

The Dutch nitrogen crisis

A court ruling has forced the Netherlands to promptly deal with its high nitrogen emissions.

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Post-Euro 6 car emissions standards

A new ICCT report highlights the limitations of current EU car emissions standards and provides detailed recommendations for how to overcome them.

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The cry of the cryosphere

Summer snow cover in the arctic areas has decreased by 2.5 million km² in fifty years. The changes for animals and human livelihoods in the affected regions are dramatic.

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Modelling a shift to sustainable diets

Peer pressure was found to be the most important driver for people to adopt a plant-based diet, when researchers integrated psychological theories into a computer model.

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Cutting air pollution will save lives

Europe's air is slowly getting cleaner, but air pollution remains the largest environmental health risk and is still responsible for about 400,000 premature deaths every year.

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EU climate policies reviewed

The EU cut CO₂ emissions by 2 per cent in 2018, but risks failing to meet sustainable energy targets, and gives green light to new fossil gas projects.

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The ten best climate measures

NGOs from northern Europe propose which climate policy measures to present for national climate plans.

In the next few months all the countries that signed the Paris agreement must submit updated plans to meet their National Determined Contributions (NDC). Here are some proposals on which measures to take. In recent years, NGOs have identified 150 ways to save the climate in northern Europe by promoting effective climate mitigation measures in the national climate policies of 11 countries that make up the Council of Baltic Sea States. These measures are delivering emission cuts, and

more measures have been added. Climate policy experts from environmental NGOs in each country listed the ten best climate mitigation measures in their countries, i.e. the Nordic-Baltic countries, and Poland, Germany and Russia. These were implemented or at least agreed upon and were summarized as 10 overall measures, together with the national reports. All 10 of the top measures described then are still good today and have led to a drop in

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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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

Annual global emissions of carbon dioxide are still more than 40 billion tonnes. To stay within a 1.5 °C global temperature rise with a 50 per cent chance, according to the IPCC¹, only about 500 billion tons

of CO₂ can be emitted from now on, and this budget will be exhausted in about 10–12 years at present annual emission levels.

That is why more and more voices are calling for a climate emergency situation, for a climate Marshall

fund of at least 500 billion US dollars, an immediate phase-out of the use of fossil fuels and a transition to 100% renewable energy worldwide before 2050.

“For more than 50 years, the petroleum industry and politicians have been warned about the climate risks of burning fossil fuels. Yet the top 20 fossil fuel firms have continued to expand and have been behind a third of all carbon emissions since 1965,” the Guardian wrote in November 2019². Today, global emissions of greenhouse gases (GHGs) are still increasing – by one per cent in 2018.

The first World Climate Conference was held in Geneva in 1979. Governments have been aware, since then at least, that emissions of greenhouse gases are causing global heating. Many more alarming UN reports have been published subsequently. The main problem is that for the past 50 years the fossil fuel industry and its allies in industry, politics and civil society have been using all financial means to counteract initiatives to effectively reduce GHG emissions. They have also promoted false, so-called clean, fossil fuel solutions or flexible mechanisms to undermine climate policy initiatives.

Is the situation really that bad? No, there is hope on the horizon, as civil society takes on the role of Asterix to fight against this oppression by the fossil fuel industry. Many people in civil society and environmental groups such as Climate Action Network, Fridays for Future, Extinction Rebellion, together with dedicated people in ministries, agencies, institutes and political parties, have been trying to drive through

policies to reduce greenhouse gases for many years. CAN was formed in 1989 and now represents 1700 NGOs worldwide and millions of members. CAN Europe alone has 40 million members today.

Thousands of actions, information and lobbying activities have been organised by this movement. Congratulations must go to CAN for fighting climate change for 30 years and for promoting a 100% renewable energy system glob-

ally latest by 2050! The Financial Times reported that investors who predicted a shift from fossil fuels to clean energy “are being richly rewarded” as solar and wind stocks outperform oil and gas “by a widening margin this year”.

There is now real hope that the United Nations and its members will finally act. 197 countries of the UN will present climate plans (NDCs) during 2020 to implement the Paris Agreement, and must lead the way to stay below the 1.5 °C target. More and more countries are introducing climate legislation with the conviction that this is the key policy tool to avoid dangerous climate change and create valuable co-benefits for humankind. Millions of new workplaces could be created in areas such as renewables and the energy-saving industry, ecological and climate friendly land-use management and the production of healthy food. The avoidance of air pollution from phasing out fossil fuels will save people from premature death (several hundred excess deaths per day in the EU alone are attributed to fossil fuels according to WHO/EEA/EASAC), forests and biodiversity will be protected and park landscapes will be created in urban areas and on degraded land to bind CO₂. People now know that we can stay within the 1.5 °C target and that there will be many co-benefits. With help of climate legislation the fossil fuel industry (coal, gas and oil) must be shut down within the next 12 years!

Reinhold Pape

¹IPCC SR1.5 2018, Chapter 2, Page 108

²<https://www.theguardian.com/environment/2019/oct/09/revealed-20-firms-third-carbon-emissions>



The Dutch nitrogen crisis

A court ruling has forced the Netherlands to promptly deal with its high nitrogen emissions. The government has decided to cut speed limits and farmers have rallied in the streets to protest against reducing livestock numbers.

The ball was set rolling back in 2017, when a small environmental NGO – Mobilisation for the Environment – went to the European Court of Justice (ECJ) to challenge the system that the Netherlands had introduced to protect Natura 2000 areas from nitrogen pollution. The system was set up as one of the obligations under the European Habitats Directive. Unlike other EU member states, the Netherlands allowed business to compensate for increases in nitrogen emissions with technical measures (such as air scrubbers) and nature restoration measures (such as extra mowing) that might deliver emission reductions in the future.

In November 2018, the ECJ decided in a court ruling that the Dutch legislation is too lax. The country's highest administrative court confirmed the ECJ ruling by scrapping the current permit system in May this year. This immediately affected more than 18,000 projects, building sites and farming operations, that either had to halt or could not get started.

Though this ruling came as a surprise to many, the problem of nitrogen emissions is not new to the Netherlands. According to government data, 70 per cent of the country's surface area exceeds critical limits for nitrogen.

A nitrogen committee was set up to examine possible measures to cut emissions. They suggested prompt reductions in speed limits on motorways and provincial roads to reduce NOx emissions from traffic. But they also pinpointed livestock

farming as the main target, since 46 per cent of the nitrogen pollution originated from domestic agriculture. Another 32 per cent comes from neighbouring countries, where farming is likely the greatest source too. Traffic and housing only account for 6 per cent each.

Despite the small size of the country, it has the world's second highest exports of agricultural products and has one of Europe's highest concentrations of livestock.

One of the government coalition parties, the social-liberal D66, supported the committee by proposing that livestock population should be halved. This could be done by buying up and closing down livestock holdings belonging to farmers near or above retirement age.

Farmers' organisations were quick to react. On 1 October, tractors flooded the streets of The Hague, causing rush-hour traffic chaos. This was followed by protests in other Dutch cities.

The other three coalition parties, ranging from liberal to conservative, were more sceptical or even in direct opposition to adjusting livestock numbers.

In mid-November, Prime Minister Mark Rutte presented a list of short-term measures. Most notable is an immediate cut in the maximum speed limit to 100 kph during daylight hours, from the previous 130 kph. Other measures included additives to livestock feed that will reduce ammonia emissions from manure. The government also granted an extra 60 million euro to a

programme that compensates pig farmers who shut down their businesses.

Greenpeace said the measures did not do enough to tackle the root causes of the nitrogen crisis. "That would mean promoting ecological agriculture with fewer animals. The cabinet could begin the process immediately if it imposed compulsory pasturing and limited the import of soy for cattle feed," a spokesman said.

Most of the "saved" nitrogen emissions from this package will be used to offset the increased emissions from building 75,000 houses in 2020. Only 30 per cent will lead to real emission reductions. It is also worrying that the Dutch government wants to discuss the possibility of repealing some of the Natura 2000 sites and the extension of other Natura 2000 sites with the EU Commission.

Prime Minister Rutte has announced that the government will present a long-term plan for handling nitrogen emissions in December.

Kajsa Pira

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The ten best climate measures

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CO₂ emissions in most countries (table).

This took place as the economy grew, at about 1 per cent per year. Climate policy has produced results in some countries, notably Denmark, Finland and Sweden. It is also instructive to see that the countries that have increased their emissions most have a strong fossil industry: Norway (oil and gas), Estonia (shale), Poland (coal) and Russia (oil, gas and coal). Poor performance by Germany may be explained by the strong position of coal, especially lignite.

In recent years the climate has increasingly become a political focus point in the wake of the fifth IPCC report in 2014 and the Paris agreement in 2015. One consequence is a growing number of increasingly stringent greenhouse gas emission targets, nationally and for the EU.

Fossil power is losing out both politically and economically to wind, solar, efficiency and smart grids. It is not conceivable to plan for investment in coal power anymore and it is increasingly difficult to defend existing coal. Greta Thunberg was not alone in condemning the German plan to phase out lignite by 2038 as unacceptably slow.

The economic pressure against some fossil use comes both from cheaper renewables and a belated reform of the European emission trading scheme (ETS). The ETS was useless in 2005–2017 when the price

was €4–6 per tonne. Since summer 2018 it has been around €25, sometimes close to €30. As long as the market players believe that prices will remain high, the ETS has great transformative potential in the heat and electricity sector and in some high-emission industries.

The price increase hits old lignite and coal power plants both immediately, and for the longer term.

One of the problems with the ETS is that it is so complicated that practically nobody understands it, and if somebody thinks s/he has understood it, new complexities will soon be added.

The effects on other sectors (than power) such as steel, cement, refineries and waste incineration are less certain. Aviation is included in the ETS, but on extremely generous terms that will not reduce emissions. Even if further improvements are made, the ETS is not a panacea.

The report identified 150 ways to save the climate. All or most of them will be needed.

Here is the top 10 list, with comments on new developments. Some of the comments are made with the benefit of hindsight and with a view to the “replicability” of the measures, i.e. whether they could be copied by the rest of the world.

1. Taxing carbon. This is ever more important, both for non-ETS emissions and for emissions within the system. The UK

Table: Carbon Dioxide Emissions

Million tonnes of CO ₂	2007	2018	Change % 2018/2007
Denmark	56.9	36.5	-36
Estonia	22.1	25.7	16
Finland	67.5	46.1	-32
Germany	819,3	716,7	-13
Iceland	3.1	3.5	15
Latvia	8.8	7.8	-12
Lithuania	13.4	12.0	-10
Norway	36.3	36.6	1
Poland	317.3	323.1	2
Sweden	58.3	41.8	-28
Russia	1528.0	1551.0	2
European Union	4249.4	3439.6	-19

Source: BP World Statistics 2019

pioneered a tax for the latter, as a backstop when the carbon price was too low and as a call to action. The Netherlands has decided to do the same.

2. Support for renewable electricity.

Renewables have advanced everywhere. The German feed-in tariffs are a well-known success story. The Swedish-Norwegian certificates have also delivered a lot of wind energy for little money.

3. Improved efficiency of buildings.

Stricter building codes are a reliable and inexpensive way to cut fuel use for heating and cooling. Airtight and well-insulated buildings make sense everywhere in the world, whether to keep the warmth in or to keep it out.

Apart from (national) building codes, Green Building, LEED and BREEAM are examples of building energy and environment certificates, some originating in the UK, US and EU, and some national. They are shrinking the direct and indirect climate footprint of new and renovated buildings.

4. Other efficiency improvements (e.g. EU labelling of fridges).

In a world of free trade, energy standards tend to be international.

The EU energy labelling of consumer products started in 1992, with modest requirements for a few products. It gained



visibility when incandescent bulbs were banned.

This showed that a relatively soft carrot-type instrument – labelling – can be part of a market transformation that includes a ban on the worst-performing products.

The US Energy Star is also widely used in Europe, and has greatly reduced energy consumption from office equipment etc.

5. District heating efficiency. Such measures were very effective, but there is not very much more to do, and district heating is not common in many countries.

6. Vehicle emission standards. The EU fleet goal for 2021 for cars is 95 grams per kilometre. Verification (through test cycles) is almost as important as the numbers, as was demonstrated by the diesel scandal.

In some countries only Euro5 or Euro6 vehicles are allowed in densely populated urban zones, which gives extra oomph to the regulation.

7. Other measures to reduce traffic CO₂ (taxes for vehicles and fuels). One of the Norwegian top 10 methods in 2013 was support for electric vehicles. By then it was not certain that electric cars would reach the range or price level to become relevant. Now most people believe battery vehicles and plug-in hybrids are an important part of the solution. They fit in well with power systems that use much more wind and solar in a smart grid.

Support for biofuels has produced good results, in Sweden for example diesel and biogas from waste and wood industry residues, though many other biofuels are either produced from imported raw materials or from unsustainable sources, or both.

Taxes for vehicles and fuels are national and complicated. Sweden's bonus-malus system for new cars which taxes high-emitters and subsidizes low-emitters was effective from mid-2018, and it may be too early to evaluate. But in principle it gives a strong incentive to sell, and indirectly to produce, more fuel-efficient cars.

If hydrogen and battery electric vehicles are to replace all fossil cars, they need different kinds of support for a long time.

8. Infrastructure planning. Moving from air and road to rail takes a long time if it is to be achieved with new infrastructure, and it is not happening on anywhere near the necessary timescale.

Another important infrastructure factor is more power lines and storage to make room for much more wind and solar. This mainly requires national or bi-national decisions and is looking more promising, with new lines from Scandinavia to Germany and the UK in the near future, for example.

Smart grid and demand-side management are still in the budding phase. They are necessary for the integration of very large amounts of wind and solar. They are also much less expensive than building power plants for reserve and peak.

New kinds of infrastructure are needed for electric vehicles and hydrogen vehicles. This is both a challenge for the electricity grid and an opportunity to make it smarter.

9. Waste and recycling. One success in much of Europe is the reduction of methane from waste disposal sites. In the EU, emissions fell from 160 to 87 Mt CO₂-equivalents between 1990 and 2017. The reduction was much greater in the Nordic countries and Germany, and much less in Poland. Such emissions increased greatly in Russia and southern Europe.

One worrying development is that the use of plastics – produced from fossil fuels – is increasing, and that only a small fraction is recycled in a meaningful sense. The recycling rate (collection) varies widely between countries; according to Eurostat it is lowest in Estonia (24.6%) and highest in Lithuania (72.4%). The high figure for Lithuania may be explained by a good system of refundable deposits. In Sweden the recycling rate is around 60 per cent, but according to the chairman of the Swedish recycling organization, former MEP Anders Wijkman, this “recycling” is overwhelmingly incineration, and only eight per cent of the plastic is actually reused.

