NO. 4, DECEMBER 2016

Acid News

End derogations for polluting coal plants

Effective regulation of air pollutant emissions from coal-fired power plants could prevent 20,000 premature deaths every year.

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A Europe powered only with renewable energy

This vision was launched in 1992 from within the world-leading power equipment company ABB.

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Climate target for agriculture

A new study proposes that the agricultural sector needs to reduce emissions by 1 billion tonnes of CO_2e per year by 2030 to contribute to the 2°C target.

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Air pollution costs trillions

Premature deaths due to air pollution cause annual global costs of about US$225 billion in lost work days, and more than US$5 trillion in welfare losses, according to a new study.

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Germany must still eliminate 145 Mt of annual greenhouse gas emissions to achieve its 2020 climate target, 16 per cent below current levels.

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Unique opportunity for Ukraine

The changed geopolitical situation in Ukraine has led to an energy crisis, and the country is now at a crossroads: sticking with coal and nuclear power or investing in renewables?

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IMO confirms 2020 date

Implementing the global rule to restrict the sulphur content in marine fuel oil to 0.5 per cent will cut shipping SO_2 emissions by nearly 80 per cent and prevent more than 100,000 annual premature deaths.

A decision to introduce a global 0.5 per cent cap on the content of sulphur in marine fuel by 2020 was originally agreed by the United Nations International Maritime Organization (IMO) back in 2008. At the same time, it was also agreed that a review should be undertaken by 2018 in order to assess whether sufficient compliant fuel oil would be available to meet the 2020 date. If not, the date might be deferred to 2025. That review was completed this summer, and concluded that sufficient compliant fuel oil would be available to meet the fuel oil requirements by 1 January 2020.

The IMO's fuel oil availability assessment study[1] was submitted to its Marine Environment Protection Committee (MEPC), and discussed at its 70th session held in London on 24–28 October.

The current global sulphur limit for marine heavy fuel oil (HFO) is set at 3.5

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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:

Air Pollution & Climate Secretariat
Första Långgatan 18, 413 28 Göteborg, Sweden
Tel: +46 31 711 45 15
Fax: +46 31 711 46 20
E-mail: *info@airclim.org*
Internet: *www.airclim.org*

Editor: Kajsa Pira
Assistant editors: Christer Ågren, Reinhold Pape & Malin Larsson

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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 lobbying 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

It is now finally settled that the global cap of 0.5 per cent for the sulphur content of the fuel oil used by ships will apply from 1 January 2020. This is a significant reduction from the current cap of 3.5 per cent and it will cut shipping SO_2 emissions by nearly 80 per cent, or around 9 million tonnes per year, and prevent more than 100,000 annual premature deaths.

Discussions about restricting air pollution from international shipping started towards the end of the eighties within the International Maritime Organization (IMO), a UN body, and agreement was reached in 1997 on an air pollution annex to its MARPOL Convention. Unfortunately, this turned out to be a very feeble document with very timid requirements.

"global sulphur cap now coming into force in 2020"

After several more years of talks but very little action, the IMO in 2008 finally agreed and unanimously adopted sulphur standards that would significantly reduce the well-documented adverse health and environmental impacts of shipping. However, a main drawback was that the new global 0.5 per cent sulphur cap was to be implemented only 12 years later, by 2020. Moreover, due to industry pressure, it was stated that the 2020 implementation date could be postponed, subject to availability of compliant fuel.

Usually industry favours international agreements, especially when it comes to sectors of a global nature, such as shipping and aviation. This is due partly to a perceived need for harmonisation, but also because it normally takes decades to settle such agreements and the standards arrived at are often set at very low levels of ambition.

With the stricter global sulphur cap now coming into force in 2020 – more than 30 years after the issue was first raised in the IMO – it is hoped that both shipping and the oil industry will embrace the IMO standards and focus their attention on establishing effective systems for compliance monitoring and enforcement.

The nature of shipping as an international business has been used as an excuse or manoeuvre to delay environmental action for much too long and it is not acceptable for the shipping industry to keep on transferring the cost of its pollution to society at large.

It must not be forgotten that the measures agreed so far in IMO for reducing emissions of nitrogen oxides (NOx) are totally inadequate and will not result in any significant reductions in total ship NOx emissions even within the next 10–15 years. Every effort must therefore be made to markedly strengthen the weak NOx emission standards, and to make them applicable to both existing and new ships.

To ensure an organised gradual phase-in of lower-sulphur fuels, to encourage the use of the best environmental techniques, and to speed up the introduction of clean and renewable fuels, the IMO standards should be complemented by economic instruments, such as emission charges.

In addition, the EU and its member states should follow the example of the United States and Canada and designate all sea areas around Europe as "full" Emission Control Areas, i.e. covering all the major air pollutants (sulphur, particulate matter and nitrogen oxides).

Shipping is also a growing source of greenhouse gases, but there is so far no agreement on capping the industry's CO_2 emissions. An IMO meeting in October agreed only to monitor ship CO_2 emissions, and to delay until at least 2023 any agreement on a CO_2 reduction target. A proposed review of ship energy efficiency targets was also delayed.

It should be obvious that the longer the shipping industry delays climate measures, the steeper the emission cuts will have to be to keep within the world's rapidly shrinking carbon budget.

Christer Ågren

End derogations for polluting coal plants

Effective regulation of air pollutant emissions from coal-fired power plants could prevent 20,000 premature deaths every year.

Establishing and enforcing air pollution standards that are in line with the best available techniques, could reduce the annual number of premature deaths in the EU caused by emissions from coal-fired power plants from 22,900 to 2,600, according to a new study by a coalition of environmental groups.

The report was published in October, ahead of an EU technical committee meeting on the final draft of the large combustion plant (LCP) BREF document. The report called on the Commission and member states to remove derogations and other loopholes from the draft BREF document.

According to the authors of the report, current legislation is failing to deliver its intended health benefits because special exceptions have been granted that allow for emissions that are higher than the agreed minimum requirements of the Industrial Emissions Directive (IED). Currently more than half of the coal power plants in the EU have been granted permissions to pollute beyond the limits set in the IED, with serious implications for public health and the environment. The pollution from these plants alone was responsible for 13,700 premature deaths in 2013, which represented 60 per cent of all coal-related deaths in the EU, the report said.

Through the revision of the LCP BREF document, the EU and member states now have an opportunity to adopt improved environmental performance standards. By agreeing stricter standards and implementing effective emission limits on coal pollution, real progress can be made in improving the health of people across Europe.

The report also called on the Commission and member states to review the directive's minimum binding emission limit values, and update them to reflect the levels set in the revised LCP BREF. Emission limits and monitoring requirements should reflect what is now technically possible to ensure that EU legislation serves as a driver towards improved environmental performance across the EU.

"The best available techniques we call for in this report are all tried-and-tested and were already being demonstrated under technically and economically viable conditions decades ago. The EU considers itself a world leader on environmental issues but when it comes to coal combustion, decision makers have their heads stuck in a dark cloud!", says Christian Schaible, Policy Manager on industrial production at the European Environmental Bureau (EEB).

Medical professionals have expressed support for the report; "Air pollution kills," says Professor Bert Brunekreef of the European Respiratory Society. "Experts in lung health want to see immediate remedial action. Inaction cannot be justified when it is human health and lives that are at stake."

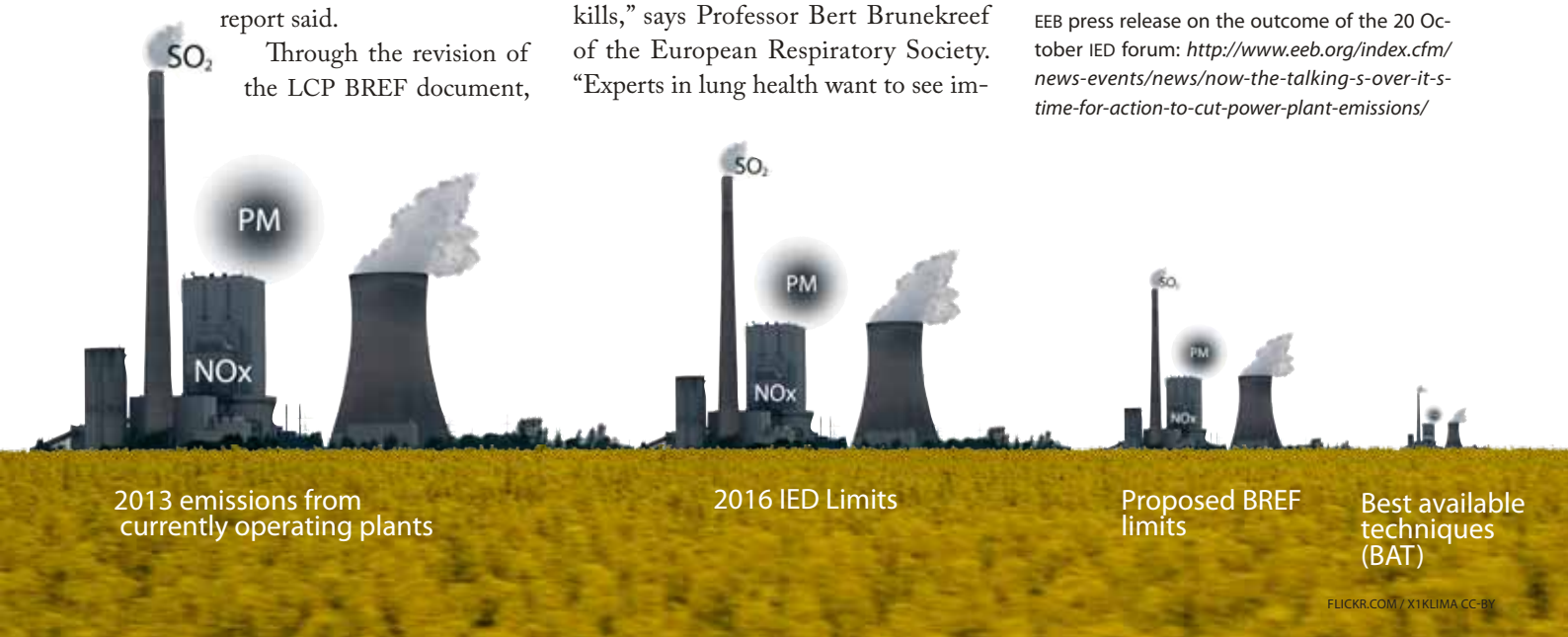
As there are no techniques that completely eliminate emissions from the burning of coal and with coal power plants responsible for 18 per cent of the EU's greenhouse gas emissions, the authors of the report conclude that truly lifting Europe's Dark Cloud will require the complete phase-out of coal power.

"The health of European citizens cannot afford any further delay in enforcing new pollution standards. While the EU's ultimate goal should be to commit to the complete phase-out of coal and to a transformation pathway to renewable energy and reduced energy consumption, the EU still needs to limit pollution from coal power plants with its deadly and costly impacts on people, health and the environment," said Joanna Flisowska, Coal Policy Coordinator at CAN Europe.

Christer Ågren

The report "Lifting Europe's Dark Cloud: How cutting coal saves lives" was produced jointly by the European Environmental Bureau (EEB), the Health and Environment Alliance (HEAL), Climate Action Network (CAN) Europe, WWF and Sandbag, and can be downloaded from: *https://drive.google.com/drive/folders/0B9LWbY1olzldSFF6TW1MZjBTUms*

EEB press release on the outcome of the 20 October IED forum: *http://www.eeb.org/index.cfm/news-events/news/now-the-talking-s-over-it-s-time-for-action-to-cut-power-plant-emissions/*



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IMO confirms 2020 date

Continued from front page

per cent, which is 3,500 times higher than the limit for fuel used in cars and trucks in the EU. As a result, shipping is one of the world's biggest emitters of sulphur dioxide (SO_2), an air pollutant that causes premature deaths from lung cancer and heart and respiratory diseases as well as acidification of sensitive natural ecosystems.

According to the third IMO greenhouse gas study from July 2014, annual emissions of SO_2 from international shipping amount to approximately 10.6 million tonnes, or approximately 12 per cent of global SO_2 emissions from anthropogenic sources. Moreover, international shipping emits some 18.6 million tonnes of nitrogen oxides (NOx), equal to 13 per cent of global anthropogenic NOx emissions.

Although the maximum allowed sulphur content is set at 3.5 per cent, the IMO's sulphur monitoring scheme shows that global average sulphur content for marine HFO over the last few years has actually been around 2.5 per cent. This means that in practice the new 0.5 per cent limit will cut SO_2 emissions from ships running on HFO by about 80 per cent.

The effects of introducing the 0.5 per cent sulphur cap in 2020 rather than delaying it to 2025 were analysed by a group of scientists from the United States and Finland and presented in another report[2] submitted to the MEPC. Some of the key findings of this study were that:

- Annual SO_2 emissions will be cut by 8.5–9 million tonnes between 2020 and 2025, approximately a 77 per cent reduction in overall global SO_2 emissions from international shipping.
- Emissions of primary particulate matter (PM) will come down by 0.76–0.81 million tonnes per year, which equals a 50 per cent reduction.
- The lowered emissions will lead to significant reductions in exposure to harmful air pollutants, especially in populated coastal areas, preventing more than 100,000 premature deaths per year. It is estimated that over the five-year period a total of 570,000 premature deaths will be avoided.
- More than 90 per cent of these health benefits will take place in the Asia-Pacific region, Africa and Latin America. (Because the sea areas around Europe and North America already have stricter fuel sulphur standards, they will receive only relatively small additional health benefits from the global cap.)

The decision by the IMO to confirm 2020 as the implementation date for the 0.5 per cent global sulphur cap was taken by consensus, but it was certainly not uncontroversial. For example, oil industry associations led by IPIECA and shipping companies represented by BIMCO had sponsored the production of a separate fuel availability study, which was also submitted to the MEPC.

The official IMO report analysed three different demand scenarios – a base case as well as a low (-12%) and a high (+14%) demand case – and found that in all scenarios the refinery sector will be able to supply sufficient quantities of low-sulphur fuel from 2020 to meet the demand. On the other hand, while the report sponsored by industry acknowledged that the refining industry could meet the fuel volumes needed by 2020, it also stated that sticking to 2020 would "lead to severe strains on global oil markets" and concluded that "a full-on switch to the global sulphur standard in January 2020 does not look workable."

