

100% renewable energy

Wind and solar are getting much cheaper. This is official according to five technology platforms for renewable energies from the EU.

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Big emissions from small chimneys

Domestic wood burning is a major source of air pollutant emissions – a new eco-labelled wood stove is allowed to emit 25 times more health-damaging particles than a ten-year old diesel truck.

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CCS is still a failure

After decades of talking and billions of investments there are no large commercial CO₂ storage facilities in Norway, Canada, the US or anywhere else in the world.

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EU needs to shut all coal plants by 2030

The EU will need to phase out CO₂ emissions from all of its coal plants in the next 15 years if it is to meet the Paris Agreement's long-term temperature goals, according to a new report.

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How to get people to eat less meat

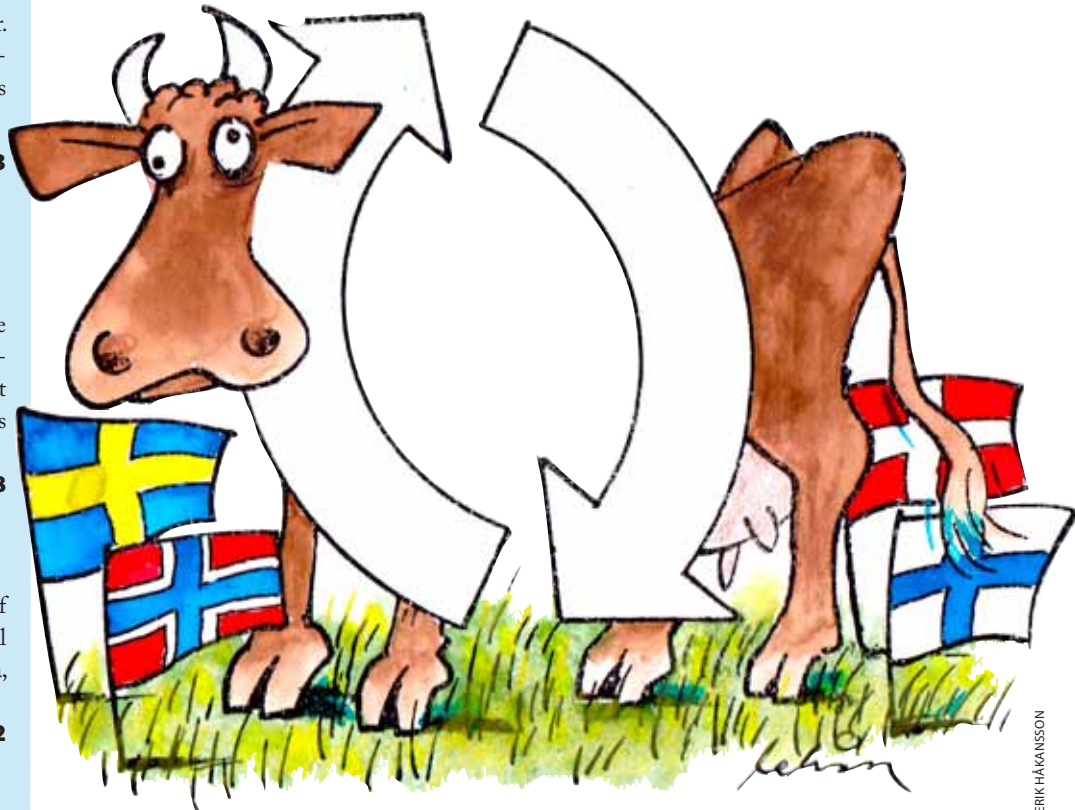
Personality, friends, religion and political instruments all have an impact on what we eat.

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Cost-effective to cut ship NOx emissions

By supplementing NOx Emission Control Areas with economic instruments, ship NOx emissions can be cut faster and further.

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Livestock on leftovers

Greenhouse gas and nitrogen emissions from agriculture in the Nordic countries could be reduced by up to 80 per cent with a diet of purely organic produce from an almost self-sufficient food system.

Most of the emissions from agriculture are linked to animal husbandry. There are several possible strategies for reducing these emissions.

The strategy mostly favoured by agricultural unions and the food industry is to make present production more efficient, so-called sustainable intensification. But this path has its limitations. If the consumption of animal products keeps growing, emissions will still increase

even if emissions per kilogram of product are reduced. In the other corner, we have those who promote a totally vegan society. "No livestock – no emissions" makes sense. But this overlooks the positive biodiversity aspects of grazing animals and the resource efficiency of letting animals forage on feed that cannot be used for human consumption.

Acid News

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

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

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

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The Air Pollution and Climate Secretariat

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

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

In furtherance of these aims, the Secretariat:

- * Keeps up observation of political trends and scientific developments.
- * Acts as an information centre, primarily for European environmentalist organisations, but also for the media, authorities, and researchers.
- * Produces information material.
- * Supports environmentalist bodies in other countries in their work towards common ends.
- * Participates in the 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

The current production and consumption of food in the western world is unsustainable. For example, in the EU food consumption is responsible for almost one third of the total environmental impact. Livestock production is the main culprit as it is responsible for 90 per cent of ammonia emissions and half of methane emissions in the EU.

The potential to reduce greenhouse gas emissions from livestock with the help of technology and improvements in management is limited. The UN Food and Agriculture Organization (FAO) has assessed it to be around 30 per cent globally, less in Europe where systems are already highly efficient in terms of kilograms of product per animal unit (AN4/2013).

In order to have a likely chance of keeping global warming below 1.5°C, global emissions need to be negative by 2050. Even with the less ambitious target to stay below 2°C, we would need agriculture to contribute considerably more to emission reductions than can be achieved through management and technological fixes alone.

To move forward, we need to review what we produce and consequently what we consume. This is a sensitive topic. What we eat is part of our identity and is perceived as something very personal. But it cannot be seen as a forbidden area for policy.

In a soon-to-be-published report prepared for AirClim by the Swedish University of Agricultural Sciences it is shown that the global warming potential due to our diet could be reduced by more than 80 per cent by producing food under a different agricultural system based on local resources, in which animal production is limited to feeding on resources that are not in direct competition with human food production (see article on front page).

“a few steps in that direction would require a far-reaching transformation of current agricultural policy”

Nitrogen emission are reduced in almost equal measure.

The various scenario diets would mean reducing meat consumption by between 50 and 90 percent compared to today and replacing it with domestically grown legumes. This may sound like a massive

reduction, but it is actually not so different from the way our grandparents ate when they were children.

The scenarios should not be seen as a blueprint for a desired future. It is probably not necessary to apply the principle of self-sufficiency quite this far to achieve the same emission reductions. There are also other possibilities, such as

innovative new foods and production systems that were not included in the study and should be explored further.

The scenarios can however show us the general direction in which we should be heading.

And just taking a few steps in that direction would require a far-reaching transformation of current agricultural policy. Three out of the four Nordic countries in the study are members of the EU and governed by the Common Agriculture Policy (CAP) – one of the EU's oldest, most influential, most debated and most costly policies.

The European Commission has just launched a major online Public Consultation on the future of the Common Agriculture Policy (CAP). It is essential that as many organisations and individuals, from as wide a variety of sectors and countries as possible, seize this golden opportunity to tell the Commission that we all need a reformed CAP that is fair, environmentally sustainable, healthy and globally responsible.

Kajsa Pira

100% renewable energy in Europe could be possible soon

Wind and solar are getting much cheaper. This is official according to five technology platforms for renewable energies from the EU. Economic and political conditions indicate a faster transition to renewables than thought possible 2–3 years ago.

In 2015 the European Technology and Innovation Platform on Wind Energy (ETIPWind), part of the Energy Union, targeted a cost for offshore wind energy of less than 10 cents by 2020, and less than 7 cents by 2030.

At the end of 2016 the winning tender for the huge 600 MW Krigers Flak park in the Danish Baltic Sea came in at 5 cents, half of the EU target and 4 years ahead of the 2020 deadline. The subsidy applies to the first 11 years. After that it will pay its own way. This was not a one-off occurrence, as it was preceded by other low-cost projects during 2016.

By comparison, the UK government will guarantee 11 cents per kWh for nuclear power over a 35-year period.

According to another technology platform for photovoltaic solar, one target was to reduce system costs by 20 per cent from 2015 to 2020. This may already have been reached by 2016 for large systems, both fixed-tilt and trackers. Investment banker Lazard noted an 85 per cent decrease in cost from 2009 to 2016, despite incomplete data for 2016. The year saw auction prices of around 3 US cents/kWh in Mexico, Dubai and Chile. The EU cost target is sure to be reached before 2020. Other targets are increased efficiency and longevity and a halving of costs for building-integrated PV. The jury may still be out there.

A similar situation applies to targets for geothermal, concentrating thermal solar, and ocean tidal and wave energy.

It is clear that some renewables can beat new fossil and nuclear power right now. But what is needed to cut CO₂ emissions

seriously is that they can also beat existing coal and gas, and do it soon.

Acid News 4/2016 reported on a 100-per-cent renewable scenario for Europe, mainly based on wind and solar, produced by the company ABB in 1992, with a 100-year perspective. Now we know it is feasible much sooner.

But this is not just about economics. The traditional power companies, such as RWE, EDF, Eon/Uniper, Vattenfall, Fortum, Engie, CEZ and others would have enormous stranded assets in the event of a rapid transition to an electricity system dominated by renewables. They and their allies are not going to take this blow sitting down. They have a lot of political clout, and they will use it as best they can.

They are already doing so. Last year the Swedish power industry lobbied successfully to get rid of a nuclear power tax (about .65 euro cent/kWh). They may avert the threat of more wind power by skewing the renewable fuel obligation, so that new wind power cannot enter the market soon, but would have a big impact in 2027–2030.

These measures may possibly save some nuclear reactors in Sweden. So-called capacity markets are extending the lives of coal and nuclear power plants in the UK, and more straightforward subsidies for coal have been or are currently being promoted in Poland, Spain and Germany.

The member states are vulnerable to lobbying from the power industry, so it is important what the EU does.

The European Union has been involved in energy planning since the early 1950s. With the consensus on nuclear power long gone, and coal generally seen as obsolescent

and unsustainable, energy policy became less of a Europe-wide issue and more up to member states. This may be changing with the Energy Union.

The union wants more security of supply (less dependence on Russia and the Mideast), more energy efficiency, more renewables, more interconnections and less greenhouse emissions. This vision includes the ITER thermonuclear fusion project, but this technology is irrelevant for energy choices as it will not reach the market for several decades, if at all. It also includes advanced nuclear fission (fast-breeder reactors), which likewise will not be around as a power producing technology by 2030, which is a target year for EU climate policy. The vision also, theoretically, opens the way for carbon sequestration and storage, CCS. Although the EU has heavily promoted CCS, and offered very large funds for projects, for example in the NER300 programme, there were no takers, so the money went to renewables instead.

So if Europe wants to do anything at all on energy, it will have to go for renewables and efficiency, along the lines proposed by the technology platforms.

Renewables are where the action is. Eighty-six percent of new power capacity in Europe came from renewables: 59 per cent from wind and 32 per cent from photovoltaics. They replaced coal and oil power. Wind energy alone supplied more than 10 per cent of EU-28 electricity consumption, all according to WindEurope's annual statistics.

Fredrik Lundberg



Livestock on leftovers

Continued from front page

A third strategy, “livestock on leftovers”, is explored in a study by the Swedish University of Agricultural Sciences, commissioned by AirClim, which focuses on four Nordic countries and will be published later this spring. Animal production is limited to feeding on resources that are not in direct competition with human food production. Ruminants are allowed to graze on semi-natural pastures and other animals are given by-products from food production.

Other key principles of the study are that food should be produced in an organic farming system and countries should be self-sufficient in the food products that can be produced locally, but are able to import other food products such as tropical fruits, nuts, coffee and tea. Agriculture should be self-sufficient in energy, but should not provide energy for other parts of society.

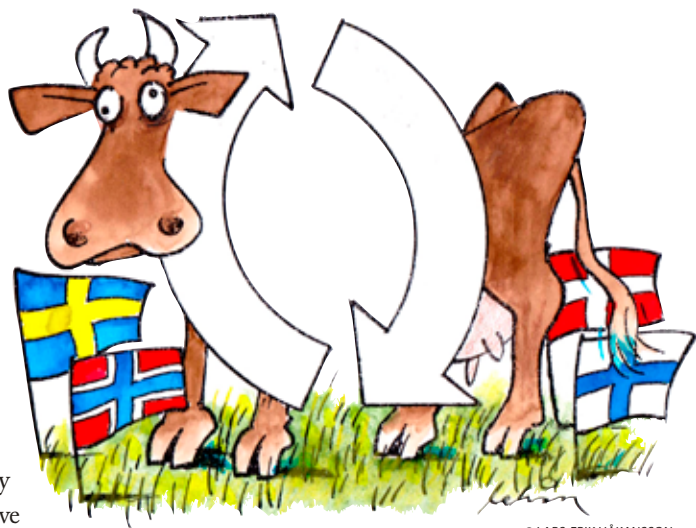
These principles have then been interpreted and modelled in three different scenarios:

- The first is a Sufficiency scenario, developed from a strict interpretation of the principles. The number of cattle and sheep was limited to the minimum needed to graze available semi-natural pastures in each country. By-products were used to feed poultry, pigs and aquaculture fish, and provide supple-

mentary feed for cattle and sheep. Only grass and by-products were allowed in the livestock diets and no additional feed was grown, apart from ley.

- The second is an Efficiency scenario, developed to improve the use of the available resources (grass and by-products). Cattle and sheep were allowed to graze on pastures on arable land, and more grass was used as winter feed in order to make use of all ley grown through crop rotation. In order to use a larger fraction of the by-products, up to 40 per cent of grown feed was included in the food rations.
- The third is a Capacity scenario, developed to explore the effects of using all available land. After land for growing plant-based food had been allocated, the remaining land was used to grow feed for animals.

To ensure a healthy diet with high acceptability to the Nordic population, the scenario diets were based on the Swedish nutrient recommendations translated into food items (SNÖ). This is a model diet designed to be similar to the present Swedish diet while also fulfilling the Nordic Nutrient Recommendations.



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The scenarios were set in 2030 and applied to the cases of Denmark, Finland, Norway and Sweden using national statistics on available arable land and semi-natural pastures, crop yields and nutrient leaching.

Drained peatlands were deducted from the available arable area since they cause considerable methane emissions when cultivated. In Denmark, there is a shortage of natural land, so 15 per cent of the arable area was deducted to increase the share of wild nature.