District heating companies in countries with a lot of district heat are now very tempted to burn mixed waste, which they are paid to import from countries that do

not have much district heating. Exporting waste to third-world countries is increasingly difficult, as it is (rightly) seen as a national abuse of the importing countries, some of which are shipping it back.

Better methods have to be developed to reduce, reuse and recycle plastic. Sweden, which burns large and increasing amounts of plastic, has recently introduced a tax on such combustion.

10. Land use (afforestation, better agricultural practices, wetland reclamation). Afforestation was among national measures in Lithuania and Iceland in the 2013 report. On a global scale it is extremely important to keep forests and expand forested area, probably the second most important measure for the climate after cutting emissions from fossil fuels. But it is not just a quantitative issue of storing X gigatonnes of carbon in forests and soil, as in the Climate Convention. Other aspects are just as vital: biodiversity, food security, supply of fibres for clothes, construction and paper, and control of large fire hazards.

Land use is mainly a national concern, and though some measures can be copied from one country to another, it is not simple.

Effective new measures:

11. ETS is working, at last. See above.

12. Climate laws and stricter targets. Very important but not easily summarized.

13. Hydrogen. The Swedish HYBRIT project aims to substitute coal for hydrogen from renewable electricity for ore mining and steel-making. Power-to-gas is being tried on a smaller scale in Germany, as a way to use “surplus” renewables. Hydrogen fuel cell vehicles such as the Toyota Mirai are now on the market on a limited scale. Whether hydrogen cars can compete with battery cars is not clear, but it is difficult to imagine a fossil-free world without a role for hydrogen. Hydrogen buses are operating or being planned in Norway, Latvia, Denmark, Iceland and above all in Germany. Hydrogen is also a possible

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Wildfires are one of the reasons for increased levels of PM_{2.5}.

Backlash for US air pollution levels

After a seven-year stretch of improvement, between 2016 and 2018 the amount of particulate matter air pollution rose, according to a new analysis of Environmental Protection Agency data by two economists at Carnegie Mellon. They found that particulate matter air pollution fell 24 per cent in the US from 2009 to 2016, but it increased 5.5 per cent in the following two years.

“That increase was associated with 9,700 premature deaths in 2018,” wrote Karen Clay and Nicholas Muller in a paper published by the National Bureau of Economic Research. The researchers say three factors could explain the increase in air pollution: stronger economic growth in recent years, an increase in wildfires and weakened enforcement of clean air rules.

Source: CBS News, 22 October 2019.

Link to the paper: <https://www.nber.org/papers/w26381>

EU Commission promotes air pollution benefits of climate policy

The European Commission’s science and knowledge service explains on its website how climate policy improves air quality and saves lives. It says that “an integrated policy perspective will prevent technological lock-in and will maximise gains for global climate and local health. In December 2015, 196 parties gathered at the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change and signed the Paris Agreement, a joint commitment to address climate change.”

Concerning energy system transformation, it says “With our energy use as key driver of greenhouse gas emissions, the ambitious climate goals set forward in the Paris Agreement demand a fundamental rethink of energy systems across the world.

Climate policies also lead to cleaner air by transforming the energy systems across the world. A more efficient use of energy

and a shift from fossil fuels to renewables are key elements in achieving co-benefits for climate and air quality.”

In addition to greenhouse gas emissions the Commission says that “energy is a key source of local air pollutants, such as particulate matter. Therefore, the transformation of energy systems needed to reach climate goals is a unique opportunity to improve air quality at the same time. Globally, avoided premature mortality by 2030 in a 2 °C scenario versus a reference scenario is estimated at 346,000 avoided premature deaths. By 2050, the number of avoided premature deaths in India would be 511,000 and in China 537,000. The website does not present the co-benefits of a 1.5 °C scenario.

Reinhold Pape

Link: <https://ec.europa.eu/jrc/en/geco/climate-policy-and-air-quality>

1,498,000 avoided premature deaths globally in 2050 in a 2 °C scenario versus a reference scenario. Each silhouette represents ten thousand deaths.



New Delhi declares public health emergency

Authorities in the Indian capital New Delhi declared a public health emergency on 1 November and closed schools

and all construction activity for a week, when the air quality index measuring the level of health-damaging PM_{2.5} hit 484 on a scale of 500. Anything above 400 poses a risk for people with respiratory illnesses and can even affect those with healthy lungs.

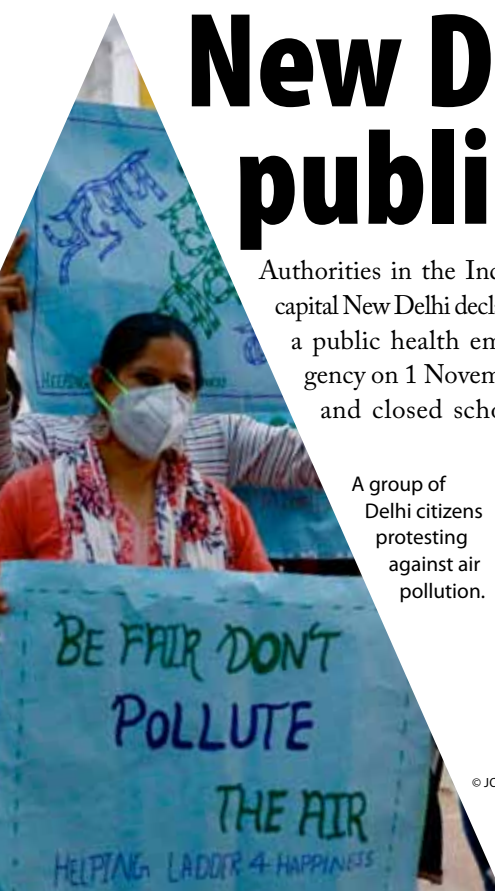
A few days later the air quality index deteriorated to above 900, way over the 500 level that qualifies as “severe-plus”. Aside from the harm it was doing to the lungs of some 40 million people living in the capital region, the smog was so bad that more than 30 flights were diverted

from Delhi airport due to poor visibility. Roads looked deserted as large numbers of people stayed home, rather than expose themselves to the noxious atmosphere outside.

The Environment Pollution Control Authority, which is leading the effort to tackle Delhi’s pollution, said: “We have to take this as a public health emergency as air pollution is now hazardous and will have adverse health impacts on all, but particularly our children.”

Source: Reuters, 1 and 3 November 2019.

A group of Delhi citizens protesting against air pollution.



The ten best climate measures

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fuel for aviation. Biofuel production needs hydrogen input to convert wood etc. to liquid fuels.

14. HFC phase-out. The phasing out CFCs (freons) had a side effect, an increase in production of soft freons (HFCs). But these are now being phased out as well, with an initial phase-out date for the sale of new HFC refrigeration machines, followed by a ban on refilling. HFC emissions are now coming down for example in Denmark, Poland and Germany.

15. Electric food. All food production has so far been based on photosynthesis, directly or indirectly (through meat, milk or fungi). Photosynthesis is at best 1% efficient in converting light to carbohydrate (solar panels have efficiencies of

15–20%). Nitrogen fertilizer production uses fossil fuels and emits N_2O .

An innovative way to mitigate the horrible environmental and climatic consequences of how we produce and consume food is to produce some of it from the air (nitrogen) with renewable electricity. This is being developed in Finland, with support from the European Space Agency.

Another way is to persuade people (and animals) to eat more organic and less meat, which is also good for public health. Some municipalities are reducing meat in school meals.

Fredrik Lundberg

Sources:

The 10 best climate mitigation measures in Northern Europe <http://airclim.org/sites/default/files/documents/APC31-The-10-best-climate-mitigation-measures-in-Northern-Europe.pdf>



© LARS-ERIK HÄKANSSON

What will it take to phase out greenhouse gas emissions from road traffic in the Nordic-Baltic region by 2030–2035? <http://airclim.org/sites/default/files/documents/apc-39-4.pdf>

Possible to phase out the climate impact of road traffic in 15 years <http://www.airclim.org/acidnews/possible-phase-out-climate-impact-road-traffic-15-years>

The Nordic-Baltic Region can be decarbonised by 2030 <http://www.airclim.org/acidnews/nordic-baltic-region-can-be-decarbonised-2030>

A vision for zero carbon emissions in the Nordic-Baltic region by about 2030 <http://airclim.org/sites/default/files/documents/apc-38-9.pdf>

Global solar PV market set for dramatic growth over next 5 years

The installation of solar PV systems on homes, commercial buildings and industrial facilities is set to take off over the next five years, transforming the way electricity is generated and consumed, according to the International Energy Agency's latest renewable energy market forecast. The report forecasts that the world's total renewable-based power capacity will grow by 50 per cent between 2019 and 2024, and solar PV will account for 60 per cent of the rise. Distributed PV accounts for almost half of the growth in the overall solar PV market through 2024. Contrary to conventional wisdom, commercial and industrial applications rather than residential uses dominate distributed PV growth, accounting for three-quarters of new installations over the next five years. This is because economies of scale combined with better alignment of PV supply and electricity demand enable

more self-consumption and bigger savings on electricity bills in the commercial and industrial sectors.

Latin America and the Caribbean could grow their installed solar capacity by a factor of 40 by 2050, a new report by the International Renewable Energy Agency (IRENA) shows. Annual investments exceeding USD seven billion would see the region's solar PV capacity rise from 7 gigawatts (GW) today, to more than 280 GW by mid-century. As new markets emerge worldwide, IRENA's latest report sees solar PV providing a quarter of global power by 2050. By that time, solar PV would represent the second-largest power source behind wind, according to the Future of Solar Photovoltaic report launched at Sun World 2019 in Lima. In total, global solar power capacity would rise from 480 GW in 2018 to over 8000

GW by 2050, growing by nearly nine per cent every year.

The magazine Spiegel reports that the world's largest solar power station is being constructed at the moment in Egypt. 650 kilometres south of Cairo, seven million photovoltaic panels will cover a 37-square-kilometre site and have a planned capacity of 1800 MW. For comparison, Spiegel reports that today's largest solar power installation is in China, with a capacity of 850 MW.

Compiled by Reinhold Pape

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Solar PV will account for 60 per cent of the growth of renewable power in the coming years.



© AMPOL KAENCHAIYAPHOOM / SHUTTERSTOCK.COM

European transboundary air pollution is slowly shrinking

For most European countries the biggest share of depositions of sulphur and nitrogen emanate from outside their own territory, and a significant share of the depositions originate from international shipping.

Since 1980, total European emissions of sulphur dioxide (SO₂) – the most significant acidifying pollutant and an important precursor to health-damaging secondary fine particles (PM_{2.5}) – from land-based emission sources were cut by 90 per cent, from around 53 million tonnes in 1980 to 5.6 million tonnes in 2017.

In the same time period, emissions of nitrogen oxides (NO_x) and non-methane volatile organic compounds (VOCs) have fallen by half, while those of ammonia (NH₃) came down only by a quarter.

Between 2000 and 2017 it is estimated that emissions of primary particulate matter (PM_{2.5}) were reduced by 24 per cent, from 2.6 to 2.0 million tonnes.

Although overall emissions continue to fall, the downward trend has flattened out over the last decade. This is especially the case for ammonia – which emanates primarily from agricultural activities – and PM_{2.5}, which are even reported to be increasing in some countries over the last few years.

Looking specifically at the 28 member states of the EU, between 1980 and 2017 emissions of SO₂ came down by 94 per cent, while those of NO_x, VOCs and ammonia fell respectively by 57, 61 and 25 per cent. Emissions of PM_{2.5} were reduced by 29 per cent between 2000 and 2017.

Air pollutant emissions from international shipping kept on steadily increasing during the 1980s and 1990s. However, the introduction of ship fuel sulphur standards, especially in the designated Sulphur Emission Control Areas (Baltic Sea and North Sea) from 2006, has resulted in a gradual decline in ship SO₂ emissions specifically in those northern sea areas. Over the last decade or so, NO_x emis-

sions from ships have also shown a slight downward trend, but because of the lack of effective ship NO_x regulation they are likely to increase again as the economy and trade grow.

The data in Table 1 is based on figures reported by countries themselves to the Convention on Long-range Transboundary Air Pollution (LRTAP), and was compiled by the Centre on Emission Inventories and Projections (CEIP) of the European Monitoring and Evaluation Programme (EMEP). The Convention's EMEP keeps track of the ways in which emissions from one country affect the environment in others. The EMEP report also provides an overview of calculations for source-receptor relationships (including transboundary movements between countries), covering acidifying, eutrophying, photo-oxidant, and particle pollution.

For most European countries the biggest share of depositions of sulphur and nitrogen emanate from outside their own territory, and a significant share of the depositions originate from international shipping.

Since land-based emissions have been falling much faster than those from international shipping, the proportion of pollutant depositions and concentrations contributed by shipping has been steadily rising in most countries. For 2017 it was estimated that ship emissions were responsible for up to 20–27 per cent of the total depositions of sulphur and oxidised nitrogen compounds (see Table 2). In the

Table 2: The proportion of total air pollutant depositions of sulphur and oxidised nitrogen from shipping, for various countries in 2017.

Sulphur		NO _x -Nitrogen	
Portugal	20%	Norway	27%
Spain	16%	Sweden	25%
Italy	13%	Denmark	25%
Ireland	13%	Portugal	22%
France	12%	Netherlands	22%
Norway	10%	Estonia	21%
UK	10%	Ireland	19%
Greece	8%	Greece	18%
Switzerland	8%	UK	18%
Netherlands	6%	Finland	18%
Sweden	5%	Spain	18%
Belgium	4%	Italy	18%

coastal areas of the affected countries, shipping's contribution to the overall pollution load is even higher.

It should be noted that the contribution of shipping to sulphur deposition in countries around the Baltic Sea and the North Sea decreased markedly after the entry into force of stricter fuel sulphur limits in those sea areas from 2015. Countries that are still particularly exposed to sulphur pollution from shipping include Portugal, Spain, Ireland, Italy and France.

Several more countries are highly impacted by ships' NO_x emissions, especially the Nordic countries, the Netherlands and Portugal, but also many Mediterranean countries as well as Ireland and the United Kingdom.

Christer Ågren

Report: "Transboundary particulate matter, photo-oxidants, acidifying and eutrophying components." EMEP Report 1/2019. www.emep.int

Shipping accounts for an increasing proportion of emissions of SO₂ and NO_x.



Table 1: European emissions of sulphur dioxide (SO₂), nitrogen oxides (as NO₂), non-methane volatile organic compounds (NMVOC), ammonia (NH₃), and particulate matter (PM_{2.5}) (kilotonnes). Data for 2000, 2010 and 2017 is from the 2019 EMEP report, while data for 1990 is from earlier EMEP reports or the EMEP website. Russia in the table refers only to the western parts of the Russian Federation.

