elections, the sitting right-centre government announced a change in the taxation regime for the oil industry in line with this scenario. The effect of the real changes in the taxation regime might be smaller than in the scenario, but it will be in the right direction. What is clear is that the tax incentives for oil exploration will be removed. This will have a positive effect in the long term in the form of reduced exploration activity, but it will not have the same short-to-medium effect as a full stop in issuing new licences.

**Connie Hedegaard**, the former EU Commissioner for Climate Action, headed a two-person commission responsible for a report in 2016 on the green transition of the Norwegian economy. Norway needs new green employment opportunities and growth that can replace the expected downturn in the petroleum-related sectors. The report defines green competitiveness as high value creation and full employment in a society with reduced CHG emissions. Existing and new workplaces must transition themselves to compete, and value creation must take place in a resource-efficient low-emission society.

The report advised the Norwegian government on how Norway should achieve a competitive green transition to a low-emission society in 2050. The most important conclusions were that Norway had committed itself to reduce emissions of GHGs. (In 2020 the government committed Norway to a reduction of at least 50% by 2030 compared to 1990 levels.) The development of new technologies,

new materials and new business models opens up new opportunities. Falling costs for zero-emission technologies lead to rapid growth of renewable energy. The petroleum sector in Norway will no longer be the same growth engine in the economy. The extraction of oil and gas had probably already reached a maximum, and is on its way down. A de-carbonisation of the world economy will reduce the demand for oil and gas in the future. As an example of a development that will reduce the demand for petroleum products, the report mentioned that electric cars would increase in numbers. In 2021, developments in Norway at least show that the report was right. In 2021 the number of electric/hybrid cars in Norway has already increased to 25 per cent of the total. In 2020, 55 per cent of all new cars sold were electric/hybrid. The Norwegian government's ambition is that by 2025 only zero-emission vehicles will be sold. This will reduce domestic demand for auto fuel considerably.

**The realisation that** something must change, and that the oil and gas industry will not go on forever, is starting to sink in. One alternative after another has been proclaimed by the media as "The next oil". Realistically, the harvesting of a limited non-renewable resource such as oil and gas will never make a comeback. Not in Norway, and not in the world. But Norway has a lot going for it. Norway has a highly educated workforce, an advanced technological and scientific base, a solid economy, and not least the so-called

Nordic model for the relations between labour and capital. Generous unemployment benefits increase the flexibility of the workforce. Changes in the economy and new opportunities for wealth creation to replace declining petroleum-related activities will therefore be less painful than in many other countries.

Where will the new employment be created? This must be speculation, and few would venture to predict exactly where, in what sectors of the economy and how many new jobs will be created. Some of the new employment will probably be in traditional sectors such as marine resources, where Norway already is a major player. But a word of caution is that automation and technology might lead to less labour-intensive harvesting of all marine and other natural resources. The new employment is more likely to be in the technology and services sector, and in many cases in technology that has not been invented yet. The changes in the economy in recent decades have been enormous, and much of it has not been foreseen in detail. There is all the more reason to expect that the changes in the future will be big, and equally unpredictable in detail, although the larger trends are easier to predict. Less dependence on the petroleum sector is a given fact that Norwegian society is gradually adapting itself to.

Tore Braend

<sup>1</sup> <https://www.ssb.no/nasjonalregnskap-og-konjunkturer/artikler-og-publikasjoner/konsekvenser-av-redusert-petroleumsvirksomhet>



# Norway's oil and gas market grows – NGOs call for phase-out

The major factor driving the market is the increasing development of new oilfields in the country over the forecast period 2021–2025.

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**Business Wire reports** that “the development of new oilfields is likely to drive the market over the forecast period. The discovery of new small oilfields is likely to provide an opportunity for the upstream oil and gas companies operating in Norway in the near future. The availability of oil reserves and increasing investment in the upstream sector are likely to drive the market over the forecast period. Norway is one of the largest oil producers and exporters in the European region. In 2019, the country's crude oil production was 1437 thousand barrels per day, which accounted for about 47.9 per cent of Europe's total crude oil production. The average offshore rig count was 16 in 2020.

The major oilfields in the country are reaching maturity and as a result Norwegian oil production has declined significantly since 2016. However, in January 2021, about 30 companies have received offers of ownership interests in a total of 61 production licences (34 in the North Sea, 24 in the Norwegian Sea, and 3 in the Barents Sea) on the Norwegian Shelf in the system of Awards in Predefined Areas (APA) 2020. Hence, with the award of 61 new production licences, the upstream segment is likely to make more profitable discoveries on the Norwegian shelf during the forecast period.

Moreover, Johan Sverdrup oilfield, the third-largest oil field on the Norwegian continental shelf, operated by Equinor, announced its plan to increase its daily

production capacity to 535,000 barrels of oil by mid-2021. Also with expected resources of 2.7 billion barrels of oil, the field is one of the most important industrial projects in Norway for the next 50 years. Phase 1 of the field was opened in October 2019, and phase 2 is scheduled to begin production in Q4 of 2022.

Some of the major fields that are expected to come on stream during the forecast period are the Johan Sverdrup oilfield, Martin Linge, and Johan Castberg. New and upcoming oil field discoveries and the expansion of existing oil fields are therefore likely to reverse the trend and register significant growth in the market over the forecast period.

Norway holds the largest share in terms of total oil reserves among the European countries. According to the Norwegian Petroleum Directorate, there are around 8 billion standard cubic metres of oil-equivalent ( $\text{Sm}^3$  o.e.) resources (oil and gas) remaining on the Norwegian continental shelf (NCS), of which 52 per cent (4.2 billion  $\text{Sm}^3$  o.e.) of resources are proven, as of February 2021. The production on the Norwegian shelf in 2020 was 229 million  $\text{Sm}^3$  o.e.

Around 43 per cent of the remaining resources are concentrated in the North Sea. The distribution of the rest indicates that 38 per cent are in the Barents Sea and 19 per cent are in the Norwegian Sea. In the Barents Sea, large parts of the remaining planned resources are not

confirmed. At the end of 2020, there were 67 producing fields in the North Sea, 20 producing fields in the Norwegian Sea, and two producing fields in the Barents Sea.

As of December 2020, the estimated total unproven resources were 665 million  $\text{Sm}^3$  o.e., 665 million  $\text{Sm}^3$  o.e. and 2,505 million  $\text{Sm}^3$  o.e. in the North Sea, Norwegian Sea, and the Barents Sea respectively. Hence, with the abundance of proven and unproven resources in the country, the oil & gas upstream sector is likely to witness significant growth over the forecast period.”

The Norwegian environmental movement is very actively campaigning to phase out oil and gas production in Norway, and has called for international help to achieve this target.

Compiled by Reinhold Pape

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# Paying farmers for carbon

Although costs for monitoring, reporting and verification are high for many result-based schemes, the European Commission favours a wider implementation.

**The European Commission** has announced that by the end of this year they will publish a Communication on Carbon Farming. This will include an action plan for carbon farming and a regulatory framework for certifying carbon removals.

