HEAL
Promoting environmental policy that contributes to good health

THE UNPAID HEALTH BILL

How coal power plants make us sick

A report from the Health and Environment Alliance

About HEAL

The Health and Environment Alliance (HEAL) is a leading European not-for-profit organisation addressing how the environment affects health in the European Union (EU). With the support of more than 65 member organisations, representing health professionals, not-for-profit health insurers, patients, citizens, women, youth and environmental experts, HEAL brings independent expertise and evidence from the health community to different decision-making processes. Members include international and Europe-wide organisations, as well as national and local groups.

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Preface

The European Respiratory Society (ERS) is the largest organisation in its field, bringing together almost 12,000 respiratory specialists, scientists, researchers and other health professionals. Our mission is to alleviate suffering from respiratory diseases and to promote lung health through research, advocacy and medical and public education.

The environment is an important health determinant, and this is especially the case with regard to lung health where exposures to pollutants in both indoor and outdoor air damage the lung. For this reason, ERS aims to improve the prevention and management of environment related respiratory disease and to contribute to an improvement in respiratory health in Europe and elsewhere by the provision of information and evidence-based recommendations to policy makers and the public. The scientific evidence on the link between air pollution and respiratory health, both in terms of mortality and morbidity, is overwhelming, and so is the need to act.

ERS published its 10 Principles for Clean Air outlining what must change in order to achieve an adequate level of health protection. At the core is the assertion that clean air is the right of every European citizen. This claim has indeed been made since the early 1970's in the Stockholm Declaration of the United Nations (UN) Conference on the Human Environment which held that air must be safeguarded for the benefit of present and future generations through careful planning or management.

European Union (EU) legislation needs to be revised to ensure that the air we breathe does not contain higher levels of pollutants than recommended by the World Health Organization (WHO). Decision makers must act now and in order to succeed all major sources for air pollution need to be addressed.

ERS warmly welcomes the current report on health implications of coal power plants in Europe by the Health and Environment Alliance (HEAL) for showcasing how a single important source of air pollution in Europe contributes to respiratory mortality and illness. Addressing air pollution from coal power plants alone has the potential to yield significant savings to health budgets, especially given that an average coal power plant operates for at least forty years. As 2013 is the European Year of Air where a review of EU air quality policy will take place, this is the right time to act. Over the next few years there will be far-reaching investment decisions on existing coal power plants due to the Industrial Emissions Directive (IED) coming into force. This is a significant opportunity to provide cleaner air for European citizens.

Health professionals and especially respiratory experts can play an important role in highlighting the existing evidence to decision makers. The current report provides an excellent source of information and points out why the external costs of coal power must be taken into account. I welcome this report as it presents an opportunity to highlight the urgent need for action on air pollution. I hope that it will serve to engage many respiratory experts in policy debates on environmental health.

Prof Jean-Paul Sculier, Secretary for European Affairs, European Respiratory Society (ERS)

Executive summary

Having been on a downward trend for decades, the use of coal in power generation in Europe is on the rise again. Coal is still a major energy source in Europe, accounting for approximately one fourth of electricity production. Around 50 new coal power plants are currently in the pipeline. But the continued reliance on coal comes with a price that decision makers are hardly aware of: the unpaid health bill. This health bill is paid by individuals, national health care budgets, and by the economy at large due to productivity losses.

How is coal pollution making us sick? Coal power plants are an important contributor to air pollution in Europe, which European respiratory experts have called an 'invisible killer' and one of today's most important public health threats. Exposure to outdoor air pollution is linked to a number of health impacts including higher rates of respiratory and cardiovascular disease. This report developed by HEAL aims to provide:

- An overview of the scientific evidence on how air pollution impacts health and how emissions from coal power plants are implicated in this;
- The first ever economic assessment of the health costs associated with air pollution from coal power plants in Europe;
- Testimonies from leading health advocates, medical experts and policy makers on why they are concerned about coal, and;
- Recommendations for policy-makers and the health community on how to address the unpaid health bill.

The main findings

Emissions from coal power plants in Europe contribute significantly to the burden of disease from environmental pollution. The brand-new figures published in this report show that European Union-wide impacts amount to more than 18,200 premature deaths, about 8,500 new cases of chronic bronchitis, and over 4 million lost working days each year. The economic costs of the health impacts from coal combustion in Europe are estimated at up to €42.8 billion per year. Adding emissions from coal power plants in Croatia, Serbia and Turkey, the figures for mortality increase to 23,300 premature deaths, or 250,600 life years lost, while the total costs are up to €54.7 billion annually. These costs are mainly associated with respiratory and cardiovascular conditions, which are two important groups of leading chronic diseases in Europe. Together, coal power plants in Poland, Romania and Germany are responsible for more than half of the total health impacts. Substantial impacts are further attributed to coal combustion in Bulgaria, Czech Republic, France, Greece, Serbia, Turkey, and the United Kingdom.

Outdoor air pollution: a major risk factor to health

There is a large body of scientific evidence consolidating the various health effects of air pollution, both in terms of premature mortality and acute as well as chronic ill-health. Although outdoor air quality in Europe has improved over the years, outdoor air pollution is still a major public health threat.

The European Environment Agency (EEA) estimates that 80-90% of the urban population in Europe is currently exposed to levels of particulate matter and ozone that are higher than recommended by the World Health Organization (WHO). Although coal power plants are only responsible for a small portion of total outdoor air pollution, they are the most important source of industrial air pollution. A large coal power plant emits several thousand tons of hazardous air pollutants every year and has an average lifetime of at least 40 years. Building new coal power plants would mean that hazardous emissions and their effects on health would continue for many years. It would also counterbalance short-term reductions in air pollutants achieved in other sectors.

The two-fold burden on human health: air pollution and climate change

Coal power generation is furthermore a major contributor to climate change, which was recognised by the Director-General of the WHO as the major public health challenge of the 21st century. Coal is the most carbon-intensive energy source in the EU, contributing approximately 20% of total greenhouse gas emissions. Evidence is growing that Europe already experiences health impacts from climate change, and scientific models project alarming increases in morbidity and mortality over the coming decades. While a phase out of coal in electricity and heat generation in Europe is a prerequisite for preventing long term health impacts from climate change, it will also benefit people's health in the short term due to lower air pollution.

Top health concerns

Coal power generation adds to already poor outdoor air quality in Europe - caused mainly by the transport sector, industrial processes, residential heating, and agriculture. Coal power plants release substantial amounts of particulate matter, sulphur dioxide, and nitrogen oxides - the latter contributing indirectly to the formation of ozone. Of these, the most worrying for health are fine particulate matter ($PM_{2.5}$) and ozone. Because pollutants can travel over long distances and across borders, the whole European population is affected by coal pollution, dispersed in outdoor air.

Significant evidence exists on how long-term exposure to these air pollutants affects the lungs and the heart. They include chronic respiratory diseases, such as chronic bronchitis, emphysema and lung cancer, and cardiovascular diseases, such as myocardial infarctions, congestive heart failure, ischemic heart disease and heart arrhythmias. Acute effects include respiratory symptoms, such as chest tightness and coughing, as well as exacerbated asthma attacks. Children, older people and patients with an underlying condition are more susceptible to these effects. Recent research suggests that air pollution may also result in low birth weight and pre-term delivery as a result of maternal exposure during pregnancy.

Other hazardous substances emitted from the smokestacks of coal power plants are heavy metals, such as mercury, and persistent organic pollutants (POPs), such as dioxins and polycyclic aromatic chemicals (PAHs). These can either be breathed in or taken up indirectly via food and water. Special concern arises from the large mercury emissions from coal power plants as mercury can impair the cognitive development of children and cause irreversible damage to vital organs of the foetus. Coal power plants are the most important source of mercury in Europe, and the EU is addressing technical options to reduce these emissions within the framework of a new UN treaty.

A breath of fresh air: what needs to be done

From a health perspective, building new coal power plants would work against efforts to tackle chronic disease, create substantial costs for public health and lock in hazardous emissions for decades. The external costs to health from coal power generation have been missing from the debate on the future of Europe's energy mix. These costs should be taken into consideration in all future energy investment decisions. Conversely, claims that domestic coal represents a cheap energy source need to be urgently revised.

Given the urgent need to tackle climate change and the substantial health risks related to air pollution, a phase out of coal in power generation is imperative on health grounds, with a moratorium on new coal power plants as a first step. Many EU Member States are struggling to meet air quality standards and plans to construct new coal power plants would threaten their progress in curbing air pollution. Instead, investments in renewable energies and energy savings should be prioritised. They have the potential to secure large health co-benefits, both in the short and long term.

How medical professionals and public health experts can advocate for a phase out of coal

Health and medical experts are becoming increasingly concerned about air pollution and the role of coal combustion in it, and they have continuously highlighted the enormous health risks of climate change. In October 2011, over 500 health and security experts, including medical associations, leading medical research institutes and public health organisations, called on governments to ban the building of new coal-fired power plants without Carbon Capture and Storage (CCS) technology, and to phase out the operation of existing coal-fired plants, starting with lignite plants due to their most harmful effects on health.

Public health experts and medical professionals can play a vital role, especially at the national and local level, in making the phase out of coal a reality. They can draw on the scientific evidence presented in this report to highlight the role of coal in air quality and climate change discussions. In addition, three annexes of this report contain specific information that can be used to advocate for better health protection: a technical report, method for the impact assessment; an overview of the most harmful pollutants originating from coal power plants and their associated health risks; and a tool box on how to apply EU environmental laws to tackle coal pollution.