In addition to the national cases, a common “Nordic” case was modelled, in which all four countries were treated as an entity. The results presented here focus primarily on that case. The projected total population of all four countries by 2030 is 28.4 million inhabitants.

The results show quite extensive changes in comparison to the current diet (box).

The sufficiency diet:

- ✗ 0.5 servings of meat every week
- ✗ 2-3 servings of fish a week
- ✗ 1 egg a week.
- ✗ Half of present consumption of milk
- ✗ A quarter of present consumption of cream and cheese
- ✗ Almost tripled consumption of beans and peas
- ✗ Two apples a day and half a litre of berries a week
- ✗ Same consumption of exotic fruits and coffee as today
- ✗ Six carrots a week, 4-5 onions a week, and 600g cabbage
- ✗ Three tomatoes or 2/3 of a cucumber a week.
- ✗ More than a sixty percent increase in bread and cereals
- ✗ More than double amount of potatoes

The efficiency diet:

- ✗ 1 servings of meat a week
- ✗ 2-3 servings of fish a week
- ✗ 3 eggs a week.
- ✗ 2/3 of present consumption of milk
- ✗ Half of present consumption of cream and cheese
- ✗ More than double consumption of beans and peas
- ✗ Two apples a day and half a litre of berries a week
- ✗ Same consumption of exotic fruits and coffee as today
- ✗ Six carrots a week, 4-5 onions a week and 600g cabbage
- ✗ Three tomatoes or 2/3 of a cucumber a week.
- ✗ More than a fifty percent increase in bread and cereals
- ✗ More than double amount of potatoes

The capacity diet:

- ✗ 2 servings of meat a week
- ✗ 2-3 servings of fish a week
- ✗ 3 eggs a week.
- ✗ 3/4 of present consumption of milk
- ✗ Half of present consumption of cream and cheese
- ✗ Almost double consumption of beans and peas
- ✗ Two apples a day and half a litre of berries a week
- ✗ Same consumption of exotic fruits and coffee as today
- ✗ Six carrots a week, 4-5 onions a week and 600g cabbage
- ✗ Three tomatoes or 2/3 of a cucumber a week
- ✗ About a fifty percent increase in bread and cereals
- ✗ More than double amount of potatoes

Meat consumption is reduced by 89 per cent in the Sufficiency scenario, by 79 per cent in the Efficiency scenario and by 52 per cent in the Capacity scenario, and replaced by legumes. It is worth noting that some of the changes are due to the fact that the new diets follow health recommendations, which means an increase in vegetables and fruits.

The changes in land use differ between the countries; in general land use will be more diversified than today (figure 1). In the first two scenarios there is excess land after providing food for the local population. This land could be used for different purposes, e.g. growing biofuels, food for export, providing a buffer for population growth or turned into wild nature. In the Sufficiency scenario the excess land could potentially support another 13 million people with the Sufficiency diet. For the Efficiency scenario the corresponding figure is 11 million people.

Livestock numbers are significantly reduced. In the Sufficiency scenario the number of cattle and sheep is around 30 per cent of present numbers, while poultry are reduced to 16 per cent and pigs to 6 per cent. The Efficiency scenario allows for slightly higher numbers; cattle and sheep are reduced to 44 per cent, poultry to 54 per cent and pigs to 16 per cent compared to today. The Capacity scenario has the highest numbers of livestock but still only allows half of the number of cattle and sheep, 57 per cent of the poultry and 68 per cent of the pigs.

There is no specialised beef production in any of the scenarios. Instead a multi-purpose breed is used for both dairy and beef. This gives lower milk yields than the most common breeds in present dairy farming, but on the other hand it can be sustained on a higher proportion of roughage.

Poultry farming under these scenarios is also quite different from today. Instead of having totally separate production systems for eggs and poultry meat, a dual-purpose breed was used, with cockerels reared for meat. The scenarios limited egg production to 12 kg per capita per year, or 40 per cent more than in the SNÖ diet. However it

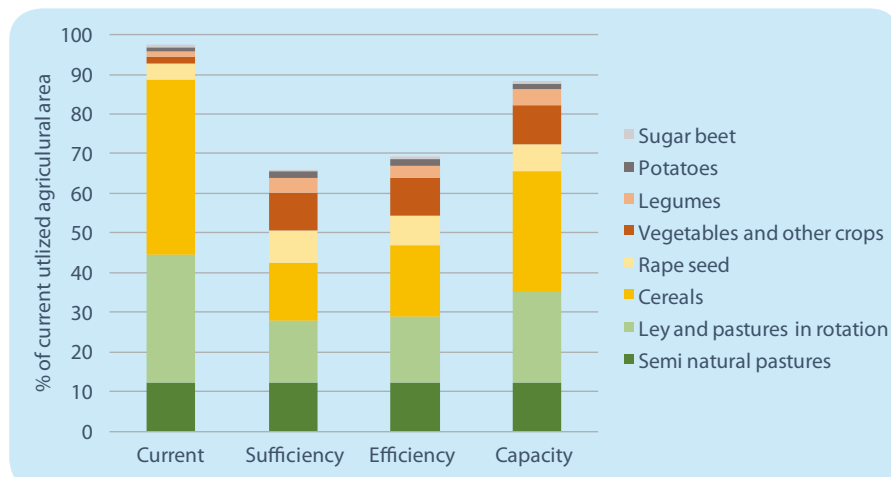


Figure 1. Land-use for the different scenarios in per cent of current utilized agricultural area.

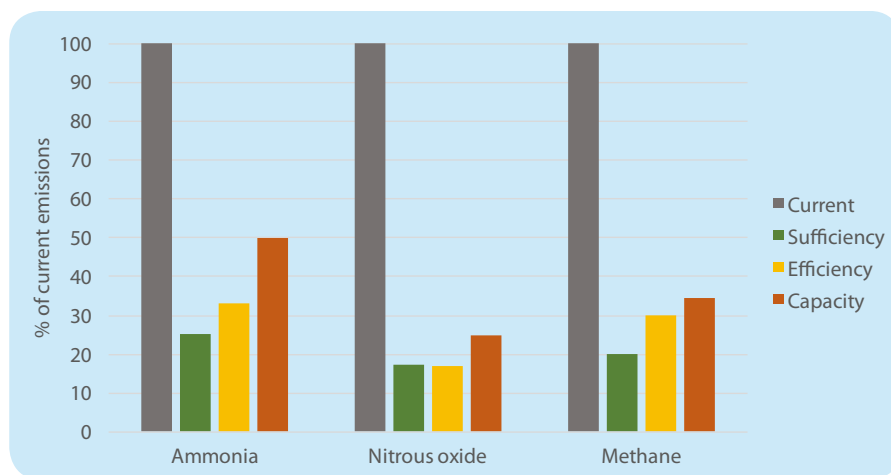


Figure 2. Emissions from agriculture for the different scenarios in per cent of current emissions.

would be possible to replace some of the pig farming in the scenarios with broiler chicken production, without extensive changes in the rest of the outcome.

Ammonia emissions are reduced by 75 per cent in the Sufficiency scenario, 66 per cent in the Efficiency scenario and by 50 per cent in the Capacity scenario, compared to present emissions. (figure 2) However, in the first two scenarios there is excess agricultural land, and if this was used to produce food for export, emissions would go up, but probably no higher than in the capacity scenario.

The effect is even greater for greenhouse gases. The global warming potential per capita for the scenario diets (including emissions from imported food) are somewhere between 0.3 and 0.4 tonnes CO₂ eq/year. For comparison, the carbon footprint of food consumption in Sweden today is in the order of 2 tonnes CO₂ eq/year.

Nitrous oxide emissions are reduced by 83 per cent in the first two scenarios and by 75 per cent in the Capacity scenario.

Methane emissions are reduced by 80 per cent in the Sufficiency scenario, 70 per cent in the Efficiency scenario and 66 per cent in the Capacity scenario.

Not included in these calculations is soil carbon. The reason for this is the huge uncertainties in terms of the data for this parameter so far. It is however possible to discuss the factors that influence it. Since the total area of ley will decrease compared to the present situation and the level of production will also decrease, sequestration will probably be reduced. This will be partially offset by the fact that organic crops have larger root systems than conventional crops. The inclusion of practices such as winter crops and catch crop production could also contribute positively to carbon sequestration.

Kajsa Pira

The report "Future Nordic Diets" will be published later this spring.



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Five member states have received final warnings.

23 countries are breaching air quality laws

Binding air quality standards are being flouted in more than 130 cities across 23 of the 28 EU member states, according to the European Commission's Environmental Implementation Review.

Infringement proceedings for PM₁₀ have been launched for a total of 16 countries: Belgium, Bulgaria, Czech Republic, Germany, Greece, Spain, France, Hungary, Italy, Latvia, Portugal, Poland, Romania, Sweden, Slovakia and Slovenia. In 2015, cases against Bulgaria and Poland were brought to the European Court of Justice.

Over the last two years, the Commission launched legal action against 12 member states for failing to enforce the air qual-

ity standards for NO₂, namely: Austria, Belgium, Czech Republic, Germany, Denmark, Spain, France, Hungary, Italy, Poland, Portugal and the UK.

On 15 February, the Commission sent final warnings (reasoned opinion) to the EU's five largest countries – Germany, France, the UK, Spain and Italy – over “repeated, persistent breaches” of the NO₂ limits.

Sources: EurActiv.com, 7 February 2017; Commission press release, 6 February 2017: http://europa.eu/rapid/press-release_IP-17-197_en.htm and 15 February 2017: http://europa.eu/rapid/press-release_IP-17-238_en.htm

Bulgaria faces court for air quality failure

Bulgaria breached EU limits for particulate matter (PM₁₀) across all its urban areas between at least 2007 and 2013 and its plans to achieve compliance were “flawed”, according to the advocate general of the European Court of Justice (ECJ), Juliane Kokott.

The plan submitted by Bulgaria to the European Commission to reduce PM₁₀ concentrations had “structural deficiencies” as it lacked a timetable for implementing air quality measures and did not describe the improvements they would bring, Kokott said in her opinion for the ECJ. It remains to be seen whether the court will follow the opinion of the advocate general when it rules on the case, which should take place in the first half of 2017.

Poland also faces a similar lawsuit, which was brought by the Commission in June 2016 for an alleged breach of PM₁₀ limits across 35 ambient air quality zones.

Source: Ends Europe Daily, 16 November 2016.

The opinion of advocate general Kokott: <http://curia.europa.eu/juris/document/document.jsf?text=&docid=185257&pageIndex=0&doclang=EN&mode=req&dir=&occ=first&part=1&cid=584889>

Air pollution linked to fifth of pre-term births

Close to a fifth of premature births worldwide could be associated with mothers' exposure to outdoor air pollution, according to a study by the Stockholm Environment Institute (SEI). It showed that up to 2.7 million of the 14.9 million births worldwide considered as pre-term, i.e. taking place before 37 weeks of gestation, can be linked to mothers' exposure to particulate matter PM_{2.5} levels above 10 micrograms per cubic metre of air (µg/m³).

“Pre-term births associated with this exposure not only contribute to infant mortality, but can have life-long health

effects in survivors,” said Chris Malley, the study's lead researcher.

According to the European Environment Agency, around 85–90 per cent of Europe's urban population is exposed to PM_{2.5} levels above the WHO annual average threshold of 10 µg/m³.

Source: Ends Europe Daily, 17 February 2017

The study: <http://www.sciencedirect.com/science/article/pii/S0160412016305992>



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New NEC Directive in force

When fully implemented in 2030, the directive will nearly halve the negative health impacts of air pollution, such as respiratory diseases and premature death.

On 17 December 2016 the new National Emission Ceilings (NEC) directive was published in the EU's Official Journal and it entered into force on 31 December.

The new NEC directive (2016/2284) sets legally binding emissions reduction commitments for the member states' emissions of sulphur dioxide (SO₂), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC), ammonia (NH₃) and fine particulate matter (PM_{2.5}).

Between 2005 and 2030, the emissions for all EU28 member states combined are to be cut by 79 per cent for SO₂; 63 per cent for NO_x; 49 per cent for PM_{2.5}; 40 per cent for NMVOC; and 19 per cent for NH₃.

The intermediate 2020 reduction commitments are identical with those that member states have already agreed internationally in the 2012 revision of the Gothenburg Protocol under the Convention on Long-Range Transboundary Air Pollution. Information on and comments to the country-by-country emissions reduction commitments can be found in Acid News No 3, 2016, pages 16-17.

Member states must transpose the Directive into national legislation by 30 June 2018 and produce a National Air Pollution Control Programme by 1 April

2019, setting out measures to ensure that emissions of the five main air pollutants are reduced by the percentages agreed for the target years 2020 and 2030. The National Air Pollution Control Programme must be updated at least every four years, and the programmes and updates shall be subject to public consultation prior to finalisation.

With the new directive, several new flexibilities are introduced, including:

- Adjustment of emission inventories;
- Three-year averaging of emissions (in case of an exceptionally cold winter or an exceptionally dry summer);
- Up to three years delay if non-compliance results from unforeseeable events (such as exceptional interruption or loss of capacity in the power/heat production system);
- Up to five years delay (for some countries) if non-compliance occurs despite implementation of all cost-effective measures; and,
- Deviation from following the linear reduction trajectory between 2020 and 2030.

The Commission will set up a European Clean Air Forum composed of national experts and stakeholders to exchange

experience and best practices. A first meeting is expected in November 2017.

Karmenu Vella, Commissioner for the Environment, Fisheries and Maritime Affairs, said: "The new European air quality rules are a significant landmark in the fight against this invisible killer that is air pollution. Air pollution kills over 450,000 people in Europe each year. This is more than ten times as many as road traffic accidents. Now it is for the national governments to start with implementation so that people can benefit from cleaner air. We will work with member states to support them in this challenge for improving the health of EU citizens."

Christer Ågren

Source: European Commission press release, 14 December 2016

The new NEC Directive EU 2016/2284:
<http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32016L2284>

Commission fact sheet on the new NEC Directive:
http://europa.eu/rapid/press-release_MEMO-16-4372_en.htm

A new more flexible
NEC directive in place.



Big emissions from small chimneys

Domestic wood burning is a major source of air pollutant emissions – a new eco-labelled wood stove is allowed to emit 25 times more health-damaging particles than a ten-year old diesel truck.

Wood burning is perceived by many as being natural and therefore environmentally benign, but it is in fact a significant source of several harmful air pollutants, including fine particulate matter (PM_{2.5}), black carbon (soot), dioxins, polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs).

These emissions contribute significantly to premature mortality and morbidity and the soot particles also contribute to Arctic warming and global climate change. Moreover, the share of emissions from residential wood burning in the EU is expected to increase as other key emission sources gradually become more efficiently regulated and because increasing costs of conventional home heating will continue to stimulate cheap wood burning.