In a preliminary study, “Operationalising an EU carbon farming initiative”, the Commission has looked at existing payment schemes that reward carbon sequestration, reduced or avoided emissions in agriculture. Note that they do not address here the sensitive issue of whether carbon credits from agriculture are allowable for trading.

The report recognises that farm-level payments for carbon farming can be action-based or result-based. The action-based schemes are already common in various forms, not least in the Common Agricultural Policy. Farmers get paid for carrying out certain actions, e.g. planting cover crops or maintaining hedges. The benefit of result-based schemes is that they directly link payments to measurable indicators and the climate benefits they provide. Another advantage is that farmers are free to choose the management strategy they use to achieve a desired result, rather than following a set of rules. The recurring challenge with result-based schemes is that you need to find ways to monitor, report and verify that emissions are either avoided or reduced.

A middle way is the use of hybrid schemes, where farmers receive a basic action-based payment topped up with an additional result-based payment if climate benefits can be demonstrated.

**Five thematic areas** for carbon farming are identified in the report: peatland restoration and rewetting; agroforestry; maintaining and enhancing soil organic carbon on mineral soils; grasslands; and livestock farm carbon audits.

Degraded peatlands are a major source of greenhouse gas emissions, but represent a relatively

small share of all EU farm land. This provides great potential to reduce emissions through restoration and rewetting. Another advantage is that greenhouse gas fluxes from peatlands and emission factors in peatlands are well correlated with water table levels, land use and vegetation type. Thus, they are easy to monitor, report and verify.

Agroforestry is a range of farming systems that involves growing shrubs and trees next to crops or in pastures. Calculating the amount of carbon in trees can be done relatively easily, but it is more difficult to assess the carbon that is stored in the ground. The report recommends that priority should be given to the restoration and maintenance of already existing agroforestry systems mainly in the Mediterranean region. Many of these are of high natural and cultural value and are currently under threat. Establishing new agroforestry systems can also provide climate mitigation and adaptation benefits. However, this should be done with forethought, considering cost-effectiveness and adaptation to local conditions.

Farmers have a range of options to improve levels of carbon in the soil, including cover cropping, improved crop rotations, agroforestry, and converting from cropland to grassland. The report states that the costs to monitor, report and verify carbon fluxes have been high in the studied projects. The potential for carbon storage in different soils is also uncertain. However, technological development that includes remote sensing could remedy some of those problems.

Grasslands cover more than a third of farmland in the EU and already contribute to a considerable level of carbon sequestration each year. The potential to retain and increase the stored carbon is considered good. The difficulty is again about measuring. The scope for carbon sequestration is dependent on soil type, climate, previous land use and subsequent management practices. However, the report believes that the potential outweighs the constraints. Results-based schemes are considered suitable for both the management of existing grasslands and the conversion of arable, fallow and marginal land to grassland.

The livestock sector accounts for 81 per cent of the greenhouse gas emissions of the agricultural sector. On-farm measures such as improved feeding, better manure management, reduced use of energy and fertilisers are estimated to have an overall potential to reduce greenhouse gas emissions by 12–30 per cent. There are already several carbon auditing tools that calculate how much greenhouse gas emissions are reduced by different actions. Here, the report recognises a trade-off between certainty and cost, e.g. it is cheaper to rely on average emissions factors than exact measurements. More stringent methods will be costlier and in the end limit uptake among farmers.

**The need for** technological and methodological developments to reduce the uncertainties and costs of monitoring, reporting and verification is clear. The report also highlights the need for farmers’ involvement in the design of schemes, as well as including the co-benefits that contribute to other environmental objectives, such as biodiversity.

Kajsa Pira

The report “Operationalising an EU carbon farming initiative”: <https://op.europa.eu/en/publication-detail/-/publication/b7b20495-a73e-11eb-9585-01aa75ed71a1/language-en>



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# The rise of floating solar photovoltaic farms

Solar power is now the cheapest source of electricity in history. To continue its expansion many have looked to the benefits of floating solar farms.

**This summer one** of the largest inland floating solar photovoltaic (PV) farms was officially deployed on the Tengeh Reservoir in Singapore. It is made up of 122,000 solar panels covering 45 hectares. The 60 megawatt-peak solar PV farm is a step towards Singapore's goal to quadruple its solar energy capabilities by 2025. The solar farm could help to reduce carbon emissions by about 32 kilotonnes annually. The project, covering an area equivalent to 45 football pitches, is long overdue as Singapore is one of the biggest carbon dioxide emitters per capita in the world.

The Asia Pacific region plays a leading role in floating solar deployment, with 87% of the world's floating solar capacity. Currently, China has the largest number of plants installed, with a capacity of around 1.1 GW. Japan and the United Kingdom follow, but India has also recently announced a plan to develop 10 GW of floating solar plants.

Recent studies have shown the technology generates more electricity than rooftop or ground-mounted solar installations. This is due to the cooling effect of the water beneath the panels and because there is no shading impact from other buildings. This can boost how efficiently

these systems generate electricity by as much as 15%.<sup>1</sup>

An interesting European example is in the Netherlands, where Europe's largest floating, sun-tracking solar park is just four miles from central Rotterdam. The energy yield is 20 to 30% higher than with static land-based systems. The system is highly efficient, due to the fact that it continually tracks the sun, and thanks to the water-cooling effect on the solar panels. Rotterdam can get strong winds, so the panels are fitted with sensors to monitor wind forces and the height of waves, making the system stormproof. If the wind gusts at 47 to 53 mph, the island square is turned into the wind, so it blows through the rows of solar panels.<sup>2</sup>

New research has even shown that floating solar farms can also help protect lakes and reservoirs. Freshwater bodies cover less than 1% of Earth's surface, they nurture almost 6% of its biodiversity and provide drinking water and crop irrigation that's vital to billions of people. The surface temperature of lakes has risen by an average of 0.34°C per decade since 1985 due to climate change. The temperature increase encourages toxic algal blooms, lowers water levels and prevents water mixing between the distinct layers that naturally form in larger and deeper lakes, thereby starving the depths of oxygen. Research based on

Windermere, the largest lake in England, showed that floating solar farms reduced evaporation and improved water mixing in the lake, which helps oxygenate the deeper water.<sup>3</sup>

If just 1% of the surface area of all human-made water bodies (which are easier to access and typically less ecologically sensitive than natural lakes) was covered by floating solar panels, it could generate 400 gigawatts. In Europe, 10% of man-made freshwater reservoirs has the potential to produce over 200 gigawatts if floating panels were installed.

In the past five years floating solar power has grown more than a hundredfold, reaching 2.6 gigawatts of installed capacity across 35 countries. It is important to look to this development and to enable floating solar farms to make an important contribution to the decarbonisation of the world's energy supplies.