The engagement of public health experts will be crucial to ensure that the unpaid health bill is taken into account in future energy decisions.

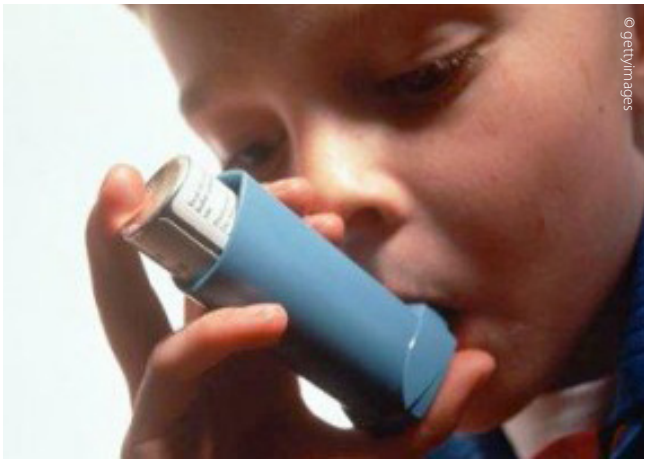
Introduction

Chronic disease from long-term exposure to air pollution

Coal power plants are an important source of industrial air pollution in Europe. Their substantial emissions have to be considered against the backdrop of a multitude of sectors contributing to outdoor air pollution, especially transport, domestic heating, and agriculture, as well as the complex dynamics of air pollutants. Although overall air quality has improved in Europe since 1990[1], outdoor air pollution is still responsible for an average reduction in life expectancy of 8.6 months[2] or, in other words, for 492,000 premature deaths every year.[3] Air pollution is the most important environmental risk factor for the health of Europeans. In a recent analysis on the Global Burden of Disease commissioned by WHO, air pollution ranked among the most important risk factors for chronic disease in the European region for the first time.[4] More than 80-90% of the urban population in Europe is exposed to levels of particulate matter and ozone higher than those recommended by WHO.[5]

"The report provides the first-ever calculation of the human health costs associated with coal-fired power stations in Europe. This important economic assessment represents an unpaid health bill that should be taken into account when determining energy policy."

Génon K Jensen, Executive Director, Health and Environment Alliance



Older people, children and patients with chronic respiratory or cardiovascular diseases experience the largest threat to their health and well-being from air pollution, as they are more susceptible to the damage done by the pollutants.

Nearly every person is exposed to outdoor air pollution throughout their life. This long-term exposure significantly increases the risk of developing chronic cardiovascular or respiratory diseases. Between 4% and 10% of the European population has been diagnosed with chronic obstructive lung disease[6], and about 30 million people in Europe suffer from asthma.[7] Prevention of outdoor air pollution has to become a priority given the large number of individuals affected and the high levels of asthma, chronic bronchitis, emphysema, and other chronic lung conditions.

Health damage occurs at lower levels of exposure than previously thought.[8] European respiratory doctors have stated that the current EU limit value for fine particulate matter in ambient air, which is well above the guideline value recommended by WHO, offers no health protection at all.[9] The same is regarded to be true, to a lesser extent, for the ozone.[10] For both pollutants, no absolute safe levels, at which no harm to public health occurs, have been established.[11] This implies that exposure has to be kept as low as possible.

Coal power plants are responsible only for a part of current outdoor air pollution; however, each coal power plant emits huge amounts of hazardous air pollutants every year and has an average lifetime of at least 40 years. Allowing new coal power plants to be built would thus lock-in hazardous emissions for many years. It would also counterbalance short-term reductions in air pollutants achieved in other sectors.

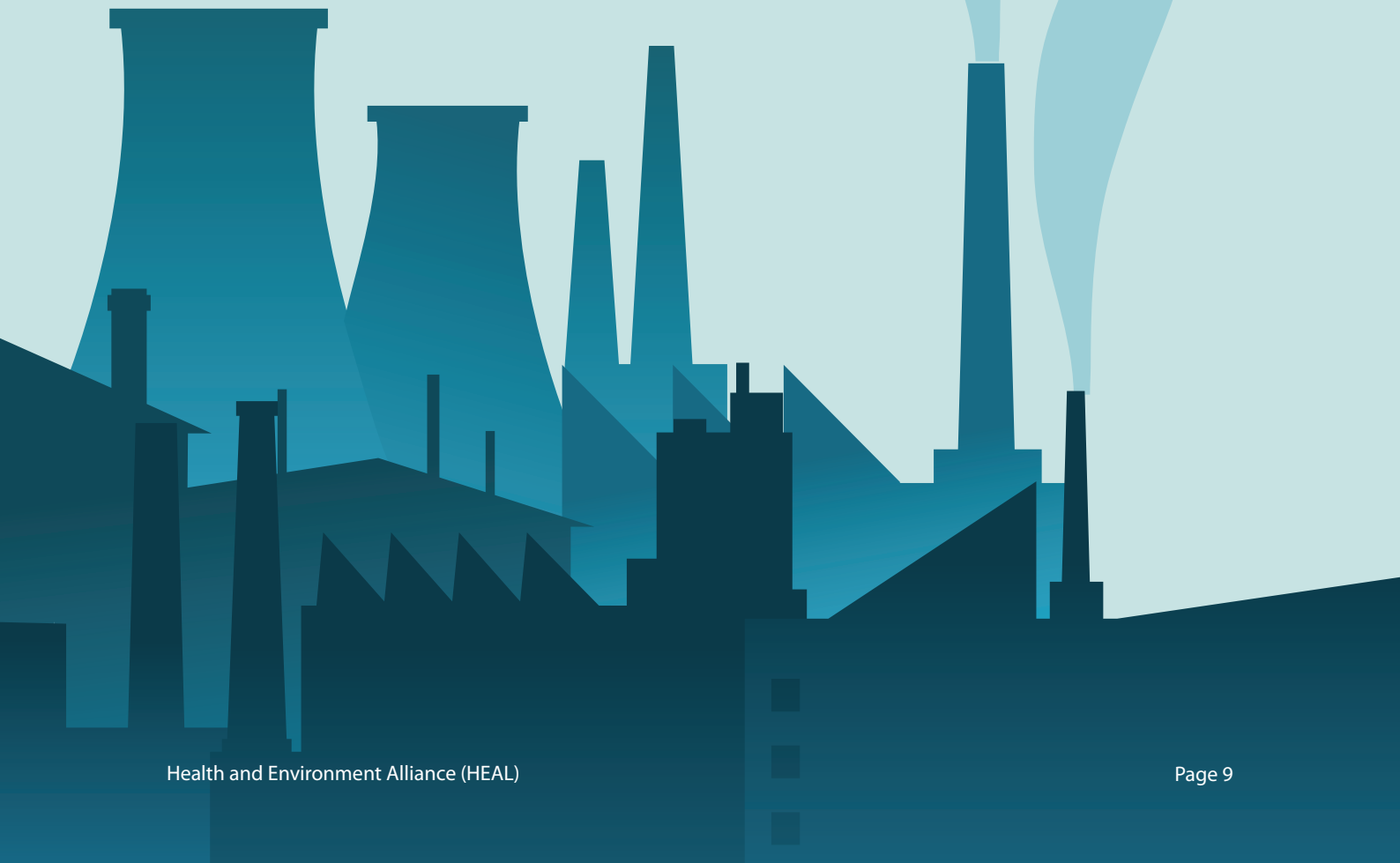
Direct and indirect air pollution from coal power plants

Chronic and irreversible harm to human health is caused via direct and indirect pathways by the air pollutants sulphur dioxide, particulate matter and nitrogen oxides (especially nitrogen dioxide), which are emitted in large quantities by coal power plants. Sulphur and nitrogen oxides further react in ambient air, forming secondary fine particulates, while nitrogen oxides are also a precursor for ozone. Both short and long-term exposure to particulate matter and ozone are causing significant damage to human health.

The main groups of diseases related to these environmental risk factors are cardiovascular, respiratory and nervous system diseases.

European doctors know air pollution to be an important risk factor for health, and the CPME has a long-standing interest in this topic. Health professionals are committed to bringing new evidence-based information to the public as well as to decision makers and using their voice to bring about policy changes."

Birgit Beger, Secretary General,
Standing Committee of European Doctors (CPME)



Health damage from coal power plant emissions

Air pollutants released from smoke stacks of coal-fired power stations constitute the largest health risk for the general public in comparison to emissions to the water or soil. They cause both acute and chronic health effects. Communities in the proximity of coal power plants sometimes experience a much higher exposure to certain airborne pollutants.[12] The major fraction of the air pollution, however, is transported over long distances and thus impacts a much bigger proportion of the population, by increasing the background levels of ambient air pollution. The report focuses on the health effects of air pollution for the general population.

"Concrete opportunities for preventing ill-health are always good news for health insurance organisations. We intend to support all advocacy efforts in favour of reducing exposure to polluted air, including from coal-powered electricity stations in Europe."

Dr Philippe Swennen, Project Manager, Association Internationale de la Mutualité (AIM)

The diagram below details figures from an expert assessment of the health impacts from coal power plant emissions in the EU commissioned by HEAL and detailed in the technical report in Annex 1.