	Sulphur dioxide				Nitrogen oxides				VOCs				Ammonia				PM _{2.5}		
	1990	2000	2010	2017	1990	2000	2010	2017	1990	2000	2010	2017	1990	2000	2010	2017	2000	2010	2017
Austria	74	32	16	13	220	214	183	145	303	180	137	120	66	64	66	69	25	19	16
Belgium	365	172	61	38	411	344	246	176	330	212	138	109	123	92	71	67	41	33	23
Bulgaria	1,101	863	387	103	284	154	148	103	561	107	87	77	121	54	47	49	26	31	32
Croatia	170	59	35	13	106	88	71	55	175	104	90	63	54	45	41	38	33	31	17
Cyprus	31	48	22	16	16	21	19	15	15	18	20	12	5	7	7	6	3	2	1
Czech Rep.	1,755	233	164	110	812	280	232	163	571	287	241	207	190	87	71	67	49	45	40
Denmark	178	32	15	10	303	227	150	112	204	169	122	102	126	97	80	76	24	25	20
Estonia	272	97	83	39	79	45	43	33	66	37	23	22	24	9	10	10	15	14	9
Finland	249	82	66	35	306	241	187	130	233	177	114	88	34	34	36	31	26	24	18
France	1,282	626	278	144	1,953	1,618	1,077	807	2,417	1,644	817	612	668	646	604	606	328	215	164
Germany	5,486	646	409	315	2,888	1,945	1,356	1,188	3,402	1,638	1,257	1,069	743	662	641	673	167	122	99
Greece	494	532	205	57	369	412	361	255	331	317	255	199	78	66	64	56	53	40	26
Hungary	824	427	30	28	235	185	145	119	320	197	146	142	149	93	78	88	48	49	48
Ireland	183	144	26	13	169	177	117	110	143	122	110	113	110	115	108	118	20	16	12
Italy	1,784	756	218	115	2,068	1,487	967	709	1,996	1,602	1,124	935	472	459	390	384	196	196	165
Latvia	100	18	4	4	89	40	41	37	83	49	40	38	37	14	16	17	22	19	18
Lithuania	191	37	18	13	129	56	59	53	117	72	55	46	80	27	31	30	7	8	7
Luxembourg	15	3	2	1	40	41	34	18	26	16	11	12	7	7	6	6	2	2	1
Malta	10	10	8	1	7	9	9	5	2	5	3	3	2	2	1	1	1	0	0
Netherlands	197	78	35	27	656	465	333	252	498	333	268	252	350	176	134	132	30	19	14
Poland	2,649	1,411	875	583	1,052	852	888	804	495	732	712	691	441	331	303	308	159	157	147
Portugal	324	301	65	48	260	285	192	159	223	249	178	168	82	77	57	58	74	56	51
Romania	802	490	356	107	487	280	241	232	353	266	261	240	131	186	175	164	103	129	112
Slovakia	418	117	68	27	215	107	85	66	169	168	133	89	74	42	33	27	41	25	18
Slovenia	201	94	11	5	72	59	48	35	64	52	37	30	22	22	20	19	11	13	11
Spain	2,053	1,389	244	220	1,391	1,356	921	739	1,021	942	630	618	502	556	459	518	140	114	104
Sweden	103	43	28	18	280	216	157	124	353	224	181	147	60	60	55	53	33	26	20
United Kingdom	3,767	1,286	450	173	3,242	2,051	1,250	893	2,990	1,625	880	809	331	306	264	283	148	119	107
Total EU28	25,078	10,026	4,179	2,276	18,139	13,255	9,560	7,537	17,461	11,544	8,070	7,013	5,082	4,336	3,868	3,954	1,825	1,549	1,300
Albania	86	34	27	13	24	18	22	25	43	23	34	39	29	29	24	24	9	14	15
Belarus	637	157	59	48	285	135	170	143	533	225	308	143	215	142	151	138	25	46	35
Bosnia & Herz.	480	121	180	170	73	35	32	31	48	52	39	33	21	17	19	21	16	15	14
Iceland	21	39	77	50	31	33	27	23	14	9	6	6	6	5	5	5	1	2	1
Moldova	152	4	10	9	91	13	25	28	100	29	42	51	52	23	22	23	4	4	11
Montenegro	14	14	28	47	8	9	10	14	10	10	8	8	6	6	3	2	4	4	5
North Macedonia	110	106	91	56	40	43	38	24	48	48	36	29	16	13	11	10	30	24	9
Norway	52	27	19	15	199	224	206	163	302	406	161	153	27	33	33	33	43	38	28
Russia	4,671	2,875	1,903	1,663	3,600	3,361	2,930	3,239	3,668	3,420	3,424	3,734	1,191	967	1,053	1,204	492	427	369
Serbia	563	464	403	420	182	148	150	148	188	146	134	125	94	76	69	65	40	43	39
Switzerland	40	16	11	5	140	105	78	61	287	147	93	78	69	60	58	55	11	8	7
Ukraine	2,783	2,310	1,241	839	1,097	828	716	637	1,369	555	534	519	729	358	251	286	121	135	145
Total Non-EU	9,609	6,167	4,049	3,335	5,770	4,952	4,404	4,536	6,610	5,070	4,819	4,918	2,455	1,729	1,699	1,866	796	760	678
Total Europe	34,687	16,193	8,228	5,611	23,909	18,207	13,964	12,073	24,071	16,614	12,889	11,931	7,537	6,065	5,567	5,820	2,621	2,309	1,987
Int. ship: Baltic Sea	199	225	89	9	360	408	346	287	3	3	3	2					29	16	9
Int. ship: Black Sea	46	52	45	40	108	122	105	90	1	1	1	1					7	7	6
Int. ship: Mediterran.	796	902	696	603	1,504	1,706	1,420	1,171	11	11	10	9					117	97	86
Int. ship: North Sea	397	450	204	29	800	907	755	609	7	7	6	5					61	38	20
Int. ship: N.E. Atlantic	517	586	473	403	1,012	1,147	953	773	8	8	7	6					76	65	57
Total internat. ship.	1,995	2,215	1,507	1,084	3,784	4,290	3,579	2,930	30	30	27	23					290	223	178
Total Euro. + ships	36,642	18,408	9,735	6,695	27,693	22,497	17,543	15,003	24,101	16,644	12,961	11,954	7,537	6,065	5,567	5,820	2,911	2,532	2,156
Turkey	1,691	2,242	2,557	2,350	255	495	707	785	885	1,072	1,049	1,099	540	557	606	740	384	368	388

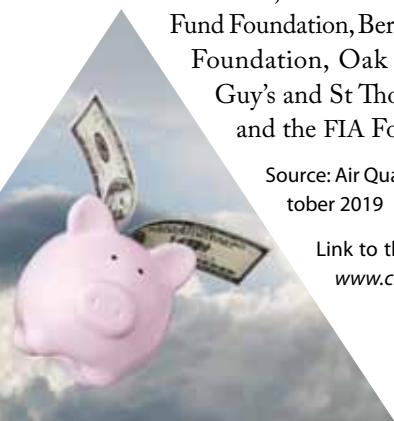
New Clean Air Fund launched

First announced at the United Nations Climate Change Summit in September, the Clean Air Fund has received USD 50 million in initial funding, which is nearly double the figure raised by the philanthropic community for air pollution support in the whole of 2018.

Donations have come from philanthropic foundations with a range of focus areas, including health, climate, mobility, and children. Funding partners include IKEA Foundation, Children's Investment Fund Foundation, Bernard van Leer Foundation, Oak Foundation, Guy's and St Thomas' Charity and the FIA Foundation.

Source: Air Quality News, 9 October 2019

Link to the fund: <https://www.cleanairfund.org>



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France found guilty of breaching NO₂ limits

The European Court of Justice (ECJ) has ruled that France "systematically and persistently" breached EU limits for nitrogen dioxide (NO₂) across 12 urban areas, including Paris, Marseille, Strasbourg, Nice and Toulouse. The limits should have been met in 2010.

The ECJ referred to article 23 of the Air Quality Directive, which states that measures must be taken to ensure that the exceedance time is kept "as short as possible". It also said that it was "irrelevant" whether the breaches

were by intent, neglect or attributable to technical or structural difficulties.

The ruling was a clear win for the Commission, which took the case to the ECJ as the final step of its infringement process. It also sets the tone for a spate of other dirty air cases against member states that include Germany, UK, Italy and more recently Spain and Bulgaria, which are still pending a decision.

Source: Ends Europe Daily, 24 October 2019
ECJ press release: <https://curia.europa.eu/jcms/upload/docs/application/pdf/2019-10/cp190132en.pdf>



LNG no solution for truck emissions

Heavy goods vehicles running on liquefied natural gas (LNG) can emit up to five times as much nitrogen oxides as the latest diesel models, according to research commissioned by green group Transport & Environment.

A study of three LNG trucks available on the EU market found that NO_x emissions were two to five times as high as the

best-performing diesel equivalent in real world testing conditions. The three LNG models were found to produce similar amounts of particles as their diesel counterparts, contradicting claims made by their manufacturers that the vehicles all but eradicate particulate pollution. LNG lorries are not required to be fitted with particulate filters until 2023.

Moreover, the study suggests that the reduction in greenhouse gas emissions from LNG trucks is also limited. The Scania and Iveco models registered a 9–10 per cent reduction in CO₂ equivalent compared to the average Euro VI diesel truck, based

on 2013 figures. A third LNG model, produced by Volvo, performed better, emitting 14 per cent less than the best-performing diesel model from the same year. However, once the full emissions associated with the extraction of natural gas are taken into account, those benefits shrink further.

"Gas trucks are not clean and can actually be worse than diesel," said Stef Cornelis, T&E's clean trucks manager. "It's time for policymakers to have a fresh look at the evidence and put an end to gas truck subsidies, LNG infrastructure investments and tax breaks for what is just another polluting fossil fuel."

Source: Ends Europe Daily, 19 Sep 2019.

The study: www.transportenvironment.org/sites/te/files/publications/2019_09_do_gas_trucks_reduce_emissions_paper_EN.pdf



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LNG trucks emit more than twice as much NO_x and a similar level of particles as new diesel trucks.

Post-Euro 6 car emissions standards

A new ICCT report highlights the limitations of current EU car emissions standards and provides detailed recommendations for how to overcome them.

In October, the International Council for Clean Transportation (ICCT) published a report that points out problems and limitations of the EU's existing Euro 6 emission standards for light-duty vehicles, compares them to current and future regulations in other parts of the world, and offers policy recommendations for new, post-Euro 6 standards.

The recommendations are timely, since the European Commission has fairly recently started the regulatory work aimed at the next stage of emission standards. Clearly, the objective of any new EU standards are to markedly improve the emissions performance of new road vehicles in order to minimise, and ultimately eliminate, their contribution to the persistent air quality problems across Europe.

Motor vehicle emissions of various air pollutants, including carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NOx), and tiny particles (PM) contribute directly as well as indirectly to health and environmental damage. The indirect effects result primarily from their role as precursors for the formation of PM_{2.5} and ground-level ozone.

Regulatory action at the EU level started in 1970 with a directive that established emission limits for CO and HC from

petrol vehicles. Emission limits for NOx were introduced in 1977, and extensions to also cover the gaseous pollutants of diesel vehicles were passed in 1983. A particulate mass (PM) emissions limit was introduced for diesel vehicles in 1988.

What are known today as the Euro 1 standards were adopted in 1991. Since then, the EU has progressively tightened emission limits through the Euro 2 (1996), Euro 3 and 4 (1998), and Euro 5 and 6 (2007) standards.

It is no news that the Euro standards have been ineffective in reducing the real-world NOx emissions from diesel vehicles. The ICCT points out that from 2000 to 2016, that is from Euro 3 to Euro 6, the nominal NOx limits set by the diesel Euro standards have been reduced by 84 per cent, but over the same time period NOx emissions from transport have only fallen by 32 per cent.

NOx emissions from petrol vehicles, on the other hand, have decreased proportionally with reductions in the limit set by the applicable Euro standard.

As the European Commission is now turning its attention to the development of post-Euro 6 emission standards, the ICCT has presented a series of recommendations covering several topics, with the

aim of strengthening the current vehicle emission standards for light-duty vehicles.

These topics include:

- Emissions of regulated, unregulated, and climate-forcing pollutants;
- Testing regimes, data evaluation methods, and boundary conditions for demonstrating compliance with type-approval and in-service conformity testing;
- Measures to improve durability, emissions performance, and compliance with standards throughout the useful life of the vehicles.

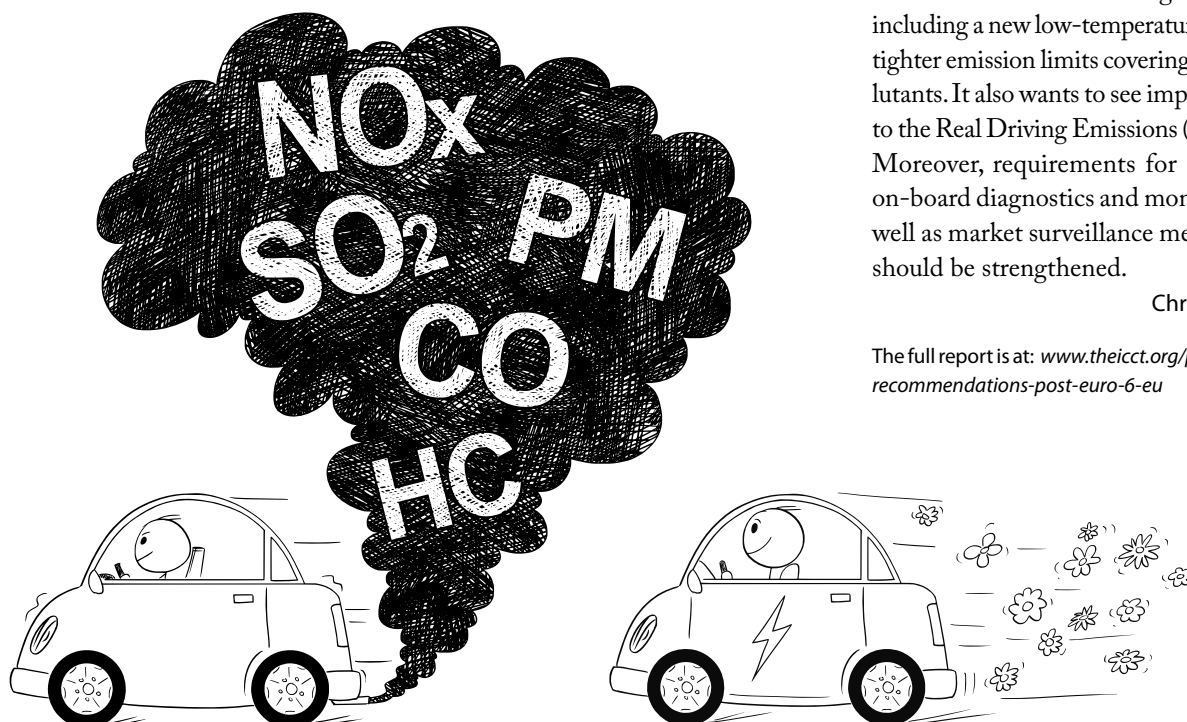
The list of recommendations is split into different categories and presents many detailed proposals. A few highlights are given below.