Apart from the very significant health and environmental benefits of the sulphur emission reductions, the fact that in 2012 the European Union had already established a 0.5 per cent sulphur limit

IMO sulphur regulation

IMO regulations governing sulphur emissions from ships are included in Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL Convention). Under the new global cap, from 1 January 2020 ships will have to use fuel oil on board with a sulphur content of no more than 0.5 per cent, as compared to the current limit of 3.5 per cent that has been in effect since 1 January 2012. Fuel oil used on board includes use in main and auxiliary engines and boilers.

Ships can meet the requirement by using lower-sulphur compliant fuel oil or other types of fuel, such as liquefied natural gas (LNG) or methanol. Alternatively, ships can meet the sulphur emission requirements by using approved exhaust gas cleaning systems (scrubbers), which remove the sulphur emissions before they are released into the atmosphere. The new global 0.5 per cent cap will not change the 0.1 per cent sulphur limit that has applied since 1 January 2015 in Sulphur Emission Control Areas (SECA) established by the IMO.

to apply from 2020 in its territorial seas, exclusive economic zones and pollution control zones is likely to have had quite some impact on the outcome of the debate. This encouraged EU countries to also argue in favour of 2020 as the implementation date for the global cap, and they were supported by among others the United States and Japan.

Commenting on the outcome, Bill Hemmings, shipping director at Transport & Environment, said: "This is a landmark decision and we are very pleased that the world has bitten the bullet and is now tackling poisonous sulphuric fuel in 2020. This decision reduces the contribution of shipping to the world's air pollution impact from about 5 per cent down to 1.5 per cent and will save millions of lives in the coming decades. Now the focus should shift towards implementing this decision, which is a big issue since it's not yet clear who should police ships on the high seas, and how."

IMO Secretary-General Kitack Lim also welcomed the decision. "The reductions in SO_2 emissions resulting from the lower global sulphur cap are expected to have a significant beneficial impact on the environment and on human health, particularly that of people living in port cities and coastal communities, beyond the existing emission control areas," Mr. Lim said.

Further work to ensure effective implementation of the 2020 global sulphur cap will continue in the IMO's Sub-Committee on Pollution Prevention and Response (PPR), which has it next meeting in January 2017.

Christer Ågren

[1] IMO Document MEPC 70/INF.6 "Assessment of fuel oil availability – final report" (July 2016).

[2] IMO Document MEPC 70/INF.34 "Study on the effects of the entry into force of the global 0.5% fuel oil sulphur content limit on human health" (August 2016).

T&E press release: *https://www.transportenvironment.org/press/eu-action-shipping-emissions-needed-say-meps-and-ngo-after-imo-agrees-yet-more-talks*

IMO briefing: *http://www.imo.org/en/MediaCentre/PressBriefings/Pages/MEPC-70-2020sulphur.aspx*

Stricter NOx standards for ships

In late October, the International Maritime Organization (IMO) accepted proposals to designate the Baltic Sea and the North Sea as NOx Emission Control Areas (NECA). After final confirmation at the next meeting of the IMO's Marine Environment Protection Committee in May 2017, these two sea areas will create a large joint NECA, in which the stricter Tier III NOx emission standard will apply to new ships built in or after 2021.

A recent computer modelling analysis estimated that the reduction in total nitrogen input to the Baltic Sea area will be 22,000 tons per year as a combined effect of the Baltic Sea and North Sea NECA and compared to a non-NECA scenario. However, a lengthy period (25–30 years) of fleet renewal is needed before the regulation will show full effect.

Source: HELCOM press release, 28 October 2016 (*www.helcom.fi*)

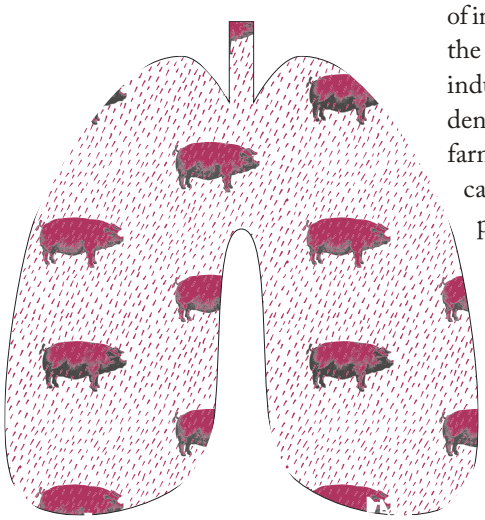
Air pollution risk in dense farming areas

A new study from the Netherlands shows that the air in heavily agricultural areas can be as risky to breathe as in traffic-choked cities. The research was released as a part of the Healthy Lungs for Life campaign and was presented at the European Respiratory Society's International Congress in London in September.

The Dutch study is one of the first to use physical health tests to measure the health effect on residents due to living in close proximity to livestock holdings. As many as 2,500 adults participated in the research. They were all living in rural areas in the Netherlands and it was shown that those living within one kilometre of 15 or more farms had five per cent lower lung function. Five per cent may not sound much, but the results are very significant, especially for those who already have reduced lung function.

The research also found that the lung function of the test participants got worse if the concentration of ammonia in the air was higher. This effect was seen in both healthy adults and those with existing respiratory conditions.

It has already been proven, in many previous studies, that agriculture is one of the major culprits regarding air pollution, and ammonia from animals is one of the main contributors. According to the researchers the effects of air pollution in rural areas are as harmful as in urban areas. It is therefore equally important that policy makers work harder to combat both agricultural emissions and urban air pollution. The researchers also highlight the importance of much better monitoring of intensive farming and the need to apply the same strict pollution laws as in other industries. Some countries have more densely populated areas near livestock farming than others, but air pollution caused by ammonia is a large-scale problem that affects everyone.



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Source : European Lung Foundation press release, 20 September 2016 (*www.europeanlung.org*)

A Europe powered only with renewable energy

This vision was launched in 1992 from within the world-leading power equipment company ABB.

Europe can be powered by wind (mainly offshore) and by solar power (mainly as concentrating solar power) in North Africa and southern Europe. That was the futuristic vision of Gunnar Asplund in 1992, as shown in the map.

Gunnar Asplund

"It was not popular within ABB," says Asplund in 2016.

Swedish Asea merged in 1988 with Swiss Brown Boveri to create ABB. At the time, ABB tried to market nuclear reactors of Swedish origin (eventually without success) and increased its nuclear power activities by the acquisition of US Combustion Engineering. ABB also developed PFBC coal and lignite plants at the time, but had no real stake in wind and solar.

By the year 2000, ABB would divest all power plant construction. But that was eight years ahead.

The idea of a gigantic grid and big centralised solar plants and big offshore wind power plants was also controversial in the NGO community. "Small is beautiful" had a strong resonance. ABB reached out to garner support from Swedish NGOs, but with no real success.

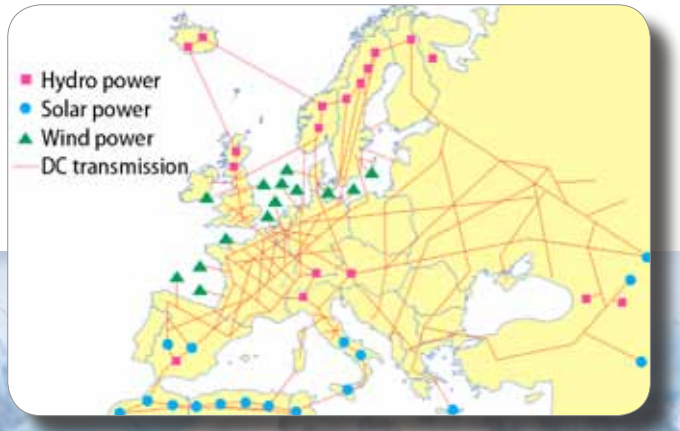
Asplund's idea was that most of the cost for electricity is for generation, and that transport of the power even for very long distances, need not add more than 25 per cent. Power should be produced where conditions are the best: most wind power offshore or at the coast, solar where the sun shines most, and all connected by many, long power lines.

Storage was to be supplied by existing hydropower in Norway, Sweden, Iceland and continental Europe.

It took some nerve to claim by 1992 that wind and solar power could be the future, even in a 100-year perspective. All the wind power in the world produced less than 5 TWh in 1992, solar only 0.5 TWh, adding up to the equivalent of a single nuclear reactor. Offshore wind was nowhere in 1992 and was of no significance until the 2010s. Nuclear power produced 2,100 TWh, and was still on the increase. So was fossil power almost everywhere in the world.

The 1992 vision is still controversial, but nobody doubts that wind and solar have a bright future.

The belief in renewables went hand-in-glove with the emergent technology that Asplund led at ABB Ludvika: HVDC light, the slimmer version of the high-voltage direct current cable.



Right: The scenario from 1992., with 700 GW from solar, 300 GW from wind and 200 GW from hydro.

Vision 1992, actual results 2015

Share of renewables. In 2015, the 28 nations that are now the EU member states (EU-28) produced 29 per cent of their electricity from renewables. This is far from 100 per cent, but a big improvement on the 15 per cent in 1992. Renewable electricity in 1992 was almost exclusively hydro. Hydro production has not changed much and totalled 337 TWh in 2015. The "other" renewables (than hydro) have grown from 21 TWh in 1992 to 601 TWh in 2015. Most of this increase took place after 2008.

Which renewables? Wind and solar have developed roughly as in the scenario. Biomass, not in the scenario, is of some importance, and produced more electricity than solar in Europe in 2015. Biomass, and the so far insignificant tidal and geothermal power are not intermittent and do not need long power lines. Wave power, which was not in the scenario, but would fit well in a super grid, has still not taken off.

Wind. Wind power has, so far, mainly been on land. It is all a part of a centralised grid. Turbines are much larger, more efficient and more reliable than in 1992. The offshore wind parks are even larger, and are connected pretty much according to the 1992 map.

But wind power has mainly grown outside the utilities. Small community ownership of wind parks has however been of importance for acceptance of wind power, at least in Germany.

Solar. In the 1990s and the 2000s the main potential of solar power was often thought to lie in concentrating thermal power (CSP) based on systems of lenses or mirrors. Heat can be stored, so output can match demand and also supply power at night. CSP promised higher efficiency than photovoltaics, at least in environments with few clouds, such as in deserts. But CSP requires large-scale installations and huge investments in one steep step. This essentially did not happen. There are a few big CSP plants in Spain and Morocco, but so far it has been a sideshow to photovoltaics (PV).

Most of the PV capacity is decentralised: rooftop or small ground-level solar farms. Some of the output is used locally so as to reduce the electricity consumption. The distance between producer and user is, in this sense, not long.

The large-scale installation (utility scale) of PV is growing even faster than rooftop solar and is now the top segment in many countries. Even so, the scale is modest compared to nuclear, coal and offshore wind.

Then again: practically all PV is grid-connected, so the millions of panels add up to big effects on national and European grids and markets. Unlike the 1992 map, much solar is in central Europe (Germany and the UK) rather than in the sunnier south.

Cables from Africa. This has not happened, but the idea lived on in the gigantic DESERTEC project, which was essentially abandoned after the disarray following the Arab Spring, the disintegration of Syria and Libya and the rise of the so-called Islamic State. One power line (though AC, not HVDC) between Europe and Africa has been in operation since 1997, between Morocco and Spain, later extended with a second cable, and a third is underway. So far the cables have been mainly used for Spanish exports of power.

Cables from Iceland. Iceland has huge hydro and geothermal resources, which could be used to balance other renewables. The cables are still not there, but a UK-Iceland government task force was set up in October 2015.

Other cables. Lithuania-Sweden went into operation in 2016, and the UK-Norway link is under construction. There are fairly recent interconnections between Norway-Netherlands-UK, Finland-Estonia, UK-France (several), Italy-Greece, and Estonia-Finland-Sweden.

To the casual observer, the map of cables all over Europe looked as if the purpose was to maximise sales of high-voltage cables.

This was indeed not so far-fetched.

"The vision served to motivate our development work," says Asplund frankly.

HVDC Light was first tested in the late 1990s and has since been a success story for ABB, sometimes exactly the way Asplund envisioned.

The technology is indeed impressive. Asplund has a sample in his office, about 12 cm in diameter. Such a cable can conduct 1000 megawatts, the output of a nuclear reactor. HVDC is well suited not only for connecting point A to point B, but also for creating a grid, like a spider's web.

HVDC is used for bringing offshore wind power in the North Sea to the UK and connecting Norway to the Netherlands, Germany and the UK so intermittent power can be balanced by Scandinavian hydro. ABB has also built a 2,000 kilometre 800 kV transmission line in China so hydro in one part of the country can supply power to other parts, and balance wind and solar power, where China leads the world.

So the 1992 concept works, and 100 per cent renewables is possible.

"By 2092 I hope it has looked like that for a long time," says Asplund.

Being an impatient person, he has moved on to another futuristic field: CO_2-free transport.

There are not enough biofuels in most countries. There is a rich resource of renewable electricity, but electric cars are heavy, expensive and take a long time to charge.

His solution: electric highways, where electric cars can run on direct-feed power from the road, and recharge batteries at the same time.

His company Elways ("el" means electricity in Swedish) works with the practical aspects of designing rails and connectors, and has been granted 17 patents and filed for several more. The company has received substantial support from the Swedish Energy Agency.

The cost for the car-owner, for connectors, may be a couple of hundred euros.

"It would be extremely expensive to have all roads in Sweden rebuilt for direct feed. To have it for the big roads, not so expensive," he says.

This second future looks a lot like the first one: an all-electric all-European spider-web.

Fredrik Lundberg

Small is beautiful

"Small is beautiful" was the catchphrase of the alternative energy movement of the 1970s.

Gunnar Boye Olesen of the INFORSE energy network in Denmark still thinks there is a case for building on a human scale.

1974 saw a rising tide of anti-nuclear sentiment in much of the world. The alternative energy movement offered a far-reaching critique not only of nuclear but also of large-scale oil, coal and hydropower.

Gunnar Boye Olesen

More than 40 years later, the alternatives are winning. Wind, solar, and biomass are standard options for new power production. All fossil-based and nuclear options are in crisis.

But what happened to the scale?

AN asked Gunnar Boye Olesen, of the International Network for Sustainable Energy (INFORSE), based in Denmark.

"A standard wind power turbine is now 30 times bigger than it was in the 1990s," he admits and sees no way to turn back.

But, he points out, a wind park in the order of 10 megawatts is still very small compared to conventional coal and nuclear power plants.

A turbine is much too big for one family, but can be the right size for a community or a municipality.

"It can still be a community project and the neighbours should have a say in project design and siting," he says.

Gunnar also doubts there is any economy of scale above tens of megawatts for renewable energy such as wind and solar. There are other reasons why big scale often prevails:

"When a community decides, they go for smaller scale than a municipality, and government decisions tend to favour still bigger scale, often above what is optimal, just because it is a simpler decision," he claims.