In European emission inventories, small-scale combustion of fuels for domestic heating is reported under a sector called “commercial, institutional and household”. In the EU28, fuel combustion in this sector is the major emission source of primary PM_{2.5}, contributing 56 per cent of total emissions, as well as PM₁₀ (40%), black

carbon (46%) and the carcinogenic PAH compound ben(a)pyrene (71%).

Expressed as grams of particles per unit of energy, the emission levels from residential wood burning are so high that they totally overshadow those from other heat sources (see figure). In addition, detailed measurements from chimneys show that emissions of PM_{2.5} may increase up to 30 times if a stove is not operated properly and up to 250 times if it is misused, which underlines the fact that emission levels can be much higher under real-life conditions.

Detailed measurements in residential areas in Denmark show that wood burning can increase local concentrations of PM_{2.5} and PAH to levels similar to those found in rush hour traffic in central Copenhagen.

Other measurements have shown that wood stoves can give rise to very high levels of indoor air pollution, a significant problem especially in the winter period, when people spend most time indoors and ventilation is limited.

Biomass fuel is usually regarded as carbon neutral, because trees take up carbon

dioxide (CO₂) from the atmosphere as they grow, and burning wood simply releases the same amount of CO₂ back into the air. This, however, assumes that the wood fuel comes only from forests that are managed and harvested in a sustainable manner, and it ignores the carbon footprint of transporting and drying the wood.

In addition, wood burning generates soot particles (black carbon) that contribute to global warming, especially in the shorter term. So even if wood burning may be largely carbon neutral, it is definitely not climate neutral.

Key challenges related to residential wood burning are the high pollution levels combined with the long lifetime of each unit (usually more than 30 years) and the intensive use of wood burning because it is a cheap or sometimes even free method for heating in many parts of Europe.

So how can the emissions from domestic wood burning be reduced?

A first measure is to minimise the heat consumption of houses through better insulation. That way you will effectively reduce the amount of wood burned, independent of whether wood is a supplementary heat source (stove) or the primary heat source (boiler).

Then you look for cleaner alternative – primarily renewable – heating sources, such as solar heat, biogas, and geothermal energy, including heat pumps (driven by green electricity). District heating, especially from combined heat and power plants that are fuelled by renewables and from industrial surplus heat, is another option.

New stoves and boilers, especially those that are eco-labelled, are generally more efficient and cleaner than old ones, even though they will still generate higher emissions than the alternative heating sources. Replacing wood logs with pel-

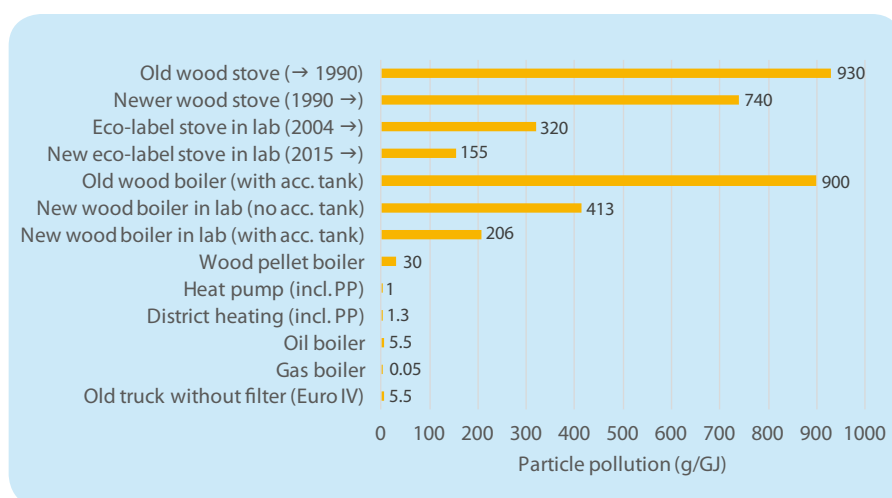


Figure: Emissions of fine particles from different sources, expressed as grams of PM_{2.5} per gigajoule of energy.



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Information campaigns aimed at wood fuel users to improve stove operation is one of the measures that could be implemented on a national level.

lets is usually beneficial, as it reduces the influence of bad burning behaviour and inferior fuel quality.

Improving stove operation can significantly reduce emissions – but this is a complex issue, and even well operated wood stoves can still be high emitters.

In 2015, the EU's Ecodesign directive was extended to include energy efficiency and emission standards that will apply to new solid fuel boilers as from 2020 and to new local space heaters as from 2022. While these new standards will help to keep the worst products from entering the market, they are much less stringent than what can actually be achieved by the best already existing appliances. Consequently there is an urgent need to revise and strengthen these standards.

Because the Ecodesign standards are harmonized at EU level, member states are not allowed to introduce stricter national requirements. But there are a number of other measures that can be taken at national and/or local level, including:

- Incentivising energy renovation and home insulation, as well as small-scale solar and geothermal energy installations;
- Banning or restricting the installation and use of domestic solid fuel appliances – especially in highly polluted areas or during pollution episodes;
- Incentivising quicker replacement or shutdown of old appliances;

- Introducing emission-related taxes/fees on domestic solid fuel burning;
- Introducing ambitious eco-labels for stoves and boilers to promote front runners in the market;
- Information campaigns to make citizens in general, and wood fuel users in particular, more aware and to improve stove operation;

For example, replacing old wood stoves with Swan-labelled stoves and replacing old wood boilers with new boilers could halve the pollution from private wood burning. And if all wood stoves and wood boilers were replaced with wood pellet equivalents, the pollution from residential wood burning could be cut by more than 90 per cent.

Economic incentives, such as emission taxes or charges, combined with strict emission limit values, are efficient instruments for speeding up the replacement (phase-out) of heavily polluting stoves and boilers.

The Danish Ecological Council has designed a tax proposal for stoves and boilers in Denmark, which is based on the type of installation, varies with emission levels and is differentiated for urban and rural areas. The tax would be paid per hour of pollution (i.e. when the stove/boiler is used), and the hours of pollution are measured by a small temperature

sensor placed in the chimney that counts the number of hours of use. The Danish Economic Councils, as well as the Danish tax authorities (Ministry of Taxation), have both calculated in 2016 that this is the most cost-efficient way to regulate wood burning. The polluter pays principle is then introduced by making the tax equal the pollution costs depending on the emission (type of device) and the health costs (urban/rural area).

The proposal would result in a fairer taxation of heat sources by increasing the fee on the most polluting types. Leading Danish health experts and economists estimated in 2016 that this tax could save about 350 annual premature death in Denmark and save Danish society health costs worth more than €450 million per year. Furthermore, incentives to insulate houses would be enhanced, as well as the promotion, sales and development of better stoves and cleaner heat sources.

Kåre Press-Kristensen and Christer Ågren

Sources: Information from the EU LIFE project Clean Heat (www.clean-heat.eu), especially the brochure "Residential wood burning – Environmental impact and sustainable solutions" and the booklet "Pollution from residential burning – Danish experience in an international perspective."

The mining curse that haunts lignite towns

Lignite is no longer the cash cow it used to be. Local communities in Germany are now struggling with fewer jobs, lost tax revenues and environmentally degraded land.

Lignite mining output in Germany has declined by almost two-thirds since 1990. However, most remaining generation plants will still be needed until nuclear power has been finally phased out in 2022. Renewable technologies are dedicated to filling this supply gap. For the time being, therefore, lignite will continue to provide nearly one-quarter of grid electricity.

Once nuclear generation has been fully superseded, however, lignite power stations can be successively retired to meet greenhouse gas reduction goals. That should not be difficult, because many plants are already unprofitable.

Germany's largest lignite producer, RWE AG in the Rhine Valley, has terminated 10,000 employees (14% of the total workforce) over the last three years in order to reduce costs. Regular dividends to local cities and banks that own nearly one-fourth of corporate stock have been fully eliminated. RWE's municipal shareholders are legally required to write down losses below the original purchase price. For this reason, the city of Essen lost €680 million of stock valuation in 2013 alone. Bochum recently divested its 6.6 million RWE shares at a unit price below €15, compared with €100 a decade ago. Most recently, RWE posted a loss of €5.7 billion for the year 2016.

Lignite mines and power plants therefore no longer insure regional prosperity. The situation in eastern Germany is particularly dramatic.

The town of Neukieritzsch, with less than 7,000 residents, formerly benefited from the highest corporate tax proceeds in western Saxony. When Vattenfall put its 934 MW Lippendorf power plant up for sale in 2015, however, it simultaneously reclaimed trade taxes paid as early as 2006. Revenues of over €1,600 per inhabitant have since been returned by Neukieritzsch to the Swedish corporation.

Vattenfall sold three additional power stations and four mines in Lusatia in 2016, where widespread communal insolvency was already emerging. Boxberg, once Saxony's most prosperous town per capita, with 4,675 residents, has been obliged to refund millions of euros previously received for its 2,575 MW power station.

State and local taxes of €40 million have also been defaulted in Brandenburg for the 2 x 800 MW Schwarze Pumpe CHP plant along with the local Welzow South surface mine. At the 3,000 MW Jänschwalde power station near the Polish border, trade taxes totalling more than €29 million have been refunded by the communities of Teichland, Peitz, and the corporate headquarter city of Cottbus.

In 2013, Vattenfall affirmed that its profits were sufficient to avoid selling its lignite assets. By the time the new successor corporation LEAG had been announced in 2016, however, many communities had already been issued revised tax notifications with increased

refund obligations. While government secrecy regulations preclude public information on the actual figures, retroactive payments of well over €100 million have been reported by local newspapers. The total trade taxes returned to Vattenfall are likely much greater.

With non-transparent taxation practices and the uncertain profitability of individual lignite operations, cities and towns continue to provide potential opportunities for energy corporations to multiply their capital assets. The state interest rate of six per cent applies to all tax debt repayments, amounting to high-yield lignite industry loans financed at public expense.

The communities are simultaneously confronted with environmentally detrimental mining legacies. Reclaimed land is agriculturally less productive than native soil. Buildings cannot be erected before the ground has firmly settled. Subsurface water rising in former mining sites can contaminate local rivers and endanger drinking water supplies.

In overcoming these obstacles, the lignite regions have begun developing their own post-carbon strategies. A great number of renewable power installations have already been located on the same plots formerly used by the lignite industry.

Jeffrey H. Michel

Lignite regions need to take the leap to a post-carbon society.



Comparing vehicle emission standards

A report named “Comparative study on the differences between the EU and US legislation on emissions in the automotive sector” was published by the European Parliament in November. It provides an overview of technologies used in vehicles to comply with emission legislation and of differences between the US and EU with regards to emission standards for air pollutants and greenhouse gases; type-approval structures; conformity of production; in-service performance verification; implementation and enforcement of legislation and its impact; and legislation on defeat devices.

The report recommends that:

- The flexibility for manufacturers to choose their regulator is removed;

- Oversight of implementation of environmental standards is placed in the hands of organisations with a clear environmental mission;
- Transparency on the use of emission control devices is improved, with manufacturers required to provide full

- information on them to regulators, and seek prior approval of the use of any defeat devices under specific derogations;
- Greater clarity is provided on the duties of regulators both to monitor in-service performance, and to identify and pursue cases of non-compliance;
- Improved EU-level monitoring of the performance of type approval authorities (TAAs) is introduced, with the option of suspending a TAA's right to issue type-approvals in the event of persistent weaknesses in performance.

The report: [www.europarl.europa.eu/RegData/etudes/STUD/2016/587331/IPOL_STU\(2016\)587331_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/STUD/2016/587331/IPOL_STU(2016)587331_EN.pdf)



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No improvement in fuel efficiency for years

New cars consume on average 42 per cent more fuel on the road than advertised in sales brochures, according to Transport & Environment's latest Mind the Gap report. Despite auto industry claims of their vehicles' ever-improving fuel economy, the gap between real-world fuel consumption and official figures has grown from 28 per cent in 2012 and 14 per cent a decade ago. In practice this means that a typical driver spends around €550 more per year in additional fuel costs compared to what might be expected from the official test figures.

Greg Archer, clean vehicles director of T&E, said: “There has been no improvement in the average efficiency of new cars on the road for four years because carmakers manipulate tests to achieve their CO₂ targets instead of designing the car to be efficient on the road. As a result, drivers are being tricked and forced to buy more fuel; governments defrauded of tax revenues; and climate targets undermined.”

Source: T&E News, 9 January 2017. Link: <https://www.transportenvironment.org/news/no-improvement-average-efficiency-new-cars-four-years>

Four of world's biggest cities to ban diesel cars

Diesel vehicles will be removed from Paris, Mexico City, Madrid and Athens by 2025, as part of an effort by mayors to improve the quality of air for their citizens. These cities also pledged to incentivise alternative vehicles and promote walking and cycling infrastructure.

“Mayors have already stood up to say that climate change is one of the greatest challenges we face,” said Anne Hidalgo, Mayor of Paris and new Chair of the C40 Cities Climate Leadership Group. “Today, we also stand up to say we no longer tolerate air pollution and the health problems and deaths it causes – particularly for our most vulnerable citizens. Big problems like air pollution require bold action, and we call on car and bus manufacturers to join us.”

Source: C40 press release, 2 December 2016. Link: http://www.c40.org/press_releases/daring-cities-make-bold-air-quality-commitment-to-remove-all-diesel-vehicles-by-2025

Trucks and buses cleaner than diesel cars

The research group International Council for Clean Transportation (ICCT), reports that heavy-duty vehicles (mainly buses and trucks) tested in Germany and Finland emitted on average about 200 milligrams of NO_x per kilometre driven, less than half of the average 500–600 mg/km pumped out in real-world driving by diesel cars that meet the highest Euro 6 standard.

As the buses and trucks have larger engines and burn roughly five time more diesel per kilometre, this means that heavy duty vehicles are ten times better than light-duty diesel vehicles at reducing NO_x emissions.

The ICCT report: <http://www.theicct.org/nox-europe-hdv-ldv-comparison-jan2017>

Five times cleaner than a Euro 6 diesel car.





CCS is still a failure

After decades of talking and billions of euros in investments there are no large commercial CO₂ storage facilities in Norway, Canada, the US or anywhere else in the world.