Emilia Samuelsson

<sup>1</sup> Reuters, Chen Lin, 2021, <https://www.reuters.com/business/energy/singapore-unveils-one-worlds-biggest-floating-solar-panel-farms-2021-07-14/>

<sup>2</sup> Barone, Jeanine. 2021. <https://www.architecturaldigest.com/story/building-europes-largest-floating-solar-park>

<sup>3</sup> Exley, Giles 2021. <https://theconversation.com/floating-solar-farms-could-cool-down-lakes-threatened-by-climate-change-157987>

Assembling and installing a floating solar farm in Colorado, United States.



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## Need for stricter vehicle emission standards

Later this year, the European Commission will finalise the next iteration of EU road vehicle emission standards, known as Euro 7 for cars and vans, and Euro VII for trucks and buses.

Studies by the International Council for Clean Transportation (ICCT) show that the introduction of Euro 7/VII standards will prevent tens of thousands of premature deaths equivalent to avoiding hundreds of thousands of years of life lost, by employing technologies that already exist, and which will increase the cost of new cars by less than 2 per cent and the cost of new trucks by less than 5 per cent. But the automobile industry claims that the proposed standards are unnecessary, infeasible, and costly.

Source: ICCT, 25 June 2021. Link: <https://theicct.org/blog/staff/stricter-emissions-limits-eu-jun2021>

# Environmental impacts of shipping analysed

On 31 August, the European Environment Agency (EEA) and the European Maritime Safety Agency (EMSA) jointly launched the “European Maritime Transport Environment Report”, which among other things shows that ships calling at EU and European Economic Area ports in 2018 emitted around 140 million tonnes of CO<sub>2</sub>. Around 40 per cent of these

emissions came from voyages between ports of EU member states and while the ships were at berth. the remaining 60 per cent emanated from voyages into and out of the EU.

Air pollutant emissions from ships calling at EU and European Economic Area ports in 2019 amounted to 1.63 million tonnes of sulphur dioxide (SO<sub>2</sub>), 4.46 million tonnes of nitrogen oxides (NO<sub>x</sub>), and 270,000 tonnes of PM<sub>2.5</sub>.

The report also looks at issues such as underwater noise, introduction of non-indigenous species, and pollution of the marine environment. Finally, it assesses the current state of emerging maritime transport sustainability solutions, including alternative fuels, batteries and onshore power supply.

Source: EEA press release, 19 August 2021. The report: <https://www.eea.europa.eu/publications/maritime-transport/>



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Ships calling at EU and European Economic Area ports in 2018 emitted around 140 million tonnes of CO<sub>2</sub>.

# International shipping must act now

“Actions taken under the International Maritime Organization to reduce greenhouse gas emissions have ranged from disappointing to completely ineffective,” says Climate Action Network International in a new statement (1). “Proceeding under the framework of the 2018 Initial IMO GHG Strategy, the negotiations for short-term measures have produced outcomes that will have no impact on emissions this decade and minimal impact thereafter,” commented CAN.

CAN is concerned that present discussions within the IMO are again delaying action for a long time. Only a small levy on fuels is proposed to fund R&D, which is unlikely to incentivise emissions reductions.

To bring shipping sector emissions in line with the imperative of limiting warming to 1.5°C, CAN demands, for example, that the IMO:

- adopts a carbon price that will enter into effect by 2025;

- adopts a rigorous lifecycle approach so that truly sustainable and renewable fuels and energy sources are used;
- revises the long-term emissions goal to ensure the complete decarbonisation of the sector by 2050 or earlier;
- adopts other measures necessary to ensure the rapid introduction of zero-carbon renewable sources of energy and propulsion.

The UK government has recently decided to include shipping emissions in its national climate policy carbon budget target. New ships have a life expectancy of 30 years, so the IMO must act now.

Reinhold Pape

(1) <https://climatenetwork.org/resource/briefing-12th-petersberg-climate-dialogue/>



FLICKR.COM / INTERNATIONAL MARITIME ORGANIZATION CC BY

IMO boss, Kitack Lim, posing next to the 13th sustainable development goal – just what CAN wants to see realised.

# New EU farm policy supports business as usual

In the coming years the European Union will continue to fund intensive farming practices with only marginal tightening of environmental requirements.

**An agreement between** the Council of Ministers and the European Parliament on the Common Agricultural Policy (CAP) 2023–2027 was reached on 25 June. As the largest budget item in the EU, around a third of the entire budget, it should have the potential to contribute to real change in the farming sector. Unfortunately, this CAP reform will not contribute to a much-needed sustainability revolution in European agriculture. What it achieves instead are some minor improvements in basic environmental requirements. Along with a great deal of uncertainty about how the member states will choose to implement the new performance-based CAP, as well as the Commission's capacity to assess their work.

Let's start with the slight improvements. There are minimum standards that all farms that receive CAP payments must comply with. The new rules prohibit farmers from cultivating peatlands and wetlands – at least after 2025 – since member states can postpone the introduction if they can show that they do not have the right map data. This move is long overdue, as cultivation on peat soils accounts for a disproportionate share of agricultural greenhouse gas emissions.

Another mini-step forward is that the previous requirement of “crop diversification” has been improved to a minimum level of “crop rotation”, which could potentially have a marginal effect on fertiliser use. However, the Commission's proposal for mandatory use of a Farm Sustainability

Tool for Nutrients was abandoned during the negotiations.

**The big news** in this CAP compared to the previous is the new delivery model: shifting from compliance-based to performance-based monitoring. Actually reviewing what is achieved out in the fields or in the paddock is quite reasonable. The challenging part is that member states need to define targets for a set of “result” indicators. The big risk is that rather than measuring actual environmental results, they measure how many hectares a particular scheme (e.g. for climate) has been rolled out on. The easier and less demanding the scheme, the easier it is to reach the target.

A weakness of this “performance framework” is that it is not clearly linked to any quantitative EU targets, nor is there an obligation on member states to set meaningful targets at national level. The Commission can only base its assessment of the national CAP Strategic Plans on qualitative aspects, which will be very hard to benchmark against the ambition level needed to deliver on environmental objectives.

During past CAP reforms, coupled support (per animal or acre) has been increasingly phased out. This mechanism is being criticised as it can function as direct support for intensive animal production without making any demands on environmental performance. In 2018, sixty per cent of the coupled support (EUR 2.4 billion) went to beef and milk production.

However, instead of continuing on the path taken and abolishing this support altogether, the rules for when member states can use coupled support have been relaxed.

However, there are a few caveats that stop member states from totally neglecting environmental concerns. There is a no-backsliding clause that stops member states from spending less on green measures. There are also ring-fencing mechanisms that require member states to spend 25 per cent of the pillar 1 direct payments on so-called eco-schemes, while 30 per cent of pillar 2 should be used for agri-environment-climate schemes.