In addition to fuel- and technology-neutral emissions limits and standards upgraded to bring them in line with other markets, ICCT is calling for additional limits for methane and nitrous oxide (as greenhouse gases), ammonia, all volatile organic compounds (not solely hydrocarbons), and specific limits for nitrogen dioxide in addition to total nitrogen oxides. It also wants to improve and strengthen emission controls for ultrafine particles and the establishment of emission limits for brake wear particles.

ICCT wants better testing conditions, including a new low-temperature test with tighter emission limits covering more pollutants. It also wants to see improvements to the Real Driving Emissions (RDE) test. Moreover, requirements for durability, on-board diagnostics and monitoring, as well as market surveillance mechanisms, should be strengthened.

Christer Ågren

The full report is at: www.theicct.org/publications/recommendations-post-euro-6-eu





The Cry of the Cryosphere

Summer snow cover in the Arctic has decreased by 2.5 million km² in fifty years. The changes for animals and human livelihoods in the affected regions are dramatic.

Since we realised the dangers of climate change, the frozen parts of our planet have been at the heart of concerns regarding the impacts of temperature rise. The glaciers, as well as ice and snow cover, form very visible targets for these impacts, and of course the effects of temperature are very direct and easy to understand. The cryosphere is to a large extent also home to important and vulnerable organisms and ecosystems that cannot survive anywhere else. Some of these species, such as polar bears, have even become the very symbol of climate change.

The recent special report by the IPCC on the Oceans and Cryosphere¹ (SROCC) and its summary for policymakers unfortunately corroborates and deepens the concerns. The effects already observed include the loss of mass from ice sheets and glaciers, as well as effects on snow cover and Arctic sea ice, together with record-high permafrost temperatures.

The scale of effects is in many cases enormous, as exemplified by mass losses averaging 278 and 155 Gt annually (2006–2015) for the Greenland and Antarctic ice sheets, respectively. The loss of June snow cover in the Arctic land areas translates into the staggering figure of 2.5 million km² between 1967 and 2018.

The physical changes also have impacts on species and biodiversity, including decreased habitats for plants adapted to cold and/or snow in high mountain areas, and for mammals and birds associated with ice in polar regions. The poster symbols

for climate change – the polar bears – are among the unfortunate losers in the battle against rising temperatures. In 2019, the second-lowest annual minimum on record was reported for Arctic sea ice², leading to drastically impaired feeding conditions for the polar bears. Not surprisingly, dramatic declines in polar bear populations have already been observed in some regions, such as the Beaufort Sea, where the population has been reduced by 40 per cent in a decade (Steven Amstrup, Polar Bears International, in citation above). The effect on polar bears sometimes also hits the headlines in a dramatic fashion, as the animals are forced to migrate: In February 2019, 52 polar bears were reported to have invaded the town of Belushya Guba in Russia³!

Naturally, as conditions change, the implications do however vary for different species. Whereas many species lose habitats, some species also benefit and can expand their range by migrating to new areas. An obvious example is the upward migration of lower-elevation mountain species. Changes in biodiversity are the ultimate outcome of the loss of ground for many species and the expansion of others, and from a conservation perspective these changes are clearly seen as negative.

Livelihoods are also affected, as exemplified by negative effects on agriculture in the Himalayas and tropical Andes, and changing conditions for people in Arctic regions, including indigenous people. The

negative impacts also include reduced food and water security. The specific livelihoods affected, in addition to agriculture, are fishing, gathering, herding and hunting. As many of these are also important for cultural identity and/or tourism, it is evident that the societal and economic consequences are vast.

Projections of further change indicate that unavoidable future effects on glacier mass, permafrost, snow cover and Arctic ice cover will occur towards 2050 under all emission scenarios. However, if greenhouse gas emissions are drastically cut, there is a chance to reduce effects beyond 2050. Nevertheless, the projections show that negative effects on nature and humans exemplified above will continue. It is vital, though, to grasp the chance to dampen the effects through rapid measures against greenhouse gas emissions.

These pessimistic projections are unfortunately supported by recent events and reports. For instance, the Greenland ice sheet lost more than 12.5 billion tons in one day during this very summer. Or, as put in perspective in a Tweet by climate scientist Martin Stendel when the melting took place: “...The amount of ice that melted from the surface of the ice sheet just during the last two days would be enough to cover #Florida with almost five inches of water.”

Apart from direct effects on plants, animals, people and livelihoods in affected regions, there are also significant feedback

Polar bear populations have declined by 40 per cent in a decade in the Beaufort Sea region north of Alaska.



Death of corals on the Great Barrier Reef

Increasingly frequent marine heatwaves can lead to the almost instant death of corals, scientists working on the Great Barrier Reef have found. These episodes of unusually high water temperatures are – like heatwaves on land – associated with climate change. Scientists studying corals after a heat event discovered that extreme temperature rises damaged reefs much more rapidly than previously thought. They published their findings in the journal *Current Biology*. During the high-temperature event that the team studied, which occurred on the Great Barrier Reef between 2016 and 2017, there was an estimated loss of a third to half of the corals. “If you imagine losing 30–50 per cent of the trees in England over the course of two years, it would be quite astounding,” said Dr James Guest from Newcastle University in the UK.

Link: <https://www.bbc.com/news/science-environment-49255642>

Mural in Sydney that highlights the acute situation for the Great Barrier Reef.



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Record big wind turbines planned off UK coast

The largest-ever wind turbines will be used at the Dogger Bank offshore windfarm in the North Sea over the next few years, the Guardian reports. Millions of British homes will be powered using wind turbines with blades more than 100 metres long by the early 2020s. The site will use GE's Haliade-X turbine, which has a capacity of 12 megawatts, making it the world's most powerful turbine. The windfarms will have a capacity of 3.6 gigawatts, capable of powering 4.5 million homes a year, roughly five per cent of the UK's electricity generation.

<https://www.theguardian.com/environment/2019/oct/01/worlds-largest-wind-turbines-to-be-built-off-yorkshire-coast>



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mechanisms between the cryosphere and other systems. For instance, the global mean sea level has exhibited an accelerated rise because of ice loss in Greenland and in Antarctica. The rise since 1902 was already 0.16 m in 2015, and the annual rise of 3.6 mm between 2006 and 2015 is said to be unprecedented in the last century. Accelerated effects on Antarctic ice may lead to sea-level rise of several metres over a longer term (centuries) and, although there is uncertainty in projections, there could be an onset of irreversible instability in these ice sheets.

Furthermore, sea ice loss contributes to increased wave heights, whereas the runoff of rivers is impacted in mountain basins dependent on snow or glaciers. This last effect is reportedly independent of emission scenario. Rises in permafrost temperature, which have already reached record-high levels, are projected to potentially lead to the release of enormous amounts (tens to hundreds of billions tons) of CO₂ and methane, which would of course further accelerate climate change in a very dramatic fashion.

The IPCC's work will continue with the preparation of the 6th assessment report. In the meantime, the work of the IPCC, civil society and increasingly the general public (not least driven by a younger generation and “the Greta effect”) has already led to more and more pressure on politics nationally and internationally. The dramatic effects on the cryosphere, and their consequences for species, biodiversity

and livelihoods, together with feedbacks on other systems driving climate and oceanographic processes, should and must make a strong argument for rapid action to strongly reduce emissions of greenhouse gases. The report is timely for the upcoming COP25 and for the EU's Green Deal, and the National Energy and Climate Plans as well as the National Long Term Strategies of the EU member states. The summary for policy makers should be an important publication to study for all governments and their representatives.

The SROCC also points to areas where scientific evidence still needs to be strengthened. Many of these areas concern large-scale processes with potentially extremely important global consequences. These processes include the release of CO₂ and methane from permafrost, the possible onset of irreversible ice sheet instability, and long-term projections on the effects of melting ice on sea level rise. It is in the interests of both civil society and concerned governments that science gets the necessary support to conduct vital studies on these subjects, and that the results can be incorporated in future work by the IPCC and civil society.

Marko Reinikainen

¹ Special Report on the Ocean and Cryosphere in a Changing Climate, 2019

² See e.g. <https://www.theguardian.com/world/2019/sep/29/polar-bears-arctic-sea-ice-environment>

³ <https://time.com/5526741/polar-bears-russia/>



Modelling a shift to sustainable diets

Peer pressure was found to be the most important driver for people to adopt a plant-based diet, when researchers integrated psychological theories into a computer model.

A massive shift towards more plant-based diets has in recent years been identified as an important element in reducing greenhouse gas emissions and competition for land. So far, most research has focused on what a sustainable diet would look like. Few studies have explored if and how food cultures with less meat could become widespread on a global scale.

In a recent paper, Sibel Eker et al. use integrated assessment modelling (IAM) to analyse the likely uptake of vegan, vegetarian and flexitarian diets in a larger population, and the environmental benefits that would follow. IAM is a widely used tool for estimating the potential of environmental policy options, since it explores the connections between society and the natural world. What is innovative about this study is the integration of theories from behavioural sciences beyond simple economic factors. Eker et al. use two psychological theories:

- The Theory of Planned Behaviour, which has been widely used in environmental contexts and focuses on the role of social norms in shaping behaviour.
- The Protection Motivation Theory, which is widely used in health contexts and focuses on individual risk.

In the case of eating less animal products, the first theory implies that if many of

your peers have adopted such a diet you are also more inclined to make a change. The second theory instead focuses on the importance of perceived risks. In this case the health risks associated with a high intake of meat and dairy and the perceived risks from climate-related events. Both theories recognise that individuals who experience obstacles to change are less likely to take action, referred to as low self-efficacy. A schematic illustration of how the researchers think these factors will affect a shift to a vegetarian diet is presented in figure 1.

The team modelled a differentiated population taking into account gender, age and educational level. The population was then divided into two groups: those who followed a meat-based diet and those who had adopted a vegetarian diet. To add to the complexity, the researchers also tried four different combinations of diets. In a reference scenario, meat-eaters ate a meat-based reference diet and the vegetarians adopted a lacto-ovo vegetarian diet. In three other scenarios meat-eaters either shifted to healthy eating guidelines (scenarios 1 and 2) or a flexitarian diet (scenario 3) by 2050, while vegetarians kept the lacto-ovo diet (scenario 1) or shifted to a vegan diet (scenario 2 and 3).

To deal with the high range of uncertain-

ty for the variables used in the model, the researchers uses a Monte-Carlo approach. They simulated the model 10,000 times with different combinations of parameter values within the uncertainty range.

Social norms among young people (ages 15–44) was the parameter that contributed to most variance in the output. This supports earlier findings that values endorsed by the peer group have more influence on whether people make a change than actual health and climate risks.

The second most influential parameter is the self-efficacy parameter among females, which is assumed to be higher than that of males. Self-efficacy among those who have completed secondary education also ranked fairly high. It is assumed to be higher for people with higher education, but it is still an important factor, since the former constitute the largest demographic group by educational attainment. This suggests that it is important to strengthen people's perceptions that their changing eating habits will have an impact.

When it comes to reducing climate impact, it seems that it is more effective to persuade a majority to move from regular meat-eating to a flexitarian diet than for a smaller group to abandon meat altogether. A population of 90 per cent of flexitarians



More vegetarian options increase sales

Increasing the share of vegetarian meals on the menu seems to be an effective way to nudge diners to choose a vegetarian option. In a British study, sales at three university cafeterias were studied. Sales of vegetarian meals increased during days when more vegetarian options were available. The statistics suggest that doubling the share of vegetarian meals on the menu from 25 to 50 per cent increases sales of the vegetarian lunches by 40–80 per cent.

Serving more vegetarian options had little impact on overall sales and no other rebound effects (such as lower vegetarian meal sales at other mealtimes such as evening meals). The results suggest that this could be a simple way to achieve more sustainable diets.

Link: https://www.researchgate.net/publication/336145612_Impact_of_increasing_vegetarian_availability_on_meal_selection_and_sales_in_cafeterias

Poland develops off-shore wind energy

Poland's ministry of energy has prepared a draft bill to support the development of offshore wind energy off the northern European country's coast. The ministry said that



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the draft is the result of "intensive work and consultations with many partners" and is now ready for "further legislative work". Minister of energy Krzysztof Tchórzewski said: "I am convinced that the proposed regulations will significantly contribute to the future creation of a systemically formed offshore wind energy sector in Poland." The ministry has also requested that the draft is included in the country's Council of Ministers' legislative work.

Link: <https://renews.biz/56318/poland-drafts-offshore-wind-bill/>

Figure 1: Conceptual framework of the diet change model. An illustration of the behavioural framework underlying the diet change model. The arrows represent a causal relation between two factors, and the polarity of an arrow indicates whether the relation is positive or negative.