There is much less focus

on CCS in the Norwegian debate these days. The reason is that in 2013 the project to build a full-scale demonstration CCS plant was shelved. But maybe the most frequently reported results from the Norwegian CCS experience are from the Sleipner project in the North Sea. Proponents of CCS point to Sleipner and say it is proof that CCS is feasible on a large scale. Among the arguments used is that it has pumped a million tons of CO₂ per year – in total 48 million cubic metres – down into a sandstone formation called the Utsira formation since 1996, without any sign of leakage. According to Professor Peter M. Haugan at the Institute for Geophysics, University of Bergen, this may be just pure coincidence (or luck, in layman's term). A careful study of the reservoir and the cap rocks above the reservoir was not carried out prior to the start of pumping in 1996. A later study of the CO₂ storage reservoir carried out in 2014 showed numerous cracks and so-called chimneys through the cap rock, and some of them reached all the way down to the sandstone, where the CO₂ is stored. A huge crack was found 25 kilometres north of the storage area. This could just as well have turned out to have been above the storage area, but nobody knew that back in 1996.

Professor Haugan's conclusion was that it is very costly to research a possible storage area in order to be sure that it will not leak. The process may take between 3 years at the best and 10 years at the worst, before one can draw a conclusion. This conclusion is not guaranteed to be positive. A long and costly process may end with a "No", that the area is not suitable for storage. This also means that CO₂ storage areas are a resource with a limited supply, and must be treated as such. They should not

be used for storage of CO₂ that may be otherwise removed by other measures.

Statoil, which is the oil company with most experience in the North Sea, and the operator of Sleipner and the CCS project there, is optimistic about the long-term prospects of CO₂ storage in the North Sea. However, at the present time, there are no large commercial CO₂ storage facilities anywhere in the world. The term "commercial" means a facility that accepts CO₂ from several customers for storage. Neither are there any large-scale CCS plants anywhere in Europe that may need a place to store CO₂. The price of CO₂ is also far too low to make a commercial CO₂ storage facility economically viable. The CO₂ price must be at least 50 USD/ton, while at present the price is just 6 USD/ton CO₂, according to Statoil.

The Sleipner project is only intended to store CO₂ separated from the natural gas extracted from the reservoir deep under the seabed, and does not accept CO₂ from other sources. An important reason for this is that the CO₂ at Sleipner has very different properties from CO₂ captured from exhaust gases at a power plant. The equipment that handles the CO₂ is designed to suit these properties, and cannot handle CO₂ with different properties. The CO₂ at the Sleipner field arrives at the surface together with natural gas under very high pressure and at very low temperature, and the separation of the CO₂ from the natural gas is tailored for this. The pressure makes it easier to pump the CO₂ down into the storage area.

These are the main reasons why the Sleipner project has only limited value as an example of what is possible regarding commercial storage of CO₂ underground,

especially in underground formations in the North Sea.

Quite often other types of CC – Carbon Capture – projects are also lumped together with real CCS projects such as the Sleipner project. This causes confusion, and creates a false impression that there are many real CCS projects around the world. This impression is of course useful for the supporters of CCS, so they do not try to clear up the misunderstanding, and may even actively contribute to the confusion. The problem lies with projects that separate CO₂ from exhaust gases, mainly from coal-fired power stations. These projects are examples of Carbon Capture – CC – but the Storage part is missing. The CO₂ from many Carbon Capture plants is not stored underground with the express intention that it should remain there for a very long period of time. Instead, the CO₂ is often used for industrial purposes, and eventually released back into the atmosphere. (Whenever you open a bottle of fizzy sugar drink, the CO₂ in the bottle is released into the atmosphere.) Another use, which is quite common, is the use in Enhanced Oil Recovery – EOR. Here, the CO₂ is pumped down into oil and gas reservoirs. This increases the pressure in the reservoir, and pushes out more oil and gas. The CO₂ will also find its way back into the atmosphere from the oil and gas reservoirs, even if it may be delayed for some time. To call this "storage" is confusing, since the CO₂ captured is not stored underground; it is only delayed on its way to the atmosphere. Lumping together CC and CCS projects and calling them all CCS is therefore dishonest, and does not reflect the real situation.

In recent years two or three such CC projects have been hailed as the next big



CCS projects, although they are not. The most recent example has been touted as America's first "clean coal" plant, as it captures CO₂ from a coal combustion plant outside Houston, Texas. However, it is not a CCS plant, since the CO₂ captured is piped 80 miles to the West Ranch oil field. There the CO₂ is used to force additional oil from the ground. The same article also describes the Kemper Plant, located further east, in the state of Mississippi. This is a plant that gasifies lignite, a type of coal, into something called syngas, and removes some of the CO₂ in the process. The syngas is burned for electricity generation, and CO₂ from the exhaust gas is also stripped away. Together, the CO₂ from both stages is then shipped to an oil field for EOR – to aid additional oil recovery. In the article, both plants are lumped together and called examples of CCS, although this is patently wrong. There is no permanent storage of the CO₂; it will escape to the atmosphere after being used in EOR.

The Boundary Dam CC plant in Canada is a third example of a plant that captures CO₂ and 90 per cent is used for EOR in an oil field not far away. A small part, 10 per cent, is used in an experimental storage facility.

A review of most of the plants that CCS supporters are lumping together and calling CCS plants would probably reveal the same facts: carbon capture is mainly done in order to get CO₂ for use in EOR – pushing more oil out of the ground. This is not doing anything to reduce the CO₂ in the atmosphere, and so cannot be called a climate mitigation measure. Rather the opposite, in fact, since it can be argued that these plants increase the amount of oil available for burning. That is not helpful for the atmosphere, or for humanity and the ecosystems on this planet.

Tore Braend

1 tonne of CO₂ melts 3 m² of Arctic ice

Study argues that Arctic summer sea ice can survive only if global warming is kept below 1.5°C.

Noting that Arctic ice cover for summer has already shrunk by more than half in the past 40 years, the climate scientists predicted that the remaining ice will disappear by the middle of the century. Published in *Science*, the study evaluates the future of the Arctic summer sea ice on the basis of observational data obtained between 1953 and 2015. Making a linear connection between carbon dioxide emissions and Arctic summer sea ice, the study led by lead author Dirk Notz from the Max Planck Institute for Meteorology in Hamburg, Germany, commented that the observed numbers are very simple. "For each ton of carbon dioxide that a person emits anywhere on this planet, 3 m² (± 0.1m²) of Arctic summer sea ice disappears," he noted.

The study argues that Arctic summer sea ice can survive only if global warming is kept below 1.5°C. by reducing greenhouse gas emissions including carbon dioxide. "The internationally

agreed 2°C global warming target is not sufficient to allow Arctic summer sea ice to survive," noted Notz.

The study traces a robust linear relationship between monthly mean September sea ice area and total CO₂ emissions based on the observational record. The methodology addresses the disparity problem that long plagued climate-model simulations regarding the sea-ice loss. According to the study, the linear relationship makes it clear that a loss of 3 ± 0.3 m² of September sea ice area per metric ton of CO₂ emission is really happening. The damage wrought by carbon dioxide as a greenhouse gas is that it keeps the heat retained in the Earth's atmosphere and escalates the global temperature more and more.

Source: <http://www.techtimes.com/articles/184807/20161105/here-s-how-much-arctic-sea-ice-you-re-melting-for-every-ton-of-carbon-dioxide-you-emit.htm>



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Global warming and its implications for coral reefs

At current projected levels of temperature increase it has been suggested that tropical coral reefs could be lost altogether as soon as 2050

Coral reefs are marine structures of limestone built from the skeletons of coral animals, and it has taken millions of years to build the reefs we see today. Coral reefs occur in at least two types. Barrier reefs extend along coasts. The best-known example is the Great Barrier Reef off the east coast of Australia, which is the world's largest coral reef (see more below). Coastal reefs form an addition to an island or a coast. Corals prefer such shallow areas where they eventually reach the water surface and create a kind of platform.

Coral reefs are also divided into two groups according to the water temperature and depth of occurrence. The most well-known and studied ones are the shallow-water coral reefs in tropical and subtropical waters, while the other type occurs in northern temperate areas in

much colder water and at great depth. Most of this overview is focused on the tropical reefs, because they are already heavily impacted by global warming.

The projected water temperature increase will greatly affect the most biodiverse ecosystems of the oceans – the tropical coral reefs – which harbour some 25 per cent of all marine species over an area covering less than 0.1 per cent of the total ocean surface (Spalding et al. 2001). Another side effect of global warming is the increased content of carbon dioxide in the atmosphere. The liming processes in the corals are disturbed by increasing carbon dioxide.

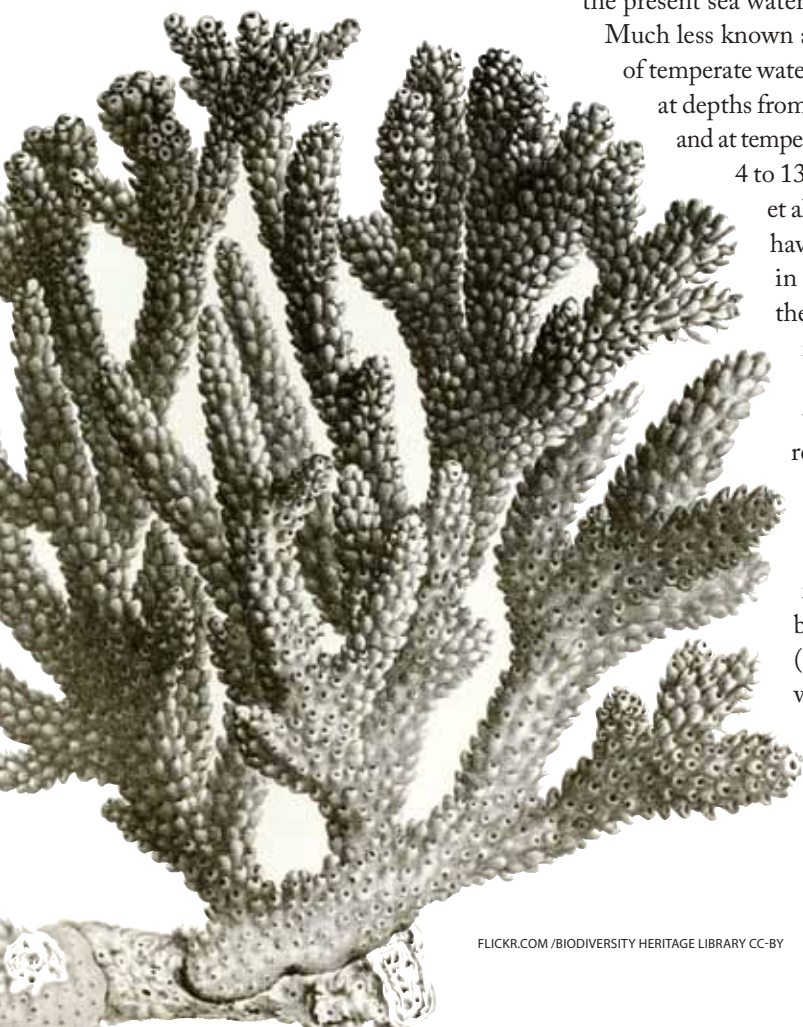
Tropical coral reefs are found in more than 100 countries. This figure refers to the warm-water coral reefs, which are by far the most well known, because they occur in very shallow water and even at the present sea water level.

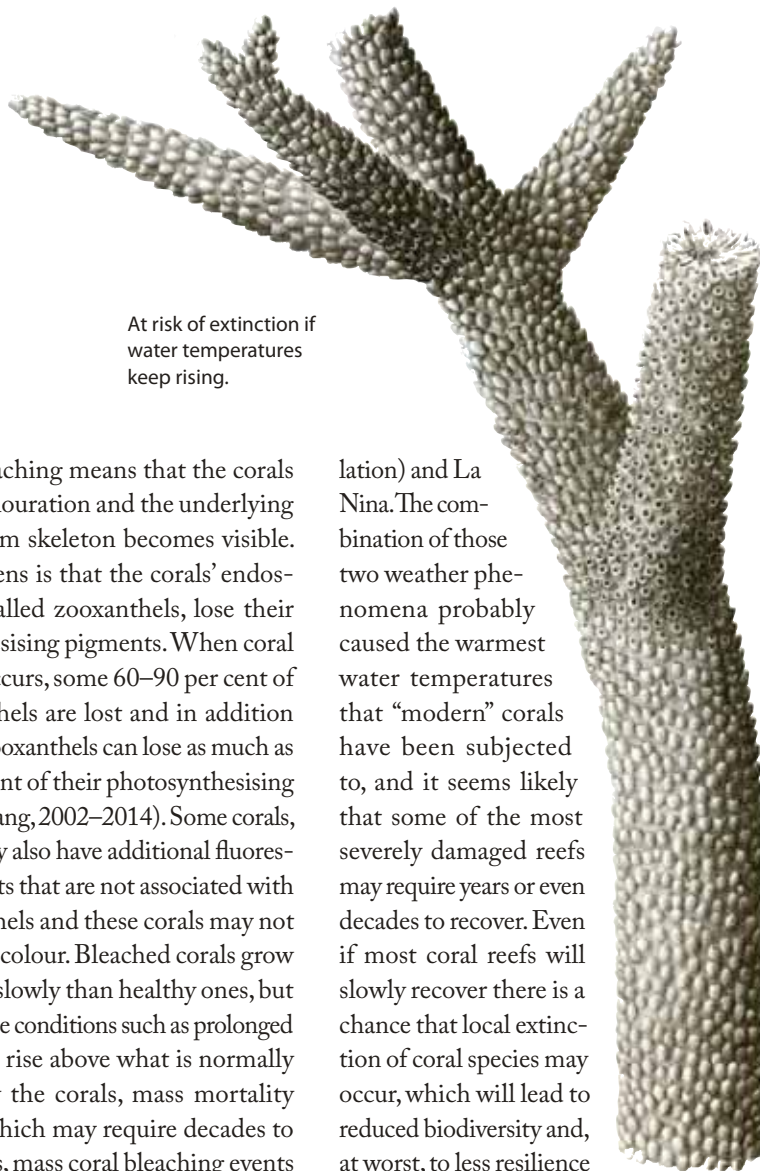
Much less known are the stone corals of temperate waters, which may occur at depths from 40 to 3,000 metres and at temperatures ranging from 4 to 13 degrees (Corcoran et al., 2006). These reefs have so far been found in 41 countries and their total area is estimated to be as great or even greater than the tropical coral reefs (Corcoran et al., 2006). In the North Atlantic these cold-water reefs are mainly built up of eyes corals (*Lophelia pertusa*), which occur off the Swedish West Coast for example (www.marbipp.se – 2016).