**There is also**, what at a first glance looks as a promising ambition, a target that 40 per cent of the CAP-funds should go towards the climate. That would mean 22 billion euro annually in climate investments, but the interpretation of “climate” is ridiculously broad. The climate budget column includes 100 per cent of the support for environmentally and climate-friendly agriculture, which makes some sense, although not all of these are specific climate measures. More questionable is that 40 per cent of the contributions to areas with natural restrictions (e.g. mountainous areas) and 40 per cent of the direct payments to farmers now called “Basic Income Support for Sustainability” and “Complementary Income Support” are reckoned as climate investments. Just days before the new agreement the European





# Global scrubber washwater discharges

A new report from the International Council for Clean Transportation (ICCT) provides the first global assessment of the mass of washwater discharges expected from ships using scrubbers to remove sulphur dioxide (SO<sub>2</sub>) from ship exhausts. The scrubber washwater is more acidic than the surrounding seawater and contains polycyclic aromatic hydrocarbons, particulate matter, nitrates, nitrites, and heavy metals including nickel, lead, copper, and mercury. It is toxic to some marine organisms, harms others, and can reduce water quality.

The authors calculate that, absent additional regulations, ships with scrubbers will emit at least 10 gigatonnes (Gt) of scrubber washwater each year. For context, the entire shipping sector carries about 11 Gt of cargo each year.

Approximately 80 per cent of scrubber discharges occur within 200 nautical miles of shore, and there are hot spots in heavily trafficked regions, including the Baltic Sea,

Polluting discharge from scrubbers is a potential threat to marine life.



North Sea, Mediterranean Sea, the Strait of Malacca, and the Caribbean Sea. Scrubber discharges also occur in IMO-designated Particularly Sensitive Sea Areas (PSSAs), including the Great Barrier Reef and the Baltic Sea.

Source: ICCT, 29 April 2021. The report: <https://theicct.org/publications/global-scrubber-discharges-Apr2021>

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Court of Auditor published a report in which they conclude that the CAP funds attributed to climate action in 2014–2020 “had little impact on agricultural emissions”.

A partial explanation for the CAP’s weak environmental performance is that the original proposal was presented back in 2018. This was before the EU stepped up their environmental and climate work by launching the European Green Deal in December 2019. It was followed by the Farm to Fork strategy in May 2020, which includes targets for climate and nitrogen: agriculture should contribute to the effort-sharing decision by reducing net greenhouse gas emissions by 55 per cent, while nutrient loss should be reduced by 50 per cent and chemical fertilisers by 20 per cent by 2030.

The fact that the agreed CAP is insufficient in relation to the European Green Deal was partly acknowledged by Commissioner Frans Timmerman when, during the press conference, he said the agreement “could have gone a bit further, obviously. I am very ambitious, the Commission is very ambitious, because of our green deal and because we believe that Europe is faced with an existential challenge due to the climate crisis and the biodiversity crisis.”

Kajsa Pira

## Netherlands plan to cut livestock numbers by 30%

Dutch politicians are considering reducing livestock numbers by almost a third over the next decade. The background is a court decision from 2019 (see AN04/19) which stated that nitrogen emissions were too high in the vicinity of Natura 2000 areas.

Urgent measures to solve the problem included lowering speed limits on roads. An immediate way to cut NO<sub>x</sub> emissions.

Government agencies have now developed two alternative scenarios on how to achieve emission reductions in the longer term. Both of them include cutting livestock numbers by 30 per cent over a ten-year period. The state will achieve this by buying land and emission rights from farmers. Expropriation may be necessary. The proposals also include support for farmers to convert to more extensive farming as well as building low-emission stables.

The percentage of sensitive nature, where nitrogen depositions are below the



Dutch farmers may be forced to sell emission rights and land, to protect nitrogen sensitive nature areas.

so-called critical loads for nitrogen, would increase by about 60 per cent under both policy variants.

PBL Netherlands Environmental Assessment Agency, Press release 6 September 2021, <https://www.pbl.nl/nieuws/2021/pbl-publiceert-quickscan-van-twee-beleidspakketten-voor-het-vervolg-van-de-structurele-aanpak-stikstof>

The Guardian, 9 September 2021, <https://www.theguardian.com/environment/2021/sep/09/netherlands-proposes-radical-plans-to-cut-livestock-numbers-by-almost-a-third>



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# Towards climate-friendly food production

We need to reduce emissions of greenhouse gases and nitrogen from what we eat. Nordic farmers and food producers show how it can be done in practice.

**A transition to** more plant-based food production combined with less intensive livestock rearing would reduce the climate and nitrogen footprint from our farms. A new report “Nordic Food Transition – Low emission opportunities in agriculture”, by AirClim, Green Transition Denmark and The Finnish Society for Nature and Environment, presents eight initiatives in Sweden and Denmark, that are considered forerunners on the way towards a more sustainable food system.

**Growing more protein-rich** crops aimed for human consumption is key. Today, much of the plant-based food is based on imported ingredients, such as soy. But it does not have to be that way. Five of the initiatives covered in the study either grow crops rich in proteins like, peas, beans and quinoa or process domestically grown legumes to products like mince, nuggets and textured protein.

Despite a relatively large production of peas and field beans in Sweden and Denmark, a very small part goes to human consumption. The most obvious reason is the lower price of the imported legumes and the fact that there are established supply chains for these.

The legume growers in the study tells about several obstacles they face. To begin with finding seeds for the right varieties that work in our climate can be challenging. At Torsåker farm they wanted to grow sweet lupin and grey pea. But seeds were

not possible to find in Sweden. Instead, the lupin seeds were recovered through German contacts and grey pea seeds were found at Latvia's university of agriculture.

Since there is no tradition to growing many of these crops the farmer must develop cultivation methods that work. There is no advisory service to rely on. One example is Fagraslätt that have tried to grow lentils. Lentils do not compete well with weed, so they are cultivated together with oat; to do so you need to know which ratio between the two crops works best. You also need to know what technique is better to clean and separate the lentils from the oat.

In the report we call for the need of more research and development in protein crops. They compare with the production of cereals have been refined over the years. Similar efforts to optimize methods and varieties needs to be done for different protein crops aimed for human consumption. There are also challenges that are specific for these crops, e.g. legumes have a relatively long development time. Varieties that allow for earlier harvesting would reduce the risk of crop failure and may push the limit of legume production further northward.

In the interviews with farmers, it also clear that these types of difficulties with more untried crops also comes with a greater financial risk for the individual farmer. Society could bear some of that risk, by at an initial phase provide eco-

nomic support to protein crops aimed for human consumption.

**To make it profitable** to grow protein crops, the products must also find their way to the market. The report shows many different examples. In the case of Fagraslätt farm, the dried legumes are cleaned and packed on the farm and sold directly to consumers and to stores, restaurants, and to a specialized wholesaler. Another case is a partnership between a large grocery chain and two farms, where the final product is frozen pea nuggets. The growers have through this collaboration a guaranteed outlet for the crops at an agreed price.

The food industry and retailers could take a greater responsibility to initiate these types of collaborations with primary producers. Through direct contact farmers, they can convey what quality of the produce is required for processing or sale to the end consumer. These types of contacts could be encouraged by governments by supporting network and alliance building activities between stakeholders.