Photovoltaics are decentralised by their very nature, but need balancing in countries like Denmark.

Denmark now gets two per cent of its electricity from PV, but very little in the winter, during power use peaks, notes Gunnar.

One move towards the very big scale is very long power lines, for example planned interconnectors between Norway-UK and Denmark-UK.

"There are admittedly many benefits of interconnectors in for example the Nordic grid," he says.

Denmark gets about 40 per cent of its electricity from wind power. That is possible today thanks to balancing provided by Norwegian and Swedish hydro.

"But power lines are not the only solution. We have fought against some such projects. They should not be built without good economic evaluation. They are expensive investments and can take away attention and funding from local solutions," says Gunnar.

The combination of small and big seems to be the optimum, at least for Northern Europe, he adds.

Alternatives to power lines, for balancing, can be more demand-side management, storage of heat, hydrogen, and also batteries if they get cheaper.

What about other renewables?

Combined heat and power for district heating and in industry, fuelled by biomass, is a medium-scale technology.

"But it will have less of a future than was thought earlier, due to cheap electricity from wind and solar."

Geothermal heat (not electricity) is a medium-scale technology that has been developed in Denmark, but which the present government has abandoned. It still has a large potential, to supply 10–30 per cent of Denmark's heating requirements, according to Gunnar.

Solar heat is also of some, even growing, importance in Denmark, in particular for smaller district heating systems, where large thermal storage tanks even make seasonal storage feasible.

As for biomass, it consists of several parts. Biogas, to replace fossil gas for vehicles, heat and power, is often smaller scale, in the order of 100 kW to two MW. Biomass for heat and electricity can be small-, medium- or large-scale.

"Biomass has another problem of scale: Very long distance high-volume trade (such as from USA to UK power plants) should be avoided, but there is nothing wrong with some trade, or even that for example Sweden becomes a net exporter," says Gunnar.

"In a very centralised system, people lose contact, and social networks do not function well. A human scale is needed to ensure public understanding of the energy transition. So decentralisation is an objective in itself, says Gunnar Boye Olesen.

Fredrik Lundberg

"A human scale is needed to ensure public understanding of the energy transition."

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Initiative to boost soil carbon

In Paris an initiative called "4 per 1000" was signed by 25 countries, with the aim to protect and increase carbon stocks in soil and to develop accounting and safeguard criteria.

About one quarter of all human-induced GHG emissions come from agriculture, forestry and other land use (AFOLU), mainly from land use change, fertiliser use, livestock and peatland degradation. Regeneration International reports that a new initiative called "4 per 1000"[1], aims to protect and increase carbon stocks in soil. The initiative, signed in Paris in 2015 by 25 countries including France, Germany, the UK, Mexico and Australia, as well as 75 research and NGO partners, is aimed at combatting climate change by recognising the ability of soil to act as a sink for greenhouse-gas emissions. The "4 per 1000," which refers to a voluntary pledge of a 0.4 per cent annual growth rate in soil carbon content, "is a game-changer", says Andre Leu from the International Federation of Organic Agriculture Movements (IFOAM)[2]. "This is revolutionary, since carbon sequestration in soils is now central to how the world tackles climate change. It is one of the most exciting pieces of news to come out of the Paris climate conference, COP21. With this initiative the French government has recognised the work done by researchers and farmers to demonstrate the ability of regenerative agriculture to restore the natural ability of soil to store carbon."

Carbon is an important component of soil, representing 58 per cent of organic matter. Through photosynthesis, a plant draws down atmospheric carbon to form carbon compounds, or sugars. Some of this is exuded through the roots to feed soil microorganisms. But when soil is exposed to the air, through tillage or the absence of plant cover, the carbon oxidizes to form CO_2. The world's cultivated soils have lost between 50 and 70 per cent of their original carbon stores, according to scientists.

The French-led plan promotes practices, adapted to local conditions, that shift agricultural soil from a carbon source to a carbon sink. Since soil carbon is central to soil fertility and water-holding capacity, CO_2 emissions may be curbed while enhancing food security as the world population rises toward an expected 9.5 billion in 2050. Practices to build soil carbon include agroecology, agroforestry, conservation agriculture and landscape management. Placing an emphasis on the accumulation of soil carbon will inevitably call attention to the climate implications of the use of nitrogen fertilisers and other industrial agriculture practices that tend to reduce soil carbon reserves.

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Cultivated soils have lost 50–70 per cent of their original carbon stores.

According to Climate Action Network (CAN), the potential for both reducing emissions and increasing removals in the AFOLU sector is large, although it must be ensured that AFOLU mitigation does not compromise adaptation, food security or other social and environmental safeguards. Several key points are crucial for CAN for the discussions on accounting rules[3]:

- "It is vital that all countries account for emissions and removals from AFOLU in a comparable and transparent way as part of their national climate plans.
- The Climate Convention employs a land-based system of reporting and this should be used in the new Paris agreement and should also be applied to accounting, based on the methodologies provided in the 2006 IPCC Guidelines.
- Parties with economy-wide plans, including absolute emission reduction targets, should comprehensively account for "what the atmosphere sees" in terms of emissions and removals, when they occur.
- Parties with plans that do not contain economy-wide absolute targets should explain why other emissions and removals are excluded and commit to overcome the deficit through capacity building on comprehensive AFOLU accounting.
- The base year or period used for reporting and accounting for AFOLU should be consistent with a Party's overall plan to facilitate comparability, i.e., baseline periods should be the same for the AFOLU sector as for other sectors and be historical rather than projected. Furthermore, the AFOLU base year or period should be measured using agreed methodologies to estimate the emissions, removals, and stocks of the sector. It may be advisable to use a base period rather than a base year."

Compiled by Reinhold Pape

[1] *http://4p1000.org/understand*

[2] *http://www.ifoam.bio/en/news/2015/12/15/what-we-say-paris-climate-agreement*

[3] *http://www.climatenetwork.org/sites/default/files/marrakech_galvanizing_ambition_october_2016.pdf*

Agriculture a major cause of air pollution

Food cultivation is the dominant source of fine particulate matter ($PM_{2.5}$) in ambient air in Europe, the central US and parts of China, according to a new study from the Earth Institute at Columbia University.

Agricultural air pollution comes mainly in the form of ammonia (NH_3), which enters the air as a gas from heavily fertilized fields and livestock waste. It blows in over cities, reacts with emissions of oxides of nitrogen (NOx) and sulphur (SO_2) from traffic and industry, and leads to the formation of so-called secondary particles. The combination of intensive agriculture, traffic and industry is unfortunately quite typical for some of the most populated parts of North America, Europe and Asia, which means that these particles are formed where they can cause a lot of damage.

The researchers used a global model to study the origin of fine particulate matter in different regions of the world. They divided the emission sources into three categories: natural, anthropogenic non-agricultural and agricultural. Agricultural emissions were defined as the change that occurred if all agricultural activities were turned on and off.

In Europe, emission precursors from fertilizers and livestock were responsible for 55 per cent of the anthropogenic $PM_{2.5}$. In the US, agricultural emissions represented around half of the human caused emissions. China shows the highest level of agriculture-related PM in absolute figures, and slightly less than half of the anthropogenic PM pollution. India is the only region in the study where agricultural emissions are less significant for $PM_{2.5}$ levels in ambient air.

Beware of pig-induced particles!

Source: The Earth Institute at Columbia University, 16 May 2016 *http://www.earth.columbia.edu/articles/view/3281*

Geophysical Research Letters, 16 May 2016, "Significant atmospheric aerosol pollution caused by world food cultivation"

Multiple actions needed to reduce food emissions

Reducing consumption of meat, dairy and eggs by three quarters in the EU will lead to reductions of 44 per cent in greenhouse gas emissions from the food sector, but other efforts are also needed to reach a 2-degree target.

In a recently published study, scientists from IVL Swedish Environmental Research Institute have examined six different interventions in the EU food sector using a life cycle assessment approach. Once again extensive changes in diets proved to be the most effective method to reduce environmental impact from food consumption.

The researchers examined two dietary interventions. One where animal proteins (except fish) were reduced by 76 per cent and one where beef consumption was reduced to a quarter and pork by half, while the lost proteins were replaced by protein from poultry.

Reducing all land-based animal proteins showed to be a far more effective way to minimise environmental impact, compared to a shift from beef and pork to chicken meat. In the first scenario per capita greenhouse gas emissions went down by 44 per cent, compared to a mere 13 per cent in the latter. A similar pattern was found for land use, where an overall reduction in animal-based food led to a 33 per cent reduction in land use, compared to a 7 per cent reduction for the poultry diet. The per capita water consumption would also increase by 3 per cent with a shift to chicken, while a low animal protein diet means a decrease of 23 per cent.

The other four interventions in the study deal with food waste. The best results are shown when sharp reductions in waste from retailers and households (-85 per cent) are also assumed to reflect corresponding reductions in food consumption, leading to a 9 per cent reduction in per capita greenhouse gas emissions from the food sector. Changes in waste management showed similar results. If the share of food waste used for biogas production is increased from 10 per cent to 45 per cent and the share of food waste incinerated with energy recovery is increased from 24 per cent to 45 per cent, per capita greenhouse gas emissions from food would decrease by almost 8 per cent.

Annual greenhouse gas emissions below 2 tonnes per capita in 2050 are needed to limit global warming to 2 degrees. A low-meat diet is the only intervention in the study that will lead to per capita greenhouse gas emissions within that budget, that is 1.5 tonnes from food. In that case food would account for 75 per cent of all greenhouse gas emissions. Assuming we would need some of that emission space for other sectors, one may conclude that all types of interventions to reduce emissions from food are desirable.

Kajsa Pira

Environmental Implications of Dynamic Policies on Food Consumption and Waste Handling in the European Union published in Sustainability 8/2016. *http://www.mdpi.com/2071-1050/8/3/282*

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Sharp reductions in food waste and increases in biogas production are two pieces in the puzzle to reduce emissions from food.

Climate target for agriculture

A new study proposes that the agricultural sector needs to reduce emissions by 1 billion tonnes of CO_2e per year by 2030 to contribute to the 2°C target.

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119 states have included mitigation of agricultural emissions in their Intended Nationally Determined Contributions (INDCs) submitted to the UNFCCC. However, little is known about how these reductions will be accomplished.

Scientists from the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) and the International Institute for Applied Systems Analysis (IIASA) used three different integrated assessment models to find that agriculture must reduce non-CO_2 emissions by 0.92–1.37 $GtCO_2e$ a year by 2030. This is what is needed in order to contribute to a "likely" (66%) chance of staying within the 2°C warming limit. It was suggested that 1 $GtCO_2e$ may be an appropriate preliminary target. This is approximately 4–5 per cent of the 26 $GtCO_2e$ reductions a year needed across all sectors to achieve the 2°C target.

The researchers also found that established methods fall short of reaching this goal. Technical improvements in livestock management, cropland management and rice-paddy management can contribute to reductions of up to 0.40 $GtCO_2e$ annually in 2030. While structural transformations, such as transforming extensive rangeland systems to more efficient livestock systems, can reduce emissions by 0.21 $GtCO_2e$ annually in 2030.

"This research is a reality check," commented Lini Wollenberg, leader of the CCAFS Low Emissions Development research programme, who led the study. "Countries want to take action on agriculture, but the options currently on offer won't make the dent in emissions needed to meet the global targets agreed to in Paris. We need a much bigger menu of technical and policy solutions, with major investment to bring them to scale."

The study discusses several options for how this gap could be bridged. Many high-tech solutions they believe will take too long to introduce, especially in developing countries. A more feasible way forward would be to introduce new breeds of cattle that emit less methane, together with wheat and corn varieties that inhibit production of nitrous oxide, since this would not require extensive changes in management.

The researchers also highlight the need for additional targets for agricultural emissions. In the absence of models they suggest some aspirational targets based on what is assumed to be achievable globally at low costs by 2030:

- Soil carbon sequestration could roughly mitigate emissions by 1.2 $GtCO_2e$, using a carbon price of US$ 20 per tonne;
- reducing land-use change due to clearing for agriculture could reduce emissions by 1.71–4.31 $GtCO_2e$ using the same carbon price;
- decreasing food loss and waste by 15per cent, could lead to emission reductions of 0.79–2.00 $GtCO_2e$;
- and shifting dietary patterns to WHO recommendations or in response to increased carbon prices would mitigate 0.31–1.37 $GtCO_2e$.

These estimates add up to a more comprehensive goal for agriculture-related emissions in the order of 5–9 $GtCO_2e$ a year, which corresponds to about 19–35 per cent of all mitigation efforts needed across all sectors.

The researchers highlight the importance of developing this approach to match top-down sectorial mitigation demands with the bottom-up mitigation potentials and the corresponding policies at a global scale. In their final conclusions they write "without the guidance of 2°C-based goal in agriculture, much effort will be driven by what is technically or politically feasible, rather than by what is necessary".

Kajsa Pira

IIASA ress release, 17 May 2016 *http://www.iiasa.ac.at/web/home/about/news/160517-ag-climate.html*

"Reducing emissions from agriculture to meet the 2°C target", Global Change Biology *http://onlinelibrary.wiley.com/doi/10.1111/gcb.13340/abstract;jsessionid=A1C26EE06292BA805A865213E862492A.f02t03*

Legal challenges over air quality in EU cities

Brussels has become the latest European region to face a legal challenge on its obligations under the EU air quality directive. Client Earth has filed a case against the Brussels regional government, calling on the city authority to produce a plan to bring levels of nitrogen dioxide down to legal limits as soon as possible, claiming that citizens have been exposed to illegal levels since 2010. This new case adds to legal actions in the UK and Germany. Cases have also recently been launched in Brno and Prague in the Czech Republic.

In September in Germany, the Administrative Court of North-Rhine Westphalia ordered authorities not to wait for the federal government to act, but to introduce by January 2018 a diesel ban in Düsseldorf to tackle ongoing illegal levels of air pollutants. The case was filed by Client Earth with German partner DUH, and more results from Germany are expected in the coming months.

Source: Ends Europe Daily, 21 September 2016.

UK government fails to tackle air pollution

The measures announced by the UK government to tackle air pollution still don't comply with EU air quality legislation and will not meet nitrogen dioxide limits in time, the country's High Court ruled on 2 November. This is the second time in 18 months that the UK government has lost in court on the issue, as green group Client Earth defeated the government on the same issue at the Supreme Court in April last year. Ministers were then ordered to draw up a new action plan, but now that new plan has also been found to be illegal.