Associated sick leave impacts productivity and causes economic costs. The need to take medication or to receive hospital treatment on the other hand is a budgetary restraint for the people affected, as well as for health care systems. But beyond economic costs it is the personal well-being of individuals, families and communities that should be protected from adverse environmental effects.

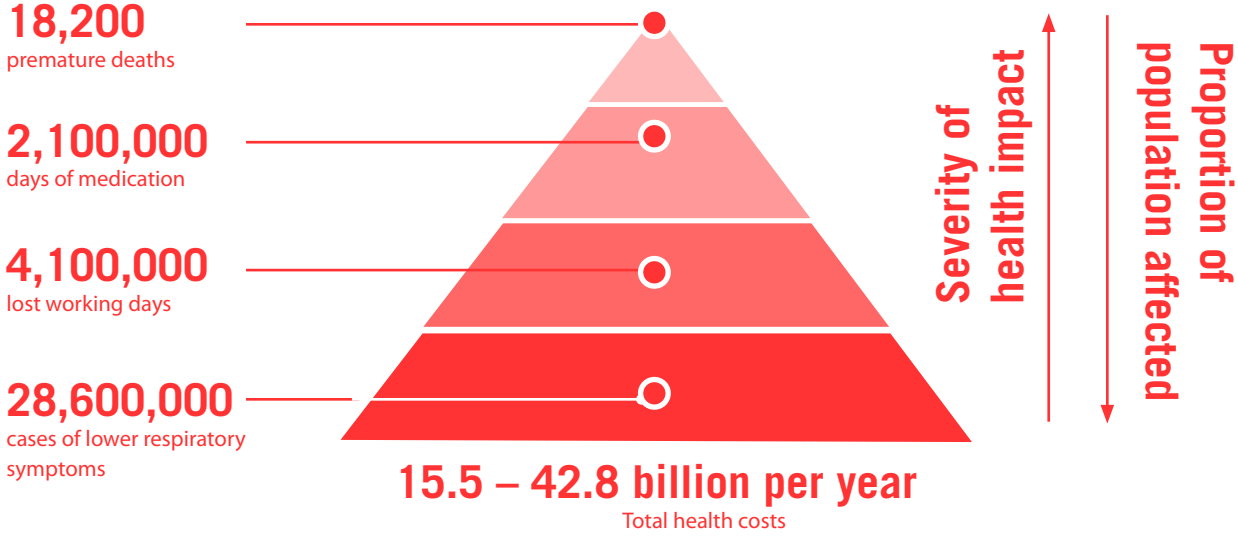
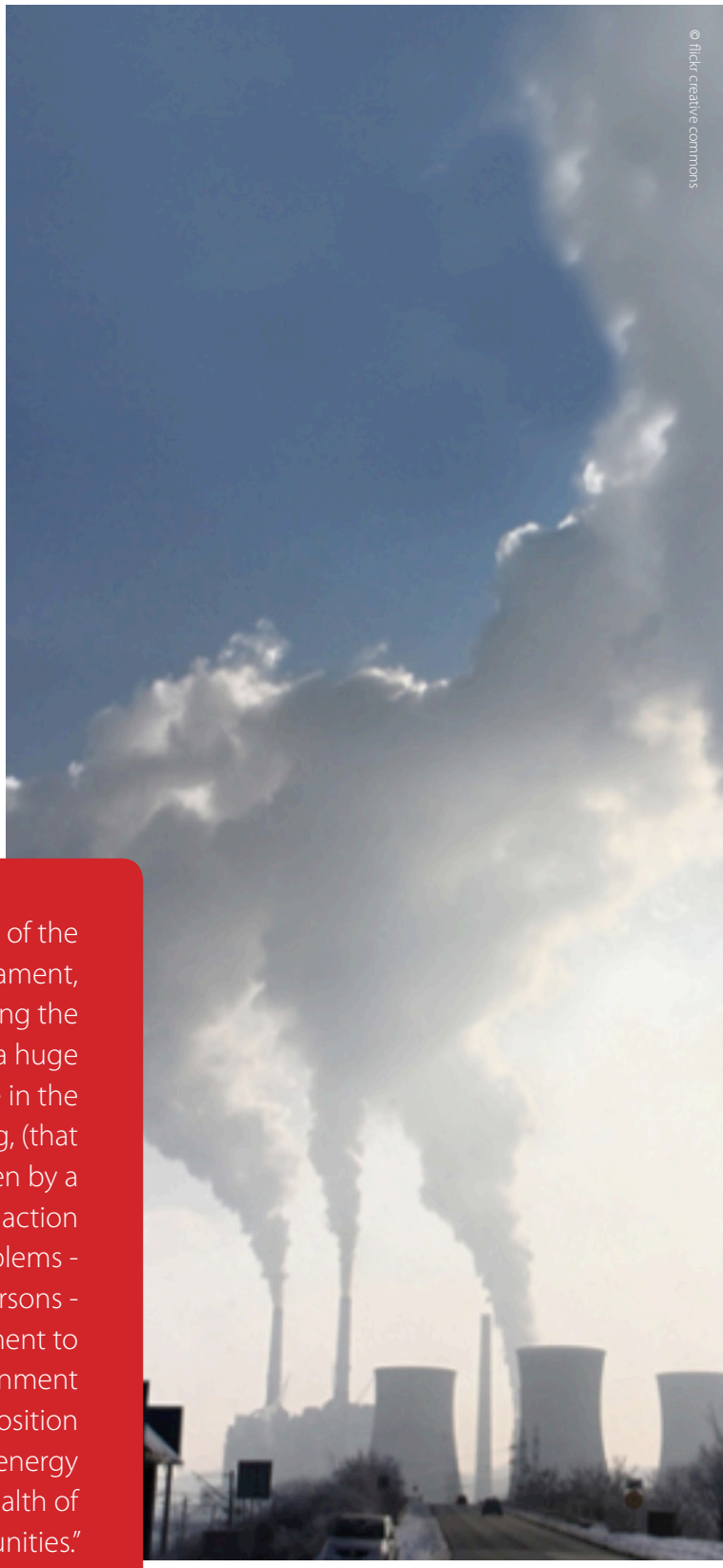


Figure 1: Annual health impacts caused by coal power plants in the EU (27 countries)
(Source: HEAL expert assessment, see Annex 1, approximate figures)

Communities in the proximity of coal mines and coal waste deposits, as well as coal miners and power plant workers are often exposed to exceptionally high concentrations of pollutants and thus have higher overall health risks. These occupational or coal life cycle related risks are not covered in this report.

Bearing in mind the beneficial public health effects that a move away from coal will bring for the general public, particular attention should be given to potential socio-economic trade-offs for local communities resulting from the closure of individual power plants. Experience shows that a loss of workplaces and the subsequent decline in household income have led to significant health and social impacts in communities in former industrial areas. Although a loss of workplaces in the coal industry is likely to be offset by nationwide job creation in the renewable energies and energy efficiency sectors, adequate retraining systems and employment initiatives for affected communities are essential to overcome barriers to re-employment.



"As a Member of the European Parliament, I have been piloting the Petition against a huge open cast mine in the area of Lower Silesia from the beginning, (that is from 2010). I hope that the weight given by a European Complaint as well as the national action of many others struggling with similar problems - governments, NGOs and private persons - will give a chance for our local government to arrange a dialogue with the national government and through that work out a common position that takes into account the needs of Polish energy without forgetting about the rights and health of local communities."

Lidia Geringer de Oedenberg,
Member of the European Parliament, Poland

Health risks related to early life exposure

Children, even before birth, are particularly susceptible to air pollutants. Increasing evidence shows how early-life exposure to air pollutants is contributing to higher risks of developing chronic diseases later in life, including obesity, diabetes, and hormone related cancers.[16,17] Furthermore, recent studies found associations between exposure to outdoor air pollution during pregnancy and lower birth weight,[18] as well as higher rates of preterm birth and pre-eclampsia.[19]

Air pollution from coal power plants is contributing to higher rates of respiratory and cardiovascular disease as well as mortality in Europe. With the exception of a few countries, cardiovascular disease is the leading cause of death in Europe and accounts for approximately 40% of deaths or 2 million deaths per year.[13] Public health costs related to cardiovascular disease were estimated at €196 billion a year for the EU,[14] the respective estimate for chronic respiratory diseases, coming from the European Lung Foundation (ELF) and the European Respiratory Society (ERS), being €102 billion per year.[15]

It should be noted, however, that the figures above are not intended for direct comparison with the results of the expert assessment commissioned for this report, as they are based on different methodological approaches.