In the report we also state the need for infrastructure that enables the processing of legumes and other protein crops. The company Organic Plant Protein produce texturized plant protein from pea and faba bean. They need to have access to a protein mill where pulses are grinded to a flour, but there is none in Denmark. Instead, they have to send the legumes to a mill in Norway and then back again for the final processing. Nor does Sweden





have a protein mill. In Finland there is one facility for faba beans, but none for peas. The establishment of domestic facilities for grinding legumes would fill an important gap in the supply chain, since the protein-rich flour could be used in several ways by the food industry.

Other gaps exist, especially at the processing stage. It can be boiling and conserving of legumes, centralised drying, sorting, and packing, or extrusion into textured protein. For example, there is no extrusion facility in Sweden.

A transition towards more plant-based production and consumption is no easy undertaking. Efforts are needed in many areas and by various actors. For a more holistic approach we recommend countries develop national action plans and targets for sustainably produced plant-based foods.

**Increasing the proportion** of plant-based food does not mean excluding livestock rearing completely. Grazing animals are essential to maintain biodiversity rich pastures. The report features two farms that have transitioned from intensive animal farming to more extensive production systems.

At Sjöholm farm in Sweden, they went from 1,200 purchased young bulls fed with purchased concentrate feed in 2017 to 350 beef cattle grazing on natural pastures not suitable for cultivation today. They have also diversified by producing grains for human consumption and want

to diversify even further by also growing vegetables and fruits. The new production system requires fewer employees, but the returns are better since the costs for external inputs are much lower.

The other example, Hvanstrup, is a combined milk and vegetable farm in southern Denmark. The number of cows is adapted to the fertiliser needs of the land and the need for being self-sufficient in feed from the grassland. The just over a hundred cows are only fed grass and the milk they produce is branded as “grass milk” at a large food retailer.

Most farms in northern Europe are today highly specialised and focused on either livestock or plant production. By diversifying, as these two examples, farmers become less vulnerable to fluctuations in market prices and disease and less dependent on inputs from other farms or even countries.

Radical changes in agricultural policy are needed, to encourage more intensive livestock farms to make the transition towards more extensive and land-based systems. This includes adequate support for nature conservation and grasslands, one-time payments for turning arable land into permanent grassland as well as a climate-based tax on greenhouse gas emissions and relaunching of quotas for livestock.

Kajsa Pira

The report Nordic Food Transition – Low emissions opportunities in agriculture, <https://pub.norden.org/temanord2021-525/>

## EU Zero Pollution Action Plan

Launched on 12 May, the European Commission's new Zero Pollution Action Plan sets out broad 2030 targets covering air, water, soil, biodiversity, noise and waste – but green groups argue it contains little in the way of concrete new commitments or targets.

The 2030 targets for air pollution include reducing the number of premature deaths attributed to air pollution by 55 per cent, and reducing by a quarter “the EU ecosystems where air pollution threatens biodiversity”, in both cases compared to base year 2005. The Commission also said it planned to bring limits for air pollution more closely in line with World Health Organization (WHO) guidelines.

But civil society was largely unimpressed by the plan. The European Environmental Bureau (EEB) said it “falls short on ramping up action to prevent pollution at source and instead mainly lists existing legal obligations and ongoing reviews”. The Health and Environment Alliance (HEAL) said “What is urgently needed is full alignment of EU's legally binding air quality standards with the regularly updated WHO guidelines and the latest science.”

Sources: ENDS Europe Daily and EurActiv, 12 May 2021. More information: [https://ec.europa.eu/environment/strategy/zero-pollution-action-plan\\_en](https://ec.europa.eu/environment/strategy/zero-pollution-action-plan_en)

## New European city air quality viewer

The European Environment Agency (EEA) has launched a “European city air quality viewer”, where you can check how the air quality has been over the past two years in the city where you live and compare it with other cities across Europe. In the viewer, more than 300 cities are ranked from the cleanest to the most polluted, on the basis of average levels of fine particulate matter (P<sub>M2.5</sub>) over the past two calendar years.



Source: EEA, 17 June 2021. <https://www.eea.europa.eu/themes/air/urban-air-quality/european-city-air-quality-viewer>

# 12 mega oil and gas projects to wreck 1.5°C chances

**Five Years Lost: how finance is blowing the Paris carbon budget.**

**18 NGOs have** released a joint report that calls attention to 12 of the most devastating fossil fuel projects that are currently planned or under development.

“These expansion projects alone would use up three-quarters of the total remaining carbon budget if we are to have a 66% probability of limiting global warming to 1.5° Celsius.

Financiers have provided \$1.6 trillion in loans and underwriting to these companies since January 2016 and as of August 2020, investors owned \$1.1 trillion in bonds and shares in these companies.

**The report exposes** the banks and investors that are providing finance to the fossil fuel companies developing large-scale, highly contested coal, oil and gas expansion projects. The 12 case studies highlight the immense environmental damage, violation of indigenous rights, negative health impacts, human rights concerns and expected CO<sub>2</sub> emissions caused by each of the projects. The group of organisations behind the report has formulated concrete policy demands for the finance industry. The finance sector needs to rapidly move money and services, such as insurance, out of the fossil fuel industry. The first priority should be to no longer enable coal, oil and gas expansion projects – such as those covered in the report – to move forward.

**The case studies** covered in the report were chosen based on their detrimental local and global impacts. They are being pushed forward against local resistance and despite calls by scientists and numerous political leaders to phase out fossil fuels. [1] The case studies are: gas extraction in Mozambique; oil & gas development in Suriname; oil & gas drilling in the US Permian Basin; oil & gas extraction in Argentina’s Vaca Muerta region; coal and gas in Bangladesh’s Payra Hub; China’s new coal power plants; India’s coal mines; coal

expansion in the Philippines; gas extraction as part of Australia’s Burrup Hub; drilling for oil & gas in the Norway Barents Sea; oil & gas projects and pipeline construction in the East Mediterranean; and offshore oil & gas drilling in the UK.

Together, these 12 projects are expected to cause at least 175 gigatons of additional CO<sub>2</sub> equivalent emissions, should they move forward as intended by the companies involved. This is almost 75 per cent of the remaining 235 Gt carbon budget if we are to limit global warming to 1.5°C with a 66 per cent probability. [2]

**The companies** represented in most of the case studies are ExxonMobil, BP and Total. These oil majors are each involved in six out of the eight oil and gas projects in the report. Royal Dutch Shell and Chevron are each involved in five of the eight oil and gas projects. Equinor is involved in four, while Repsol and Eni are each represented in three.

**The report finds** that financial institutions have provided \$1.6 trillion in loans and underwriting since January 2016 and invested \$1.1 trillion in bonds and shares in the 133 companies driving the 12 fossil fuel expansion projects. On the banking side, the companies that have received the most funding since the Paris Agreement are BP, ExxonMobil, Petrobras, Occidental Petroleum and State Grid Corporation of China with a total of \$358 billion in loans and underwriting from January 2016 to August 2020. The companies in the report with the highest investment value are Chevron, ExxonMobil, Royal Dutch Shell, Total, and BP. Together, investors hold bonds and shares to a value of \$394 billion in these five companies, as of August 2020.