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Client Earth air quality lawyer Alan Andrews said: "We hope the new Government will finally get on with preparing a credible plan to resolve this issue once and for all. We need a national network of clean air zones to be in place by 2018 in cities across the UK, not just in a handful of cities. Future projections of compliance need to be based on what is really coming out of the exhausts of diesel cars when driving on the road, not just the results of discredited laboratory tests."

Client Earth press release, 2 November 2016 (www.clientearth.org)

WHO: Air pollution rising in cities

More than 80 per cent of people living in urban areas that monitor air pollution are exposed to levels that exceed the World Health Organization (WHO) guidelines. All regions of the world are affected, but people in low-income cities suffer the worst effects. Some 98 per cent of cities in low- and middle-income countries with more than 100,000 inhabitants do not meet the WHO air quality guidelines. In high-income countries, that figure decreases to 56 per cent of cities.

These figures come from the WHO's recent update of its global urban ambient air pollution database. Data from a total of 795 cities in 67 countries was compared for levels of small and fine particulate matter (PM_{10} and $PM_{2.5}$) between 2008 and 2013. Over these six years, global urban air pollution levels increased by eight per cent, despite improvements in some regions.

PM_{10} and $PM_{2.5}$ include pollutants such as sulphates, nitrates and black carbon, which penetrate deep into the lungs and into the cardiovascular system, posing the greatest risks to human health.

According to the database, levels of $PM_{2.5}$ are highest in India, which has 16 of the world's 30 most polluted cities. China has improved since 2011 and now has only five cities in the top 30. Nine other countries, including Pakistan and Iran, have one city each in the worst 30.

"It is crucial for city and national governments to make urban air quality a health and development priority," said Dr Carlos Dora, co-ordinator of the WHO's Interventions for Healthy Environments programme. "When air quality improves, health costs from air-pollution-related diseases shrink, worker productivity expands and life expectancy grows."

The WHO database, including a summary, is at: *www.who.int/phe/health_topics/outdoorair/databases/cities/en*

Smog over New Delhi.

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Air pollution costs trillions

Premature deaths due to air pollution cause annual global costs of about US$225 billion in lost work days, and more than US$5 trillion in welfare losses, according to a new study.

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Exposure to air pollution increases the risk of contracting cancers and heart, lung and respiratory diseases. According to the latest available estimates by the World Health Organization (WHO), 5.5 million premature deaths worldwide, or 1 in every 10 deaths, in 2013 were attributable to indoor and outdoor air pollution.

A joint study, entitled "The Cost of Air Pollution: Strengthening the economic case for action", published by the World Bank and the Institute for Health Metrics and Evaluation, has estimated the costs of premature deaths related to air pollution.

Using the WHO estimates of premature mortality attributable to air pollution, the study valued the economic costs following two different approaches: Firstly a welfare-based approach that monetizes the increased fatality risk from air pollution according to individuals' willingness to pay, and secondly an income-based approach that equates the financial cost of premature mortality with the present value of forgone lifetime earnings.

In 2013, the cost to the world's economy of welfare losses due to exposure to ambient and household air pollution amounted to some US$5.11 trillion. In terms of magnitude, welfare losses in South Asia and East Asia and the Pacific were the equivalent of about 7.5 per cent of the regional gross domestic product (GDP), while in Europe and North America they were equal to respectively 5.1 and 2.8 per cent of GDP. At the low end, losses were still equal to 2.2 per cent of GDP in the Middle East and North Africa.

It is pointed out that the full costs of air pollution to society are even greater than is reported in the study. Examples of other costs not included in this report are the costs of illnesses (e.g. hospital care, medication), reduced output of agricultural crops, damage to natural ecosystems and cultural heritage, and lowered economic competitiveness of growing cities.

On top of being a major health risk, air pollution is also a drag on development. By causing illness and premature death, air pollution reduces the quality of life. By causing a loss of productive labour, it also reduces productivity and incomes.

According to the study, annual labour income losses cost the equivalent of 0.83 per cent of the gross domestic product (GDP) in South Asia. In East Asia and the Pacific, where the population is ageing, labour income losses represent 0.25 per cent of GDP, while in Sub-Saharan Africa, where air pollution impairs the earning potential of younger populations, annual labour income losses represent 0.61 per cent of GDP.

"Air pollution is a challenge that threatens basic human welfare, damages natural and physical capital, and constrains economic growth. We hope this study will translate the cost of premature deaths into an economic language that resonates with policy makers so that more resources will be devoted to improving air quality. By supporting healthier cities and investments in cleaner sources of energy, we can reduce dangerous emissions, slow climate change, and most importantly save lives," said Laura Tuck, Vice President for Sustainable Development at the World Bank.

Christer Ågren

The report: *https://openknowledge.worldbank.org/handle/10986/25013*

World Bank press release, 8 September 2016: *http://www.worldbank.org/en/news/press-release/2016/09/08/air-pollution-deaths-cost-global-economy-225-billion*

Germany's slow decarbonisation

Germany must still eliminate 145 Mt of annual greenhouse gas emissions to achieve its 2020 climate target, 16 per cent below current levels.

Germany has made inadequate progress in decarbonising its energy supplies. Renewable technologies are generally only being used to replace outdated nuclear reactors, while coal and lignite power plants continue to impede greenhouse gas reduction strategies. Carbon capture and storage (CCS), encouraged by many EU parliamentarians, has not been realised because of high costs and technological complications. Confirmed geological formations are also not available for storing the billions of tonnes of carbon dioxide that will still be emitted by electrical power generation before final coal phase-out. According to the German government, lignite plants could now continue operation without carbon reduction until 2040.

CO_2-neutral renewable energy has achieved noteworthy levels, exceeding original expectations. Renewable technologies have also become cost-competitive whenever available, but that is not always the case. Only about four per cent of Germany's primary energy requirements are currently being met by solar and wind power, and 12.4 per cent overall when biomass, hydroelectric and geothermal energy are included.

Renewable power generation is expanding faster than transmission line construction, making it difficult for CO_2-neutral electricity from the countryside to reach urban customers. Highly redundant wind and solar capacities often overload transmission networks on windy sunny days, necessitating expensive grid-balancing measures. Renewable electricity surpluses may cause wholesale trading prices at the EEX European Energy Exchange to plummet below €15/MWh, half the break-even price of even the most efficient power generation. Because of renewable energy shortages at other times, however, coal and lignite power plants continue to provide more than 40 per cent of the electricity used in Germany.

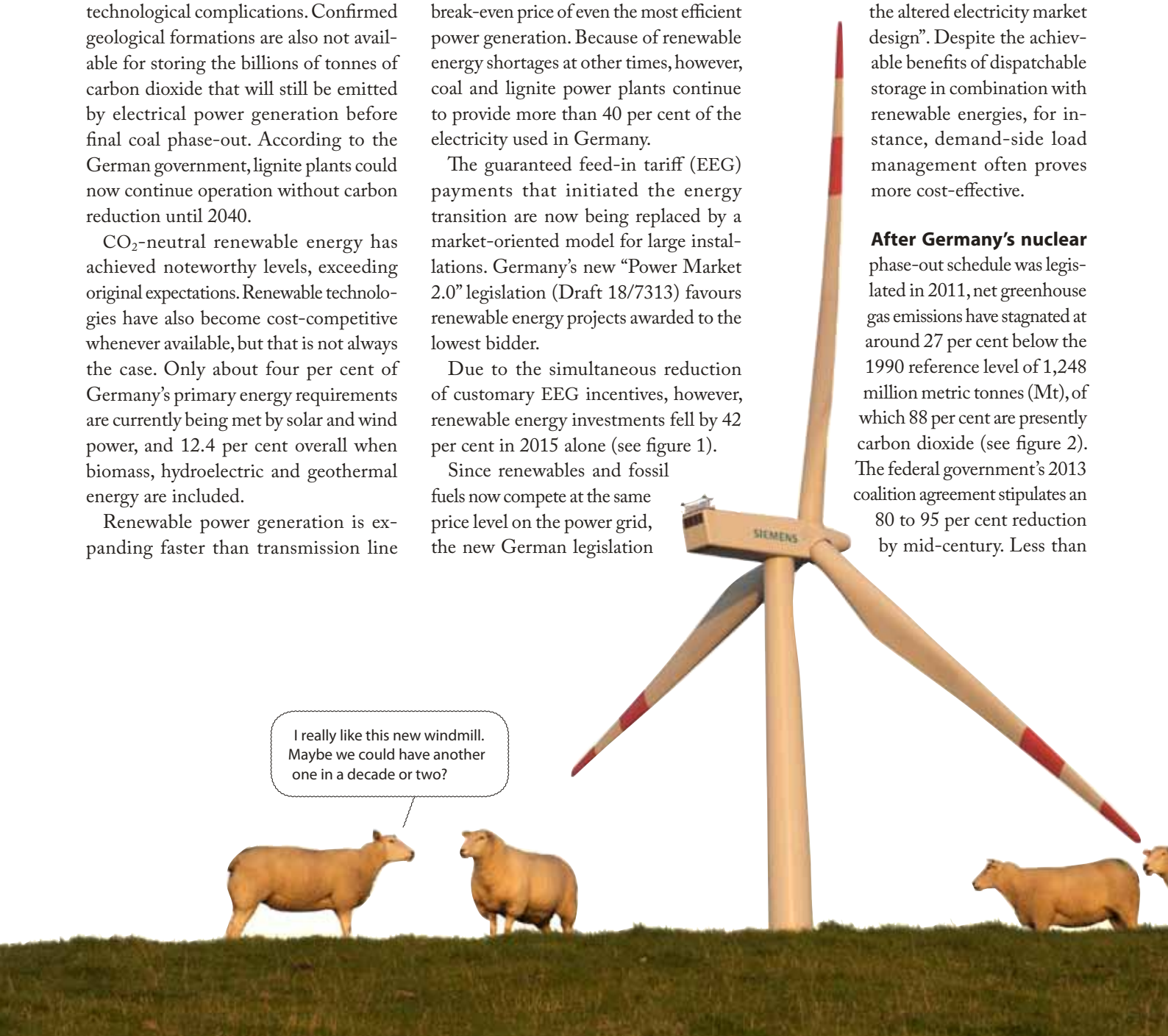
The guaranteed feed-in tariff (EEG) payments that initiated the energy transition are now being replaced by a market-oriented model for large installations. Germany's new "Power Market 2.0" legislation (Draft 18/7313) favours renewable energy projects awarded to the lowest bidder.

Due to the simultaneous reduction of customary EEG incentives, however, renewable energy investments fell by 42 per cent in 2015 alone (see figure 1).

Since renewables and fossil fuels now compete at the same price level on the power grid, the new German legislation treats them indiscriminately. Beginning in July 2017, comprehensive data will be made available on a "national information platform" encompassing electricity generation, load conditions, transmission capacities, and power imported and exported between countries.

Technological impartiality is exemplified by electrical storage as "only one of many flexibility options within the framework of the altered electricity market design". Despite the achievable benefits of dispatchable storage in combination with renewable energies, for instance, demand-side load management often proves more cost-effective.

After Germany's nuclear phase-out schedule was legislated in 2011, net greenhouse gas emissions have stagnated at around 27 per cent below the 1990 reference level of 1,248 million metric tonnes (Mt), of which 88 per cent are presently carbon dioxide (see figure 2). The federal government's 2013 coalition agreement stipulates an 80 to 95 per cent reduction by mid-century. Less than



four years now remain to achieve the 40 per cent interim target set for 2020. The corresponding 159 Mt greenhouse gas elimination figure roughly equals Germany's total lignite power emissions.

The Power Market 2.0 departs from technological neutrality by requiring the standby retirement of eight aging lignite power plants that supply 2.7 GW. Starting in 2016, each installation will assume reserve status for four years before being decommissioned. By the time the final plant has entered standby service in October 2020, annual CO_2 emissions will have been diminished by 10 Mt. The participating operators – RWE (with 5 plants), LEAG (2), and MIBRAG (1) – will collectively receive €230 million annually for seven years to compensate for lost revenues, increasing electricity rates by 0.05 €/kWh. An additional CO_2 reduction of 4 Mt/a will be achieved by expanding co-generation.

Only 5.2 per cent of Germany's transportation was powered by renewable energies in 2015, notably in electrified rail service. Reduced motor fuel prices since 2014 are impeding CO_2 emission reductions in road transportation. Renewable technologies also cover just 13.2 per cent of all heating and cooling demand (see figure 3).

After deducting power plant CO_2 reductions under the new power market legislation, Germany must still eliminate around 145 Mt of annual greenhouse gas emissions to achieve its 2020 climate targets –16 per cent below 2015 levels.

Jeffrey H. Michel

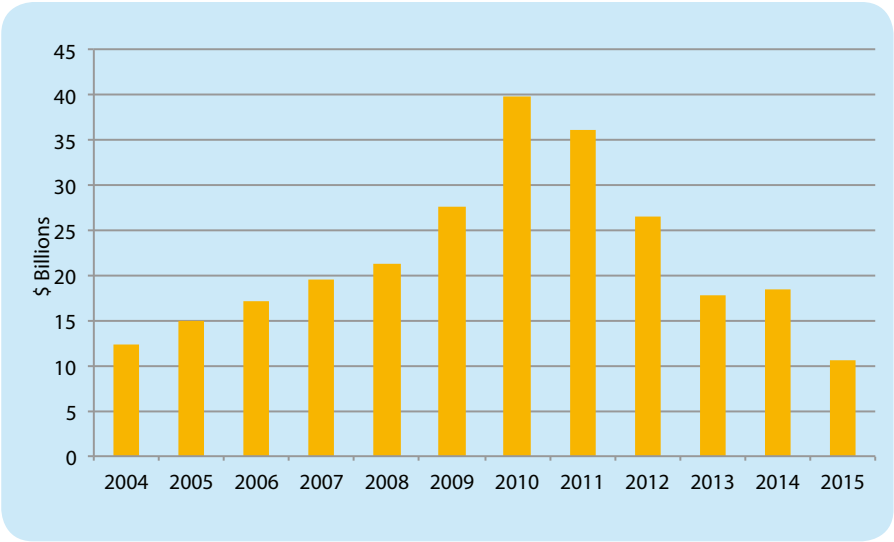


Figure 1. Investments in renewable energy in Germany. Source: Bloomberg.