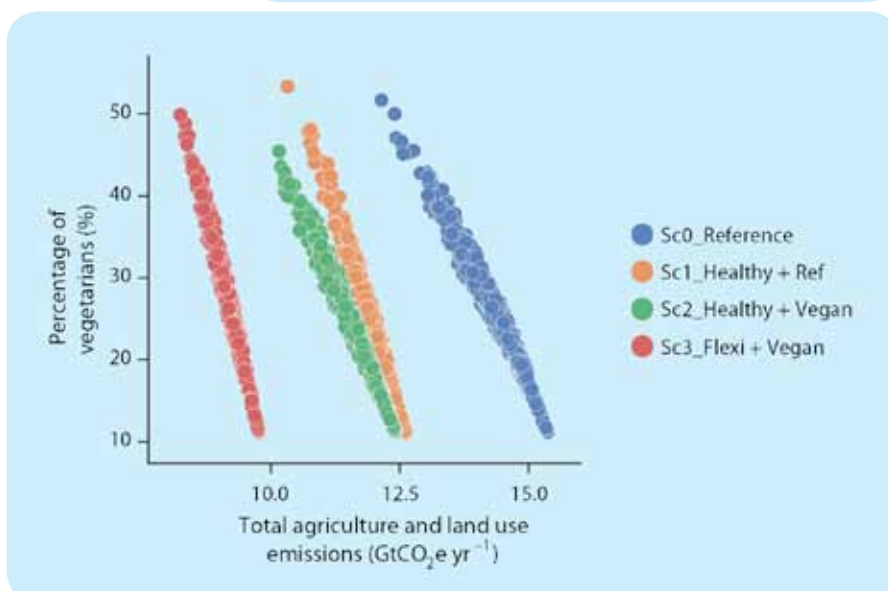
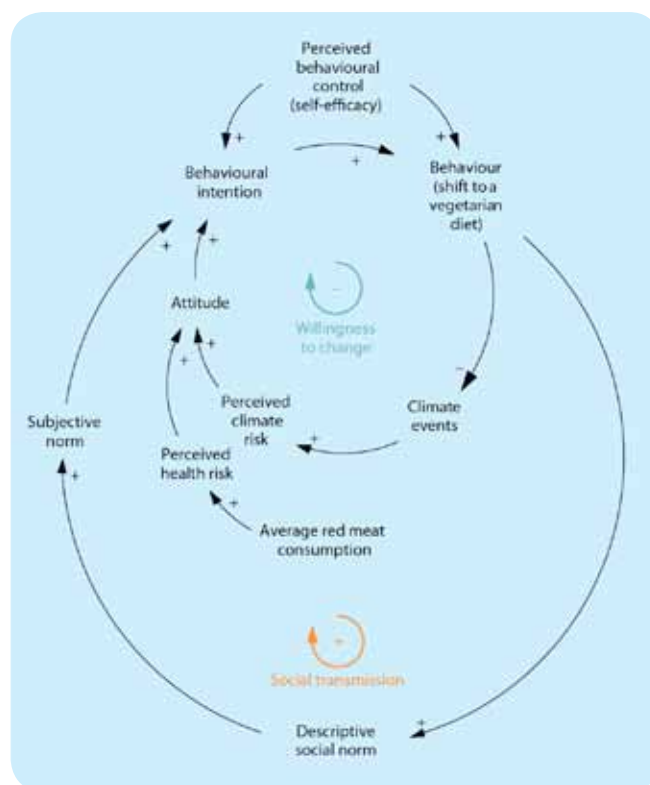


Figure 2: The climate impact of diet change scenarios in 2050, the results of 10,000 model simulations for 2050 for the percentage of vegetarians/vegans in the total population.

and 10 per cent vegans (scenario 3) will contribute to less greenhouse gases than 50 per cent regular meat-eaters and 50 per cent lacto-ovo vegetarians (reference scenario) (see figure 2).

The researchers write that, to their knowledge, this is the first model that couples climate, diet and behaviour. One of the limitations is that it is based on psychological theories and data that are drawn largely from studies of Western industrialised nations. To further develop the model, they plan to collect more data from sources such as social media, as

well as focusing on specific cases where cultural values and traditions also play an important role in whether people are willing to adapt their behaviour or not.

Kajsa Pira

IIASA press release 22 July 2019: <https://www.iiasa.ac.at/web/home/about/news/190722-sustainable-diets.html>

Modelling the drivers of a widespread shift to sustainable diets <https://www.nature.com/articles/s41893-019-0331-1>

Scientists call for urgent action on nitrogen

In an open letter to UN secretary general António Guterres more than 150 scientists from 35 countries are calling for “urgent action on nitrogen pollution, to tackle the widespread harm it is causing to humans,

wildlife and the planet”, and for a halving of nitrogen waste from all sources globally by 2030.

Nitrogen in various forms, such as ammonia, nitrogen dioxide, nitrous oxide and nitrate, is polluting air, soil and water, posing a threat to human health, biodiversity, economies and livelihoods. Nitrogen losses amount to 200 million tonnes

a year at cost of USD 200 billion, according to the scientists.

Better management would “prevent millions of premature deaths, help ensure food security, and simultaneously help protect wildlife and the ozone layer”, they say. The letter is accompanied by a report which highlights possible ways of reducing nitrogen pollution.

Source: Ends Europe Daily, 23 Oct 2019

Link to the letter: <http://www.inms.international/INMS-letter-to-UNSecretary-General>



Scientists call to "Halve Nitrogen Waste" from all sources globally by 2030.

© PHOTO ONE / SHUTTERSTOCK.COM

Climate change threat to European farming

Yields from non-irrigated crops, such as wheat, corn and sugar beet, are projected to decrease in southern Europe by up to 50 per cent by 2050, according to scenarios in a report from the European Environment Agency (EEA). The report notes that it will have major effects on farmers' income and land prices in the region. However, it is not believed that this is enough to threaten food security in the European Union, though food prices are likely to rise in the coming decades.

Although the EU has an overall adaptation strategy, the EEA sees flaws in

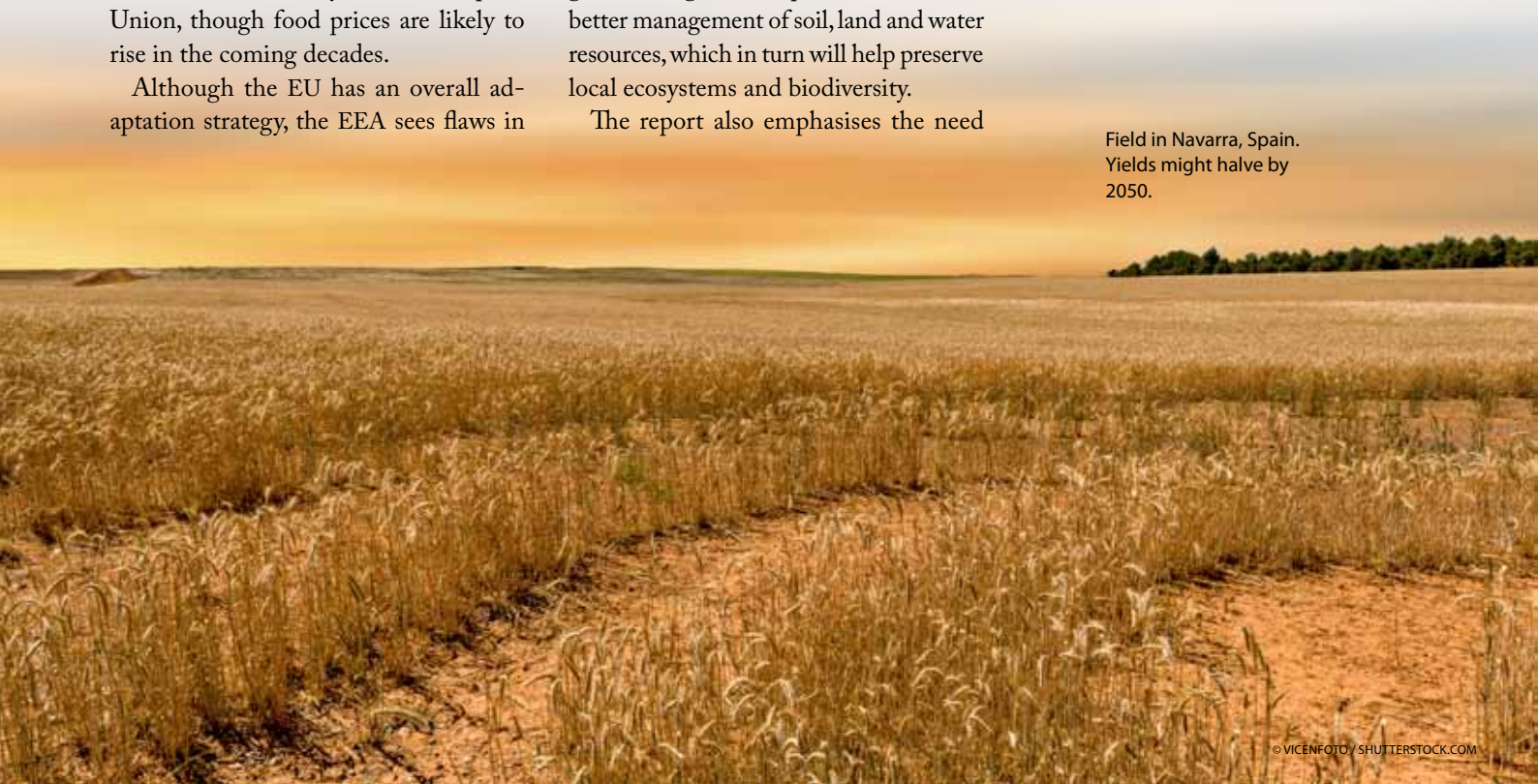
farm-level implementation. The report stresses that more knowledge, innovation and awareness raising are required to improve the effective use of the already available adaptation measures, like introducing adapted crops, improved irrigation techniques, field margins and agroforestry, crop diversification or precision farming. These practices should also lead to lower greenhouse gas and air pollutant emissions, better management of soil, land and water resources, which in turn will help preserve local ecosystems and biodiversity.

The report also emphasises the need

for the farming sector to reduce its own greenhouse gas emissions. Measures highlighted are improvements in fertiliser use, in manure handling efficiencies and in animal productivity through breeding, as well as changes in consumer behaviour, like eating less meat and reducing food waste.

Report Climate Change Adaption in the Agricultural Sector in Europe <https://www.eea.europa.eu/publications/cc-adaptation-agriculture>

Field in Navarra, Spain.
Yields might halve by 2050.



Money quarrels delay a CAP with diluted climate ambition

EU member states have deeply divided opinions on the CAP budget, but agree on weakening the environmental and climate baseline.

In order for the EU's Common Agricultural Policy (CAP) for 2021–2027 to be launched within a year, it had to be more or less fully negotiated by the end of this year. This is not going to happen. Instead, temporary legislation will need to be introduced for 2021 at least.

The biggest obstacle that must be overcome is agreeing on the long-term EU budget, the so-called multiannual financial framework (MFF), for the new period. This not only sets the size of the CAP budget, but also the monetary division between the two pillars, which in turn affects how much money there is for environmental and climate measures.

Right now, there are several areas of conflict. A group of member states known as the “frugal five” – Austria, Denmark, Germany, the Netherlands and Sweden – are pushing for a smaller overall budget. They are major contributors to the EU budget and do not want to increase their fees, which would otherwise be necessary to compensate for the UK leaving. Another group, of eastern and southern member states, is fighting to maintain funding for regional development. Some of them also back the Commission's proposal to increase the EU budget from 1 to 1.11 per cent of GNI.

At present, agriculture receives around 35 per cent of total spending from the EU budget, and the Commission had proposed to reduce this share to about 28 per cent in the next seven-year framework. According to the proposal, the savings will primarily affect Pillar 2, which includes the rural development programmes and agri-environmental schemes.

A majority of member states – Austria, Bulgaria, Cyprus, Czech Republic, Croatia, Estonia, France, Greece, Hungary, Ireland, Latvia, Lithuania, Luxembourg, Poland, Portugal, Romania, Slovakia, Spain and Malta – want to maintain the share of the CAP budget as it is. It is not clear whether

they want more money to fall under Pillar 1 or 2, and opinions are probably divided.

At the latest agriculture council meeting in October, the Finnish presidency proposed raising the Commission's proposal from 28.6 to 30.9 per cent of the total budget.

Jabier Ruiz, senior policy officer for agriculture at WWF's European Policy Office, said it was “completely deceitful that agriculture ministers are asking for more EU money to green the CAP and, at the same time, drastically diminishing the environmental standards attached to CAP subsidies”.

One of the changes he refers to is the Council's wish to weaken some of the improvements to the conditionality that have been introduced by the Commission. Conditionality is the basic requirement that farmers must comply with in order to receive direct payments.

Regarding protection of carbon-rich soils, the original proposal requires “appropriate” protection, while the Council wants to dilute this to “minimum” protection. They also want to delay the introduction of this rule to 2024. Since organic soils cover only 1.5 per cent of EU cropland but account for 55 per cent of total cropland soil emissions, this would be a relatively cheap and effective measure to encourage farmers to reduce their carbon emissions.

The Council wishes to get rid of the rule that requires all EU farms to carry out crop rotation. Crop rotation brings many benefits. Farmers can reduce their pesticide use. When legumes are included in the rotation, they can also reduce the



Wake me up when they get serious about environmental measures.

use of nitrogen fertiliser and this can lower greenhouse gas and nitrogen emissions.

In the European parliament both the AGRI committee and the ENVI committee voted on positions before the elections in May. The AGRI committee managed to erode much of the environmental ambition in the original proposal, for example they wanted to shift some of the conditionality to the non-compulsory “eco-schemes”. The ENVI committee on the other hand came up with several improvements, such as tightening some of the proposed conditionality and introducing a new rule on maximum stocking density.

Since the new Parliament has been assembled, the AGRI committee has decided to keep its report and to negotiate new compromise amendments to somewhat reconcile its position with the ENVI committee's opinion. We can expect a plenary vote to be scheduled as soon as this process is concluded, likely in early 2020.

Kajsa Pira

Sources:

ENDS Daily 16 October 2019

ENDS Daily 6 November 2019

Politico 4 November 2019, <https://www.politico.eu/article/the-eus-budget-tribes-explained/>

Amazon rainforest “close to irreversible tipping point”

The Amazon rainforest is dangerously close to an irreversible “tipping point” within two years according to a new report, the Guardian writes. After this point the rainforest would stop producing enough rain to sustain itself and start slowly degrading into a drier savannah, releasing billions of tonnes of carbon into the atmosphere, which would exacerbate global heating and disrupt weather across South America. The report sparked controversy among climate scientists. Some believe the tipping point is still 15 to 20 years away, while others say the warning accurately reflect

Scientists argue at what point the rainforest will stop generating enough rain to sustain itself.

the danger that President Bolsonaro and global heating pose to the Amazon’s survival. The report noted that Brazil’s space research institute, INPE, reported that deforestation in August was 222 per cent higher than in August 2018. Maintaining the current rate of increase reported by INPE between January and August this year would bring the Amazon “dangerously close to the estimated tipping point as soon as 2021 ... beyond which the rainforest can no longer generate enough rain to sustain itself”.

Link: <https://www.theguardian.com/environment/2019/oct/23/amazon-rainforest-close-to-irreversible-tipping-point>

Deforestation must decrease by 95 per cent in a 1.5 °C world

Measures within the land sector could contribute about 30 per cent, or 15 billion tonnes of carbon dioxide equivalent (GtCO₂e) per year, of the global mitigation needed by 2050 to deliver on the 1.5 °C target, according to a recent article in Nature and Climate Change.

The researchers based their roadmap on more than a hundred top-down modelled 1.5°C pathways from other studies, as well as bottom-up assessments of the mitigation potential of 24 land-based activities.

Land-based emissions need to be halved each decade (85% decrease by 2050) and carbon removal (sinking) needs to increase tenfold between 2030 and 2050. This would make the land sector net carbon-zero by 2040 and a net sink of approximately 3 GtCO₂e per year by 2050.

The greatest contribution will come from reducing deforestation, which must fall 70 per cent by 2030 and 95 per cent by 2050.

“The roadmap foresees a phased approach where first actions to avoid emissions are prioritised. This means concentrating on avoiding deforestation in hotspot geographies such as Brazil and Indonesia,” explains Michael Obersteiner, one of the study authors.

Afforestation and reforestation will also be important. The roadmap suggests that more than 320 Mha of new or restored forests will be needed. This can be compared to the 43 Mha that so far have been pledged in national climate plans (NDCs).