**20 investors provided** almost half the total investments – \$535 billion of the total \$1.1 trillion – identified in the

report. Among the top investors, US financial institutions are the worst offenders. With bonds and shares worth \$110 billion, BlackRock (USA) is the top investor in the report’s coal, oil and gas companies. Vanguard (USA) follows closely behind with \$104 billion in bonds and shares. State Street (USA) is in third place with \$50.8 billion, followed by Capital Group (USA) with \$48.4 billion. Only four of the top 20 investors are not from the US: the Norwegian Government Pension Fund with \$31.9 billion in fifth place, UBS (Switzerland) with \$11.8 billion in 11th place, Deutsche Bank (Germany) with \$10.4 billion in 19th place and Legal & General (UK) with \$9.8 billion in 20th place.

**The top 20 banks** provided more than half of the total funding to the fossil fuel companies involved in these 12 projects: \$949 billion out of the total \$1.6 trillion. The US banks CitiGroup, Bank of America and JPMorgan Chase are the top financiers with a total of \$295 billion. There are eight European banks among the top 20. Together, they provided \$308 billion, led by Barclays (\$66.4 billion) and HSBC (\$55.2 billion), and followed by BNP Paribas (\$52.7 billion), Deutsche Bank (\$27.6 billion), Credit Suisse (\$22.5 billion) and Santander (\$21.1 billion). The Japanese banks in the top 20, Mitsubishi, Mizuho and SMBC, provided financing worth \$149 billion. Also among the top 20 financiers are the Bank of China (\$26.5 billion) and the Industrial and Commercial Bank of China (\$24.9 billion), and the Royal Bank of Canada (\$24.7 billion).

“These 12 case studies illustrate the lamentable failure of banks to respond to the urgency of the climate crisis. Instead of adopting a rigorous approach that would prevent the expansion of fossil fuels and facilitate their phase-out, global banks are refusing to break with the fatal growth





Extinction Rebellion protest against the fossil fuel oil industry lobby.

announcements clearly ring hollow. It is high time for financial institutions to adopt policies that exclude companies whose fossil fuel expansion plans will blow our carbon budget. Otherwise global efforts to fight the climate crisis will fail.

“Developing new coal, oil and gas reserves while the world is already experiencing the devastating effects of climate change is insane. This is the opposite of reducing CO<sub>2</sub> emissions as agreed five years ago in Paris. If carbon bomb mega-projects such as the ones showcased in this report move forward, we will overshoot 1.5° of global warming. The leading investors of the companies behind these projects are BlackRock, Vanguard and StateStreet. These institutions are gambling away our future and are exposing themselves to a risk of huge stranded assets at the same time. The only reasonable decision for investors in this situation is to green their portfolio and to quit companies planning new fossil investments now,” says Katrin Ganswindt, Finance Campaigner with Urgewald.

Compiled by Reinhold Pape

The full report can be downloaded at: <https://urgewald.org/five-years-lost>.

Reclaim Finance, Five Years Lost How Finance is Blowing the Paris Carbon Budget, <https://reclaimfinance.org/site/wp-content/uploads/2020/12/FiveYearsLostReport.pdf>

trend in fossil extraction. BNP Paribas, JPMorgan Chase and Mitsubishi all have very different coal, oil and gas exclusion policies. However, this report shows that there is something that clearly unites them: they all keep supporting some of the worst projects worldwide through their loyal financing to the oil and gas majors,” comments Lucie Pinson, executive director of Reclaim Finance.

“The Vaca Muerta geological basin in Argentina has the world's second largest reserves of shale gas. But fracking is not financially viable without huge government subsidies: in 2021, the subsidies to private companies are projected to cost the government one per cent of Argentina's national budget, and four times its total projected health expenses for Covid-19.

So exploiting Vaca Muerta is not part of the climate solution.” says María Marta di Paola, director of investigations with FARN.

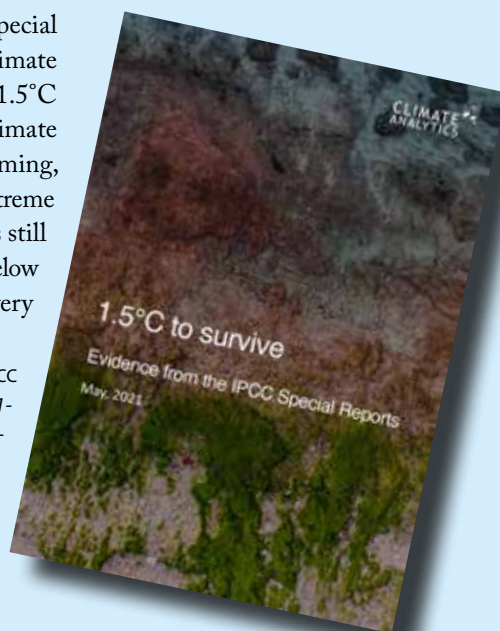
**A multitude of** new exclusion policies and sustainability commitments have recently been released by banks and investors. However, the findings outlined in the Five Years Lost report prove that the finance industry is failing to align its business model with the Paris Agreement. The 12 case studies, which are by no means the only examples of unhindered fossil fuel expansion, should be seen as a litmus test for the industry. As long as financiers do not divest from the top companies driving these fossil fuel expansion projects forward, their sustainability

## 1.5°C to survive – Evidence from the IPCC Special Reports

**Climate Analytics** has prepared science policy briefings<sup>1</sup> for Climate Action Network and AirClim that summarise the impacts of global warming at and above 1.5°C relative to pre-industrial levels. Key information is extracted from the Special Reports of the Intergovernmental Panel on Climate Change (IPCC) in its sixth assessment report cycle (AR6), including Impacts of Global Warming of 1.5°C, Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems, Ocean and Cryosphere in

a Changing Climate. The IPCC Special Reports are clear according to Climate Analytics: “limiting warming to 1.5°C can avoid the worst impacts of climate change. Compared to 2°C of warming, 1.5°C would see much less severe extreme events. The 1.5°C warming limit is still within reach. Limiting warming to below 1.5°C is still possible but requires very urgent and rapid action now”.

<sup>1</sup>Read the briefings produced from the IPCC Special Reports: <https://caneurope.org/1-point-5-degrees-to-survive-evidence-from-ipcc-special-reports/>



# No future for nuclear power

Nuclear power has tried to reinvent itself for two decades with the so-called Fourth Generation and Small Modular reactors. Both have failed.

**The Nuclear Fourth** Generation Forum celebrated its 20th anniversary<sup>1</sup> on 28 April 2021.

The Fourth Generation set out to solve an age-old and existential problem for nuclear power, that there is not enough cheap uranium for a sustained growth of nuclear.

Theoretically there is a lot of uranium, but most of it is in low-grade ores. Mining is not cheap, clean, quick or popular.

Long-term nuclear needs uranium to be used more efficiently. That requires fast-neutron reactors, as was recognised already during the Manhattan project back in 1944.

A standard “slow neutron” reactor uses only a small part of the energy in uranium. Fast neutrons can split all the uranium, plutonium and thorium nuclei.