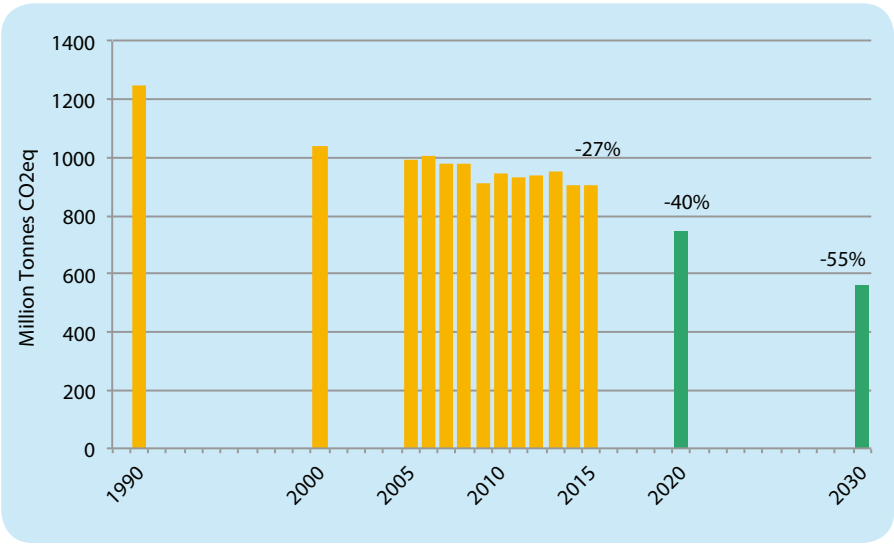


Figure 2. Greenhouse gas emissions in Germany, history and targets.

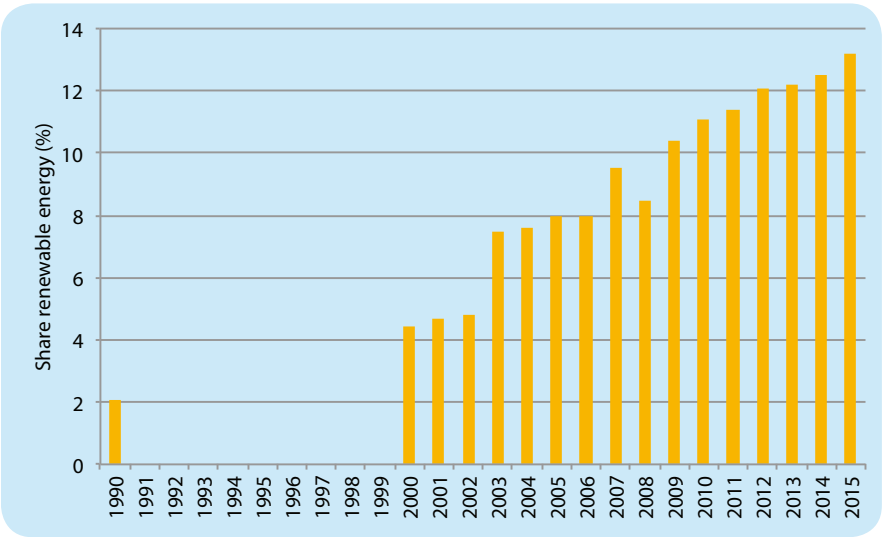


Figure 3. Development of renewable-based heat and cold consumption in Germany. Source: Federal Ministry for Economic Affairs and Energy.

Proposed gas strategy is a gamble with the climate

The EU, Norway and Russia are all promoting fossil gas as a long-term clean and sustainable energy solution. ''There's no such thing as clean gas'', says Friends of the Earth Europe.

The European Parliament voted in October 2016 in favour of a EU strategy to promote LNG and gas storage. The decision, likely influenced by big oil and gas corporations according to FoE Europe, will lock Europe into decades of fossil fuel use, and open the doors to carbon-intensive imports like shale gas – which can be as harmful for the climate as coal. Antoine Simon from FoE Europe said: "There's no such thing as clean gas – it's a fossil fuel with climate-killing carbon and methane emissions. They're playing Russian roulette with the climate, and completely ignoring the implications of the Paris Agreement for our energy sector."

The European Parliament prioritises subsidies for, and investments in, dirty fossil gas, and the infrastructure required for them, to the detriment of renewables and energy efficiency. The emphasis on liquefied natural gas (LNG) encourages further imports of gas to the EU. Antoine Simon continued: "This decision opens the door to carbon-intensive fracked gas, especially from the US, which is linked to devastating local environmental and social impacts. Europe urgently needs to transition away from fossil fuels towards community-owned renewables and energy efficiency."

Norway is also promoting fossil gas. It wants other countries to leave their coal and oil in the ground to meet new global climate change targets, but its industry is planning to increase production of its own fossil fuels, says the British newspaper The Guardian.

The Norwegian oil and gas association argues "if Europe were to replace coal with Norwegian natural gas, this would result in a 50 per cent decrease in greenhouse gas emissions for every unit of energy produced. We produce gas with low emissions, which can replace coal with high emissions." Despite the Paris agreement to cut global emissions and oil prices falling to under $30 a barrel, Europe's biggest oil and gas producer intends to expand production in some of the riskiest and most environmentally sensitive areas like the Lofoten Islands and the Arctic Ocean north of Norway.

"The government is hypocritical and in denial over Paris. It does not think it is any brake on oil. They say our oil is cleaner and that the EU needs us. Meanwhile it is lobbying in Europe against stronger energy efficiency laws. There seem to be no limits on the Norwegian oil industry. They want to keep on expanding," said Silje Lundberg, of Friends of the Earth Norway.

Norway intends to reduce emissions by 30 per cent by 2020 and 40 per cent by 2030. However, it is one of very few wealthy countries to have increased emissions since 1990. State statistics bureau SSB has stated that Norway's oil industry accounted for 27 per cent of all carbon emissions in Norway in 2013. Annual emissions from oil and gas production have increased by 91 per cent since 1990.

Russia and other countries are also promoting the building of new gas pipelines in the north-east and south-east of Europe. Critics like the NGO network Bankwatch and FOE Europe argue EU funding for the Southern Gas Corridor energy project would undermine EU climate change targets. The European Investment Bank (EIB), which is owned by European Union member states, is about to provide the scheme with up to €3 billion.

Natural gas comprises a substantial percentage of human carbon emissions, and this contribution is projected to grow. According to IPCC, fossil gas produced about 5 billion tons a year of CO_2 emissions, while coal and oil produced about 10 billion tons each (2005). According to emission scenarios by 2030, fossil gas would be the source of around 11 billion tons of CO_2 emissions a year.

AirClim argues that all use of fossil fuels including fossil gas must be phased out in Europe by 2030. This should be Europe's contribution to give the world a chance to stay below 1.5°C of global warming while giving developing countries more time to phase out their fossil fuels by 2050 at the latest.

Compiled by Reinhold Pape

Source: FOE Europe press release, 25 October 2016, *https://www.foeeurope.org/winter-package-russian-roulette-climate-251016*

The Guardian, Norwegian industry plans to up fossil fuel production despite Paris pledge, 29 January 2026, *https://www.theguardian.com/environment/2016/jan/29/norwegian-industry-plans-to-up-fossil-fuel-production-despite-paris-pledge*

IPCC AR *https://www.ipcc.ch/report/ar5/*

See also AirClim report from March 2016: Phasing out fossil gas, by Fredrik Lundberg *http://airclim.org/publications/reports*

If I wear a funny hat and call myself "natural" maybe no one will realise that I am fossil?

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Phasing out fossil fuel power is essential

The EU should seize the opportunity to replace ageing and end-of-life coal-fired plants with renewable energy sources.

Significant changes will be needed in the member states' energy-generating mix if the European Union is to meet its goal to cut greenhouse gas (GHG) emissions by 80–95 per cent by 2050, according to a recent European Environment Agency (EEA) report. While the European Union has made progress in improving energy efficiency and using renewable energy sources, a well-planned transition away from carbon-intensive power generation is needed.

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Activists helping out with the much-needed phase-out.

The report "Transforming the EU power sector: avoiding a carbon lock-in" stresses the need for the EU to become more forward-looking when it comes to investing in cleaner energy sources. It calls on the EU to seize the opportunity to decarbonise the energy generating sector, replacing ageing and end-of-life coal-fired plants with renewable energy sources where possible between now and 2030.

It gives a detailed analysis of the energy generating sector, looking specifically at the technical lifetimes of existing fossil fuel capacity, showing that similar lifetimes in the future would be inc ompatible with the EU's climate goals and highlighting that meeting these goals can only be realised if fossil fuel capacity decreases progressively within this decade.

The report calls for an integrated and coherent tracking of progress towards EU climate and energy targets. It also suggests that an increased alignment of energy, climate and environmental policies can maximise benefits and speed up the transition to a secure, sustainable and competitive EU power sector.

"Europe is now generating four times more wind power and 70 times more solar power as in 2005. This is good news, but a clear, forward-looking investment strategy is also necessary across the fossil fuel power sector to meet our long-term challenge to cut CO_2 emissions. Europe is committed to decarbonise its economy so we cannot afford to tie up our investments in emission-intensive technologies. Investing in renewables and energy efficiency provides the best return on our money," said Hans Bruyninckx, EEA Executive Director.

Source: EEA News, 7 Oct 2016

The report: *http://www.eea.europa.eu/publications/transforming-the-eu-power-sector/*

300 million children breathing toxic air

Three hundred million of the world's children live in areas where the levels of toxic air pollution are more than six times the international guidelines set by the World Health Organization (WHO), according to new research by UNICEF. Moreover, almost 90 per cent of the world's children – two billion – live in places where outdoor air pollution exceeds the WHO recommended levels.

"Air pollution is a major contributing factor in the deaths of around 600,000 children under five every year – and it threatens the lives and futures of millions more every day," said UNICEF Executive Director Anthony Lake. "Pollutants don't only harm children's developing lungs – they can actually cross the blood-brain barrier and permanently damage their developing brains – and, thus, their futures. No society can afford to ignore air pollution."

Children are more susceptible than adults to air pollution as their lungs, brains and immune systems are still developing and their respiratory tracts are more permeable. The most disadvantaged, who already tend to have poorer health and inadequate access to health services, are the most vulnerable to the illnesses caused by polluted air.

Source: UNICEF press release, 31 October 2016 (*www.unicef.org*)

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Unique oppurtunity for Ukraine

The changed geopolitical situation in Ukraine has led to an energy crisis, and the country is now at a crossroads: sticking with coal and nuclear power or investing in renewables?

It is transition time in Ukraine. While Sweden is deciding on its green energy mix by 2040 and Switzerland is to hold a referendum on decommissioning of all nuclear units, Ukraine is struggling to step away from the traditional track and move toward a greener future, together with the rest of the world.

All the conditions seem to be perfect for change: the coal crisis that came with the occupation of the Donbas region (the country's main source of "domestic" coal) in Eastern Ukraine undermined secure access to coal and at the same time helped Ukraine to get rid of multi-billion subsidies to the sector; the ageing nuclear power fleet which is dependent on nuclear fuel produced in Russia had mostly reached the end of its design life; struggles to meet demand for natural gas and oil; ageing of all the energy system infrastructure and a need for total reconstruction. There could be no better time to start tackling all these problems with one simple solution – 100 per cent domestic renewable energy sources. This solution would also address other vulnerabilities: economic restructuring and development, employment, and the social and natural environments.

It is difficult to believe, but the Ukrainian energy ministry is acting as if the events of recent years are insignificant – as if there is no problem obtaining nuclear fuel and as if Donbas is still a secure source of coal.

Admittedly attempts have been made to find alternative sources of coal for import (e.g. South Africa), to find other sources of nuclear fuel assemblies (e.g. from Sweden) to achieve a diversification level of at least 50 per cent, and to keep natural gas imports from Russia to zero. These would be acceptable solutions if there were no alternatives and there were no problems with the existing generating facilities. But there are! The country cannot rely on existing generating capacities as they are too old and unsafe. Besides, changing the source of imports does not make the country's energy system secure. This is especially true for nuclear power, since it is not clear when Westinghouse will be able to manufacture enough nuclear fuel to replace the Russian fuel.

The alternative is clear and more achievable than ever before. Ukraine can become energy independent by turning to renewable sources. Even if this is not done for environmental reasons, the simple struggle to achieve energy independence should be good enough reason to put every effort into restructuring the energy system.

The Ukrainian government's own actions could set a fine example of the dramatic changes that happen once tough policy decisions are made. The country has finally started to act to improve its energy efficiency. In 1995 the Ukrainian president officially proclaimed energy efficiency to be the priority for energy sector development. But nothing happened until last year when the government (under international pressure) finally decreased subsidies for the energy sector, so that saving energy made finally some economic sense.

What could Ukraine's energy future look like?

Scientists have shown that a transition toward 100 per cent renewables by 2050 for Ukraine is possible. According to the latest research by NeoCarbonEnergy (2016), within 20 years solar and wind energy sources could dominate the country's power mix, with all coal generation capacity phased out.

The government does not yet consider

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setting such a long-term goal and taking the first steps to achieve it. It is still struggling with meeting its energy community obligation to provide 11 per cent from renewable energy by 2020. However, ratification of the Paris Climate Agreement, a range of international obligations which Ukraine undertook, as well as the costs of renewables in the world are stimulating the country to implement more environmentally-sound policies and draw attention to the issues of energy efficiency and the need for renewables.

The circumstances are putting the current energy system and its owners under pressure: to modernise and to change. It's only a question of time before all the drawbacks of conventional energy sources are carefully evaluated and the goal to phase out conventional energy sources will become a confirmed national target. The question is: How much more time and money will we lose before the mind shift will happen?

Olexi Pasyuk
National Ecological Center of Ukraine

Case study: Trypillia coal-fired power plant

The 1,800 MW Trypillia coal-fired power plant, 40 km south of Kiev, is the fourth largest in all of Ukraine. Greenpeace has studied and calculated the impacts of the pollution emissions from the power plant on local and regional air quality and health using US EPA and WHO guidelines. The emissions from the power plant elevate the levels of toxic particles, SO_2 and NO_2 in the air over entire central Ukraine, with some of the worst impacts felt in Kiev due to prevalent wind patterns. Exposure to these pollutants increases the risk of diseases such as stroke, lung cancer, heart and respiratory diseases in adults, as well as respiratory symptoms in children. This can lead to premature deaths from these causes. SO_2, NOx and dust emissions contribute to toxic particle exposure. Importantly, the modelling system is capable of simulating the chemical transformation of SO_2 and NOx emissions into secondary $PM_{2.5}$ pollution in the atmosphere, a very important impact pathway that is usually neglected in Environmental Impact Assessments and regulatory processes.

The estimated health impacts due to $PM_{2.5}$ exposure are 1,250 premature deaths per year. The estimated number of babies born with a low birth weight due to the emissions is 440.