Restoration of peatlands and wetlands, reduced methane and nitrous oxide emissions, shifting to plant-based diets, reduced

food waste, improved forest management and agroforestry, and enhanced soil carbon sequestration will also contribute to the emission reductions according to the roadmap. To achieve negative emissions the researchers have also included moderate use of bioenergy with carbon capture and storage (BECCS), that will contribute 7 per cent of the annual emission reductions by 2050.

Nature and climate change, 21 October 2019
<https://doi.org/10.1038/s41558-019-0591-9>

IIASA press release 21 October 2019, <https://www.iiasa.ac.at/web/home/about/news/191021-roadmap-for-carbon-neutral-land-sector.html>

Afforestation and reforestation will also be important.

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Ship scrubbers could render UK ports unusable

According to The Independent, the global shipping industry has spent more than USD 12bn on installing scrubbers on more than 3,700 ships worldwide to comply with new environmental legislation that ends up polluting the sea instead of the air. But only 65 of these vessels have had closed-loop scrubbers installed, a technology that stores the extracted sulphur in tanks before discharging it at a safe disposal facility in a port.

The others are able to discharge the waste products, which are acidic and often contain carcinogens, including polycyclic aromatic hydrocarbons (PAHs) and heavy metals, into the sea.

“We are worried that contaminated sediments will build up in berths and navigation channels over the long term. Contamination makes it very difficult for ports to get permission to dispose of

the sediment and it can raise the cost of dredging by about 10 times,” said Mark Simmonds, at the British Ports Association

IMO guidelines for scrubber discharge, which are under review, are set out in terms of the concentrations that are emitted, rather than the absolute quantity of pollutants that are discharged.

The British Ports Association says that it is yet to see convincing studies that address its concerns about the impact of scrubber discharge on sediments over a time period of five or 10 years.

Source: The Independent, 28 October 2019.

Link: <https://www.independent.co.uk/news/uk/home-news/shipping-uk-ports-environmental-cheat-devices-scrubbers-dredging-pollution-a9171476.html>



Malaysia bans open-loop ship scrubbers

In a notice issued on 12 November to the shipping industry, Malaysia's maritime department said ships are now prohibited from discharging wash water from open-loop scrubbers while operating in Malaysian waters.

Singapore and Fujairah in the United Arab Emirates, both major marine refuelling hubs, have banned the use of open-loop scrubbers from the start of next year. China is also set to extend a ban on scrubber discharge to more coastal regions.

Source: Reuters, 18 November 2019

Big benefits of reducing ship speeds

The large positive effect that reduced speeds can have on ship GHG emissions is well known, but less attention has been given to other positive impacts on nature and human health.

A new report from Seas at Risk and Transport & Environment describes how a modest 20 per cent reduction in ship speed would reduce underwater noise pollution by 66 per cent, and the chance of a fatal collision between a ship and a whale by a massive 78 per cent.

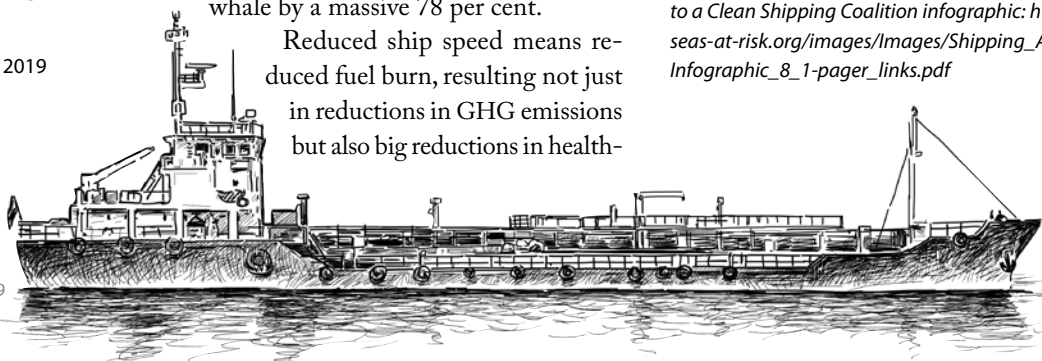
Reduced ship speed means reduced fuel burn, resulting not just in reductions in GHG emissions but also big reductions in health-

damaging SO₂, NO_x and PM (including black carbon), all important air pollutants.

“Killing four birds with one stone is pretty good, but when you add in that it saves shipowners money on their fuel bill, it really is a no-brainer,” said Faig Abbasov from Transport & Environment.

Source: Press release from Seas at Risk and T&E, 11 November 2019.

Link to the report: <https://seas-at-risk.org/24-publications/988-multi-issue-speed-report.html>, and to a Clean Shipping Coalition infographic: https://seas-at-risk.org/images/Images/Shipping_Arctic/Infographic_8_1-pager_links.pdf



Cutting air pollution will save lives

Europe's air is slowly getting cleaner, but air pollution remains the largest environmental health risk and is still responsible for about 400,000 premature deaths every year.

A new report from the European Environment Agency (EEA) presents the latest official air quality data reported by more than 4,000 monitoring stations across Europe in 2017. It shows that despite slow improvements (see Figure), high concentrations of air pollutants still have significant health impacts, with particulate matter, nitrogen dioxide (NO₂) and ground-level ozone (O₃) causing the greatest harm.

Air pollution shortens people's lives and contributes to serious illnesses such as heart disease, respiratory problems and cancer. Between 2015 and 2017, up to 81 per cent of the EU urban population was exposed to levels of fine

particulate matter (PM_{2.5}) exceeding the air quality guidelines established by the World Health Organization (WHO) to protect people's health. And up to 98 per cent of EU urban citizens were exposed to ozone levels above the WHO's guideline value (see Table 1).

In the 41 countries considered, 412,000 premature deaths in 2016 were attributed to PM_{2.5} exposure, 71,000 to nitrogen dioxide exposure and 15,100 to ozone exposure. In the EU-28, the numbers of premature deaths attributed to PM_{2.5}, NO₂ and O₃ exposure were 374,000, 68,000 and 14,000, respectively.

Table 2 shows the best-estimate figures for total mortality due to exposure to each of the three pollutants, for each of the European countries included in the analysis.

Country-by-country data is presented for the estimated number of years of life lost (YLL) and the YLL per 100,000 inhabitants due to exposure to the various pollutants. Regarding the latter, the largest impacts from PM_{2.5} are observed in the central and eastern European countries, which is also where the highest concentrations are observed, i.e. Kosovo, Serbia, Bulgaria, Albania and North Macedonia.

The largest health impacts attributable to NO₂ exposure, expressed as YLL per 100,000 in-

habitants, are found in Greece, Italy, Serbia, Cyprus and the United Kingdom. Regarding ozone, the countries with the highest rates of YLL per 100,000 inhabitants are Greece, Albania, Kosovo, Italy and Montenegro.

It should be noted that the impacts estimated for each pollutant may not be added to determine the total impact attributable to exposure to the three pollutants. Because concentrations – especially those of PM_{2.5} and NO₂ – are correlated, additions may result in double counting.

In 2017, annual PM_{2.5} concentrations were exceeding WHO guidelines at 69 per cent of monitoring stations across Europe, including at least some monitoring stations in all reporting countries, except Estonia, Finland and Norway.

The monitoring revealed PM_{2.5} concentrations in excess of the binding EU limit values in seven EU member states (Bulgaria, Croatia, Czechia, Italy, Poland, Romania and Slovakia). In addition, four EU countries (Bulgaria, Hungary, Poland and Slovakia) have not yet met the EU's 2015 target for the three-year average exposure for PM_{2.5}.

On top of the health impacts, air pollution continues to damage vegetation and ecosystems. Elevated concentrations of ground-level ozone, for example, damage agricultural crops, forests and plants. In 2016, the EU's long-term objective for the protection of vegetation was exceeded in 73 per cent of the total EU agricultural area, and the critical level for the protection of forests was exceeded in 62 per cent of the total EU forest area.

Excess deposition of sulphur and nitrogen compounds (from emissions of SO₂, NO_x, and NH₃) contribute to the acidification of soil, lakes and rivers, causing the loss of biodiversity. In 2016, five per cent of the EU's ecosystem area was exposed to

Italy is one of the European countries with most years of life lost due to NO₂ and ozone.



Table 1. Percentage of EU urban population exposed to air pollutant concentrations above EU and WHO reference levels (2015–2017).

Pollutant	EU reference value ($\mu\text{g}/\text{m}^3$)	Exposure estimate (%)	WHO air quality guideline ($\mu\text{g}/\text{m}^3$)	Exposure estimate (%)
PM ₁₀	Day (50)	13–19	Year (20)	42–52
PM _{2.5}	Day (25)	6–8	Year (10)	74–81
O ₃	8-hour (120)	12–29	8-hour (100)	95–98
NO ₂	Year (40)	7–8	Year (40)	7–8
BaP	Year (1 ng/m ³)	17–20	Year (0.12 ng/m ³)	83–90
SO ₂	Day (125)	< 1	Day (20)	21–31

Colour coding: < 5% 5–50% 50–75% > 75%

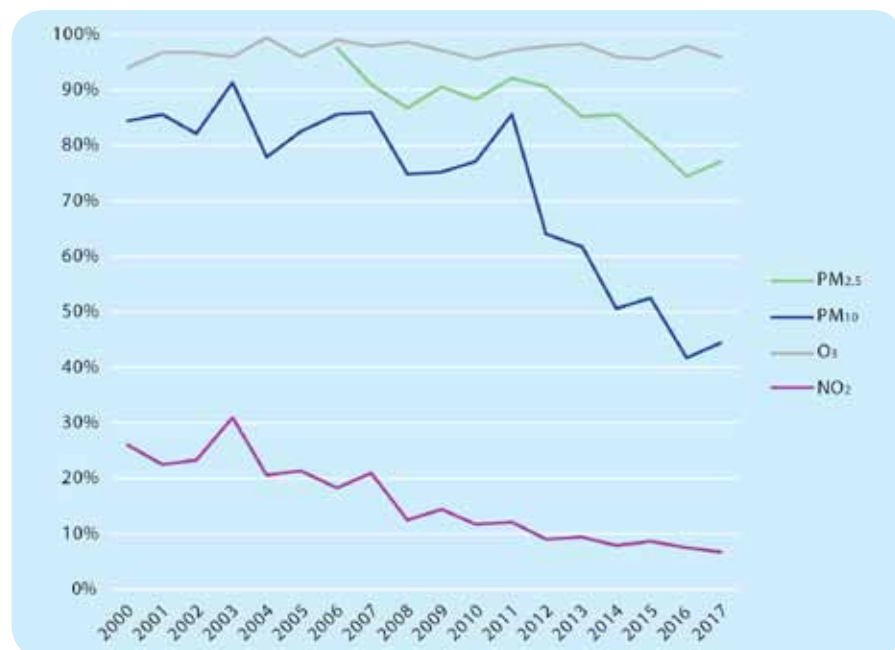


Figure: Percentage of EU urban population exposed to air pollutant concentrations above WHO air quality guidelines (2000–2017).

acidifying depositions exceeding the limits of nature's tolerance.

Emissions of NH₃ and NO_x also disrupt land and water ecosystems by introducing excessive amounts of nutrient nitrogen, causing eutrophication (the over-supply of nutrients), with resulting impacts on biodiversity. In 2016, about 73 per cent of the EU's ecosystem area was exposed to nitrogen deposition exceeding the critical eutrophication limits.

This year's report also includes a hypothetical assessment of the potential minimum health benefits of meeting the WHO air quality guidelines for PM_{2.5}. The calculations were based on the assumption that all PM_{2.5} concentrations for 2016 over 10 $\mu\text{g}/\text{m}^3$ are lowered to 10 $\mu\text{g}/\text{m}^3$, while the concentrations below this level remain unchanged.

It is stressed that the estimated benefits represent a minimum, i.e. the benefits

are likely underestimated. The reason being that real measures to bring down concentrations would not only lower concentrations that are currently above 10 $\mu\text{g}/\text{m}^3$, but also further reduce concentrations elsewhere (that are currently below the WHO guideline).

The assessment shows that the numbers of annual premature deaths due to PM_{2.5} in the EU would decrease by 102,000, or 27 per cent, compared to the current figure for 2016. When all 41 of the countries considered are included, the numbers of premature deaths would fall by 122,000, or 30 per cent.

Christer Ågren

The report "Air quality in Europe – 2019 report" (EEA Report No. 10/2019) is available at: www.eea.europa.eu

Table 2. Estimates of premature deaths attributable to exposure to PM_{2.5}, NO₂ and O₃ in 41 European countries in 2016.

	PM _{2.5}	NO ₂	O ₃
Austria	5,300	1,000	270
Belgium	7,600	1,600	180
Bulgaria	13,100	1,100	280
Croatia	5,300	260	190
Cyprus	580	240	30
Czech Rep.	9,600	240	350
Denmark	2,700	80	90
Estonia	500		20
Finland	1,500		60
France	33,200	7,500	1,400
Germany	59,600	11,900	2,400
Greece	12,900	2,900	640
Hungary	12,100	770	380
Ireland	1,100	50	30
Italy	58,600	14,600	3,000
Latvia	1,700	60	60
Lithuania	2,600	20	70
Luxembourg	230	50	10
Malta	210		20
Netherlands	9,200	1,500	270
Poland	43,100	1,500	1,100
Portugal	4,900	610	320
Romania	23,400	2,600	490
Slovakia	4,800	20	160
Slovenia	1,700	70	70
Spain	24,100	7,700	1,500
Sweden	2,900	30	120
UK	31,800	11,800	530
Total EU28	374,000	68,000	14,000
Albania	5,100	70	180
Andorra	40		
Bosnia & Herz.	5,400	20	120
Iceland	60		
Kosovo	3,800	20	100
Lichtenstein	20		
Monaco	30	10	
Montenegro	630		20
N. Macedonia	3,400	110	70
Norway	1,300	130	50
San Marino	30		
Serbia	13,700	1,500	280
Switzerland	3,700	620	240
Total all	412,000	71,000	15,000

EEA: Air quality in Europe – 2019 report

EU climate policies reviewed

EU reduces CO₂ emissions by 2 per cent, risks failing to meet sustainable energy targets, and gives green light to new fossil gas projects.

The European Union (EU) cut its greenhouse gas (GHG) emissions by 2 per cent in 2018, according to preliminary estimates released on 31 October 2019 by the European Environment Agency. The EEA public statement says that “rising energy consumption continues to hamper progress on the share of energy generated by renewable sources and on energy efficiency. As in previous years, the transport sector remains a particular concern with rising GHG emissions, low uptake of renewable energy sources and insufficient reductions in the life-cycle emissions of transport fuels. The EEA report “Trends and projections in Europe 2019 — Tracking progress towards Europe’s climate and energy targets” presents analysis of EU progress towards the 2020 and 2030 targets for climate and energy. Two specific analyses provide an overview of emission trends under the EU Emissions Trading System (ETS) up to

Krk LNG terminal, one of several examples of fossil fuel projects backed by the EU.