How inhalation of particulate matter may affect our health

Lungs

- Inflammation
- Oxidative stress
- Accelerated progression and exacerbation of COPD
- Increased respiratory symptoms
- Effected pulmonary reflexes
- Reduced lung function

Brain

- Increased cerebrovascular ischemia

Heart

- Altered cardiac autonomic function
- Oxidative stress
- Increased dysrhythmic susceptibility
- Altered cardiac repolarisaion
- Increased myocardial ischemia

Blood

- Altered rheology
- Increased coagulability
- Translocated particles
- Peripheral thrombosis
- Reduced oxygen saturation

Vasculature

- Atherosclerosis, accelerated progression and destabilisation of plaques
- Endothelial dysfunction
- Vasoconstriction and hypertension

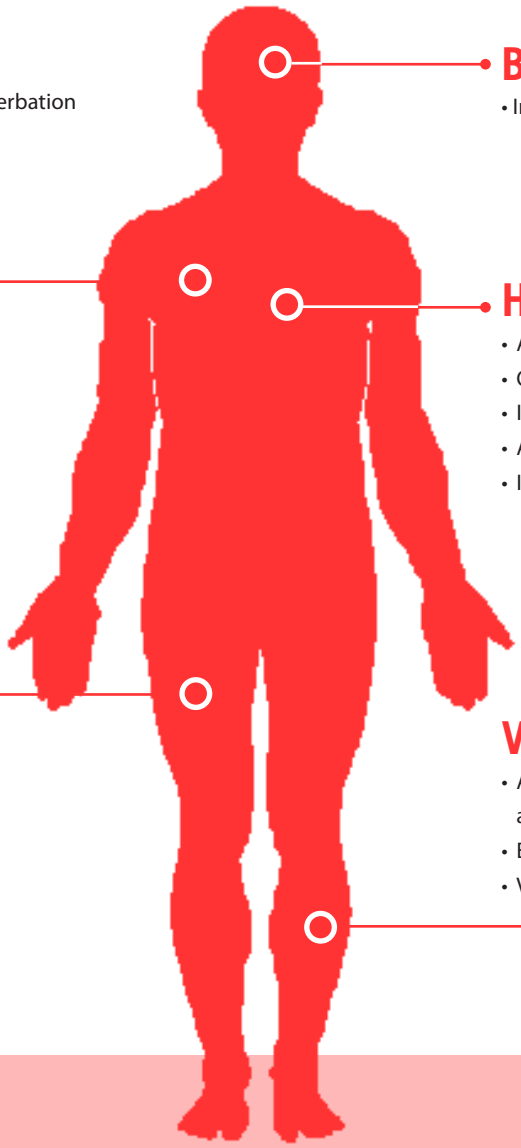


Figure 2: Exposure to particulate matter ($PM_{2.5}$) causes a multitude of health impacts

Adapted from source: Aphekom project (2012): Summary report of the Aphekom project 2008-2011

Respiratory system

Coal fumes contribute to polluting the air with NO_x, SO_2, PM and secondary ozone,[20] which can cause or exacerbate different respiratory conditions. Ozone exposure leads to acute breathing difficulties and exacerbates conditions such as asthma and chronic obstructive pulmonary disease. Longer exposure to certain levels of fine particulates can result in chronic obstructive pulmonary disease (COPD)[21], a group of lung diseases including chronic bronchitis and emphysema, which are characterised by airways becoming narrowed, shortness of breath, and continuing decline of lung function. Fine particulates are even associated with increased mortality rates for lung cancer.[22,23] In addition, diagnosed COPD is also a risk factor for lung cancer mortality.[24]

"For patients with asthma, allergies and other respiratory diseases, air pollution can have severe consequences, imposing limitations on their daily lives, restricting their activities outdoors and even resulting in days off from work. Policymakers should use every opportunity to create an environment that is free from the burden of air pollution, with looking at the health implications of coal consumption being one of them."

Roberta Savli, EU Policy Officer, European Federation of Allergy and Airways Diseases Patients Associations (EFA)

Children are particularly susceptible to air pollutants, because they breathe more air in relation to their body weight and spend more time outside but also due to the immaturity of their immune and enzyme systems and their airways still being in the growth process. Some air pollutants such as NO_2 and $PM_{2.5}$ adversely affect lung development in children which often precedes the development of chronic pulmonary diseases. Lung damage resulting from exposure in early life reduces the maximal lung function level a child can reach in adulthood.[25] The clearest relationships have been established for particulates and for nitrogen oxides.

Asthma is a major respiratory disease and can be triggered by air pollution. In particular, ozone exposure can trigger or exacerbate asthma symptoms.[26] Particulate matter is known to aggravate asthma symptoms, too,[27] but it is also suspected to contribute to asthma development. There are 30 million asthma patients in Europe and as many as 6 million of these people suffer symptoms that are characterized as severe.[28] 10% of European children suffer from asthma symptoms. The European research project APHEKOM found that 15-30% of new asthma cases in children were explained by the child living close to busy roads and thus being exposed to higher local levels of air pollution.[29] The economic consequences of this high incidence are affecting public health budgets. The total cost of asthma in Europe is estimated to be €17.7 billion per year, and productivity lost to patients' poor control of their asthma is estimated at €9.8 billion per annum.[30] Asthma and allergic disorders are one of the major chronic diseases in children and one of the most frequent reasons for a child to miss school, as well as a leading cause of emergency department visits and hospitalisations.[31] In many cases the asthma will persist throughout the person's whole life.

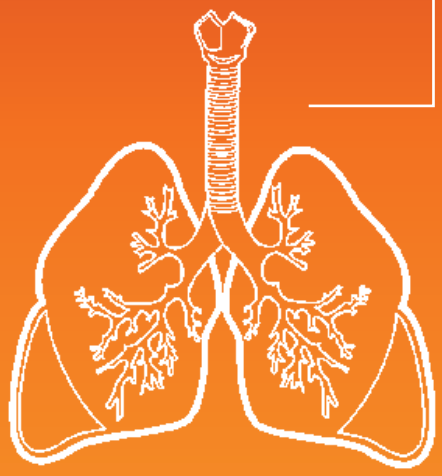
Air pollutants also play a role in the development of (COPD) a lung disease characterised by permanent narrowing of the airways: Exposure to particulate matter exacerbates the disease through the development of inflammation.[32] The development of lung cancer as well as mortality from lung cancer, which is the most frequent deadly cancer worldwide,[33] is also correlated with long-term exposures to particulates.[34]

10%

of European children have asthma

30 million people

in Europe suffer from asthma



54,500 Europeans

die every year from lung cancers attributed to air pollution[3]

4% to 10%

of adults in Europe are diagnosed with COPD

"We have estimated the costs of four major respiratory diseases in Europe at €47.3 billion per year. Improving air quality will reduce these costs already in the short term. Even daily fluctuations have been shown to reflect in the numbers of asthma attacks or hospitalisation and in death rates."

Monica Fletcher, Chair, European Lung Foundation (ELF)

Cardiovascular system

Air pollution's negative impact on cardiovascular health is increasingly acknowledged in the peer reviewed literature. Overall there is a clear positive correlation between air pollution and rates of major cardiovascular diseases, as well as cardiovascular mortality. The associations are the strongest for particulate matter. A systematic review suggests that cardiovascular mortality rises by 12% to 14% per 10 microgram increase of fine particulate concentrations.[35]

Even short-term exposure to fine particulate matter can trigger myocardial infarctions, symptoms of ischemic (= coronary) heart disease, stroke and heart arrhythmias, and cause death. Increased hospital admissions due to these conditions have been documented for periods with elevated fine particulates in ambient air.[36,37,38] Long term PM exposure increases the risk for developing a variety of cardiovascular diseases, including hypertension and atherosclerosis.[39]

Fine particles with less than 2.5 microns diameter are small enough to penetrate the lung tissue and enter the blood stream. A recent literature review provides evidence that these particles can cause inflammation of cardiovascular tissue as well as coagulation of the blood.[40] Exposure to air pollution can thus be linked to artery blockages, which lead to heart attacks.[41] The exact mechanisms through which air pollutants impact cardiovascular health are not yet fully understood. At least three main underlying mechanisms may be involved[42] with the different adverse effects changing over time.[43]

Higher death rates from cardiovascular as well as respiratory disease have been associated with higher NO_2 concentrations in Italian cities.[44] Similarly, decreases in cardiovascular mortality within a period of a few years were associated with reductions in particulate levels.[45]

"Air quality and its impact on public health have been overlooked for too long and it is now essential that we identify and address all health risks associated with air pollution. We must link up our environmental objectives with a concrete public health outcome on chronic airways and cardiovascular diseases. All Europeans have the right to breathe clean air!"

Antonyia Parvanova,
Member of the European Parliament, Bulgaria

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40% of deaths

in Europe are attributed to cardiovascular diseases

2.5 microns

or less is the diameter of the particles that affect cardiovascular health

12-14%

higher mortality rates have been associated with an increase of 10 microgram particle mass per cubic meter of air

1.9 million

people die every year in the EU from cardiovascular diseases[17]

Nervous system

Arteries that nourish the brain are affected by air pollutants in the same way as coronary arteries by air pollutants. Inflammation and oxidative stress due to short or long-term exposure to air pollution can cause ischemic stroke and other cerebrovascular disease. An ischemic stroke is triggered by low blood supply to parts of the brain. Enhanced exposure to $PM_{2.5}$ has been correlated with an increase in hospital admission rates for ischemic stroke and other cerebrovascular diseases.[46,47] In particular, there is strong epidemiologic evidence for a causal relationship between exposure to particulate matter and the occurrence of cerebrovascular disease (stroke and cerebral venous thrombosis) among people with diabetes.[48,49]

Although a small proportion of all strokes appear to be related to air pollutants, the large number of people who suffer from a stroke means that even this small risk leads to a large total health impact.[50] Stroke events in Europe were 1.1 million per year in 2000,[51] projected to rise to more than 1.5 million per year in 2025.[52]

Health impacts from heavy metals and organic pollutants

New evidence shows that children exposed to mercury or lead are three to five times more likely to have problems associated with Attention Deficit Hyperactivity Disorder (ADHD),[57] even if the exposure happens before birth.[58]