The largest yet discovered cold-water coral reef made up of eyes corals is found off the Lofoten archipelago in Norway, and appears to cover an area of close to 100 km² (Fosså et al., 2003). The high density of reefs shown in the North Atlantic most probably reflects the intensity of research in this region and further discoveries are expected mainly in the deeper waters of tropical and subtropical regions.

The global oceans regulate our climate and weather conditions, like rainfall and floods. The oceans also absorb roughly one third of all carbon dioxide emitted through human activities, and have also absorbed some 90 per cent of the extra heat trapped by the rising concentrations of greenhouse gases (Gattuso et al., 2015). The temperature rises so far experienced mean that three-quarters of the world's coral reefs are currently under threat (Burke et al., 2011).

As mentioned above, tropical coral reefs are probably among the least resilient marine ecosystems, as well as the first victims of global warming. These reefs occur in shallow water, where the temperature is rarely less than 20 degrees and salinity is around 3.5 per cent. I have emphasised (see below) that the number of fish species has declined significantly, but the most destructive effect on the well-being of a coral reef ecosystem is the effect on the reef itself. This process is termed coral bleaching. Corals are adapted to live within a narrow temperature regime. A temperature increase above the corals' threshold level by as little as 1–2 degrees (C) for 5–10 weeks can lead to coral bleaching (Lang, 2002–2014).





At risk of extinction if water temperatures keep rising.

Coral bleaching means that the corals lose their colouration and the underlying white calcium skeleton becomes visible. What happens is that the corals' endosymbionts, called zooxanthels, lose their photosynthesising pigments. When coral bleaching occurs, some 60–90 per cent of the zooxanthels are lost and in addition individual zooxanthels can lose as much as 50–80 per cent of their photosynthesising pigments (Lang, 2002–2014). Some corals, however, may also have additional fluorescent pigments that are not associated with the zooxanthels and these corals may not lose all their colour. Bleached corals grow much more slowly than healthy ones, but under extreme conditions such as prolonged temperature rise above what is normally tolerated by the corals, mass mortality can occur, which may require decades to recover. Thus, mass coral bleaching events are projected to increase in frequency and intensity, and even preserving more than 10 per cent of present coral reefs would require warming to be limited to below 1.5 C (Frieler et al., 2013).

In the period 1997–98 warm-water coral reefs all over the world suffered from massive bleaching. The major impact was noted in the coral reefs of the Central Indian Ocean, where some 90 per cent of all corals in an area covering several thousand km² died, including most corals in the Maldives, the Chagos Archipelago and the Seychelles (Lang, 2002–2014). Other coral reefs, e.g. off the coasts of Thailand and Vietnam, were also badly damaged but they included more robust coral species that allowed the reefs to recover. Even parts of the Great Barrier Reef, Indonesia, the Philippines and the Caribbean area were also damaged but with a lower mortality of some 20–50 per cent (Lang, 2002–2014). These events were attributed to a combination of two weather scenarios, ENSO (El Niño–Southern Oscil-

lation) and La Niña. The combination of those two weather phenomena probably caused the warmest water temperatures that “modern” corals have been subjected to, and it seems likely that some of the most severely damaged reefs may require years or even decades to recover. Even if most coral reefs will slowly recover there is a chance that local extinction of coral species may occur, which will lead to reduced biodiversity and, at worst, to less resilience to future accidents. This worst-case scenario may in future occur annually as a consequence of continued temperature increase, i.e. cause local or even regional destruction of entire coral reef ecosystems. At current projected levels of temperature increase it has been suggested that tropical coral reefs could be lost altogether as early as 2050 (Hoegh-Guldberg et al., 2015) and, in fact, fluctuating and rising ocean temperatures caused by global warming present the largest primary threat to coral reefs.

Lennart Nyman

The next issue of Acid News will include an overview of the impact of global warming on regional coral reef ecosystems.

China forecasts stable or declining CO₂ emissions

China is forecasting a significant drop in CO₂ emissions of approximately one per cent, according to Greenpeace East Asia's analysis of China's National Energy Administration forecasts for 2017. This would be the fourth year in a row of either zero growth or a decline in CO₂ emissions. Statistics released today from the Statistical Communique on Economic and Social Development show that coal consumption in 2016 fell for the third year in a row, by approximately 1.3 per cent. Data released in January shows that China is also smashing records for solar panel installations, installing enough panels to cover three football pitches every single hour of the year.

US greenhouse gas emissions fell in 2015

After two years of increases, greenhouse gas emissions fell in 2015, reducing America's overall climate pollution to below 1994 levels, according to the Environmental Protection Agency. The decline in 2015 was mainly because that year's mild winter reduced demand for heat across the country, and electric power companies were using less coal and more natural gas to generate electricity than in previous years, the report says. Emissions fell 2.2 percent overall. The draft report is required to be produced annually under an agreement with the United Nations. It is open for public comment and scheduled to be finalised in April, according to an EPA statement.

<http://www.climatecentral.org/news/americas-climate-pollution-falling-epa-21165>

Portugal halts oil exploration

The government has scrapped the Tavira and Aljezur onshore oil exploration and extraction contracts. The concession contracts covering offshore exploration blocks are also to be halted as the government recognises that the Algarve is serious in its opposition to hosting an oil industry. No company will be drilling for oil or gas.

<http://www.algarvedailynews.com/news/10603-government-halts-oil-exploration-in-the-algarve-portfuel-deals-scrapped>

EU needs to shut all coal plants by 2030

The EU will need to phase out CO₂ emissions from all of its coal plants in the next 15 years if it is to meet the Paris Agreement's long-term temperature goals, according to a new Climate Analytics report released in Brussels in February 2017

The report – A stress test for coal in Europe under the Paris Agreement, by climate research institute Climate Analytics, sets out the first science-based analysis of when – and where – each of the EU's more than 300 coal power plants would need to be phased out.

Climate Analytics has calculated that to stay within the Paris Agreement's long-term temperature limits of "well below" 2°C and "pursuing efforts to limit the temperature increase to 1.5°C," the EU's CO₂ emissions budget for coal in the power sector is around 6.5 Gt by 2050. The EU will exceed its Paris Agreement-compatible coal emissions budget by 85 per cent if its existing coal-fired power plants continue operating to their full lifespan.

"Not only would existing coal plants exceed the EU's emissions budget, but the eleven planned and announced plants would raise EU emissions to almost twice the levels required to keep warming to the Paris Agreement's long-term temperature goal," said Dr Michiel Schaeffer, Climate Analytics Science Director.

The report shows that emissions from coal in the EU electricity sector need to be close to zero by 2030 (95% by 2030; 100% by 2031), with a quarter of operating coal-fired power plants switched off before 2020 and a further 47 per cent going offline by 2025.

"We find the cheapest way for the EU to make the emissions cuts required to meet its Paris Agreement commitments is to phase out coal from the electricity sector, and replace this capacity with renewables and energy efficiency measures," said Paola Yanguas Parra, a lead author of the report.

"Germany and Poland have the most work to do on a coal phase-out: they are jointly responsible for 51 per cent of installed coal capacity and 54 per cent of emissions from coal."

The report outlines two possible pathways showing how the EU could achieve a complete coal phase-out, and proposes a shutdown date for each of the EU's 315 power plants (738 generating units in total).

One pathway is based around a "market" perspective, where the economic value of the plant is prioritised over its emissions intensity, and the other is based on a "regulator" perspective, where plants with the highest emissions intensity are phased out first. Both yield a phase-out of coal by 2030, but the date each specific plant goes offline differs significantly between the two approaches, with different potential impacts on regions within a given country.

To achieve this ambitious phase-out schedule, the EU will need to design enhanced policy settings and approaches that complement each other, including:

- a more effective EU Emissions Trading Scheme
- a stable and predictable investment framework
- bigger targets for renewables – instrumental in a successful coal phase-out
- strategies and policies at both national and regional level to ensure a smooth transition and maximise usage of socio-economic opportunities.

Substantial human, institutional and financial resources will need to be devoted to maximise the economic, social and environmental benefits of this essential transformation of the energy sector.

"It is remarkable that for 25 years the European Union has led the way globally on climate change policy, be it in mitigation or adaptation, the legal structures of international agreements, or financing actions in developing countries. Its next big challenge is to lead the way on meeting the 1.5°C limit, holding warming 'well below 2°C' as agreed in Paris," said Bill

Hare, CEO of Climate Analytics.

"This new and innovative plant-by-plant analysis shows that one of the biggest challenges for Europe will be the phase-out of coal fired-power emissions by 2030. For any country, in any region, and at any time this would be a major challenge, both economically and politically."

"However, the EU already has many of the key policy instruments in place, including those required for fair and just transition strategies. The challenge now is for Europe to capitalise on its massive investments in climate policy, seize the opportunities created by a coal phase-out, and use its institutions to ensure all regions benefit from this."

Germany is Europe's largest consumer of coal, has built a number of large coal power plants in the last 15 years and another large one could come online in 2018. Climate Analytics analysis shows "that these plants will need to be shut down long before the end of their lifetimes to stay within the Paris Agreement's long-term temperature goal and this is already implied by the German Climate Action Plan 2050.

In Poland coal provides 85 per cent of electricity and it is facing growing extraction costs, dwindling reserves and increased competition from renewables, as well as large environmental and health impacts, says the report. Nevertheless the Polish government is still favouring coal as the future mainstay of Polish electricity supply. Implementing the Paris Agreement means that Poland cannot go ahead with its plans for new coal plants, and instead needs to start planning for a phase-out. Policies at the EU and national level for the EU-ETS and Renewable Energy need to be complemented by long-term planning for a sustainable transition, in particular, for the



FLICKR.COM / THOMAS LISKE CC-BY

In the background Boxberg one of more than 300 coal power plants that the EU needs to replace with renewable energy.

regions most affected. While a transition would be challenging, there were numerous possibilities to replace coal, especially given the significant decrease in the cost of wind and solar energy and the potential for biomass, all of which offered Poland an opportunity to make its power sector cleaner and more diversified. The necessary switch away from coal in Poland can have positive socio-economic implications. The alternatives in the renewable energy area and energy efficiency will produce large social, economic and environmental benefits that will be durable and lasting for the longer term. The European Union level policy approaches the need to acknowledge these issues and ensure that adequate resources are provided for the transformation in Poland. In particular EU policies need to assist in developing structural alternatives and avoid structural breaks that would have negative socio-economic implications for some regions and create sustainable job opportunities. Aside from job creation, a transition from coal to renewables will also make the Polish power sector more resilient to the threat of electricity outages experienced due to increased frequency of droughts and associated lack of cooling water for coal power plants, concludes the report.

Source: Climate Analytics press-release, 9 February 2017 <http://climateanalytics.org/hot-topics/eu-coal-phase-out.html>

Global soil carbon losses in response to warming

In a recent study published in Nature, 50 researchers from around the world confirm the concerns that they have had for a long time: soils will release a large amount of carbon in response to the rising air temperature.

The study is a summary of 49 empirical studies that have investigated carbon emissions from the soil in different places around the world. Although the results varied slightly from area to area, the team saw a pattern in which the carbon losses were higher in those regions that have had the largest rise in temperature so far. The largest losses of carbon were seen in the Arctic areas where the soil is warming up rapidly and is quite deep. They also saw high losses along the mid-latitude areas. The study only considered the upper layers of soil, and if the soil turns out to release carbon from the deeper

permafrost layer, emissions could be even more devastating.

The researchers believe that if we continue with a “business-as-usual” scenario, the soil will release 200 billion tons of carbon dioxide by the year 2050. Even if the planet’s vegetation can reclaim some of this carbon, it will not compensate for the losses that have occurred.

Source: The Washington post, 30 November, 2016. Scientists have long feared this ‘feedback’ to the climate system. Now they say it’s happening.

<https://www.washingtonpost.com/news/energy-environment/wp/2016/11/30/the-ground-beneath-our-feet-is-poised-to-make-global-warming-much-worse-scientists-find/>



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Consultation on CAP reform

The European Commission has launched a major online Public Consultation on the future of the common agricultural policy (CAP) which runs until 2 May 2017. Speaking at a press conference, EU agriculture commissioner Phil Hogan said recent developments such as the Paris deal on climate change justify discussing CAP reform only four years after the last wave of changes.

Welcoming this public consultation, EEB EU Policy Director Pieter de Pous said: “This is an excellent opportunity to show the European Commission that a fundamental CAP reform is urgently needed. We can’t simply tinker round the edges and make small cosmetic changes to the policy this time. Most of the CAP budget supports the farms that pollute

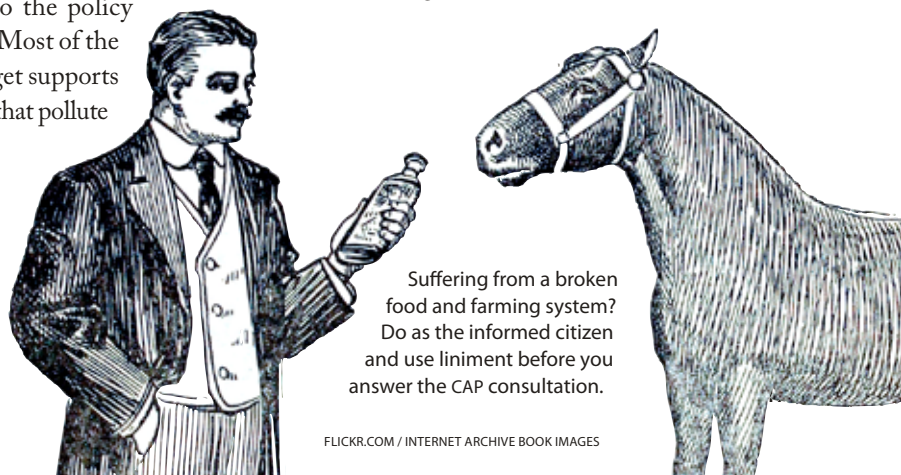
the most. We need broad participation in this consultation to highlight that the current agricultural policy is inadequate for today’s societal challenges.”

Together with Bird Life and WWF, the EEB has launched “the Living Land” campaign with the aim to unite organisations and concerned citizens and encourage them to respond to the consultation

The results of the public consultation will be published online and presented by Commissioner Hogan at a conference in Brussels in July 2017.

The consultation: https://ec.europa.eu/agriculture/consultations/cap-modernising/2017_en

The Living Land campaign: <https://www.living-land.org/>



Suffering from a broken food and farming system? Do as the informed citizen and use liniment before you answer the CAP consultation.



Climate change, poverty and hunger must be tackled together

The agriculture sectors accounts for at least one-fifth of total emissions of greenhouse gases. A new FAO report discusses the challenge of reducing our greenhouse gas emissions while at the same time meeting the world's demand for food.