For $PM_{2.5}$, which is the biggest health concern, the largest impacts take place to the east and to the northwest of the power plant – in the direction of Kiev. Because of the large population exposed, increases in pollution levels over Kiev have significant implications for health.

In the most-affected locations, the emissions from the Trypillia coal-fired power plant can increase daily average $PM_{2.5}$ levels by up to 15 $\mu g/m^3$, or 70 per cent above annual average levels, in worst-case conditions. Local SO_2 and NO_2 levels can be affected very dramatically during unfavourable wind conditions, with daily SO_2 concentrations of up to 80 $\mu g/m^3$ and NO_2 concentrations of up to 10 $\mu g/m^3$ projected within 10 kilometres of the power plant, and SO_2 concentrations of up to 20 $\mu g/m^3$ within 20 km. The SO_2 levels in particular can cause respiratory symptoms.

As the ambient pollution levels in the area are significantly above WHO guidelines, the emissions from the power plant contribute significantly to the unhealthy levels of pollution that the population is exposed to.

Lauri Myllyvirta,
Greenpeace International

Air quality and health impacts of the Trypillia coal-fired power plant near Kiev *http://www.greenpeace.org/eastasia/Global/eastasia/publications/campaigns/Climate%20and%20Energy/Trypillia%20case%20study.pdf*

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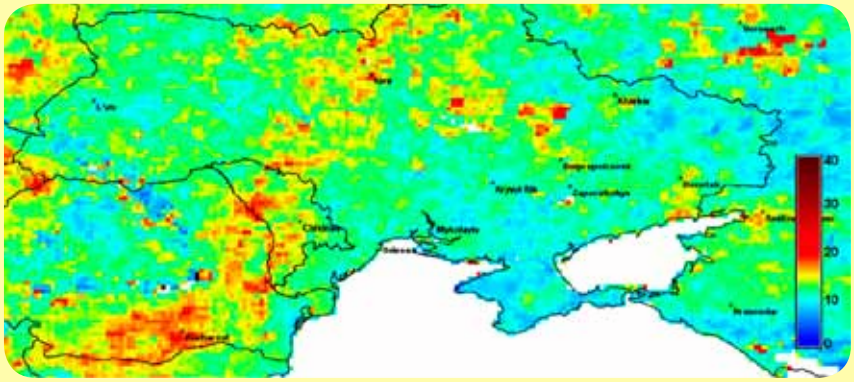
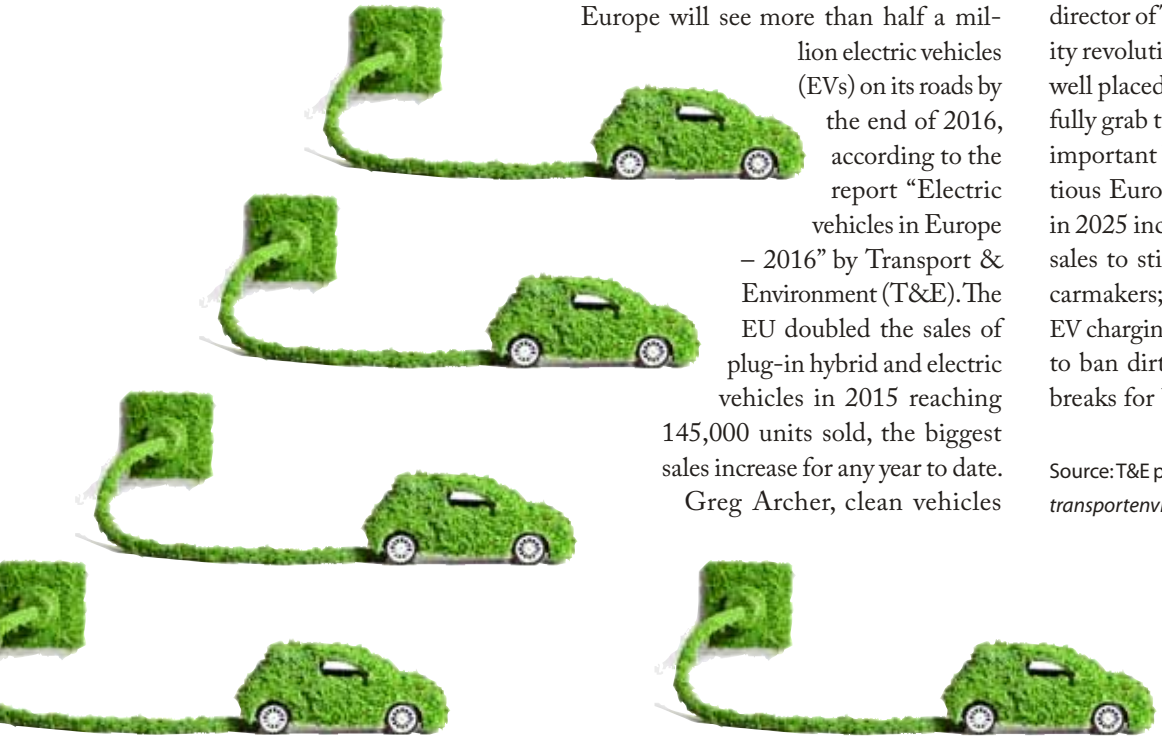


Average $PM_{2.5}$ levels in Ukraine ($\mu g/m^3$)[1]. No official $PM_{2.5}$ measurement data was available in the study region, but satellite-based observations indicate that average $PM_{2.5}$ levels in and around Kiev are among the highest in Ukraine and substantially exceed the World Health Organization guideline of 10 $\mu g/m^3$.

[1] Visualized from: van Donkelaar, A., R.V Martin, M.Brauer, N. C. Hsu, R. A. Kahn, R. C Levy, A. Lyapustin, A. M. Sayer, and D. M Winker, Global Estimates of Fine Particulate Matter using a Combined Geophysical-Statistical Method with Information from Satellites, Models, and Monitors, Environ. Sci. Technol, doi: 10.1021/acs.est.5b05833, 2016.

Soon more than 500,000 electric vehicles on the roads



Europe will see more than half a million electric vehicles (EVs) on its roads by the end of 2016, according to the report "Electric vehicles in Europe – 2016" by Transport & Environment (T&E). The EU doubled the sales of plug-in hybrid and electric vehicles in 2015 reaching 145,000 units sold, the biggest sales increase for any year to date.

Greg Archer, clean vehicles director of T&E, said: "The electromobility revolution is underway and Europe is well placed to take a leading position. To fully grab this chance, Europe needs four important boosts from regulators: ambitious European CO_2 limits for new cars in 2025 including a specific target for EV sales to stimulate competition amongst carmakers; to accelerate the roll-out of EV charging infrastructure across Europe; to ban dirty diesels from cities; and tax breaks for battery electric vehicles."

Source: T&E press release, 13 October 2016 (*www.transportenvironment.org*)

Greening transport with more electric vehicles

A large scale roll-out of electric cars on EU roads would result in significantly lower greenhouse gas emissions and lower levels of certain air pollutants.

A new briefing from the European Environment Agency (EEA) looks at the impact of different scenarios for the increased use of electric cars and their effect on the EU's energy system, and on emissions of greenhouse gases and selected air pollutants.

Two scenarios were explored where the share of electric vehicles as part of the entire EU car fleet in 2050 on average was assumed to be respectively 50 and 80 per cent. They were compared with a reference projection in which only 8 per cent of cars would be electric in 2050.

Under the 80-per-cent scenario, the share of total electricity consumption in the EU by electric vehicles would increase from around 0.03 per cent in 2014, to 9.5 per cent by 2050. Overall, an additional electrical capacity of 150 GW would be needed in 2050 to charge electric cars.

The resulting carbon dioxide (CO_2) emission reductions from road transport would outweigh the higher emissions caused by the continued use of fossil fuels in the power-generating sector. In the EU, a net reduction of 255 million tonnes of CO_2 could be delivered in 2050, equivalent to around 10 per cent of the total emissions estimated for that year. However in countries with a high share of fossil power plants, environmental benefits would be lower.

An 80 per cent share of electric cars would also significantly reduce overall emissions of certain air pollutants such as nitrogen oxides and particulate matter, while emissions of sulphur dioxide could increase due to the continued use of coal in the electricity generation sector.

Sales and use of electric vehicles are increasing, but they currently only make up 1.2 per cent of total passenger car sales in the EU. Current estimates also show that electric cars only account for 0.15 per cent of the total car fleet.

Source: EEA News, 26 Sep 2016.

EEA Briefing: *http://www.eea.europa.eu/themes/transport/electric-vehicles/electric-vehicles-and-energy*

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New diesel cars still emit up to 15 times too much NOx

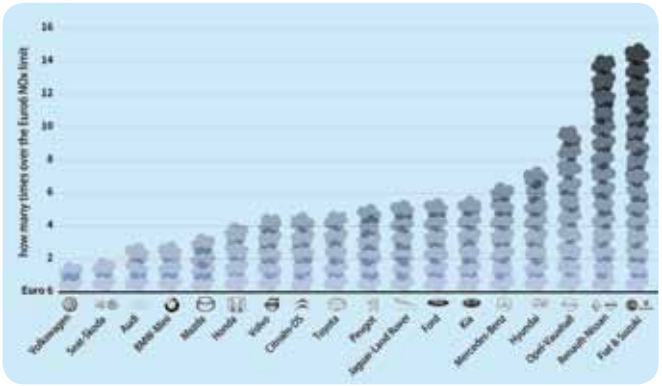
Over four in five Euro 5 diesel cars produce more than three times their laboratory limit value for NOx when driven on the road, and two-thirds of Euro 6 diesel cars still emit more than three times their limit.

Published one year after the Dieselgate scandal first hit the headlines, a new study by Transport and Environment (T&E) reveals that all major diesel car brands are selling models that in real-world driving emit far higher levels of nitrogen oxides (NOx) than allowed.

More surprisingly, it reveals that Volkswagen is currently selling the least-polluting Euro 6 diesel vehicles. However, the better performance of Volkswagen Euro 6 cars has nothing to do with Dieselgate, but rather with better technology choices made before the scandal burst.

All new diesel cars produced after September 2015 have to comply with the EU's Euro 6 exhaust emissions standard, which sets a limit of 80 milligrammes NOx per km – a significant reduction from the previous Euro 5 standard (applicable 2011–2015) which allowed 180 mg NOx per km. But these limits are tested in laboratory conditions only.

Based on emissions test data taken from investigations conducted by the British, French and German governments, as well as a large public database, T&E analysed data from around 230 diesel car models. It was found that in real-world driving conditions not one single brand complies with the latest Euro 6 air pollution limits for diesel cars and vans – Fiat and Suzuki diesel cars on average pollute 15 times more than the legal NOx limit; Renault-Nissan vehicles exceed the limit more than 14 times; Opel/Vauxhall pollute ten times more; while Volkswagen diesel cars pollute twice as much as the Euro 6 standard.



Above and beyond the legal NOx limits. Source: T&E

For Euro 5 vehicles, the ranking of the worst-performing companies was slightly different. Renault (including Dacia) pollute eight times over the standard, while Land Rover, Hyundai, Opel/Vauxhall, Nissan, Fiat and Kia all exceed the limit by six times or more.

T&E's calculations also show that 29 million Euro 5 and Euro 6 diesel cars and vans currently driving on roads in the EU can be classified as "dirty" in the sense that in real driving they are at least three times over the relevant NOx limit. All these vehicles were approved for sale by national type approval authorities. The largest number of "dirty" diesels is found on French roads (5.5 million), followed by Germany (5.3 million), the UK (4.3 million), Italy (3.1 million), Spain (1.9 million) and Belgium (1.4 million).

Last year, the European Environment Agency reported that nitrogen dioxide (NO_2), mainly created by diesel engines in urban areas, is responsible for an estimated 72,000 premature deaths in the EU. NOx emissions also contribute to excess levels of fine particulate matter ($PM_{2.5}$) and ground-level ozone, which are responsible for more than 400,000 premature deaths in the EU. Moreover, emissions of NOx cause eutrophication and acidification of natural ecosystems, resulting in damage to biodiversity.

The EU decided last year to tighten the Euro 6 car emissions regulation, with effect from September 2017. But new diesel cars will still be allowed to emit 2.1 times the limit value in real driving tests (RDE) until 2020, and 1.5 times the limit value as from 2021.

Christer Ågren

T&E press release: *www.transportenvironment.org*

The report "Dieselgate: Who? What? How?": *https://www.transportenvironment.org/publications/dieselgate-who-what-how*

Dieselgate

The United States Environmental Protection Agency announced on 18 September 2015 that diesel cars from model years 2009 to 2015 produced by the Volkswagen Group were breaching the US federal emissions legislation by fitting illegal software (defeat device) to cheat emissions tests. The device recognised that a vehicle was undergoing a laboratory test and lowered the emissions of NOx so that the vehicle achieved the strict US regulatory limit. On the road, the same vehicle produced up to 40 times more NOx emissions. VW later admitted that it had fitted the illegal software to 11 million vehicles worldwide – 8.5 million of which are in Europe and 500,000 in the US.

European emission trends updated

Overall air pollutant emissions keep on slowly shrinking – sulphur emissions show the biggest reductions, while there is much less improvement for ammonia and particulate matter.

Since 1980, total European emissions of sulphur dioxide (SO_2) – the most significant acidifying pollutant and an important precursor to health-damaging secondary fine particles ($PM_{2.5}$) – from land-based emission sources have fallen by 87 per cent, from around 53 million tonnes in 1980 to 6.7 million tonnes in 2014.

Emissions of nitrogen oxides (NOx), non-methane volatile organic compounds (VOCs), and ammonia have also gone down, although to a lesser extent. VOCs and NOx have more than halved (-59 and -52 per cent, respectively) since 1980, while ammonia emissions – which emanate primarily from agricultural activities – have dropped by only 33 per cent.

Historic emissions of primary particulate matter ($PM_{2.5}$) are not as well documented as those of other air pollutants, and many countries lack emissions data for the 1990s. Between 2000 and 2014 it is estimated that emissions of $PM_{2.5}$ from land-based sources have fallen by 15 per cent, from 3 to 2.6 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 and primary particles, 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 2014 the emissions of SO_2 came down by as much as 92 per cent, while those of NOx and VOCs fell respectively by 55 and 62 per cent. Emissions of ammonia fell by only 26 per cent. Primary $PM_{2.5}$ particles were reduced by 27 per cent between 2000 and 2014.

Table 2: European countries where the proportion of air pollutant depositions of sulphur and oxidised nitrogen from ships is the most marked.