Estimates for current levels of mercury exposure, both within and outside Europe, give rise for great concern. A recent study estimated the burden of impaired cognitive development in children based on exposure estimates from a human bio-monitoring project in 17 European countries as well as literature data from eight further countries. According to the study, about 200,000 children born in Europe each year have been exposed to critical levels of methylmercury in the womb. The associated costs resulting from lost IQ benefits are estimated to exceed €9 billion per year for the 27 Member States of the EU.[59]

Global as well as European efforts aim at phasing out the use of mercury in different applications.[60] Yet, this general aim is not recognised in energy policy as there is no EU wide limit value for mercury released to the air from coal power plants. Because gaseous mercury can be transported over very long distances, regulating mercury emissions from coal power plants should be a common concern in Europe. Mercury emitted to the air by coal power plants is deposited through precipitation and enters the water cycle, where it is then transformed to the organic form of methylmercury by certain bacteria. Methylmercury accumulates as it moves up the food chain and reaches the highest concentrations in long living fish species. Human exposure to the neurotoxic methylmercury is mainly derived from the consumption of contaminated fish. Increased levels of methylmercury in fish have been shown in the proximity of a coal power plant, although selenium emissions from the same source partly masked the effect in this study.[61]

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MERCURY

COAL FIRED POWER STATIONS...

are the biggest human source for mercury in Europe in terms of total emissions.[53] In the frame of a new treaty under the UN aiming at the phase out of man-made mercury emissions, the EU has committed to implement technical measures to decrease mercury emissions from coal power plants.[54] Organic mercury taken up through food is notorious as a nervous system toxicant and can cause birth defects. It greatly impacts the brain development of children. This damage is neurologically irreversible, and mostly arises from exposure during early foetal development. Brain injury happens at doses much lower than previously recognised and there may be no safe level of mercury in the body of pregnant women.[55,56]

"A pregnant woman's exposure to mercury can cause irreversible damage to the brain development of her unborn child. A recent study has put a price tag on this in Europe to the tune of some 9 billion a year. Stricter EU regulation of mercury emissions, reducing to a minimum use of coal in power production, would represent an important step."

Sascha Gabizon, Executive Director,
Women in Europe for a Common Future (WECF)

LEAD

THE HEAVY METAL LEAD IS ALSO...

emitted by some coal power plants. Like mercury, lead damages the developing nervous system of children. In adults it can disturb the functioning of the cardiovascular system, which can lead to death, cause hypertension or anaemia.[62,63] It affects almost every system of the body and is directly poisonous in high concentrations. Other metals and semi-metals (which are often included in the terminology "heavy metals" in medicinal contexts) emitted by coal fired power stations include the carcinogens arsenic, beryllium and chromium.

POPs

PERSISTENT ORGANIC POLLUTANTS (POPs) SUCH AS DIOXIN DO NOT...

break down and can remain in the environment for many years. Dioxins are the most dangerous POP and are created as unintentional by-products in coal combustion, but they are only released in very small quantities. Dioxins can be transported over long distances and can cause significant harm even at very low concentrations. Some dioxins can be carcinogenic (they can cause cancer[64]), mutagenic (alter genes), neurotoxic or reprotoxic (damage the nervous system or the reproductive system),[65] and at least one is known as an endocrine disruptor (it interferes with human hormone systems).[66] Other POPs originating from coal combustion are from the group of polycyclic aromatic hydrocarbons (PAHs), some of which are carcinogenic.[67]

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Climate change: The heat is on

Coal combustion also has indirect health effects as it is responsible for enormous greenhouse gas emissions, which accelerates climate change and thus contributes to a number of present and future health risks, also for the European region. Coal power generation contributes to about 20% of Europe's total greenhouse gas emissions.[68] It is the most carbon-intensive energy source in Europe.[69]

During heat waves hot temperatures and certain air pollutants act in synergy and dramatically increase the frequency of cardio-respiratory cases, leading to an increase in hospital admissions on these days. For example, it has been estimated that, for the UK alone, there will be 1,500 more ozone-associated deaths by 2020 due to climate change.[72] According to ERS, people with respiratory problems will be hit particularly hard by temperature increases. For them, the risk of premature death from heat stress is much higher, as recent scientific evidence shows. For a 1°C higher mean temperature in Europe overall mortality and hospital admissions will increase two to three times more among respiratory patients than on average.[73,74]

"Emissions from coal-fired power plants pose a risk to human health and contribute to climate change, which in turn creates further threats to health through the onset of more extreme weather conditions."

Daciana Octavia Sarbu, Member of the European Parliament, Romania

Similar to the differences in susceptibility to air pollution, the population groups that will be hit hardest by climate change impacts are the elderly, children and people with underlying medical conditions. Globally, the impacts from unchecked climate change will affect the health of billions of people.

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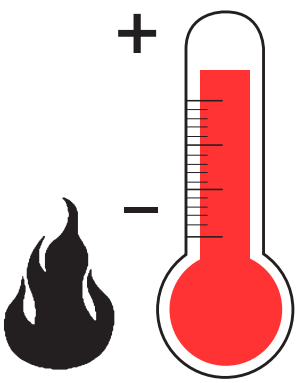
The heat waves of summer 2003 with more than 70,000 excess deaths recorded in Europe can be regarded as a foretaste of climate change health impacts.[70] Extreme events like heat waves are becoming more likely as global mean temperatures rise.[71]



Trans-boundary air pollution from coal power plants

Of 10,000 industrial facilities in Europe, the 20 facilities causing the highest damage to human health and the environment are all coal power plants. For these 20 plants the annual external costs are of the order of several hundred million Euros each.[75]

Coarse particulate matter (PM_{10}) is a component of the ashes and soot created when burning coal, whereas fine particles ($PM_{2.5}$) with a smaller diameter are not only emitted directly but are to a great extent created by chemical reactions in the atmosphere between the various air pollutants. The sheer quantity and number of pollutants released from the combustion of coal exceeds emissions from many other industrial sources, such as the steel or chemical industry.[76]

Particulate matter can travel as far as a thousand kilometres and precursors of ozone (so-called volatile organic compounds or VOCs) even beyond that. Nitrogen oxides remain in the atmosphere for about four days, however, it has been demonstrated that nitrogen oxides originating from power plants in South Africa can travel across the Indian Ocean to Australia.[77] These facts make pollution from coal power plants a European and not a national problem, as has long been recognised in EU policy measures such as the National Emission Ceilings Directive, designed to address acidification and ground level ozone pollution across the EU.

"Polluted air is a top risk factor for ill-health in Europe. Families with low income are more likely to live near industrial sites or busy roads and are thus more likely to be impacted. Addressing air pollution can help to reduce health inequalities."

Monika Kosinska, Secretary General, European Public Health Alliance (EPHA)

The health damage caused by coal combustion is not limited to the proximity of the power plant, as the exhaust cloud from the smokestack can be transported up to several hundred kilometres and across borders, until pollutants deposit in ecosystems or in people's lungs. The height of smokestacks and wind conditions determine where pollution is transported.

LOCAL
(10km)

Coarse particulates (PM_{10}), nitrogen oxides, sulphur dioxide, acid gases, persistent organic pollutants, heavy metals, dioxins

TRANS-BOUNDARY

Sulphur dioxide, nitrogen oxides, VOCs, heavy metals, dioxins, fine particulates ($PM_{2.5}$)

GLOBAL
(>1000km)

Fine particulate matter ($PM_{2.5}$), mercury, dioxins

Figure 3: Likely scale of diffusion of direct and indirect pollutants from coal power stations

Table 1 shows the annual total emissions of 20 large coal power plants in Europe. These plants are among the largest coal power plants in terms of electrical power and burn large amounts of coal. They cause an estimated €7.7 – 21 billion of health and environmental damage annually.[78] Only five of these plants are fired by hard coal whereas 15 use lignite, also called brown coal.

Table 1: 2009 air pollutant emissions of the 20 most health damaging coal fired power stations in Europe

Ranking according to "High VSL" estimate, EEA 2011b; Emissions data: European Pollutant Release and Transfer Register

Facility name	Country	Village/ Town	SO_2 (t)	NO_x (t)	PM_{10} (t)	Mercury (kg)
Maritsa iztok 2	Bulgaria	Kovachevo	138,000	11,800	:	:
Turceni	Romania	Turceni	81,200	14,000	1,320	426
Bełchatów	Poland	Rogowiec	73,500	41,900	1,450	1,580
Megalopolis A	Greece	Megalopoli	47,900	2,510	1,540	169
Jänschwalde	Germany	Peitz	21,400	18,700	573	348
Rovinari	Romania	Rovinari	54,800	11,100	1,850	340
Drax	UK	Selby	28,100	40,600	586	222
Turów	Poland	Bogatynia	39,800	12,100	1,490	:
Kozienice	Poland	Świerże Górne	35,100	21,700	730	411
Romag Termo	Romania	Drobeta Turnu Severin	34,500	2,230	604	98
Longannet	UK	Kincardine	45,200	15,200	587	110
Isalnita	Romania	Isalnita	21,300	1,270	529	:
Gorivna	Bulgaria	Galabovo	58,600	1,060	:	:
Nováky	Slovakia	Zemianske Kostoľany	36,400	3,540	:	:
Niederaußem	Germany	Bergheim	6,870	17,900	386	467
Lippendorf	Germany	Böhlen	13,800	8,570	108	1070
Bobov dol	Bulgaria	Golemo selo	41,400	3,540	2,700	:
Prunéřov	Czech Republic	Kadaň	17,300	16,800	635	196
Deva	Romania	Mintia	17,900	7,400	2,460	:
Rybnik	Poland	Rybnik	18,600	15,100	498	:

: indicates no data reported or no emissions

LIGNITE COMBUSTION:

more dangerous to human health

Burning one tonne of lignite, commonly known as brown coal, will usually release less air pollution in comparison to hard coal. However, as lignite has a lower energy content than hard coal, up to three times as much lignite needs to be burned in order to generate the same amount of energy. A lignite plant with the same electrical power output as a hard coal fired plant will thus generally have more hazardous air pollution emissions, correlated also to the lower efficiency of the plant. These plants also have to meet lower emission standards than hard coal plants, so if new lignite plants were built they would be an even larger source of health damage than refurbished hard coal plants.