Emissions from agriculture mainly come from our livestock and crop production, and the conversion of forests to agricultural land. In 2050, the global demand for food is projected to be at least 60 per cent higher than 2006 levels. In the coming decades, population growth will mainly take place in those parts of the world with the highest prevalence of malnutrition and high vulnerability to the effects of climate change. The 2016 FAO report – The state of food and agriculture – highlights several key areas relevant to the combination of climate change, agriculture and food safety. It also describes how the agricultural sector can and should respond to climate change through both adaptation and mitigation. There are many synergies and trade-offs among the objectives of food security, adaption and mitigation, and we should therefore tackle all of them as one. To optimise the mitigation potential of agriculture,

we must create an understanding of how carbon and nitrogen cycles interact with agricultural activities.

The Paris Agreement calls for measures to conserve and increase sinks and reservoirs of greenhouse gas, and one of these measures is to promote improved agricultural practices. Soil is the second most important carbon pool on earth, right after water, and small changes in the stock of carbon may result in large changes in the carbon dioxide in the atmosphere. The composition of soil can vary and it can behave differently depending on which part of the world it is found in. This means that to maximise carbon sequestration, different agricultural approaches are needed. But generally, the integration of trees and shrubs in the agricultural landscape prevents erosion and supports carbon sequestration, which also improves the resistance of soils to drought and flooding.

Agriculture is heavily dependent on nitrogen; together with water it is the most important element for successful harvests. Fifty per cent of the nitrogen in food production depends on fertilisers, while the other half is found in soil, animal manure, crop residues etc. Unfortunately, much of the nitrogen in the agricultural system is lost through volatilisation and leaching. Those losses are important to consider since nitrous oxide is the third most vital greenhouse gas. Nitrogen fertilisers also have a direct negative impact on climate change, because of the energy-demanding production process.

Six case studies show that sustainable practices in the livestock sector would lead to a reduction of between 14 and 41 per cent of the sector's total emissions of greenhouse gases. For the reduction of methane emissions and for sequestering soil carbon in grazing lands, improved grazing management and sowing of legumes were

the most affordable practices according to the studies. It was shown that these measures could reduce emissions by 11 per cent of annual global ruminant emissions. In fact, the potential of changes varies within similar livestock systems due to differences in agro-ecological conditions, farming practices and management of the supply chain. In the livestock sector, improving pasture productivity can limit the expansion of pasture into tropical forests and enhance the conservation and sustainable development of carbon-rich landscapes.

By increasing carbon sequestration and reducing emissions from the value chain, fisheries and aquaculture can also contribute to climate change mitigation. The sector can reduce its fuel and energy use through more efficient fishing techniques and by improvements along the entire supply chain. It is mainly the processing, storage and transportation of the fish that is the main source of the sector's contribution to climate change.

Forests are calculated to bind 2.6 billion tons of carbon each year and deforestation currently accounts for about 11 per cent of all greenhouse gas emissions in the world. Planting new trees and reducing or avoiding logging are a few ways to reduce losses from forests. These goals can be achieved by improved education, involving rural communities in planning and decision-making, increasing the use of new conservation methods, etc.

To further reduce agriculture's negative impact on climate change, our food system could be improved by minimising losses and waste, and by promoting sustainable diets. FAO estimates that 30–40 per cent of food produced for humans is lost before it even reaches the market, due to inadequate routines in agriculture and throughout the supply chain. By improving soil health, improving feed efficiency for livestock benefit, favouring pollinators and creating diversified landscapes this number can be reduced. In low-income countries, most of the food waste is seen at the beginning of the supply chain, while the waste in high-income countries is caused directly by consumer behaviour and policy regulations. A combination of less meat, low intake of seafood and variety and balance between different products seems to have a good

influence on our health and contributes to reduced emissions.

The report shows estimates of the economic mitigation potential. Regarding all levels of carbon values, the largest mitigation potential for agriculture, forestry and land use is found in Asia. Among other mitigation options, cropland management has the highest potential at lower carbon prices of US\$20 per tonne. At higher prices of US\$100, the restoration of organic soils has the greatest potential. The potential of grazing land management and restoration of degraded soils increases with higher carbon prices. The FAO report estimate that forestry represents the highest mitigation potential in Latin America, at all levels of carbon prices. Forest management, followed by afforestation, are the major options in OECD countries, Eastern Europe and Asia.

There are several institutional and economic approaches that can facilitate the implementation of agricultural emission reductions. The institutional approach would include providing information to farmers about agricultural practices that create adaptation/mitigation synergies, as well as access to credit to implement such measures. The economic approach would include positive incentives for farmers to provide and maintain carbon sinks, the taxation of nitrogen fertiliser in countries where it is over-used, and supply-chain initiatives to market food products with a lower carbon footprint.

To reduce the negative trends in the agriculture sector, FAO suggest that we should reduce overgrazing, recycle crop residues as fertiliser, increase the use of cover crops, intercropping, and agroforestry. Further measures include the use of improved plant varieties, nitrogen-fixing legumes, organic fertilisers and improved water management.

Five strategies we need to adopt according to the FAO report: improved crop production, improved animal production, improved manure management, improved food utilisation and less protein in diets.

Malin Larsson

The state of food and agriculture. Climate change, agriculture and food security.

A report from FAO (Food and Agriculture Organization of the United Nations), 2016. <http://www.fao.org/3/a-i6030e.pdf>

WHO air quality guidelines – report

A new report “Evolution of WHO air quality guidelines: past, present and future”, was published in February 2017 by WHO Europe. It summarises the development of the WHO air quality guidelines since the 1950s and outlines the evolution of the scientific evidence on the health effects of air pollution and how this was used for setting outdoor and indoor air quality management strategies worldwide. Current WHO activities and their future directions in this field are also presented.

The report: http://www.euro.who.int/__data/assets/pdf_file/0019/331660/Evolution-air-quality.pdf

High emissions from chainsaws and trimmers

Tests organised by the German environmentalist group Deutsche UmweltHilfe (DUH) show that 18 of the 24 tested chainsaws and trimmers significantly exceed the EU standards for emissions total of hydrocarbons and nitrogen oxides (HC+NOx).

In 2016, DUH tested machines from the German, Swedish and French markets. Of a total of 33 devices measured, only seven complied with the current limit values of the EU's Non-Road Mobile Machinery Directive.

According to the DUH, the current lack of controls and sanctions by the responsible authorities mean that manufacturers and traders can bring products into circulation that do not comply with the legal limit values.

The DUH report: http://www.duh.de/fileadmin/user_upload/download/Projektinformation/Handgefuehrte_Maschinen/Background-paper_MobileMachinery_2016_final.pdf

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How to get people to eat less meat

Personality, friends, religion and political instruments all have an impact on what we eat. A successful strategy to reduce meat consumption therefore needs to have a mixed approach that targets different factors simultaneously.

Livestock farming contributes to emissions of air pollutants and greenhouse gases, including more than 90 per cent of the EU's ammonia emissions and about half of the EU's methane emissions. Decreased meat consumption has been a recurring recommendation to bring these emissions down.

In a meta-study, researchers from Greifswald University have studied barriers and opportunities for reducing meat consumption in developed and transition countries. They found 155 studies that covered the topic in different ways. Barriers and opportunities were categorised into three main types: personal factors, socio-cultural factors and external factors (table).

Some of the factors are similar to those that predict other types of behaviour that have an environmental impact. Awareness of the negative consequences is needed in order to bring about change. Awareness of the environmental impact of animal products has grown, but is still quite low. In one study, only 30 per cent of people identified meat and livestock as a significant contributor to climate change. Many people also believe that meat is necessary for a meal to be nutritious. People also need skills to change their behaviour, such as a knowledge of vegetarian cooking.

Values have a strong impact on people's behaviour. Studies have shown that moral values, particularly concerning animal welfare, are one of the key factors

that influence someone to become vegetarian.

Adequate knowledge and values are not always enough, however. Cognitive dissonance is a negative feeling that occurs when you have multiple contradictory ideas simultaneously. Common strategies to reduce such dissonance include denial and delegation. The latter can be to blame politicians or food corporations instead of taking responsibility oneself.

Day-to-day routines are an often-identified barrier to reduced meat consumption. "Convenience" is important in an age when many people feel that they have little time, lack of knowledge or interest in cooking. That they like the taste of meat is often mentioned as a reason when people are asked to justify a high level of meat consumption. Taste preferences are not

however independent from other factors such as identity and moral beliefs.

Gender is found to be one of strongest factors predicting level of meat consumption. Men tend to eat more meat than women and are also less willing to reduce their consumption. There are also signs of a generational shift where young people have the highest proportion of vegetarians and are more open to "flexitarian" eating, meaning to actively omit meat from some meals without excluding meat completely from the diet.

Fatty meats are nowadays associated with low-income groups and poor education in many western countries. The proportion of vegetarians increases slightly with level of income. However, in emerging economies, such as China, meat consumption is still seen as an indicator of wealth.

Personality traits also play a role. Not too surprisingly, conscientious people are better at reducing their meat consumption than people who are not. Openness and agreeableness are also traits linked to environmentally conscious behaviour.

The perceived ability to control behaviour is also important in changing one's behaviour. People who lack the feeling of self-efficacy tend to regard barriers such as high prices and poor supply as greater than people who do not.

Many people see meat-eating more as a cultural norm than active choice. There are also several cul-

Factors	Barriers & Opportunities
Personal factors	
Awareness and skills	Awareness of the impact of meat-eating; degree of cooking skills
Values and attitudes	Priority on values that favour low meat-consumption
Emotions and cognitive dissonance	Cognitive dissonance blocks awareness and value through denial and defence mechanisms
Habits and taste	Day-to-day routines and taste preferences
Sociodemographic variables and personality traits	Gender, age, class and personality predict food preferences
Perceived behaviour control	Perceived ability to control behaviour correlates with the actual ability to behave in that way
Socio-cultural factors	
Culture and religion	There are cultural beliefs and symbolism connected to meat. In several religions, meat-eating is associated with different taboos
Social identity and lifestyle	What you eat is a social marker in the construction of identity and lifestyle
Social norms, roles and relationships	Perception of normative behaviour by socially connected peers will influence food choices
External factors	
Political and economic factors	Political targets and recommendations, subsidies and taxes, internalising environmental costs
Food environment	Presence of facilities that offer affordable, healthy and tasty non-meat alternatives



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Peer pressure should not be underestimated. Having vegetarian friends is a way to reduce your own meat consumption.

tures and religions where meat-eating is surrounded by various restrictions and taboos, e.g. Lent in Christian tradition and the importance of not hurting other living creatures in Buddhism and Hinduism.

Peer pressure should not be underestimated. One study shows that for men, the number of vegetarian and non-vegetarian friends is the greatest predictor for their level of meat consumption. The behaviours of others in social occasions can work both as a barrier and an opportunity.

What you eat is also a social marker of identity. The concept of flexitarianism that has emerged in the past few years offers an opportunity for people to identify with a diet low in meat without going vegan or vegetarian.

Among the external factors, economy is one of the more obvious ones. Livestock products are directly and indirectly subsidised in many countries and price has a strong influence on people's food choices.

The food infrastructure also plays a part. Supermarkets and restaurants must offer meat-free alternatives in order for

people to choose them. There has been a massive growth in vegetarian alternatives in recent years, but availability can vary, even between neighbourhoods in the same city.

Though there is growing institutional awareness about the negative environmental impact of meat and livestock production this has not yet translated into policy. Nevertheless, steps have been taken. Germany has included reduced meat consumption in its national climate goals and China is running a campaign to halve meat consumption. Private companies such as IKEA are promoting vegan alternatives in their restaurants.

The researchers argue for a mixed approach to encourage synergies between the different factors they identified. Different groups need to be targeted with different arguments. For older people and men, health arguments and flexitarianism (reduced meat consumption) are believed to be more effective.

They also stress the importance of prominent role models – actors, musicians, politicians and sport heroes – taking a

lead, such as Paul McCartney, Bill Clinton, Mike Tyson and Kate Winslet. They can help and encourage people to do the right sustainable thing even if they are surrounded by sceptics.

Finally, they call for more political and economic measures, “these include removing harmful subsidies from livestock production, imposing taxes and more generally internalising social and environmental externalities in food production costs”.

Kajsa Pira

Reducing meat consumption in developed and transition countries to counter climate change and biodiversity loss: a review of influence factors, by Susanne Stoll-Kleemann and Uta Johanna Schmidt, <http://link.springer.com/article/10.1007/s10113-016-1057-5>

Stronger air quality measures needed

Air pollution remains the single largest environmental health hazard in Europe, resulting in a lower quality of life due to illnesses and nearly half a million premature deaths per year.

Air quality in Europe is slowly improving, according to a new report by the European Environment Agency (EEA). Using data from official monitoring stations across Europe, and including more than 400 cities, the report presents an updated overview and analysis of air quality from 2000 to 2014.

The good news is that annual average levels of PM₁₀ have fallen in three-quarters of the monitored locations during the period 2000–2014, and average PM_{2.5} concentrations have also decreased between 2006 and 2014.

Despite these improvements, almost all city dwellers continue to be exposed to pollutants at levels deemed unsafe by the World Health Organization (WHO). In 2014, around nine out of ten urban citizens in the EU were exposed to fine particulate matter (PM_{2.5}) and ozone levels above the WHO guideline values. See Table 1.

Moreover, in the 41 countries considered, 467,000 premature deaths in 2013 were attributed to PM_{2.5} exposure and 71,000 and 17,000 premature deaths to nitrogen dioxide (NO₂) and ozone (O₃) exposure, respectively. In the EU28, the numbers of premature deaths attributed to PM_{2.5}, NO₂ and O₃ exposure were 436,000, 68,000 and 16,000, respectively.

EU environmental indicators

More action is needed to protect the natural environment and people's health. This is the main conclusion of the EEA's new report on environmental indicators, which gives a snapshot of progress made so far in meeting a selected number of EU policy objectives that are relevant to achieving the three key priority objectives of the EU's 7th Environment Action Programme: natural capital; resource-efficient, low-carbon economy, and people's health and well-being.

The report and briefings: <http://www.eea.europa.eu/airs>

Table 2 shows the best estimate figures for total mortality due to exposure to PM_{2.5}, NO₂ and O₃ per country, for all the European countries included in the analysis.

The report also shows country-by-country data on the estimated number of years of life lost (YLL) and the YLL per 100,000 inhabitants due to exposure to the different pollutants. In the EU28, the YLL attributed to PM_{2.5}, NO₂ and O₃ exposure are 4,668,000, 723,000 and 179,000, respectively.