Sulphur		NOx-Nitrogen	
Portugal	26%	Norway	28%
Denmark	24%	Sweden	26%
Netherlands	22%	Denmark	26%
Ireland	20%	Portugal	24%
Norway	19%	Greece	23%
Spain	18%	Ireland	23%
Sweden	17%	Netherlands	19%
France	15%	Finland	18%
UK	13%	Spain	18%
Italy	13%	UK	18%
Belgium	10%	Italy	15%
Greece	9%	France	14%

Emissions of SO_2 from international shipping in European waters showed a steady increase up to around 2006, after which emissions have fallen, primarily as a result of ship fuel sulphur regulations introduced by the EU and the International Maritime Organization (IMO). The emission reductions were particularly marked in the northern Sulphur Emission Control Areas (SECA), which cover the Baltic Sea and the North Sea, including the English Channel. It should be noted that the EMEP data for shipping emissions has been updated only up to 2011, which means that no trends after that year have been accounted for.

Ship NOx emissions increased steadily for many years, but appeared to stabilise, or even come down somewhat, during the economic crisis of 2008–2009. However, because of the lack of effective international ship NOx 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. This shows that for most European countries the biggest share of depositions of sulphur and nitrogen emanate from outside their own territory.

Since land-based emissions have been falling much faster than those from international shipping, shipping's contribution to pollutant depositions and concentrations has been getting bigger and bigger over time. For 2013 it was estimated that ship emissions were responsible for ten per cent or more of the total depositions of both sulphur and oxidised nitrogen compounds in many countries (see Table 2). In the coastal areas of these countries, shipping's contribution to the overall pollution load is even higher. Countries that are particularly exposed to air pollution from shipping include Portugal, Denmark, Norway, Sweden, Ireland, the Netherlands, Spain, France and the United Kingdom.

Christer Ågren

Report: "Transboundary particulate matter, photo-oxidants, acidifying and eutrophying components." EMEP Status Report 1/2016. *www.emep.int*

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Ammonia and primary particles are reported to have risen in some countries.

Table 1: European emissions of sulphur dioxide (SO_2), nitrogen oxides (as NO_2), non-methane volatile organic compounds (NMVOC), ammonia (NH_3), and particulate matter ($PM_{2.5}$) (kilotonnes). Data for 2000 and 2014 is from the 2016 EMEP report, while data for 1980 and 1990 is from earlier EMEP reports or from the EMEP website. Russia in the table refers only to the western part of the Russian Federation.

	Sulphur dioxide				Nitrogen oxides				VOCs				Ammonia				$PM_{2.5}$	
	1980	1990	2000	2014	1980	1990	2000	2014	1980	1990	2000	2014	1980	1990	2000	2014	2000	2014
Austria	360	74	32	16	246	195	210	151	437	276	164	110	52	65	67	67	24	17
Belgium	828	362	174	42	442	401	347	197	274	315	227	122	89	120	83	66	41	28
Bulgaria	2,050	1,100	861	189	416	249	145	133	309	620	99	99	144	133	41	31	23	34
Croatia	150	174	59	16	60	95	84	55	105	113	76	60	37	51	41	26	15	19
Cyprus	28	31	50	17	13	17	22	17	14	17	13	7	8	5	6	5	4	1
Czech Rep.	2,257	1,876	301	127	937	742	283	170	275	374	261	138	156	157	92	69	41	23
Denmark	452	176	32	11	307	275	224	113	194	166	174	106	138	114	98	73	24	18
Estonia	287	274	97	41	70	74	37	33	81	70	45	23	24	25	10	13	22	8
Finland	584	263	79	44	295	323	201	137	210	239	166	75	39	38	38	37	41	24
France	3,214	1,354	628	169	2,024	1,865	1,610	886	2,734	2,589	1,681	639	795	704	748	708	311	169
Germany	7,514	5,292	645	388	3,334	2,882	1,925	1,224	3,224	3,128	1,600	1,041	835	692	696	740	158	104
Greece	400	473	591	144	306	329	450	242	255	268	312	174	79	85	57	51	66	38
Hungary	1,633	1,010	428	27	273	238	206	120	215	205	176	116	157	124	94	84	37	26
Ireland	222	182	142	19	73	121	137	77	111	93	112	87	112	107	115	105	21	15
Italy	3,440	1,794	754	145	1,585	2,014	1,456	790	2,032	2,015	1,524	849	441	468	453	393	163	152
Latvia	96	105	15	4	83	65	44	35	152	102	102	54	38	48	14	17	25	18
Lithuania	311	222	37	18	152	158	51	51	100	108	72	69	85	84	39	41	19	17
Luxembourg	24	15	3	2	23	39	42	28	15	19	14	11	7	5	5	6	3	2
Malta	26	29	23	5	9	14	9	6	2	8	5	3	5	1	2	2	1	1
Netherlands	490	192	73	29	583	566	395	235	579	477	239	143	234	355	182	134	25	13
Poland	4,100	3,210	1,451	800	1,229	1,280	844	723	1 036	831	575	606	550	508	284	265	157	135
Portugal	253	295	250	35	158	234	262	160	189	295	248	169	96	63	65	49	61	44
Romania	1,055	1,311	818	176	523	546	291	218	829	616	393	319	340	300	183	162	159	116
Slovakia	780	542	127	45	197	215	107	85	252	122	67	106	63	66	32	37	23	30
Slovenia	234	198	93	9	51	60	52	39	39	55	53	32	24	20	21	19	12	12
Spain	2,913	2,097	1,464	243	1 068	1 224	1,300	745	1 392	1 006	960	599	285	316	397	371	95	67
Sweden	491	105	42	24	404	269	207	135	528	359	224	184	54	55	59	54	25	21
UK	4,852	3,707	1,217	308	2,580	2,885	1,798	949	2,100	2,762	1,567	819	361	360	322	281	121	105
Total EU28	39,044	26,463	10,486	3,093	17,441	17,375	12,739	7,754	17,683	17,248	11,149	6,760	5,248	5,069	4,244	3,906	1,717	1,257
Albania	72	78	10	13	24	22	15	19	31	43	29	30	32	28	18	21	8	9
Belarus	740	888	170	91	234	379	194	161	549	497	228	180	142	215	115	155	58	51
Bosn. Herz.	482	484	192	214	79	73	35	31	51	48	52	35	31	21	17	20	16	14
Iceland	18	21	35	71	21	27	27	21	8	12	8	5	3	3	3	5	1	0
Macedonia	107	110	106	101	39	46	32	33	19	21	29	18	17	15	10	8	14	11
Moldova	308	175	8	4	115	131	23	18	105	123	25	27	53	61	17	15	11	10
Montenegro	0	0	14	40	0	0	9	13	0	0	10	9	0	0	6	3	4	5
Norway	136	52	27	17	191	190	202	140	173	289	379	138	20	20	26	26	42	27
Russia	7,323	4,330	1,807	1,518	3,634	4,641	2,777	2,157	3,410	3,772	2,692	1,999	1,189	1,191	551	541	723	793
Serbia	406	593	474	327	192	165	144	113	142	158	145	118	90	74	82	86	39	34
Switzerland	116	41	15	8	170	145	108	69	323	289	143	80	77	73	66	54	11	8
Ukraine	3,849	3,921	1,390	1,161	1,145	1,753	888	667	1 626	1 053	574	421	729	682	302	271	388	360
Total Non-EU	13,557	10,693	4,248	3,565	5,844	7,572	4,454	3,442	6,437	6,305	4,314	3,060	2,383	2,383	1,213	1,205	1,315	1,322
Total Europe	52,601	37,156	14,734	6,658	23,285	24,947	17,193	11,196	24,120	23,553	15,463	9,820	7,631	7,452	5,457	5,111	3,032	2,579
Int. ship: Baltic Sea	139	168	170	69	215	236	285	271	5	8	9	7	-	-	-	-	19	11
Int. ship: Black Sea	35	45	50	53	52	62	83	79	1	2	3	2	-	-	-	-	6	6
Int.ship: Mediterran.	725	858	931	976	1,000	1,234	1,578	1,497	21	41	47	45	-	-	-	-	104	109
Int. ship: North Sea	277	361	406	163	395	508	677	644	9	18	20	17	-	-	-	-	45	27
Int.s.: N.E. Atlantic	550	384	433	452	772	565	733	695	15	19	22	21	-	-	-	-	48	50
Total internat. ship.	1,726	1,816	1,990	1,713	2,434	2,605	3,356	3,186	51	88	101	92	-	-	-	-	222	203
Tot. Europe + ships	54,327	38,972	16,724	8,371	25,719	27,552	20,549	14,382	23,641	15,564	9912	10,385	7,631	7,452	5,457	5,111	3,254	2,782
Turkey	1 030	1 519	2,335	2,147	364	691	840	1,055	359	636	955	967	321	373	482	1,085	471	539

Industry does not need CCS

Swedish steel group SSAB, the country's top CO_2 emitter, foregoes CCS. It opts to replace coal with hydrogen. The cement industry and refineries also show low-CO_2 potential soon, and without CCS.

If R&D efforts are successful they may be replicated all over the world, and pay part of the cost for the introduction of hydrogen as transport fuel.

Blast furnaces produce large amount of CO_2, since coal is used to reduce iron oxides to iron.

So far, the approach to producing CO_2-free steel has been dominated by CCS in combination with improved fuel efficiency, at least in Europe, as manifested in the Ulcos/Hisarna[1] project in the Netherlands.

CCS has also dominated the Swedish approach to CO_2 reduction in all heavy industry. The Confederation of Swedish Enterprise was very clear about this in May 2015 at a seminar about carbon cuts[2]. Nothing was, however, mentioned about costs and who is supposed to pay.

Swedish steel group SSAB, the country's top CO_2 emitter, foregoes CCS. It opts to replace coal with hydrogen.

But in April 2016, SSAB announced[3] that they together with miner LKAB and power producer Vattenfall were launching an R&D effort to use hydrogen as a reductant, hoping to achieve zero carbon, and using direct reduction or iron sponge technology.

Hydrogen is a very clean fuel and can be zero carbon if produced by electrolysis from zero-carbon electricity. This is technically possible anywhere in the world. In Sweden, the prospect of very low carbon power is not that distant.

Electricity in Sweden is produced mainly from hydro, nuclear, wind and biomass. So the CO_2 emissions are low now, and can stay low when nuclear power is phased out. Vattenfall, SSAB and LKAB expect it to be replaced with more renewables.

SSAB emitted 21 per cent of Sweden's ETS emissions in 2015. Another three per cent came from LKAB mining, mainly from sintering/pelleting of iron ore.

Neither company has elaborated, but an obvious factor is that SSAB and LKAB believe that after Paris, "coal forever" is no longer an option, while CCS is not making much headway. Another factor is that power prices are low and are expected to stay low.

With an increasing share of renewables, power prices are expected to fluctuate more: higher when there is little wind and lower when it is windy. In Germany and Denmark there are sometimes even negative prices, which is not viable.

This is a problem hydrogen/iron can actually help to solve. With some flexibility in either iron production or some storage of hydrogen, use of electricity at peak price can be avoided for perhaps several hundreds of hours per year. This would lower its cost considerably, for a small loss in production.

That way SSAB and LKAB would act as virtual power plants, so real peak power plants will not be needed even with much more wind power.

The time perspective[4] is early 2030s, i.e. 15–18 years.

This is at least as fast as CCS. According to the IEA, as of 2013, CCS for huge blast furnaces "will not be available before 2030–40"[5].

Both technology choices involve technical and economic risks, and the demonstration phase needs public support. But hydrogen solves the CO_2 problem for good.

Using wood instead of concrete reduces CO_2 emissions.

FOTOLIA.COM © MICHAEL FLIPPO

Even if CCS could operate earlier than hydrogen it would involve huge costs being written off over just a few years. To go for both would mean paying twice.

One reason why hydrogen may be faster is that blast furnaces have to be made very large to make economic sense. Direct reduction iron plants exist today, with natural gas as fuel. They can be made smaller and also more flexible to operate.

Blast furnaces also have to run continuously, so carbon capture must not stop them at any time. This calls for very careful planning, tight schedules for installing the huge parts, and clarification of all the legal details regarding responsibilities, guarantees, indemnification etc., or the plant owner cannot take the risk.

Sweden has the wrong geology for CO_2 storage, so long pipelines to Norway or the Baltic Sea may have to be built from the two furnaces, which are 1,000 km apart.

Another huge global problem, for which CCS has been touted as the only solution, is cement production. But other ways to reduce emissions have recently appeared, again in Sweden.

CO_2 is released when quicklime (CaO) is produced from limestone ($CaCO_3$), and accounted for almost six per cent of global CO_2 emissions[6] in 2013. On top of that fossil fuels are used for heating the lime in kilns.

Riksbyggen is a cooperative developer and manager of apartment blocks. The company has set a number of green requirements for an apartment block to be built in Gothenburg soon, and claims to be able to reduce the carbon footprint for the concrete framework by 30–35 per cent compared to standard concrete. They are doing so in cooperation with Cementa (part of Heidelberg Cement), mainly by changing the recipe for the cement, by decreasing the share of quicklime and increasing the share of fly ash.

Another Swedish company, Thomas Concrete Group, has started marketing products with 30 per cent fly ash, as a substitute for Portland cement.

Fly ash is produced in large quantities at coal power stations, also from biopower. So far much of it has been used as landfill, which is becoming more difficult in countries such as the US and India. There are also huge amounts of similar ash of volcanic origin. Another cement substitute is slag from steel production. Neither emits CO_2.

In Sweden, wood is often used as an alternative to concrete, sometimes combined with magnesium oxide, for example in making boards.

If construction companies demand greener building materials and methods, as they sometimes[7] do, they can start a chain reaction in the market. Low environmental impact is an important competitive factor, as many customers want their buildings to be certified as LEED Platinum or Gold, where low-CO_2 concrete can earn points[8].

There is a discernible market dynamic, perhaps even without government intervention, but certainly with it.

Refineries are also big point sources of CO_2. These emissions can be tackled in at least three other ways than CCS. A higher share of biofuels means less emissions from vehicles and from refineries. This has happened in Sweden to some extent, especially for diesel-from-wood.

Hydrogen is used in large quantities in refineries, but is now of fossil origin. The biggest refiner in Sweden, Preem, is investigating the production of "green hydrogen"[9].

Finally, if electric cars and hydrogen cars, and biofuels such as methane, ethanol, and methanol take more market share, oil refineries can be phased out.