The economics of health impacts from coal power generation

The external costs caused by coal power plants in terms of harm to human health and the environment are not included in the price for electricity. However, power plants are obliged to report their annual emissions to the EU, namely the European Pollutant Release and Transfer Register E-PRTR, which makes these data publicly available. By modelling the dispersion of the pollutants in the atmosphere and taking into account the size of the population that is exposed, external costs to health can be quantified.

"The external costs to health from coal power generation are bigger than for any other energy source. The costs of reducing greenhouse gases are partially paid back because of lower health costs."

Professor Paul Wilkinson, London School of Hygiene and Tropical Medicine (LSHTM)

The external costs to health for electricity produced from lignite and coal are higher than for any other energy source in Europe.[79] According to an assessment published in The Lancet in 2007, based on the results of the European research project ExternE, one Terawatt hour (TWh) of electricity produced from hard coal implies on average 24.5 air pollution related deaths. Lignite combustion was associated with an even higher number of 32.6 premature deaths per TWh. In addition, 298 cases of serious respiratory, cardiovascular and cerebrovascular disease (225 for hard coal) were part of the estimated health burden of electricity generation from lignite, as well as 13,288 (hard coal: 17,676) cases of minor illnesses. In comparison, a large coal power plant operating at full load throughout the year usually produces several Terawatt hours of electricity.[80]

A recent report by the European Environment Agency (EEA 2011) found that the largest share of damage to health and the environment from industrial air pollution in Europe came from power plants.[81] Two thirds (between €66 and €112 billion) of the total damage of €102 - 169 billion annually was caused by thermal power plants.[82] Excluding damage from CO_2, the external costs from the energy sector were estimated at €26–71 billion. However, the EEA report did not include reference to the type of fuel consumed by the power plants, nor differentiate their efficiency or size. The data base used for HEAL's assessment are data reported from facilities falling under the Large Combustion Plants Directive (Directive 2001/80/EC), which contains fuel details.

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RESULTS OF HEAL EXPERT ASSESSMENT OF THE HEALTH IMPACTS AND COSTS FOR EUROPE

HEAL commissioned an expert assessment of the health impacts and costs from coal-fired combustion plants for 30 countries in Europe (EU27 plus Croatia, Serbia and Turkey). The assessment is based on data reported under the Large Combustion Plants Directive (LCPD), while the calculation of health impacts and related costs is based on the same methodology as used by the Clean Air For Europe (CAFE) Programme. Detailed information on the methodology and data sources can be found in the technical report in Annex 1.

The main findings are:

- The total health impacts from coal combustion plants in the EU amount to 196,218 life years lost, or 18,247 premature deaths per year. When including Croatia, Serbia and Turkey in the analysis mortality increases to 250,604 life years lost, corresponding to 23,289 premature deaths, annually.
- Chronic health effects were calculated with 8,580 new cases of chronic bronchitis every year, and 5,498 hospital admissions due to respiratory or cardiovascular conditions were additionally attributed to coal pollution in the EU.
- Acute impacts are for example about 28.6 million incidents of lower respiratory symptoms.
- Ill-health causes people to miss their work or at least limit their active tasks on certain days. About 4.1 million lost working days out of a total of 18.2 million restricted activity days for the working age population were associated with coal power plant emissions in the EU.

The results of this expert assessment are well within the range of the coarse factors for mortality and morbidity established by the ExternE project and cited in a study in The Lancet in 2007.[83] To each of the adverse health outcomes a theoretical price tag is proposed in scientific literature. The total costs of ill-health and mortality in the EU together amount to €15.5 to 42.8 billion annually (lower and upper bound due to two different expressions of mortality). Premature deaths, health care costs caused by additional cases of chronic bronchitis and restricted activity days account for the largest expenditures. These costs are paid from different budgets, ranging from national health care budgets, to those borne by the overall economy in lost productivity, and ultimately individuals' household budgets and savings.

Table 2: Health impacts and attributed costs from coal power generation in the EU (2009)

Health impact	Burden associated with coal power generation in the EU (2009)	Attributed costs (€ million per year)
Chronic mortality (premature deaths, VSL)	18,247	37,954
Chronic mortality (life years lost, VOLY)	196,218	10,596
Chronic bronchitis	8,580	1,785
Hospital admissions (respiratory and cardiovascular)	5,498	13
Restricted activity days (working age population)	18,242,034	1,769
Lost working days	4,140,942	
Respiratory medication use	2,066,720	2
Lower respiratory symptoms	28,587,351	1,201
TOTAL COSTS		**15,453 - 42,811**

European countries contribute different amounts to these overall health costs. Table 3 details the costs on a country level. Coal pollution from Bulgaria, Czech Republic, France, Germany, Greece, Poland, Romania, Serbia, Turkey and the United Kingdom, each accounts for costs of more than €1 billion in annual health damage. Poland, Romania and Germany are ranking highest in total health costs and together are responsible for more than half of the price tag.[84] It is important to note that the attribution of health costs to individual countries does not reflect where the health impacts finally occur.

Table 3: Economic valuation of the health impacts by source country

Country	Health costs in million Euro, mortality upper and lower bound (VOLY and VSL)	
Austria	74	27
Belgium	134	46
Bulgaria	4,629	1,678
Czech Republic	2,842	1,034
Denmark	63	23
Estonia	445	159
Finland	169	62
France	1,879	697
Germany	6,385	2,303
Greece	4,089	1,474
Hungary	268	101
Ireland	201	72
Italy	857	312
Latvia	3	1
Netherlands	386	129
Poland	8,219	2,979
Portugal	90	33
Romania	6,409	2,315
Slovenia	228	86
Slovakia	925	336
Spain	827	310
Sweden	7	3
UK	3,682	1,275
non EU countries		
Croatia	243	88
Serbia	4,987	1,832
Turkey	6,689	2,448
Total	54,730	19,821
EU 27	**42,811**	**15,453**

Costs to health excluded from the assessment

The assessment excludes health impacts from emissions to water, and focuses only on three main air pollutants. It further excludes neurological damage related to the release of mercury, which is significant. A recent assessment showed that preventing environmental exposure to methylmercury could save the EU €8-9 billion Euros per year.[85]

More importantly, the assessment does not consider all health impacts during the life cycle of coal, for example the impacts from coal mining, transport and waste disposal. A study on US coal power published in 2011 estimated the full life-cycle costs of coal power generation at up to US$500 billion (about €400 billion).[86] More importantly, it concluded that coal prices would double or triple if external costs were included; the best estimate for the almost full life cycle related costs was US$0.178 cents (€0.14) per kilowatt hour of electricity.

Several EU Member States directly or indirectly subsidise coal combustion and coal mining. For example, in 2005 taxpayers contributed €2.7 billion for coal subsidies in Germany alone.[87] Although coal is promoted as a cheap fuel, new coal plants receive substantial state subsidies, whether directly or through tax exemptions – financial resources which are thus diverted from investment in renewable energy. In the light of substantial external costs to public health, claims that coal is a cheap fuel need to be revised, and state and EU subsidies to coal extraction or coal power plants should be abandoned immediately.

SHOULD COAL POWER GENERATION HAVE A FUTURE IN EUROPE?

Over the past decades, the use of coal for electricity generation in the EU has fallen, from 39% in 1990 to 24% in 2010.[88] However, there are indications for a recent short term rebound in coal electricity and heat generation[89,90] due to high gas prices and a low carbon price. The threat of continued investment in coal in the EU and some of its neighbouring countries still looms. Some countries intend to further exploit their domestic resources of lignite because they regard it as a cheap fuel contributing to national energy security, although it is the dirtiest and least efficient form of coal. An increase in coal utilisation for energy generation is not a safe option in view of current levels of air pollution and the impacts on health.

Coal is still one of the major sources of primary energy in the European region: 25% or one in four kilowatt hours of final electricity consumed is generated by coal power plants,[91] with 15% from hard coal and the smaller fraction from burning lignite (10% of electricity consumed).[92] Roughly 200 million tons of hard coal and 400 million tons of lignite were burned in the EU in 2010. The obvious lack of correlation with the electrical output data is due to the lower calorific value of lignite, requiring more fuel to be burnt. Some EU Member states do not use coal at all in their electricity mix (Cyprus, Lithuania, Luxembourg and Malta). Air pollution from coal power, however, is a joint concern for all European countries, due to its transboundary nature.