When considering YLL per 100,000 inhabitants due to PM_{2.5}, the largest impacts are observed in the central and eastern European countries, which is also where the highest concentrations are observed, i.e. Kosovo, Bulgaria, Macedonia, Poland, Serbia, Hungary, Romania, Greece, the Czech Republic and Slovakia.

The largest health impacts attributable

Elevated concentrations of ground-level ozone are still a hazard for both crops and people.

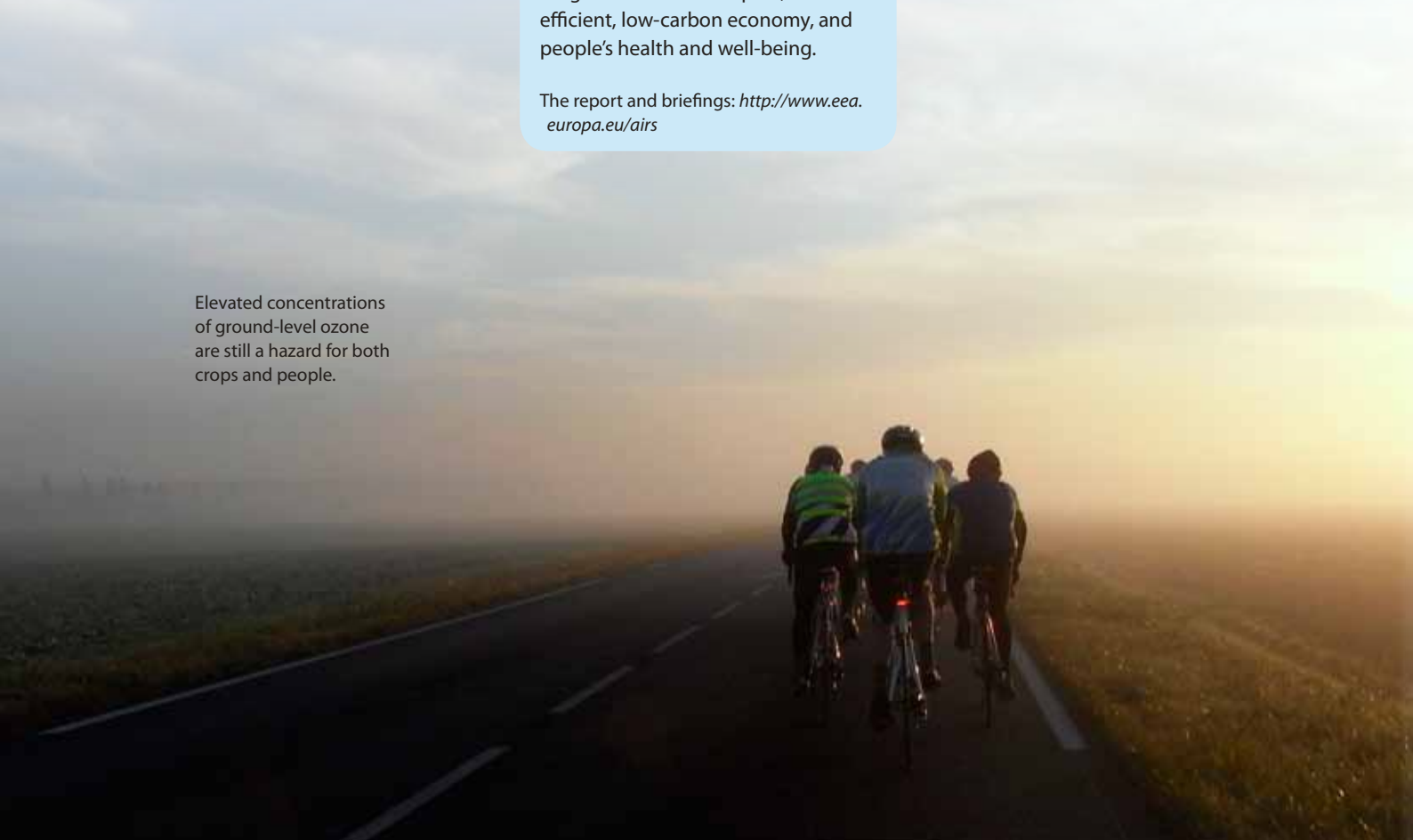


Table 1. Percentage of the urban population in the EU28 exposed to air pollutant concentrations above EU and WHO reference levels (2012–2014).

Pollutant	EU reference value	Exposure estimate (%)	WHO air quality	Exposure estimate (%)
PM _{2.5}	Year (25 µg/m ³)	8–12	Year (10 µg/m ³)	85–91
PM ₁₀	Day (50 µg/m ³)	16–21	Year (20 µg/m ³)	50–63
O ₃	8-hour (120 µg/m ³)	8–17	8-hour (100 µg/m ³)	96–98
NO ₂	Year (40 µg/m ³)	7–9	Year (40 µg/m ³)	7–9
BaP	Year (1 ng/m ³)	20–24	Year (0.12 ng/m ³)	88–91
SO ₂	Day (125 µg/m ³)	< 1	Day (20 µg/m ³)	35–49

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

to NO₂ exposure and expressed as YLL per 100,000 inhabitants, are found in Italy, Belgium, the UK and Serbia. Regarding ozone, the countries with the highest rates of YLL per 100,000 inhabitants are Greece, Italy, most of the countries in the western Balkans and Hungary.

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

On top of the health impacts, air pollution continues to damage vegetation and ecosystems. Elevated concentrations of ground-level ozone damage agricultural crops, forests and plants by reducing photosynthesis. In 2013, the EU's long-term objective for the protection of vegetation was exceeded in 81 per cent of the total EU agricultural area, and the critical level for the protection of forests was exceeded in 68 per cent of the total EU forest area.

Excess deposition of sulphur and nitrogen compounds (from emissions of SO₂, NO_x, and NH₃) contribute to the acidification of soil, lakes and rivers, causing the loss

of biodiversity. In 2010, seven per cent of the total EU ecosystem area and five per cent of the Natura 2000 area were exposed to acidifying depositions exceeding the limits of nature's tolerance.

Emissions of NH₃ and NO_x also disrupt land and water ecosystems by introducing excessive amounts of nutrient nitrogen, causing eutrophication, an oversupply of nutrients, with resulting impacts on biodiversity. In 2010, nearly two-thirds of the total EU ecosystem area and three-quarters of the Natura 2000 area were exposed to nitrogen deposition exceeding the critical eutrophication limits.

Commenting on the report, EEA Executive Director Hans Bruyninckx said: "Emission reductions have led to improvements in air quality in Europe, but not enough to avoid unacceptable damage to human health and the environment. We need to tackle the root causes of air pollution, which calls for a fundamental and innovative transformation of our mobility, energy and food systems. This process of change requires action from us all, including public authorities, businesses, citizens and research community."

Christer Ågren

Note: PM in ambient air originates both from primary particles emitted directly into the air and from secondary particles produced as a result of chemical reactions of PM precursor pollutants, namely sulphur dioxide (SO₂), nitrogen oxides (NO_x), ammonia (NH₃) and volatile organic compounds (VOCs). New research shows that PM concentrations can be considerably reduced by additional cuts in agricultural NH₃ emissions.

Air quality in Europe - 2016 report. EEA Report No 28/2016. Available at: <http://www.eea.europa.eu/publications/air-quality-in-europe-2016>

Table 2. Estimates of premature deaths attributable to exposure to PM_{2.5}, O₃ and NO₂ in 40 European countries.

	PM _{2.5}	O ₃	NO ₂
Austria	6,960	330	910
Belgium	10,050	210	2,320
Bulgaria	13,700	330	570
Croatia	4,820	240	160
Cyprus	450	30	
Czech Rep.	12,030	370	330
Denmark	2,890	110	60
Estonia	690	30	
Finland	1,730	80	
France	45,120	1,780	8,230
Germany	73,400	2,500	10,610
Greece	13,730	840	1,490
Hungary	12,890	460	390
Ireland	1,520	50	30
Italy	66,630	3,380	21,040
Latvia	2,080	60	110
Lithuania	3,170	90	
Luxembourg	280	10	80
Malta	230	20	
Netherlands	11,530	270	1,820
Poland	48,270	1,150	1,610
Portugal	6,070	420	150
Romania	25,330	430	1,900
Slovakia	5,620	200	
Slovenia	1,960	100	150
Spain	23,940	1,760	4,280
Sweden	3 020	160	
UK	37,930	710	11 940
Total EU28	436,040	16,120	68,180
Albania	2,010	100	10
Andorra	40		
Bosnia & Herz.	3,620	180	80
Iceland	80		
Kosovo	3,530	100	230
Lichtenstein	20		10
Macedonia	3,360	100	210
Monaco	20		10
Montenegro	600	30	30
Norway	1,590	70	170
San Marino	30		
Serbia	10,730	320	1,340
Switzerland	4,980	240	1,140
Total all	466,650	17,260	71,410

EEA: Air Quality in Europe - 2016 report

Cost-effective to cut ship NOx emissions

By supplementing NOx Emission Control Areas with economic instruments, ship NOx emissions can be cut faster and further.

A new study has analysed the effectiveness, costs and health benefits of applying two specific policy instruments for reducing NOx emissions from shipping in the Baltic Sea, the North Sea and the English Channel up to 2040. One instrument was to establish a NOx Emission Control Area (NECA), the other to supplement the NECA with a NOx levy, where the revenue would be used to fund the uptake of NOx abatement measures in the sector.

Emissions of air pollutants – including sulphur dioxide (SO₂), nitrogen oxides (NOx) and small particles (PM_{2.5}) – from shipping in European sea areas, contribute significantly to serious damage to health and the environment. According

to a Danish study, ship emissions cause about 50,000 premature deaths per year in Europe. In several coastal countries, ship emissions are responsible for more than one fifth of the total fallout of sulphur and oxidised nitrogen – pollutants that cause damage to ecosystems and biodiversity through acidification and eutrophication.

As a result of both EU and global regulations, sulphur emissions from ships are expected to gradually come down, but there is currently no regulation that will ensure any significant cuts in their NOx emissions (see box).

An analysis of the potential for reducing NOx emissions from shipping was presented last year in a study prepared

jointly by IVL Swedish Environmental Research Institute and CE Delft (see AN 3/2016). Projections were given for two main scenarios – one business-as-usual (BAU), and another with a NECA in place from 2021. In addition, the study evaluated several policy instruments that could be implemented in addition or as an alternative to the NECA. These policy instruments would address NOx emissions from the entire fleet, not only from newly built ships.

This new study builds on the one from last year by using the same emission projections. It has been expanded to include a more in-depth analysis of the abatement costs and new estimates of the resulting health benefits, thus making it possible to compare the monetised health benefits with the costs. It has also estimated the resulting reductions in nitrogen deposition on land and at sea.

Current NOx emissions from ships in the Baltic Sea and the North Sea were estimated to amount to 830,000 tonnes. Under the BAU scenario, emissions in 2040 are expected to come down slightly, by about 14 per cent, to 715,000 tonnes. Assuming that a NECA is in place from 2021, emissions in 2040 would instead be reduced by nearly two-thirds, to 306,000 tonnes.

Introducing a levy & fund on top of the NECA could reduce ship NOx emissions further and much faster. As early as 2025, emissions could be cut by more than two-thirds, and by 2040 they could be cut by three-quarters, to 220,000 tonnes (see Figure).

It should be noted that the study used the rather cautious assumption that only three-quarters of the existing ships would be retrofitted with emission abatement technology. Despite this, the use of economic



Ship NOx control

The only existing regulation of NOx from international shipping is in Annex VI of the MARPOL Convention under the International Maritime Organization (IMO). However, the NOx emission standards in this regulation solely apply to newly constructed ship engines, and the currently (since 2012) applicable Tier II standard accomplishes just a modest 15 to 20 per cent emission reduction compared to an unabated Tier I engine.

There is however a stricter Tier III standard that requires emission reductions of about 80 per cent compared to a Tier I engine, but this applies only to newly built ships in designated NOx Emission Control Areas (NECA), which currently only exist in North America.

While the Tier II standard can be achieved by internal engine modifications that adjust combustion parameters, bigger changes are needed to reach the Tier III standard.

There are several different abatement options for reducing emissions of NOx from marine engines, including:

- ✦ Exhaust gas after-treatment, where the main option is selective catalytic reduction (SCR).
- ✦ Combustion modification using techniques such as exhaust gas recirculation (EGR) or methods where water is introduced into the engine.
- ✦ Switching from marine fuel oils to, for example, liquefied natural gas (LNG) or methanol.
- ✦ Reduced fuel consumption, e.g. through slow steaming.

SCR, EGR and using LNG as fuel can all reduce NOx emissions to Tier III levels. Of these, SCR has the longest history of marine applications, LNG is increasingly being used as a marine fuel, and while EGR is said by engine manufacturers to live up to the standard, so far there is limited data from practical applications.

Because the NOx standards apply only to newly built ships and ships have a very long lifetime, the introduction of economic instruments such as a levy & fund can provide a very useful complement, by also ensuring significant emission cuts in the short term.



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instruments would cut NO_x emissions by about 500,000 tonnes per year on average throughout the 2020s. For comparison, this is nearly as much as the current annual total land-based NO_x emissions of Sweden, Norway, Denmark and Finland combined.

Altogether over the 20-year period 2021–2040, the establishment of a NECA would cut ship NO_x emissions in the Baltic Sea and the North Sea by 4.5 million tonnes at a cost of about €6.2 billion. Using the lower health valuation (VOLY – value of life year lost), the accumulated health benefits amount to €12.5 billion, resulting in a net socio-economic benefit of €6.6 billion.

When the NECA is combined with a levy & fund system, the accumulated emission reductions would more than double to reach 9.9 million tonnes, increasing the monetised health benefits to €28.3 billion (VOLY). The costs would amount to €16.5 million, also more than a doubling, resulting in a net socio-economic benefit of €11.8 billion.

A comparison of annual costs with annual monetised health benefits that instead uses the higher health valuation (VSL – value of statistical life) results in even higher benefit-to-cost ratios, where the benefits exceed the costs by between five and eight times.

Not surprisingly, it is the coastal countries that will gain the most from ship NO_x reductions – the biggest health improvements are expected in France, Germany, UK, Netherlands, Poland, Belgium and Denmark.

On top of these significant health benefits, there will also be environmental gains as a result of lowered input of eutrophying nitrogen to terrestrial and marine ecosystems. The nitrogen fallout on land

Table: Calculated costs and benefits for the NECA and the combined NECA + levy & fund scenarios (million euro).