The drawback is that a fast-neutron chain reaction is much like an atomic bomb. It is hard to control and hard to cool. Coolants are liquid metal, sodium, lead or mercury.

Efforts to build fast-neutron reactors have been ongoing for 75 years, and have

resulted in a number of serious accidents, from the Clementine reactor in the US (1946–52) onwards. They were a series of financial disasters, with the French Superphenix as probably the worst case. Some did not even start operation (Clinch River, Monju, Kalkar). The French/EU Astrid project spent 800 million euros on R&D, after which it was ditched in 2019.

But the die-hard fast reactor proponents have persisted and got a new chance when George W. Bush became president in 2001, and the Generation IV Forum was formed. It identified six reactor technologies for the next generation of nuclear. Here is a summary of what happened so far:

- The gas-cooled fast reactor: one smallish reactor under construction in China, since 2012. At least four years late.
- The lead-cooled fast reactor: formerly used for Russian submarines, construction of one reactor started in Russia 2021.
- The molten salt reactor: another idea from the 1950s. Has generated much hype, but no construction.
- The sodium-cooled fast reactor: formerly called fast breeder reactor. Abandoned in Europe, America, and Japan, but developed in Russia and China (by Russia). Since 2001 Japan and France have abandoned development of

this reactor type, as the US, Germany and the UK did earlier.

- The supercritical water-cooled reactor: nothing.

**Over the last** 20 years, Generation IV has delivered at best 5 TWh of electricity per year since 2016, all of it from Beloyarsk 4 in Russia.

For comparison, solar power grew from 1 TWh globally in 2000 to about a 1000 TWh in 2020.

Most of the Generation IV tech requires reprocessing of spent fuel from today's reactors. Reprocessing means sawing the intensively radioactive fuel and dissolving it in boiling nitric acid, so the uranium and plutonium can be reused.

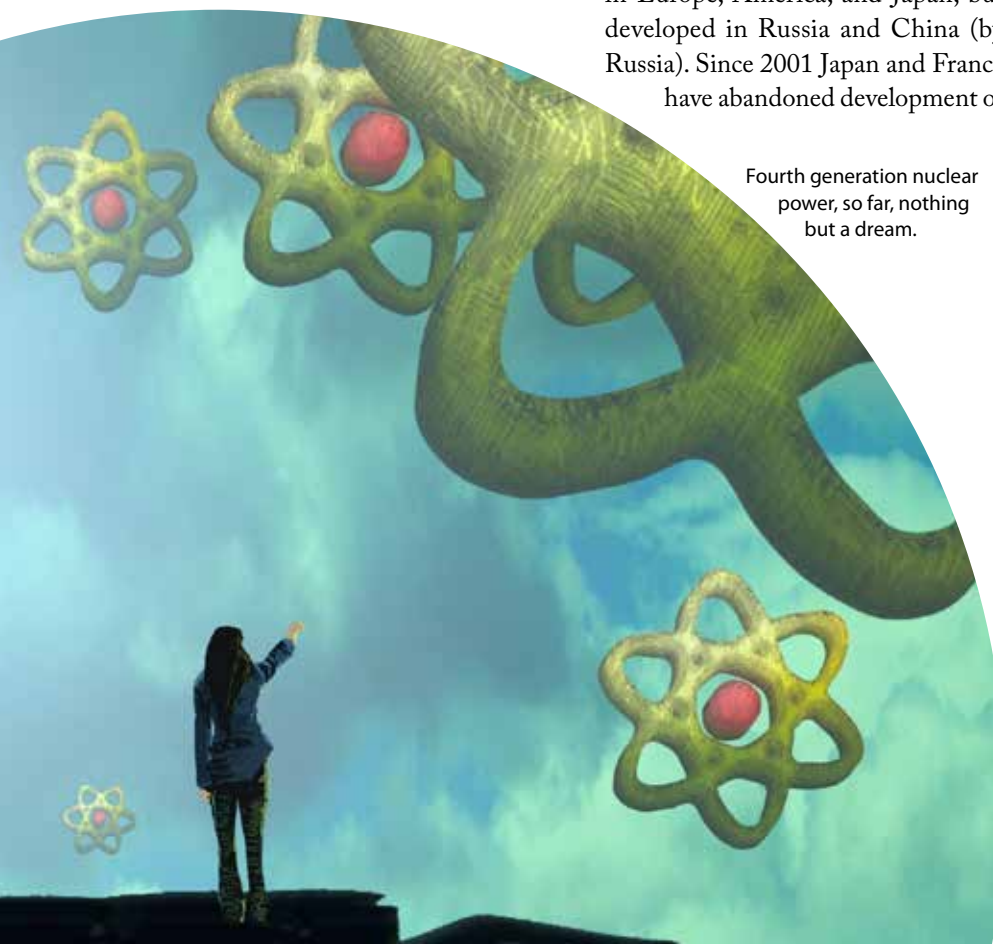
It is dangerous and expensive. It also means that plutonium will be much more readily available for terrorists and governments that want nuclear weapons. For these reasons, and others, reprocessing was abandoned in the US in the 1970s, after which Germany and the UK followed suit. The last UK plant is being shut down in 2021. Japan has a reprocessing plant under construction – since 1993 – but despite a price tag of 28 billion dollars so far, its future is uncertain.

Capital costs are much higher for Generation IV, because the reactors themselves are more expensive than a standard reactor. On top of that, they have to support reprocessing plants, plutonium fuel plants, and waste vitrification plants.

“Small modular reactors” have been hyped for several years, just like Generation IV, but nothing happens. There are reasons for this, as there are reasons why most reactors became so big in the first place.

The small reactors could in principle be manufactured in a factory, like cars. But their construction is dependent on location. The safety case must make it reasonably sure that the reactor will get enough water and power in every conceivable situation, and that it is not subject to flooding, tsunamis, earthquakes, idiots, crashing planes and terrorist attacks.

Fourth generation nuclear power, so far, nothing but a dream.





Much of the costs are the same whether it is a 1600 MW reactor (Olkiluoto 3), a 160 MW reactor or a 16 MW reactor.

Security and safety also carry about the same cost for a small or a large reactor. All reactors contain huge amounts of radioactivity. There has to be physical intrusion protection and armed guards twenty-four seven. Staff must also be present in the control room twenty-four seven.

With enough political will it is possible to build a few small modular reactors in the world, if money is no object. The question is why.

Billionaires Bill Gates and Warren Buffet and the TerraPower company claimed in early June 2020 that they are building a small modular reactor in Wyoming, a “multibillion dollar project to be split evenly between government” and themselves.

“This is our fastest and clearest course to becoming carbon negative”, said Wyoming’s governor, Mark Gordon, to the Guardian.

How fast? It “hopes to apply” for a licence by 2026<sup>2</sup>.

Another way to reduce carbon would be to catch up with other states on wind and solar. But that is not the Wyoming way. The state has threatened to sue other states because their climate goals have led to less demand for Wyoming coal and coal power.

Wyoming is by far the top coal producer in the US, and also has the highest CO<sub>2</sub> output per kilowatt hour generated. TerraPower claim that their reactor is the solution for the 2030s.