On the other hand, a wave of ageing coal plants is due to close before the end of 2015 because of EU legislation (the Large Combustion Plants Directive) that requires them to have improved SO_x, NO_x and dust controls in place by that date, or to close. More than half of the European coal fired power plants are already older than 25 years, and 10% are older than 40 years.[93] Some utilities chose to invest in their old coal plants and refurbish them, while others chose to close them before the end of 2015, and in some cases propose new coal plants to replace them. During the last couple of years, if a proposed new coal plant had not already been granted a permit, its chances of moving from announcement to construction in the EU were small. For example, since 2007, only seven new plants have been permitted in the EU and 67 proposals for new plants have been abandoned. Instead the EU is promoting safer and healthier electricity generation capacity through massive investments in renewable energy sources. In 2011 for example, 71% of newly installed capacity in the EU was renewables-based. This demonstrates that new coal is no longer necessary for electricity supply anywhere in Europe as other options become more viable. Not one of the new coal plants proposed in Europe is needed to keep the lights on and indeed phasing out coal in power generation by 2040 is a realistic goal.[94]

Around 50 new coal power plants are currently in the pipeline in Europe (excluding Turkey); about half of these would burn locally mined lignite. The average life span of a coal power plant is at least 40 years. If any of the 50 new coal power plants were built millions of tons of hazardous air pollution, massive health damage and greenhouse gas emissions would be locked in for decades. This unhealthy future has to be avoided.

How coal might jeopardise reaching climate targets

Runaway climate change, which could already be triggered by 2 degrees celsius of global temperature rise and which would cause immeasurable impacts on human health, must be avoided. Therefore global greenhouse gas emissions have to decline steeply over the next decades. The EU as well as other industrialised countries of the G8 have pledged to reduce their greenhouse gas emissions to 80% below the level of 1990, as a fair share of global efforts to stay below the 2 degrees threshold.[95]

Anything other than a substantial reduction in the amount of coal consumed for power generation would move this target out of reach, even if technology was to be applied in all new and most of the existing plants that would almost completely eliminate CO_2 emissions.[96] In particular Carbon Capture and Storage (CCS) technologies have been discussed as a means to burn coal with few greenhouse gas emissions. However, the technology gives several reasons for concern and poses substantial risks to human health (see next chapter).

The huge public health benefits that arise from decreasing the burning of fossil fuels such as coal can substantially mitigate costs of greenhouse gas reductions. Putting it the other way around, mitigating climate change saves enormous costs in air pollution control. Importantly, the health benefits already occur at a short and medium time scale.

"The EU has committed to protect public health from air pollution as well as from climate change impacts. As the use of coal in Europe is currently increasing, there is a significant threat to people's health in the short and long term."

Dr. Peter Liese,
Member of the European Parliament, Germany

In October 2011 over 500 health and security experts called on governments to ban the building of unabated coal power plants and to phase out the operation of existing coal-fired plants, starting with lignite plants, due to their most harmful direct effects on health. The British Medical Journal (BMJ) conference statement calls for urgent action on climate change and has been signed by medical associations, leading medical research institutes and as well as public health organisations.[97]

CAN THERE BE SUCH A THING AS 'CLEAN COAL'?

Even maintaining the status quo of the current coal burning capacity will lead to immense damage to public health. An increase in coal generating capacity would be detrimental to health protection. Voices from the industry claim that new coal power plants would deploy 'clean coal technology' and thus replacing older coal power plants with new ones would lead to improvements in air quality. The following paragraphs aim at shedding more light on the myth of clean coal. An important consideration in any debate on clean coal should be that there is no legal requirement in Europe to close down an old coal power plant whenever a new one is constructed. The promise of clean coal thus implies the risk of an increase in the overall number of coal power plants.

CAN MORE EFFICIENT COAL POWER PLANTS BE CLEAN AND SAFE FOR HUMAN HEALTH?

Technical advances mean more efficient coal power plants, but improvements are small. The higher the efficiency of a coal fired power plant the less coal it consumes to produce 1 kilowatt hour of electricity. The current state-of-the-art thermal efficiency of a coal power plant in Europe is between 34% and 40%. The new generation "high efficiency" coal plants have a maximum 46% efficiency for hard coal and 43% for lignite. In other words, more than half the coal burnt in a "high efficiency" coal plant is not converted to useful electricity. In addition, there is a general trade-off between improvements in efficiency and improvements in air pollution control: current filter technology decreases the thermal efficiency by about 1%.[98] The better the different filters can catch particulates, sulphur and nitrogen oxides, the more energy or steam they consume within the power plant.

If a coal power plant not only produces electricity but also heat, (an option called combined heat and power generation (CHP) or co-generation), the total efficiency is much larger, although less electricity is produced. However, selling the heat requires a different business model that many utilities are not yet interested in taking on and the plant needs to be close to a suitable user for the heat; many large plants are situated far away from centres of population. Another technological option targets the CO_2 in the air: Carbon Capture and Storage (CCS) is the most frequently discussed "clean coal technology". Although frequently promoted as such, CCS cannot make coal carbon neutral, nor will it make the exhaust fumes free of hazardous air pollutants. The technology carries a number of important further health risks and to date remains an empty promise.

CLEANING UP EXISTING COAL PLANTS THROUGH IMPROVED FILTER TECHNOLOGY

Existing coal power plants have to be required to apply the best pollution control technology available, in order to minimise their impact on people's health. This includes electrostatic filters or fabric filters for particulates and desulphurisation appliances. Improved pollution control would transfer part of

CAN HAZARDOUS AIR POLLUTANT EMISSIONS BE REDUCED BY CARBON CAPTURE AND STORAGE TECHNOLOGIES?

CCS technologies are widely discussed as a means to make coal combustion a 'clean' technology in terms of low greenhouse gas emissions. Through direct and indirect effects CCS would also impact the rate of emissions of hazardous air pollutants: NO_x emissions from a CCS coal power plant would be higher, while SO_2 emissions would decrease.[99]

The central principle of CCS is to separate carbon dioxide from a gas mixture, for example in a coal power plant, compress and transport it and then dispose of the CO_2 underground.[100] Some CCS options for the capturing process require a high reduction of sulphur oxides or particulate matter in the gas beforehand, so that the ultimate emissions of SO_2 and PM10 are low. Those CCS technologies that filter the flue gas after combustion usually use organic solvents, which may also capture some hazardous air pollutants, while others will not be filtered out.

The downside of every CCS technology is that it is very energy intensive and burns 20-30% more coal, in other words, it substantially reduces the efficiency of the coal plant.[101] This leads to higher total emissions of NO_x per kWh electricity produced while it may counterbalance the above mentioned effect for particulate matter emissions and reduce the positive effect on SO_2 emissions. The oxy-fuel combustion technology seems to be the only CCS option currently under development that may decrease both greenhouse gas and air pollutant emissions from the combustion plant.[102]

Apart from the continued health impact from air pollution, the storage of captured CO_2 below ground poses additional significant risks to human health and the environment. At the storage site, groundwater may be contaminated by leaked chemicals used in the injection process, or by the upwards displacement of brine loaded with toxic metals and organics.[103] CO_2 leaking during transport or from the storage site could cause headaches and unconsciousness at concentrations of 7 to 10%[104], whereas an accidental release of huge quantities of the gas could even cause mass suffocation.

The risks emanating from different stages in the CCS life cycle simply make it a gamble with people's health. From the health perspective, CCS should not be pursued as an energy option in Europe. The only proven way to decrease all air pollution from coal power plants is installing the best abatement technology available.

the costs that would otherwise be imposed on public health back to the polluter.

The most recent EU legislation with regard to pollution control from coal power plants is the Industrial Emissions Directive (IED), which will come into force in 2016 and introduces stricter emission limits for existing as well as new coal fired power plants. Some of the neighbouring countries of the EU, the signatories of the Energy Community Treaty (including Turkey, the Ukraine and the countries of the Western Balkans) have also bound themselves to IED pollution controls albeit on a slightly slower timetable and with no enforcement mechanism.

But the standards laid out in the IED are already out of date – the USA and China both introduced far higher pollution controls for all major air pollutants from coal power plants in 2012. For example, the Chinese and USA limit values for nitrous oxides emissions are 100 and 117 mg/m^3 respectively, whereas the EU limit value is 200 mg/m^3.[105]

Unfortunately, the text of the IED provides for a number of loopholes and derogations that could be granted to older plants so that they can continue operating with higher pollution levels until 2020-2022 or even longer.[106] These gaps in the IED need to be closed immediately. Furthermore, the Chinese and the USA examples show that the EU should even raise the standards set in the IED in order to better protect public health from hazardous emissions. Better filter technology is already available.

POLICY RECOMMENDATIONS

TO MEDICAL PROFESSIONALS AND PUBLIC HEALTH EXPERTS:

The time is right for advocacy on the health damage from coal. Based on the established scientific evidence about the health risks from coal combustion, doctors and health organisations can add a long neglected perspective to the debate about Europe's future energy supply.

THEY SHOULD >>>>>

- Highlight to EU and national decision makers that the health impacts and external costs of coal have to be taken into account in energy decisions. From a health perspective building new coal power plants is detrimental to efforts of tackling chronic disease and creates unnecessary costs.
- Become involved in the debates on higher air quality standards and more ambitious climate action at EU level as well as nationally.
- Raise awareness on the health risks from coal power in local consultation processes and help to ensure the enforcement of better pollution control for existing coal in order to protect public health. The tool box in Annex 3 aims to support medical experts by showing how they can get involved in relation to coal power plants in their region.