2030, and of GHG intensity of transport fuels in 2017. Climate Action Network Europe commented that “the data published was just bringing emissions back down to approximately the level the EU had already achieved in 2014. This practically means that the EU’s emissions were at a standstill for four years. The report also shows that more emission cuts could be achieved if member states revive the boom in renewable energy, and more importantly if they push energy savings a lot more than currently as the EU’s energy efficiency target for 2020 is clearly at risk of not being met”. CAN Europe concludes that “progress in renewable energy share and energy efficiency is clearly too slow”. It also highlights that member states have to greatly accelerate the pace of the energy transition in the next decade for the EU to meet its 2030 energy targets. “In order to achieve ambitious greenhouse gas emission cuts by 2030, EU countries’ energy and climate plans must aim at accelerating the pace of the clean energy transition and phasing out the use of fossil fuels. This is the only way for them to account to the millions of citizens who are demanding concrete and rapid action to prevent the worsening of climate change.”

Friends of the Earth Europe reported that on the same day the EEA published its report in one of the last acts of President Juncker’s administration, the European Commission had backed 55 new climate-damaging fossil fuel projects, as part of a list of priority energy projects – a move that flies in the face of the climate emergency, say Friends of the Earth Europe in a press release. This fourth edition of the list, known as the Projects of Common Interest (PCI) list, lends European Commission support to dozens of new climate-damaging gas infrastructure projects with lifetimes lasting decades.

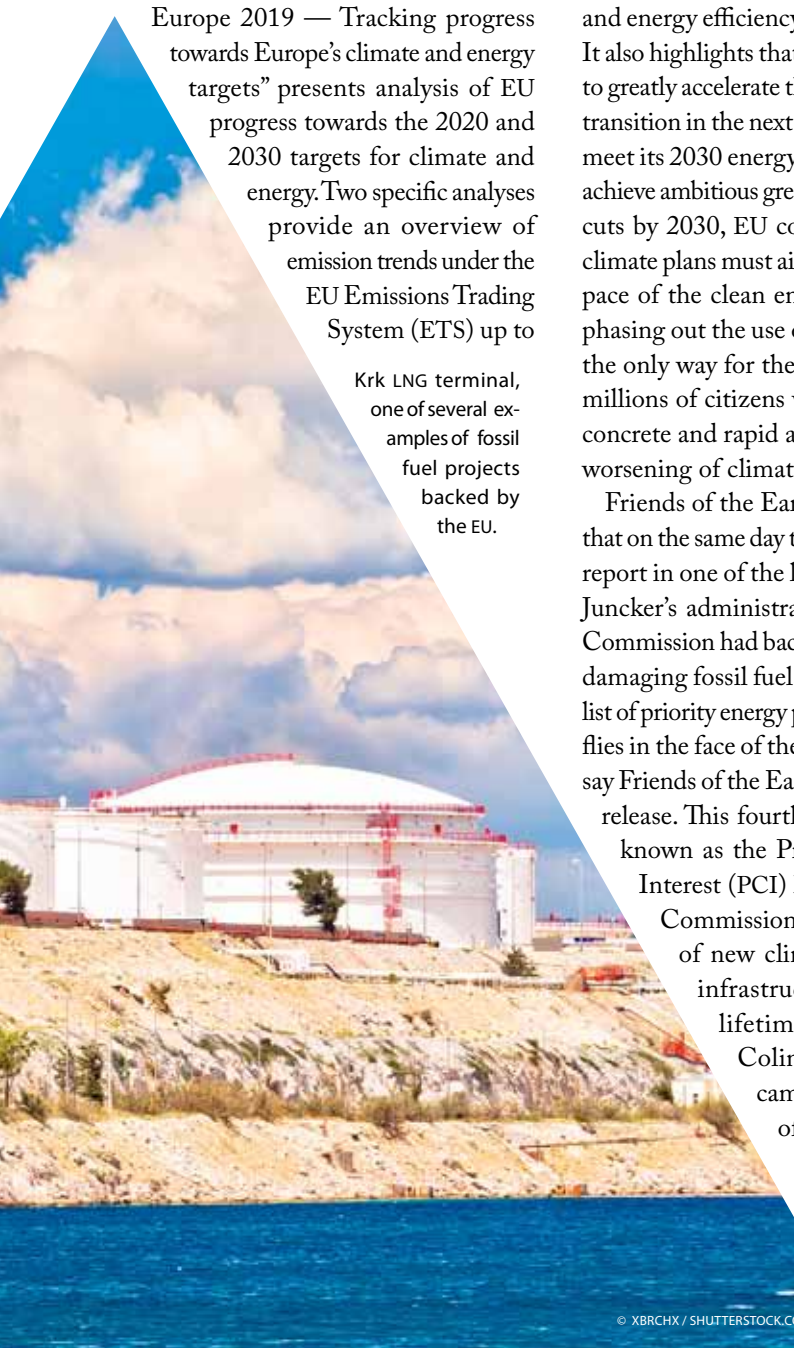
Colin Roche, fossil-free campaigner for Friends of the Earth Europe said: “In one of its last

acts, the Juncker Commission’s support for yet more fossil gas projects will bring us a step closer to climate breakdown. This new PCI list makes a mockery of the EU’s commitments to deliver a ‘carbon neutral’ Europe, and insults all those who have voted and protested for decisive climate action. MEPs must now reject this list and all new fossil fuel projects.”

Controversial fossil fuel projects supported include new gas pipelines and LNG terminals – many to import fracked gas from the United States – which could shackle Europe to decades more fossil fuel use. This is despite incoming European Commission President von der Leyen’s promise of a “carbon-neutral” continent by 2050 and a “Green Deal” for Europe in her first 100 days.

Controversial projects backed by the EU Commission include: Gas mega-pipelines connecting Europe to Azerbaijan and crisis-ridden eastern Mediterranean countries; and terminals for importing polluting fracked gas from the US, including the controversial LNG terminals in Krk in Croatia, and Shannon in Ireland (which is caught up in a legal dispute and faces criticism for its links to the US fracking industry), as well as terminals in Greece, Cyprus and Poland. EU LNG import terminals have been running at less than a quarter of their capacities in recent years. Energy projects on the PCI list are eligible to receive EU subsidy under the Connecting Europe Facility, even though the EU has committed to phase out fossil fuel subsidies.

- Frida Kieninger, from Food & Water Europe said: “MEPs must reject EU support for yet more dirty gas projects – this list is based on a deeply flawed selection process that is untransparent, riddled with gas industry interests, and does not consider climate impacts. The climate crisis has no space for the EU Commission’s blatant promotion of dirty fossil fuels.”
- Kate Ruddock, of Friends of the Earth Ireland, commenting on the EU Com-



Germany starts up new 1.1 GW coal power station

mission's support for an LNG terminal in Shannon, Ireland, said: "It's hard to see how the Shannon LNG terminal even qualifies as a so-called 'project of common interest' – it does not connect with the rest of Europe, it has not been assessed for the impacts on our climate targets – it's in the interest of an American fossil fuel company, not the people of Europe.

- Marija Mileta, of Zelena Akcija / Friends of the Earth Croatia, commenting on the EU Commission's support for the Krk LNG terminal in Croatia, said: "It's unacceptable that the European Commission is giving support to climate-wrecking projects such as the Krk LNG terminal, while at the same time it's portraying itself as a climate leader and talking about a European 'green deal'. What's more, the Commission is pushing for a project that is opposed by the whole Krk community, and despite there being numerous legal omissions and complaints from civil society organisations. In a state of climate emergency, this is not only hypocritical, but also dangerous."

"Campaigners are calling for the Trans-European Networks – Energy (TEN-E) Regulation, which governs the PCI list, to be aligned to EU climate commitments," concludes Friends of the Earth Europe.

Compiled by Reinhold Pape

<https://www.eea.europa.eu/highlights/climate-change-significant-drop-in>

<http://www.caneurope.org/publications/press-releases/1837-faster-energy-transition-needed-new-report-says>

<https://www.foeeurope.org/EU-commission-backs-55-controversial-new-fossil-fuel-projects-311019>

Energy company Uniper has announced that its highly controversial Datteln 4 coal-powered plant will go online in January 2020, thus ignoring the proposal of Germany's coal commission. The decision is an embarrassing development for the German government, which after months of delays and negotiations over possible compensation payments for utilities has still not put the recommendations of its coal commission into law.

"Germany is the EU's largest greenhouse gas emitter and must phase out all coal from its electricity sector by 2030 to be able to respect the UN Paris climate agreement. Allowing Datteln 4 to go online not only undermines the coal commission's already inadequate coal exit proposal, it also shows how unprepared the German government is to answer the call for climate action made by the 1.4 million people that took to the streets in Germany during the Global Climate Strikes in September.

None of these people will believe they have been heard by their government," said Kathrin Gutmann, Europe Beyond Coal campaign director.

Uniper has long held that the German coal commission's recommendation of a 2038 total coal phase-out justifies the introduction of its 1.1 gigawatt, 1.5 billion euro plant, despite the commission's explicit recommendation that no new coal power plants should go online. Germany is the only country in Europe to announce a coal phase-out that is not Paris-compliant.

Source: www.beyond-coal.eu

Europe Beyond Coal is an alliance of civil society groups working to catalyse the closures of coal mines and power plants, prevent the building of any new coal projects and hasten the just transition to clean, renewable energy and energy efficiency. Our groups are devoting their time, energy and resources to this independent campaign to make Europe coal free by 2030 or sooner.

Electric cars could be charged in 10 minutes

New battery technology could give electric cars more than 200 miles of charge in as little as 10 minutes, according to new research. "If we have a ubiquitous fast-charging infrastructure on the roadside, drivers need no longer to worry about the cruise range. After driving 200–300 miles per charge, one can pick up another 200–300 miles by charging for 10 minutes," Dr Chao-Yang Wang, a professor at the Pennsylvania State University and co-author of the study, told the Guardian. The future, Wang said, looks bright.

"Our technology is simple but elegant ... I guess that it will take two to three years of in-vehicle testing and evaluation before it is used in commercial vehicles."

<https://www.theguardian.com/environment/2019/oct/30/electric-cars-could-be-charged-in-10-minutes-in-future-finds-research>

10-minute charging possible within a few years, scientist believe.



World Energy Outlook faces increasing criticism

The World Energy Outlook (WEO) from the International Energy Agency (IEA), the self-acclaimed “gold standard of long-term energy analysis”, is increasingly being questioned for pointing in the wrong direction.

The New Policies Scenario (NPS) is the IEA’s main scenario, renamed for 2019 as the Stated Policies Scenario, in which it claims to incorporate announced policy and targets and to “hold up a mirror to the plans of today’s policy makers and illustrate their consequences, not to guess how these policy preferences may change in the future”.

The IEA also produces two other sets of projections: the Current Policies Scenario and the Sustainable Development Scenario (SDS). The SDS claims to be Paris-compatible.

Oil Change International¹ (OIC), a US NGO think-tank with links to the Sierra Club, has questioned both the “mirror” line of argument and whether the SDS is what it claims to be.

The Stated Policies Scenario projects large investments in fossil fuels, and that more oil, gas and coal will be used by 2040 than in 2017. (This can be seen from the

tables at the end of the 810-page report, but it costs EUR 120.)

Oil Change International has demonstrated that both the Stated Policies Scenario and SDS are used as justification for a fossil future.

“The Canadian Association of Petroleum Producers routinely uses the WEO to justify the expansion of the tar sands. In its 2018 Financial and Operating Review, ExxonMobil cites the WEO as showing that USD 21 trillion in cumulative investment in oil and gas is needed from 2018 to 2040. Last year, Norway’s energy minister cited the SDS to justify Norway’s continued expansion of oil production, saying Norway will “be there as a stable producer of oil and gas for decades to come”. In the New York Times, BP CEO Bob Dudley also cited the SDS as a reason why the world needs more oil and gas.

The SDS is not a 1.5 °C scenario; it has a 50 per cent chance of staying below 1.65 °C. This looks close, but it is achieved with a massive overshoot, with massive nuclear and massive CCS. The overshoot means

that it will deliver not by 2050, but by 2070, which is a time hori-

zon that does not worry the fossil industry overmuch, as seen in the quotes above.

Oil Change International is not alone. The claim that the SDS is not Paris-compatible has been backed up by Joeri Rogelj, the lead author of the IPCC 1.5 °C report and by Cristina Figueres², the chief negotiator in Paris in 2015.

Another perennial criticism of the WEOs is that they are demonstrably wrong. They always overestimate nuclear and always underestimate solar and wind.

A total of 51 nuclear reactors disappeared from the forecast for 2025 between WEO 2018 and WEO 2019, reducing nuclear output from 3,089 to 2,801 TWh. WEO 2014 said 3,540 TWh. In the space of five years, 132 reactors of the future have evaporated.

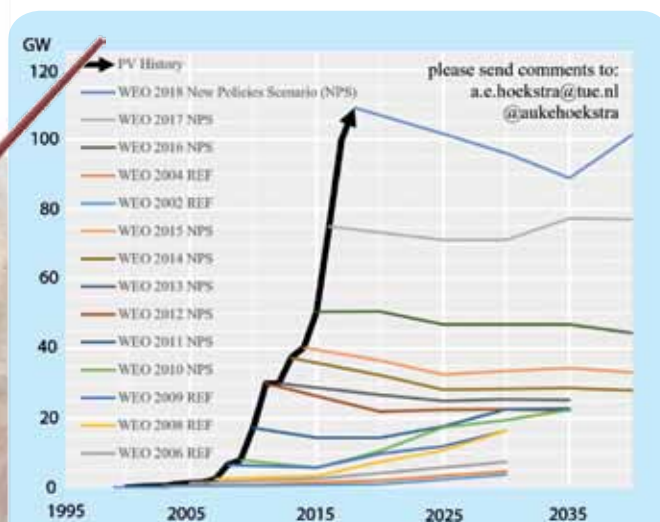
This has been the pattern since the IEA was formed by the OECD in 1974 as a counterweight to OPEC, the cartel of oil producers, in the wake of the first oil price shock.

As for photovoltaics, Auke Hoekstra, senior adviser on electric mobility at the Eindhoven University of Technology, has published a telling diagram (figure).

The black line to the left shows how many gigawatts of solar was installed each year. The other lines show the IEA forecasts of different years. It looks much like a standing comb. Every year they believe that PV will grow by roughly a constant number in the future, not exponentially.

Figure: Annual solar PV additions: historic data versus IEA WEO predictions. In GW of added capacity per year – source International Energy Agency - World Energy Outlook.

WEO has consistently underestimated the development of solar PV.