This may be an attractive time perspective for fossil interests.

Fredrik Lundberg

<sup>1</sup> [www.world-nuclear-news.org/Articles/Generation-IV-Forum-marks-anniversary](http://www.world-nuclear-news.org/Articles/Generation-IV-Forum-marks-anniversary)

<sup>2</sup> [www.world-nuclear-news.org/Articles/TerraPower-eyes-Natrium-construction-permit-in-202](http://www.world-nuclear-news.org/Articles/TerraPower-eyes-Natrium-construction-permit-in-202)

## Climate toolkit for Russian municipalities

The Russian Socio-Ecological Union has in cooperation with AirClim published new material (1) that includes positive examples of sustainable transport and energy solutions in Europe, including climate plans for municipalities, mitigation and adaptation, energy efficiency, renewable energy resources, climate and waste problems. One briefing summarises boreal forest and climate discussions in Russia (2). During 2022 circular economy concepts and sustainable production and consumption patterns will be an important issue for discussion and cooperation.

(1) <https://rusecounion.ru/climateinfokit>  
<https://rusecounion.ru/eng/climateinfokit>  
(2) [https://rusecounion.ru/sites/default/files/inline/files/forests\\_eng\\_0.pdf](https://rusecounion.ru/sites/default/files/inline/files/forests_eng_0.pdf)  
<https://rusecounion.ru/ru/climateinfokit/forests>



## Excess pollution from large combustion plants

**From 16 August**, EU governments are required to comply with the revised best available techniques reference document for large combustion plants, known as the LCP BREF. But according to the European Environmental Bureau (EEB), complacent national regulators have chosen to set the highest permissible emission levels for nitrogen oxides, sulphur dioxide, mercury and particulate matter allowed in the LCP BREF, even though industry players considered the lowest – and therefore most ambitious – levels to be “economically and technically viable” when it was agreed back in 2017.

The EEB has called on member state authorities to “stop agreeing derogations

‘on demand’ and use their power to enforce the most ambitious BREF limits”. For its part, the European Commission should aim to raise those limits in revised best available technique conclusions due some time before January next year, as well as in its review of the Industrial Emissions Directive and in its regulation implementing the UN Minamata Convention on mercury, it added. Moreover, reporting rules should be overhauled “to enable centralised EU benchmarking and compliance promotion”, the EEB said.

Sources: ENDS Europe Daily and EEB press briefing, 17 Aug 2021. <https://eeb.org/four-years-of-unnecessary-pollution-eu-governments-fail-to-curb-emissions-from-most-toxic-plants/>

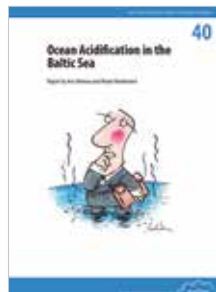
The Turow Electric Power Station in Bogatynia, Poland.



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Reports can be downloaded in PDF format from [www.airclim.org](http://www.airclim.org)



**Ocean Acidification in the Baltic Sea** (March 2018). By Lennart Nyman. Tropical coral reefs harbour some 25 per cent of all marine species.



**1.5°C to survive. Evidence from the IPCC Special Reports** (May, 2021). By Susanne Baur, Alexander Nauels & Carl-Friedrich Schleussner.



**Climate and health** (September 2020). By Björn Fagerberg et al. A summary of knowledge.



**Nordic Food Transition – Low emission opportunities in agriculture** (June 2021). By Annika Lund Gade et al. Eight case studies and forty policy recommendations.



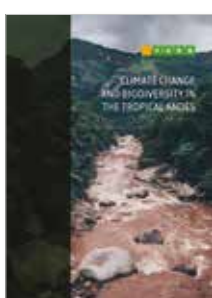
**Phasing out fossil gas power stations in Europe by 2030** (February 2021). By Fredrik Lundberg. A list of 142 gas-fired power stations that should be closed or not commissioned.



**Climate change and the Andean cryosphere** (2019). By Catalina María Gonda. The cryosphere has unique functions and influences the physical, biological and social systems.



**Analysing marine geoengineering technologies** (February 2021). By Fredrik Lundberg.



**Climate change and Biodiversity in the Tropical Andes** (2020). By Catalina María Gonda. Two major crises pose severe threats for life on Earth.

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## Coming events

**EU Environment Council.** Luxembourg, 6 October 2021. Information: <https://www.consilium.europa.eu/en/meetings/env/2021/10/06/>

**Air Pollution threats to Plant Ecosystems Conference.** Paphos, Cyprus, 11 - 15 October 2021. Information: <https://cyprus2021.com>

**Health Effects at Low Air Pollution Levels in Europe.** Health Effects Institute webinar. 12 October 2021. Information: <https://www.healtheffects.org/meeting/hei-webinar-new-results-health-effects-low-air-pollution-levels-28-million-participants>

**IMO 10th Intersessional Working Group on reduction of GHG emissions from ships.** Remote meeting, London, UK, 18 - 22 October 2021. Information: [www.imo.org](http://www.imo.org)

**American Association for Aerosol Research Annual Conference,** Virtual, 18-22 October 2021. Information: <https://www.aaar.org/2021/>

**EU Sustainable Energy Week.** Remote meeting, 25 - 29 October 2021. Information: <https://eusew.eu>

**UN FCCC COP26.** Glasgow, UK, 1 - 12 November 2021. Information: <http://unfccc.int/>

**Annual Aerosol Science Conference,** Virtual, November 4-5, 2021. Information: <https://aerosol-soc.com/events/annual-aerosol-science-conference-2021/>

**2021 Global Conference on Health and Climate Change.** Glasgow, UK, 6 - 7 November 2021. Information: <https://www.who.int/news-room/events/detail/2021/11/06/default-calendar/2021-global-conference-on-health-and-climate-change>

**Third EU Clean Air Forum.** Madrid, Spain, 18 - 19 November 2021. Information: [https://ec.europa.eu/environment/events/eu-clean-air-forum\\_en](https://ec.europa.eu/environment/events/eu-clean-air-forum_en)

**IMO Marine Environment Protection Committee (MEPC 77).** Remote meeting, London, UK, 22 - 26 November 2021. Information: [www.imo.org](http://www.imo.org)

**CLRTAP Expert Panel on Clean Air in Cities.** Remote meeting, 29 November 2021. Information: [www.unece.org/env/lrtap/welcome.html](http://www.unece.org/env/lrtap/welcome.html)

**2021 POLIS Annual Conference.** Gothenburg, Sweden, 1 - 2 December 2021. Information: <https://www.polisnetwork.eu/2021-annual-polis-conference/>

**CLRTAP Executive Body.** Geneva, Switzerland, 6 - 10 December 2021. Information: [www.unece.org/env/lrtap/welcome.html](http://www.unece.org/env/lrtap/welcome.html)

**EU Environment Council.** Brussels, 20 December 2021. Information: <https://www.consilium.europa.eu/en/meetings/env/2021/12/20/>