Year	NECA					NECA + levy & fund				
	Benefits		Costs	Net benefits		Benefits		Costs	Net benefits	
	VOLY	VSL		VOLY	VSL	VOLY	VSL		VOLY	VSL
2021	80	240	30	40	210	1,220	3,950	820	400	3,130
2025	350	1,190	170	180	1,020	1,490	5,050	940	550	4,110
2030	620	2,200	300	320	1,900	1,450	5,150	870	590	4,280
2035	880	3,360	430	450	2,930	1,420	5,320	760	670	4,560
2040	1,150	4,520	560	580	3,960	1,390	5,490	720	670	4,770
2020–2040 accumulated	12,700	-	6,200	6,600	-	28,300	-	16,500	11,800	-

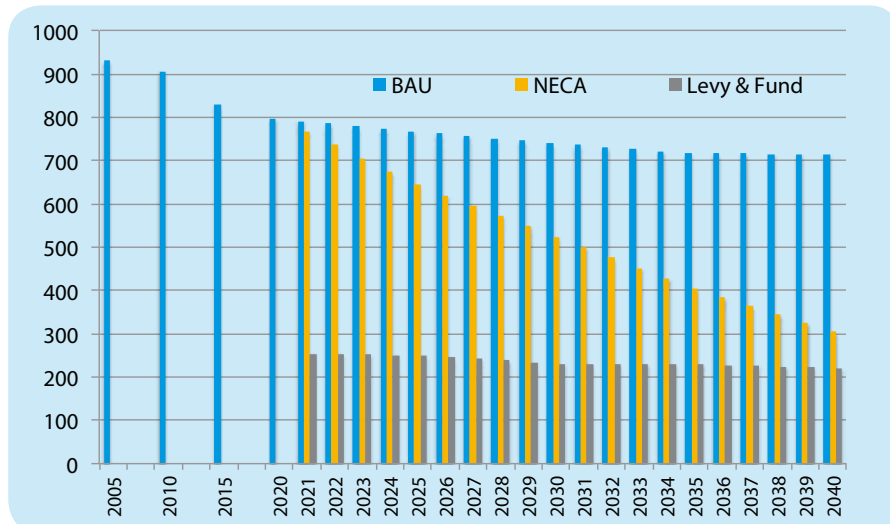


Figure 1: NO_x emissions from international shipping in the Baltic Sea, the North Sea and the English Channel 2005–2040 under a) business-as-usual (BAU); b) a NO_x emission control area (NECA), and; c) a NO_x levy & fund system.

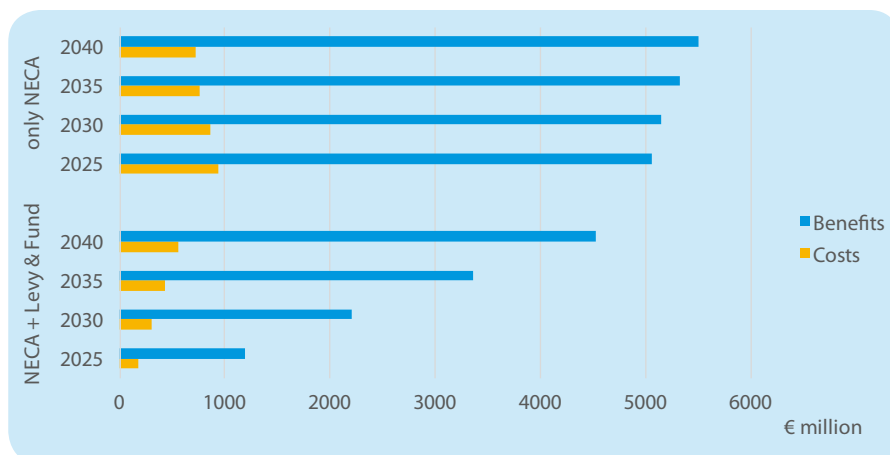


Figure 2: Comparison of costs and monetised health benefits (VSL) for the NECA and the combined NECA + levy & fund scenarios (million euro).

areas would be reduced by up to 80,000 tonnes per year, and inputs of nitrogen to the Baltic Sea and the North Sea would be cut by up to 45,000 tonnes per year, which equals approximately 20 per cent of the current annual deposition of oxidised nitrogen to these two sea areas.

The authors conclude that a levy & fund appears to be a very effective complement to a NECA, with the potential to bring

noticeable health and environmental benefits shortly after its enforcement.

Christer Ågren

The study “Cost-benefit analysis of NO_x control for ships in the Baltic Sea and the North Sea” (March 2017) was commissioned by AirClim and prepared by IVL Swedish Environmental Research Institute. It can be downloaded at: www.airclim.org

Ships and planes keep on increasing GHG emissions

Under measures already in place, land transport in the EU is expected to consume 43 Mtoe (million tonnes of oil equivalent) less energy per year in 2030 than it did in 2010, according to a study by CE Delft. Even this 43 Mtoe cut is less than half of what will be required from land transport under the EU's proposed 2030 Effort Sharing Regulation. Yet ships and planes in Europe will consume 19 Mtoe more fuel annually in 2030 than they did 20 years earlier. The growth in

shipping and aviation will thus undo almost half of the already insufficient progress made by cars, vans, trucks, rail and inland navigation.

Bill Hemmings at Transport & Environment (T&E), said: "Planes and ships are free riding at the expense of land transport's already insufficient efforts to cut emissions. This is not only unfair but a roadblock to the EU meeting its own climate commitments. Governments need to think again and include shipping in the emissions trading system and strengthen its aviation provisions."

Globally, shipping is projected to account for 17 per cent of total emissions by 2050. Yet the International Maritime Organization recently decided to delay by at least seven years any agreement on introducing a global measure to reduce

Greetings from some free-riding means of transport!

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GHGs from the sector, with the actual implementation date possibly many years further away.

Source: T&E press release, 6 December 2016. Link: <http://transenv.eu/2hdAGaV>

Chinese ship emission control areas

Last year Chinese authorities introduced three domestic sulphur emission control areas (ECA) – setting a maximum limit on sulphur in fuel of 0.5 per cent – in ports in the coastal regions of the Yangtze River Delta (from 1 April 2016), the Pearl River Delta (from 1 October 2016), and in the Bohai Sea (from 1 January 2017).

From 1 January 2018, ships will have to shift to low-sulphur fuel before berthing at all ports located within the three ECAs, and from 1 January 2019, the 0.5-per-cent fuel sulphur limit will extend to ships operating within the designated ECAs and they will be required to make the fuel changeover prior to entry. The ECA boundaries have been clearly designated, mostly extending 12 nautical miles from shore.

Towards the end of 2019, the Chinese government is scheduled to determine if the fuel sulphur limit in its domestic ECAs should be reduced to 0.1 per cent. This would bring the Chinese ECA requirements into line with regulation MARPOL Annex VI of the International Maritime Organization.

Source: green4sea.com, 19 December 2016.



High air pollution levels found on cruise ship's deck

Undercover measurements of harmful ultra-fine particles (PM) on the sun deck of a European cruise ship revealed concentrations up to 200 times higher than natural background levels and 20 times worse than in the busy city centres with heavy traffic, according to the German environmental group Nature and Biodiversity Conservation Union (NABU).

The measurements were made for the French documentary television series *Thalassa*. Previously, NABU had made a series of air pollution measurements in several port cities and next to cruise ship terminals in Venice, Hamburg, Marseille and Barcelona.

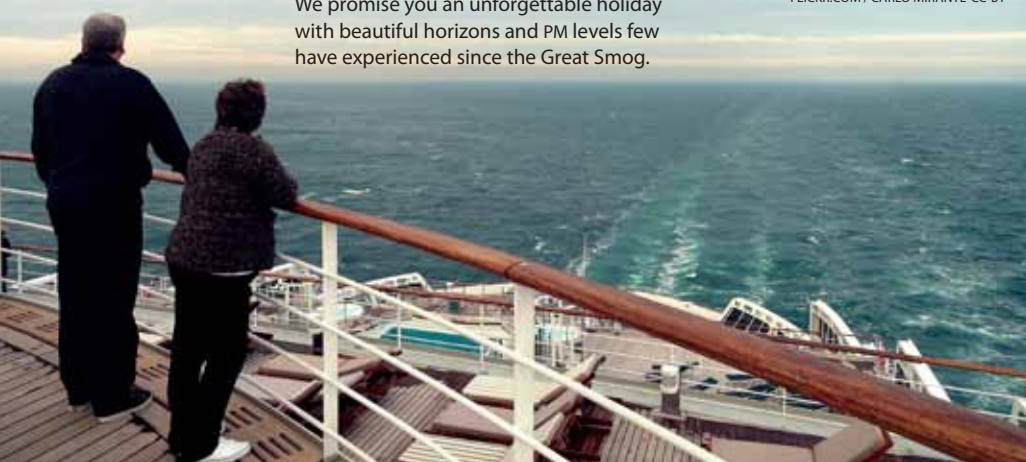
NABU's transport policy officer, Daniel Rieger, warned that the results are most likely indicative of the poor air quality on nearly all cruise ships. But it wouldn't be difficult for cruise ships to reduce emissions – improvements could be made by switching to cleaner fuel, ideally road diesel or liquid natural gas, and by installing particle filters and nitrogen catalysts, he said.

Source: NABU press release, 24 January 2017: <https://en.nabu.de/news/2017/21870.html>

The Telegraph, 1 February 2017: <http://www.telegraph.co.uk/travel/cruises/news/air-pollution-levels-200-times-higher-on-cruise-ships/>

We promise you an unforgettable holiday with beautiful horizons and PM levels few have experienced since the Great Smog.

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Coal project in Croatia stopped

Croatian electricity company HEP Proizvodnja was proposing that a new 500 MW unit replace the ageing Plomin 1 plant, at the site of the existing Plomin Power Station. As a result, the Plomin Power Station capacity would have increased from 335 MW to 710 MW

"After five years of campaigning against the construction of the harmful Plomin C coal power plant, a big victory was achieved," reported the Croatian environmental organisation Zelena Akcija last year. The Minister of Economy, Tomislav Panenić, had stated that the realisation of this project had been cancelled. In a press statement Zelena Akcija said:

"We are sure that after convincing arguments against the construction and the circumstances that occurred, the Government had no other choice but to stop Plomin C.

We send a big thank you to all the citizens that supported us in this big campaign.

During the campaign we have reported extensively on the harmful environmental and health consequences, low economic feasibility and the negative impact of this project in terms of climate change, as well as its incompatibility with EU regulations, and constantly advocated for the use of renewable energy sources and energy efficiency. We organised around 40 activities, performances, lectures and other events, conducted several studies on the legality, economics and energy efficiency of the project. We also initiated three court cases and one case was sent to DORH (the Croatian State's Attorney Office); we sent around 10 letters to potential investors and banks arguing the harmfulness of the project; organised a big campaign before the advisory (local) referendum in Labinština; and communicated with the European Commission pointing out that the planned contract between HEP (Croatian Power Utility) and the Japanese investor is unacceptable."

Zelena Akcija summarized that "all of these activities, in conjunction with the increased European practice of abandoning coal, have led to the current situation where the realisation of the Plomin C project is no longer possible. As a result, Croatia has been saved from a power plant that would run on imported coal and pollute the air for the next 40 years, while



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After years of protests the Minister of Economy has declared that the coal power plant Plomin in Istria, Croatia will not be expanded as the electricity company HEP Proizvodnja wanted.

producing extremely expensive electricity and contributing to climate change. This project started seven or eight years ago and was promoted by the old HDZ (Christian Democrat or centre-right) government, and later, with the same enthusiasm, by the Kukuriku coalition government (centre-left), as well as some ministers in the current government (right-wing). With the discontinuation of Plomin C, the opportunity for a big step forward in the energy sector has finally been created. It will now be necessary to ensure a good energy strategy and a strategy for low-carbon development, which can't include new coal power plants, but must be based on energy efficiency and the use of renewable energy sources."

Zelena Akcija send a big thank you to all the citizens that supported this big campaign. As a reminder, the idea of

constructing this power plant was rejected last year in a referendum by 94 per cent of Labinština's inhabitants, and according to research conducted by the IPSOS agency two years ago, 64 per cent of Croatian citizens were against the Plomin C project.

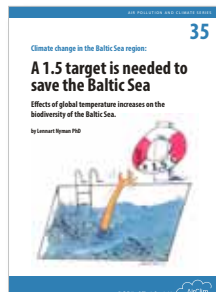
Zelena Akcija concluded that it will continue to keep track of the process and try to ensure a good energy policy in Croatia that won't allow projects like Plomin C. If some unreasonable, incompetent or corrupt government official decides to restart this project, it will surely know how to respond and continue the campaign."

Source: Zelena Akcija press release 15 June 2016:
http://zelena-akcija.hr/en/programmes/energy_and_climate_change/we_stopped_the_harmful_coal_project_plomin_c

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



Short Paper on the UNFCCC Structured Expert Dialogue on the 2013–2015 Review (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. An agriculture and food system with reduced emissions.



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



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



1.5 Stay Alive (April 2015). Short documentary about climate change in the coastal zones of the Caribbean region. Winner of the Golden Sun award 2016. Contact info@airclim.org for access.

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Coming events

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

EU informal meeting of environment ministers. Malta, 25 - 26 April 2017. Information: www.consilium.europa.eu/en/press/calendar/

Health Effects Institute Annual Conference. Alexandria, Virginia, USA, 30 April - 2 May 2017. Information: <https://www.healtheffects.org/annual-conference>

UNFCCC First sessional period in 2017. Bonn, Germany, 8 - 18 May 2017. Information: <http://unfccc.int/>

6th International symposium on ultrafine particles: Air quality and Climate. Brussels, Belgium, 10 - 11 May 2017. Information: <http://ufp.efca.net>

6th ICP Forests Scientific Conference 2017 - Air pollution, climate change and forest ecosystems. Bucharest, Bulgaria, 16 - 17 May 2017. Information: <http://icp-forests.net/events/task-force-meeting-of-icp-forests-2>

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>

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

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/

Innovative solutions for sustainable management of nitrogen. Aarhus, Denmark, 26 - 28 June, 2017. Information: <http://sustainableconference.dnmark.org>

IMO MEPC 71 (Marine Environment Protection Committee). London, UK, 3 - 7 July 2017. Information: www.imo.org

CLRTAP EMEP Steering Body & Working Group on Effects. Geneva, Switzerland, 11 - 15 September 2017. Information: www.unece.org/env/lrtap/welcome.html

UNFCCC Second sessional period in 2017. Bonn, Germany, 6 - 17 November 2017. Information: <http://unfccc.int/>

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