Ocean acidification can cause the mass extinction

Carbon emissions make seas more acidic and wiped out 75 per cent of marine species around 66 million years ago, reports a new study according to the Guardian. A key impact of today's climate crisis is that seas are again getting more acidic, as they absorb carbon emissions from the burning of coal, oil and gas. Scientists said the latest research is a warning that humanity is risking potential "ecological collapse" in the oceans, which produce half the oxygen we breathe. The researchers analysed small seashells in sediment laid down shortly after a giant meteorite hit the Earth, wiping out the dinosaurs and three-quarters of marine species. Chemical analysis of the shells showed a sharp drop in the pH of the ocean after the meteorite struck. The researchers found that the pH dropped by 0.25 pH units in the 100–1,000 years after the strike. It is possible that there was an even bigger drop in pH in the decade or two after the strike and the scientists are examining other sediments in even finer detail. The



When a meteorite hit Earth, the pH of the oceans dropped by 0.25 units, causing mass extinctions of marine life.

researchers said: "If 0.25 was enough to precipitate a mass extinction, we should be worried." Researchers estimate that the pH of the ocean will drop by 0.4 pH units by the end of this century if carbon emissions are not stopped, or by 0.15 units if global temperature rise is limited to 2 °C.

Source: The Guardian 21 October 2019 <https://www.theguardian.com/environment/2019/oct/21/ocean-acidification-can-cause-mass-extinctions-fossils-reveal>

The 2019 forecast, not included in the diagram, is adjusted upwards, but still remains horizontal, meaning that the same amount of capacity is added in all future years. But PV growth has actually been exponential so far, as can be seen from the thick black line. There are no signs of this letting up in the near future.

The reason why the WEO does not explore a true 1.5 degrees scenario by 2050 is simple. It would disturb the present order of energy companies too much:

"The changes required to set such a course are rapid, deep and unprecedented and their implications would be far-reaching and extend well beyond the energy sector."

The tacit assumption is that the same thing could not be said about climate change itself.

The WEO is however a major analytical undertaking, and produces some unexpected results. Anti-coal organisation sandbag.org.uk was eager to point out that the WEO shows that coal methane emissions are equivalent to the combined CO₂ from both aviation and shipping.

As for bio-CCS, WEO is very cautious, and SDS foresees only 0.25 gigatons of it, compared to 4.7 gigatons in the IPCC 1.5 °C median pathway. "Many of the technologies or methods involved are unproven at scale, and could have negative consequences outside the energy system," they write.

Fredrik Lundberg

¹ <http://priceofoil.org/2019/11/13/iea-2019-weo-working-for-fossil-fuels-not-climate/>

² <https://mission2020.global/letter-to-iea/>

³ In 2018, on average the world's 451 reactors produced 5.6 TWh each.

⁴ <https://steinbuch.wordpress.com/2017/06/12/photovoltaic-growth-reality-versus-projections-of-the-international-energy-agency/>

Nuclear power should not be part of climate-friendly energy mix

The debate on effective climate protection is heating up in Germany and the rest of the world. Nuclear energy is being touted as "clean" energy. Given the circumstances, a recent study has analysed the historical, current, and future costs and risks of nuclear energy. The findings show that nuclear energy can by no means be called "clean" due to radioactive emissions, which will endanger humans and the natural environment for over one million years. It also carries a high risk of proliferation. An empirical survey of the 674 nuclear

power plants that have ever been built showed that private economic motives never played a role. Instead military interests have always been the driving force behind their construction. Even ignoring the expense of dismantling nuclear power plants and the long-term storage of nuclear waste, purely economic private investment in nuclear power plant would result in high losses – an average of five billion euros per nuclear power plant, as one financial simulation revealed. In countries such as China and Russia, where nuclear power plants are still being built, private investment does not play a role either. Nuclear power is too expensive and dangerous, so it should not be part of the climate-friendly energy mix of the future.

Source: Abstract by German Institute for Economic Research https://www.diw.de/de/diw_01.c.670590.de/publikationen/weekly_reports/high_priced_and_dangerous_nuclear_power_is_not_an_option_for_the_climate_friendly_energy_mix.html

Nuclear power is dirty and expensive. Instead military interests is the driving force behind new constructions.



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40 years of partnership for clean air

The Air Convention has developed and applied new tools resulting in cost-effective, effect-based strategies to tackle air pollution.

It was over fifty years ago that air pollution was identified as an environmental problem that was not limited by national borders, and one that required international co-operation. This fact laid the foundation for the drawing up of the Convention on Long-Range Transboundary Air Pollution (also known as the Air Convention), which was signed in Geneva on 12 November 1979, and is now celebrating its 40th anniversary.

The Air Convention, which covers 51 parties across Europe and North America, initiated a process that stimulated research and the international exchange of knowledge and information, which in turn spurred on political decisions on the measures needed to reduce emissions, both nationally and internationally. Since it was signed, the Convention has led to a series of agreements, known as protocols, which prescribe binding commitments on emission limits.

Since 1980, emissions of sulphur dioxide from land-based sources in Europe have fallen by nearly 90 per cent. Emissions of other air pollutants have also dropped, but not by anywhere near as much – nitrogen oxides and volatile organic compounds

have fallen by roughly half, and ammonia by a quarter (see article on page 8).

It is naturally difficult, and perhaps impossible, to give a quantitative estimate of the proportions of these emission reductions that can be ascribed to the Air Convention, but there is no doubt that it has been a contributory factor.

The work carried out under the Convention has had a consistently strong scientific basis, particularly the mapping out and description of air pollutant emissions, transport, deposition and environmental effects. During the 1980s and 1990s the Convention also developed and applied new tools, such as critical loads (scientifically derived limits to Nature's tolerance to pollutant exposure) and integrated assessment modelling, which in turn led to the development of cost-effective, effect-based strategies to tackle the problems.

The Air Convention's data and methods of work were used also by the European Commission and the EU member states when developing the National Emission Ceilings Directives of 2001 and 2016.

In a recent article in *Ambio*, a group of experienced scientists and policy-makers concludes that the close involvement of scientists has been a signature of the Air Convention. They also note that during all interactions between science and policy, it is of critical importance that scientific credibility is maintained.

Scientists have continuously had a role at the Convention's policy meetings, where they communicate results from basic air pollution research, report on outcomes of monitoring and inventories, and present options for control strategies. In this way, scientists have taken responsibility for bringing up-to-date scientific knowledge into the policy negotiations and presenting

results in a way that has been understandable and useful for the policy work.

The authors also note that public awareness is important for promoting stronger interest and putting pressure on decision-makers, and that NGOs have played an important role in spreading awareness of air pollution more widely, and could therefore be important for a more global movement towards cleaner air.

The latest agreement under the Air Convention – the Gothenburg Protocol as amended in 2012 – was put together according to this model of science-policy interaction, and it sets binding national emission reduction commitments for five pollutants (SO₂, NO_x, VOCs, NH₃ and PM_{2.5}) that must be achieved by 2020.

However, even when the Protocol was signed in 2012 it was obvious that the agreed emission reductions, the outcome of political compromises, were clearly insufficient to achieve the long-term objectives of not exceeding critical loads and protecting people's health. It is therefore expected that there will be a process of review and revision in which emission limits are progressively strengthened.

After the eighteenth ratification, the Protocol came into force on 7 October. There are currently 22 parties to the Protocol, and the number is growing.

The entry into force opens the way for a review and revision of the Protocol – an issue that will be debated at the next meeting of the Convention's Executive Body on 9–13 December in Geneva. On 11–12 December, the meeting will also hold a special session to celebrate the Air Convention's 40-year anniversary.

Christer Ågren

The Convention's website: <http://www.unece.org/env/lrtap/welcome.html>

Ambio article: "Acid rain and air pollution: 50 years of progress in environmental science and policy" (August 2019). By P. Grennfelt, A. Englerd, M. Forsius, Ø. Hov, H. Rodhe & E. Cowling. Link: <https://doi.org/10.1007/s13280-019-01244-4>.

The convention has been successful at reducing air pollution, but more ambition is still needed to achieve the long-term objectives.



Tokyo, one of the cities that have signed the declaration.

Cities for clean air

On 11 October, 35 mayors pledged to deliver clean air for over 140 million people who live in their cities. By signing the C40 Clean Air Cities Declaration, the mayors recognise that breathing clean air is a human right and commit to work together to form an unparalleled global coalition for clean air.

Signatories of the declaration pledge to: Set ambitious pollution reduction targets within two years that meet or exceed national commitments, putting them on a path towards meeting World Health Organization guidelines; Imple-

ment substantive clean air policies by 2025 that address the unique causes of pollution in their cities; and Publicly report progress on achieving these goals.

Cities signing the declaration include Barcelona, Berlin, Buenos Aires, Copenhagen, Delhi, Los Angeles, Lima, London, Madrid, Mexico City, Milan, Oslo, Paris, Rotterdam, Seoul, Stockholm, Sydney, Tokyo, Warsaw and Washington D.C.

Source: Press release from C40 Cities, 11 October 2019. Link: www.c40.org

London's ULEZ cuts NO₂

Since the introduction of an Ultra-Low Emission Zone (ULEZ) in April 2019, nitrogen dioxide (NO₂) concentrations in London have been cut by a third, according to a City Hall report. Quarterly averages reveal that levels of NO₂ on roadside monitors have fallen by 36 per cent, from 89 µg/m³ in January to March 2017 to 57 µg/m³ in July to September 2019.

Levels of fine particulate matter (PM_{2.5}) have fallen only slightly, with the report saying that over half of London's PM_{2.5} is blown into the capital from outside sources.

The London Mayor Sadiq Khan plans to expand the zone's boundary in 2021 should he be re-elected next year.

Source: Car Lines, No 9, 2019



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UK air is cleaner but challenges remain

Policies to improve air quality in the UK over the past 40 years have led to significant reductions in pollution and associated mortality rates, a new study has found.

Research led by the Centre for Ecology & Hydrology charted the levels of emissions of a variety of air pollutants in the UK between 1970 and 2010 – a period in which a raft of national and European legislation was introduced to tackle pollution. They found that over the 40-year period, total annual emissions of PM_{2.5}, NO_x, SO₂ and NMVOCs in the UK all reduced substantially – by between 58 and 93 per cent. However, emissions of ammonia (NH₃) fell only by 17 per cent, and have even increased slightly in recent years.

As a result of emission reductions, mortality rates attributed to PM_{2.5} and NO₂ (pollutants that increase the risk of respiratory and cardiovascular diseases)

declined by 56 and 44 per cent, respectively, in the UK over the 40-year period.

However, scientists involved in the research stress that tackling air pollution in the UK remains an ongoing challenge. NO₂ concentrations are still often above legal limits in many urban areas and levels of ammonia emissions are increasing.

Edward Carnell of the Centre for Ecology & Hydrology, lead author of the study, said: "Our results demonstrate the effectiveness of a series of policies at UK and European level since 1970 and this



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Ammonia emissions have only fallen by 17 per cent in the past 40 years.

research supports policy-makers' efforts to continue implementing much-needed measures to further improve air quality."

Source: ScienceDaily, 26 June 2019. Link: <https://www.sciencedaily.com/releases/2019/06/190626124958.htm>

Air Pollution & Climate Secretariat
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Sweden

Recent publications from the Secretariat

Reports can be downloaded in PDF format from www.airclim.org



The Greenhouse Effect, Global warming and Implications for Coral Reefs (March 2018). By Lennart Nyman. Tropical coral reefs harbour some 25 per cent of all marine species.



Cost-benefit analysis of NOx control for ships in the Baltic Sea and the North Sea (April 2017). By Katarina Yaramenka, Hulda Winnes, Stefan Åström, Erik Fridell.



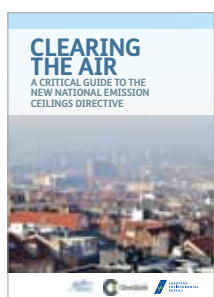
A vision for zero emissions in the Nordic-Baltic region by about 2030 (March 2018). By Fredrik Lundberg. A scenario for the electricity, heat and industrial sectors.



Paths to a sustainable agricultural system (Dec 2017). By Johan Karlsson et al. Exploring ways for sustainably feeding the Nordic countries.



What will it take to phase out greenhouse gas emissions from road traffic in the Nordic-Baltic region by 2030-2035? (March 2018). By Mats-Ola Larsson. A conceivable scenario.



Clearing the air (Feb 2017). A critical guide to the new National Emissions Ceilings directive.



Ecological effects of ocean acidification (March 2018). By Lennart Nyman. By absorbing CO₂ the ocean is becoming more acidic, and this happens at a rate faster than any period in the past 300 million years.



Phasing out coal in Europe by 2025 (Feb 2019). By Fredrik Lundberg. An updated list of coal power stations throughout Europe and a proposal of phasing out coal by 2025.

Coming events

UNFCCC COP25. Madrid, Spain. 2 - 12 December 2019. Information: <http://unfccc.int/>

CLRTAP Executive Body. Geneva, Switzerland, 9 - 13 December 2019. Information: www.unece.org/env/lrtap/welcome.html

EU Environment Council. 19 December 2019. Information: www.consilium.europa.eu/en/press/calendar/

IMO PPR 7 (Sub-Committee on Pollution Prevention and Response). London, UK, 17 - 21 February 2020. Information: www.imo.org

12th International Conference on Air Quality – Science and Application. Thessaloniki, Greece, 9 - 13 March 2020. Information: <https://www.herts.ac.uk/airqualityconference>

IMO Intersessional Working Group on reduction of GHG emissions from ships. London, UK, 23 - 27 March 2020. Information: www.imo.org

IMO MEPC 75 (Marine Environment Protection Committee). London, UK, 30 March - 3 April 2020. Information: www.imo.org

Rethinking transport: Towards clean and inclusive mobility. Helsinki, Finland, 27 - 30 April 2020. Information: <https://traconference.eu>

8th Global Nitrogen Conference. Berlin, Germany, 3 - 7 May 2020. Information: <https://ini2020.com>

CLRTAP Working Group on Strategies and Review. Geneva, Switzerland, 26 - 29 May 2020. Information: www.unece.org/env/lrtap/welcome.html

7th International Conference on Energy, Sustainability and Climate Change (ESCC 2020). Skiathos Island, Greece, 1 - 3 June 2020. Information: <http://esc.uth.gr/submission-info/>

CLRTAP EMEP Steering Body and the Working Group on Effects. Geneva, Switzerland, 14 - 18 September 2020. Information: www.unece.org/env/lrtap/welcome.html

IMO MEPC 76 (Marine Environment Protection Committee). London, UK, 19 - 23 October 2020. Information: www.imo.org

UNFCCC COP26. Glasgow, UK. 9 - 19 November 2020. Information: <http://unfccc.int/>

CLRTAP Executive Body. Geneva, Switzerland, 14 - 18 December 2020. Information: www.unece.org/env/lrtap/welcome.html

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