Fredrik Lundberg

[1] *www.ulcos.org/en/research/isarna.php*
[2] *www.svensktnaringsliv.se/fragor/miljo-energi-klimat/basindustrin-siktar-mot-nollutslapp_619454.html* (in Swedish)
[3] *www.ssab.com/GlobalData/News-Center/2016/04/04/05/32/SSAB-LKAB-and-Vattenfall-launch-initiative-for-a-carbondioxidefree-steel-industry*
[4] *http://news.vattenfall.com/en/article/renewable-electricity-and-hydrogen-solution-co2-free-steel*
[5] *http://ieaghg.org/docs/General_Docs/IEAGHG_Presentations/S._Santos_-_Grangemouth_Wkshp_Final_Version_v_1.0.pdf*
[6] *http://cdiac.ornl.gov/ftp/ndp030/global.1751_2013.ems*
[7] *http://www.skanska.co.uk/services/cementation-piling-and-foundations/sustainability/green-concrete/*
[8] *http://flyash.com/data/upfiles/resource/TB%2028%20Fly%20Ash%20in%20LEED%20NC%20Version%202.2%202015.pdf*
[9] *https://preem.se/framtiden* (in Swedish)

Kraków will ban solid fuel for domestic heating

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The 19th century just called, they want their source of heating back!

City authorities in southern Poland have won a legal victory over the introduction of new rules to combat local air pollution. The regulation, passed by the regional council of Małopolska, which includes Kraków, is set to come into force in September 2019 and will ban the use of solid fuel such as coal for heating in households, offices, government buildings and restaurants.

Client Earth lawyer Małgorzata Smolak, who represented the city authorities, described the decision as a "breakthrough victory" for the people of Kraków and Poland more widely. Although it is likely to be appealed, "the court has shown that local authorities have in their hands an effective tool to combat air pollution," she said.

Poland's air quality is among the worst in Europe, and in December 2015, the European Commission referred Poland to the EU Court of Justice over its persistently high levels of particulate matter (PM).

Source: Ends Europe Daily, 29 September 2016.

Offshore wind booms

The market for offshore wind turbines is going to grow explosively over the next 15 years in Denmark, and beyond the North Sea area and Europe, according to the OECD in a new analysis, "The Ocean Economy in 2030". The number of jobs in the sector is expected to rise by a factor of 12 to 435,000 full time employments, and offshore wind over the coming period is expected to grow from one to 8 per cent of the global, sea-based economy. The Swedish company Vattenfall has won the rights to build the largest wind farm in the Nordics, the Danish Kriegers Flak, a 600 MW offshore wind farm in the Baltic Sea. The winning tender represents one of the lowest costs per MW hour in the world for any offshore wind power project, coming in at just €49.9/MWh, according to Clean Technica News Service.

Source: cleantechnica.com, 10 November 2016

CO_2 levels above 400 ppm reality for many generations

Globally averaged concentration of carbon dioxide in the atmosphere reached the symbolic and significant milestone of 400 parts per million for the first time in 2015 and surged again to new records in 2016 on the back of the very powerful El Niño event, according to the World Meteorological Organization (WMO)

CO_2 levels had previously reached the 400 ppm barrier for certain months of the year and in certain locations but never before on a global average basis for the entire year. The longest-established greenhouse gas monitoring station at Mauna Loa, Hawaii, predicts that CO_2 concentrations will stay above 400 ppm for the whole of 2016 and not dip below that level for many generations.

The growth spurt in CO_2 was fuelled by the El Niño event, which started in 2015 and had a strong impact well into 2016. This triggered droughts in tropical regions and reduced the capacity of "sinks" like forests, vegetation and the oceans to absorb CO_2. These sinks currently absorb about half of CO_2 emissions but there is a risk that they may become saturated, which would increase the fraction of emitted carbon dioxide which stays in the atmosphere, according to WMO.

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Excuse me, but I believe we have a serious problem with radiative forcing here.

Between 1990 and 2015 there was a 37 per cent increase in radiative forcing – the warming effect on our climate – because of long-lived greenhouse gases such as carbon dioxide, methane and nitrous oxide (N_2O) from industrial, agricultural and domestic activities.

The real elephant in the room is carbon dioxide, which remains in the atmosphere for thousands of years and in the oceans for even longer. Without tackling CO_2 emissions, we cannot tackle climate change and keep temperature increases to below 2°C above the pre-industrial era. It is therefore of the utmost importance that the Paris Agreement does indeed enter into force well ahead of schedule on 4 November and that we fast-track its implementation," the WMO said.

Source: WMO press release, 24 October 2016

Little progress on climate policies

The rapid entry into force of the Paris Agreement has created the legal basis for countries to increase their level of action and ambition to meet the 1.5°C warming limit over the next two years in the lead-up to 2018. The Climate Action Tracker (CAT) has evaluated the starting point for this process and found there has been little progress on national climate policies in the eleven months since the Paris Agreement was adopted.

Government pledges and climate action commitments made under the now-ratified Paris Agreement will lead to a warming of 2.8°C, with a likely chance of holding warming below 3.1°C. The CAT has also assessed current government policies and found little change since Paris. Policies still lead to a warming of 3.6°C, now even further from the globally agreed warming limit of 1.5°C.

Assessments have been updated for 25 countries, amounting to 69 per cent of global emissions, and no government has gained an upgraded rating.

Source: Climate Action Tracker, 10 November 2016

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Bored? No, I am just waiting for governments to impress me with some kick-ass climate action.

Planet could warm by 10°C

The planet would warm by a searing 10°C if all fossil fuels are burned, according to a new study published in Nature Climate Change, leaving some regions uninhabitable and wreaking profound damage on human health, food supplies and the global economy.

The Arctic, already warming fast today, would heat up even more – 20°C by 2300 – the new research into the extreme scenario found.

"I think it is really important to know what would happen if we don't take any action to mitigate climate change," said Katarzyna Tokarska, at the University of Victoria in Canada and who led the new research.

If recent trends in global emissions continue, about two trillion tonnes will be emitted by the end of the century.

The new work considers the impact of emitting five trillion tonnes of carbon emissions. This is the lower-end estimate of burning all fossil fuels currently known about, though not including future finds or those made available by new extraction technologies.

The researchers used a series of sophisticated climate models and found this rise in CO_2 would lead to surface temperatures rising by an average of 8°C across the world by 2300. When the effect of other greenhouse gases is added, the rise climbs to 10°C.

The heating predicted by the models was not uniform across the globe. In the Arctic, the higher CO_2 levels led to 17°C of warming, with another 3°C from other greenhouse gases, across the year. These rises are higher than indicated by previous, less comprehensive models, which are less accurate at modelling how the oceans take up heat. In February, parts of the Arctic had already recorded temperatures 16°C above normal.

The warming caused by burning all fossil fuels would also have enormous impact on rainfall. The new research shows rainfall decreasing by two-thirds over parts of Central America and northern Africa and by half over parts of Australia, the Mediterranean, southern Africa and the Amazon.

Source: The Guardian, 23 May 2016

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NOAA: Reefs are boiled to death

The soaring temperature of the oceans is the "greatest hidden challenge of our generation"and global coral bleaching continues for a third year due to global warming.

The US National Oceanic and Atmospheric Administrations (NOAA) and its project Coral Reef Watch reports that the world is in a third year of coral bleaching across the globe. "This is the most widespread, longest coral bleaching event ever to occur globally," Mark Eakin, the director of NOAA Coral Reef Watch, said.

The soaring temperature of the oceans is the "greatest hidden challenge of our generation" that is altering the make-up of marine species, shrinking fishing areas and starting to spread disease to humans, according to a new International Union for Conservation of Nature (IUCN) report on ocean warming.

Warming is already causing fish, seabirds, sea turtles, jellyfish and other species to change their behaviour and habitat, it says. Species are fleeing to the cooler poles, away from the equator, at a rate that is up to five times faster than the shifts seen in species on land. Even in the north Atlantic, fish will move northwards, with shifts already documented for pilchard, anchovy, mackerel and herring. The warming is having its greatest impact upon the building blocks of life in the seas, such as phytoplankton, zooplankton and krill. The movement of fish will create winners and losers among the 4.3 billion people in the world who rely heavily upon fish for sustenance. In Southeast Asia, harvests from fisheries could drop by nearly a third by 2050 if emissions are not severely curtailed. Humans are also set to suffer from the spread of disease as the ocean continues to heat up. The IUCN report found there is growing evidence of vibrio bacterial disease, which can cause cholera, and harmful algal bloom species that can cause food poisoning. People are also being affected by more severe, if not more numerous, hurricanes due to the extra energy in the ocean and atmosphere.

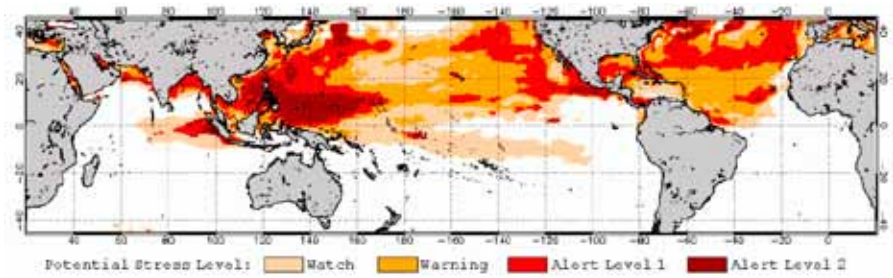
Ocean acidification, where rising carbon dioxide absorption increases the acidity of the water, is making it harder for animals such as crabs, shrimps and clams to form their calcium carbonate shells.

Coral reefs, which support around a quarter of all marine species, are suffering from episodes of bleaching that have increased three-fold in the past 30 years. This bleaching occurs when prolonged high temperatures cause coral to expel its symbiotic algae, causing it to whiten and ultimately die.

NOAA says that over the past two years, reefs have been essentially boiled to death in parts of every ocean basin on earth. Abnormally hot waters have turned vibrant coral communities into pale white ghost communities as heat has sapped coral of the algae they need to survive. There are only two other global coral bleaching events to precede this one: in 1998 and 2010. Both came during El Niño years. This event is different, it started in 2014, when El Niño was just beginning, and it's still going strong in the middle of 2016 despite El Niño's passing.

Reefs in many countries have been hit (see map from NOAA), 40 per cent of reefs have been affected globally, and 70 per cent of US reefs, including the Florida Keys. Other locations affected include the US Virgin Islands, Puerto Rico, and reefs near Hawaii, Guam and the Commonwealth of the Northern Mariana Islands. The Great Barrier Reef has also been hit hard with up to 93 per cent of the reef showing signs of bleaching. Other parts of the ocean have been equally devastated, including some of the most pristine reefs on the planet that lie in the middle of the Pacific.

Compiled by Reinhold Pape



Coral bleaching forecast, 60% probability for coral bleaching thermal stress for June to September 2016. Source: NOAA Coral Reef Watch

Sources:

Link to NOAA Coral Reef Watch report: *http://coralreefwatch.noaa.gov/satellite/analyses_guidance/global_coral_bleaching_2014-17_status.php*

Link to IUCN report: *http://www.iucnworldconservationcongress.org/news/20160905/article/global-warning-ocean-warming*

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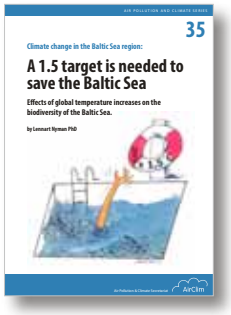

A 1.5 target is needed to save the Baltic Sea (March 2016). By Lennart Nyman. Effects of global temperatures increases the biodiversity of the Baltic Sea.

Short Paper on the UNFCCC Structured Expert Dialogue on the 2013–2015 (Nov 2015). By Climate Analytics. Review, with a particular focus on the 1.5°C target.

Phasing out fossil gas in Europe (March 2016). By Fredrik Lundberg. The natural gas industry faces strategic choices.

Paths to a sustainable agricultural system (March 2016). By Kajsa Pira et al. A agricultural and food system with reduced emissions.

Carbon Capture and Storage in Norway (2nd edition, March 2016). ByTore Braend. The Norwegian interest in CCS depends on the oil and gas sector.

Grasping for Air (Sep 2014).Twelve factsheets on agriculture, climate, cultural heritage, domestic heating, economy, ecosystems, health, industry, non-roadmachine, road vehicles, shipping and solvents.

1.5 Stay Alive (April 2015). Short doucumentary about climate change in the coastal zones of the Carribean region. Winner of the Golden Sun award 2016. *https://www.youtube.com/watch?v=ckMVASFRxUk*

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Coming events

7th International Nitrogen Initiative (INI 2016). Melbourne, Australia, 4 - 8 December 2016. Information: *http://www.ini2016.com/*

CLRTAP Working Group on Strategies and Review + Executive Body. Geneva, Switzerland, 13 - 16 December 2016. Information: *www.unece.org/env/lrtap/welcome.html*

EU Environment Council. Brussels, 19 December 2016. Information: *www.consilium.europa.eu/en/press/calendar/*

IMO PPR 4 (Sub-Committee on Pollution Prevention and Response). London, UK, 16 - 20 January 2017. Information: *www.imo.org*

EU Environment Council. Brussels, 28 February 2017. Information: *www.consilium.europa.eu/en/press/calendar/*

Air Pollution 2017. 25th International conference on modelling, monitoring and management of air pollution. Cadiz, Spain, 25 - 27 April 2017. Information: http://w**ww.wessex.ac.uk/conferences/2017/air-pollution-2017**

CLRTAP Working Group on Strategies and Review. Geneva, Switzerland, 31 May - 2 June 2017. Information: ww**w.unece.org/env/lrtap/welcome.html**

IMO MEPC 71 (Marine Environment Protection Committee). London, UK, 8 - 12 May 2017. Information: *www.imo.org*

UNFCCC First sessional period in 2017. Venue to be decided. 8 - 18 May 2017. Information: *http://unfccc.int/*

ICAPC 2017: 19th International Conference on Air Pollution and Control. London, UK, 25 - 27 May 2017. Information: *https://www.waset.org/conference/2017/05/london/ICAPC*

European Biomass Conference and Exhibition (EUBCE). Stockholm, Sweden, 12 - 15 June 2017. Information: *http://www.eubce.com/home.html*

EU Environment Council. Luxembourg, 19 June 2017. Information: *www.consilium.europa.eu/en/press/calendar/*

UNFCCC Second sessional period in 2017. Venue to be decided. 6 - 17 November 2017. Information: *http://unfccc.int/*

CLRTAP Working Executive Body. Geneva, Switzerland, 11 - 14 December 2017. Information: *www.unece.org/env/lrtap/welcome.html*