TO NATIONAL AUTHORITIES:

National authorities have to take the gloves off and reduce outdoor air pollution from coal power plants. In the interest of their citizens' health but also of their neighbouring countries

THEY SHOULD >>>>>

- Introduce a moratorium on the construction of new coal power plants.
- Develop a national phase-out plan for coal in power generation.
- End all exemptions from the highest pollution control standards for existing coal plants.
- End all direct and indirect subsidies and tax exemptions for hard coal and lignite mining as well as coal power generation by 2018, when direct hard coal mining subsidies are already required to end.

TO THE EU:

The phase out of coal power in Europe is possible by 2040 and constitutes an important step to improve air quality, reduce chronic disease and cut greenhouse gas emissions at the same time.

THEY SHOULD >>

- Ensure that the costs and benefits to health are taken into account in any energy and climate policy assessments and decisions.
- Strengthen the IED which regulates air pollution from coal power plants by removing all exemptions for existing plants.
- Adopt stricter emission limit values, comparable to recent Chinese and USA standards, for the whole of the EU by 2020 and introduce binding mercury emission limit values.
- Make sure that Croatia as an EU accession country is required to meet EU pollution control standards for coal power plants without any derogation by 2018, and encourage EU candidate countries to do likewise.
- Support a termination of all EU lending, including by EU financial institutions, to coal plants, coal mining and infrastructure projects that would contribute to an increase in coal capacity. Similarly, support an ending of EU subsidies for CCS technologies.

ANNEX 1

TECHNICAL REPORT, METHOD FOR THE IMPACT ASSESSMENT

The approach used to quantify effects follows the impact pathway approach developed in the EC-funded ExternE study[107] and adopted for assessment of air quality regulation in the EU since the mid-1990s, including the Clean Air For Europe Programme that underpinned the development of the EU's Thematic Strategy on Air Pollution. Analysis proceeds through the following stages:

1. Quantify emissions. For most of the countries featured in the analysis data on emissions, combined with information on fuel used, are taken from the Large Combustion Plant Database held by the European Environment Agency.[108] Emissions were taken for the year 2009. Emissions for some plant result from the use of more than one fuel, and for the present purposes it is necessary to allocate emissions by fuel. The following relationships have been used, drawing on plant-specific information from a large number of case studies under the ExternE Project series, covering plant with a variety of abatement technologies in place. Application of these factors has made a difference in total emissions attributed to coal of only 8% for SO_2, 3% for NO_x and 6% for dust compared to a simpler approach where emissions were attributed to different fuels according to the thermal input of each fuel. This small difference between the cases suggests that any uncertainty introduced by this scaling process is very small.

Table 4: Typical pollutant emission ratios relative to coal for large combustion plant

	SO_2	NO_x	DUST
Coal and lignite	1.00	1.00	1.00
Oil	1.00	1.50	0.42
Natural gas	0.00	0.38	0.00
Biomass	0.36	0.61	1.00

Emissions of dust are specified in the LCP Directive as applying to total suspended particulate (TSP). For the purpose of the analysis presented here, TSP needs to be converted to $PM_{2.5}$, the fraction of particulate matter that is sufficiently fine to penetrate deep into the lung. A factor of 0.59 is applied to convert TSP to $PM_{2.5}$ drawing on information from ExternE[109] (a factor of 0.9 to convert from TSP to PM_{10}) and CAFE[110] (a factor of 0.65 to convert from PM_{10} to $PM_{2.5}$).

Three countries, Czech Republic, France and the Netherlands, do not report the fuel used to the LCP database. Data are also unavailable from the LCP Database for Croatia and Turkey. A second source[111] has been used for data from all five countries, reports to the European Environment Agency (EEA) under the UNECE Convention on Long Range Transboundary Air Pollution, taking emissions for the sector 'Public Electricity and Heat Production', again for 2009. This provides the following estimates for the sector:

Table 5: Emissions from 'Public Electricity and Heat Production' in 2009

	SO_2	NO_x	$PM_{2.5}$	TSP
Czech Republic	104,345	79,233	1,871	
France	74,114	68,259	2,277	
Netherlands	6,335	26,314	272	
Croatia	25,830	7,455		1,226
Serbia	244,546	108,580	2,744	
Turkey	946,689	380,292		142,591

Particle emissions are this time expressed as $PM_{2.5}$ for the Czech Republic, France and the Netherlands, and so there is no need to apply conversion factors for these countries. However, in all cases, results apply to total emissions from power and heat production, rather than from coal fired facilities specifically. Data on fuel mix are derived from the Eurostat energy database[112] (Table 6) except for Serbia[113] and the emissions from Table 5 allocated to coal generation using the factors shown in Table 4. The figures exclude the nuclear fraction of generating capacity (on the grounds that it will not directly emit the pollutants of interest here) and the waste fraction. The latter will cause some overestimation in attribution of the share of coal, though this is considered likely to be small, and balanced by other biases in the analysis towards underestimation.

Table 6: Relative proportion of different fossil fuels and biomass used in power generation in each country (excluding nuclear, hydro and waste)

	COAL	OIL	NATURAL GAS	BIOMASS
Czech Republic	95%	0%	2%	3%
France	41%	8%	45%	6%
Netherlands	25%	0%	70%	5%
Croatia	28%	34%	38%	0%
Serbia	99%	0%	1%	0%
Turkey	35%	3%	62%	0%

Results are shown in Table 7. A separate assessment of emissions of SO_2 and NO_x from the Turkish power sector developed by Greenpeace (L. Myllyvirta, personal communication) suggests that the CLRTAP data may be too pessimistic for Turkey (PM emissions were not considered). Comparison of PM emissions for Turkey with those of other countries with high emissions of the three pollutants suggests potential for error in the PM data also. To account for this, an alternative PM emission estimate for Turkey has been generated by applying the ratio of $PM_{2.5}$: NO_x from Bulgaria, Greece, Poland, Romania and Serbia combined. An alternative set of emissions data are therefore shown for Turkey in Table 7. Whilst the ends of the ranges shown may be questionable, there is reasonable confidence that the true figure for emissions is within the range shown. Reflecting some other conservative positions adopted here, the lower estimates have been used for the analysis in the main report.

Table 7: Estimated emissions from coal and lignite fired power generation for the countries for which complete data were unavailable from the LCP database

	SO_2	NO_x	$PM_{2.5}$
Czech Republic	103,172	77,736	1,814
France	59,396	49,393	1,854
Netherlands	5,910	23,453	227
Croatia	11,665	2,642	475
Serbia	244,546	108,580	2,745
Turkey	871,950	336,968	80,517
Turkey (lower estimate)	760,100	182,000	29,086

2. Assess human exposure to pollutants. This is based on earlier analysis designed to derive damage figures per tonne emission of various pollutants, using transfer matrices developed using the EMEP model[114] to describe atmospheric chemistry and transport. Since the model runs were originally undertaken the dispersion modelling has been revised in relation to the formation of HNO_3, effects of which are assessed here via the contribution of NO_x emissions to atmospheric particles. It is reported[115] that:

   The largest differences was found for nitrate aerosol, where changes up to around 40% appear for countries with high NO_x and NH_3 emissions.

   For the purposes of the present analysis this is accounted for by a 50% reduction in nitrate exposure in all countries. Whilst this goes beyond the reported reduction it provides better transparency for the analysis than a more complex, country by country, approach.

3. Apply response functions to quantify effects on health, using the functions, prevalence and other data reported for use in the methodology of the Clean Air For Europe (CAFE) Programme[116] and also by the EEA[117].

4. Apply valuations to obtain the economic equivalent of impacts to health. The data used here are again taken from the methodology of the CAFE Programme, which remains the recommended data set for application in analysis for the European Commission. The values used are updated in line with the EEA's assessment of damage by facilities reporting via the E-PRTR. Mortality is valued using both the value of a life year (VOLY) and the value of statistical life (VSL), reflecting alternative views of economists working in the field (the present author's preference is for the former). Taking the extreme positions on each gives a range of a factor of about 3 from low to high.

5. No account is taken in this analysis of damage to receptors apart from health. Hence, results exclude damage from acid deposition to buildings, including cultural heritage and from deposition of acidifying and eutrophying pollutants to ecosystems.

Table 8: Health costs from coal power generation per country, per capita and per kilowatt hour electricity

COUNTRY	TOTAL COSTS, VSL UPPER BOUND ESTIMATE	TOTAL COSTS, VOLY LOWER BOUND ESTIMATE	COSTS PER CAPITA[118] (VSL)	RELATIVE COSTS, EURO CENT PER KWH ELECTRICITY[119] PRODUCED FROM COAL (VSL)
Austria	74	27	9	2.0
Belgium	134	46	12	2.6
Bulgaria	4,629	1,678	608	23.3
Czech Republic	2,842	1,034	271	6.2
Denmark	63	23	11	0.4
Estonia	445	159	332	5.8
Finland	169	62	32	1.5
France	1,879	697	29	8.7
Germany	6,385	2,303	78	2.6
Greece	4,089	1,474	363	12.0
Hungary	268	101	27	4.2
Ireland	201	72	45	5.0
Italy	857	312	14	2.2
Latvia	3	1	1	2.5
Netherlands	386	129	23	1.6
Poland	8,219	2,979	216	6.2
Portugal	90	33	8	0.7
Romania	6,409	2,315	298	29.5
Slovenia	228	86	112	4.5
Slovakia	925	336	171	24.0
Spain	827	310	18	2.3
Sweden	7	3	1	1.4
UK	3,682	1,275	60	3.6
EU27	42,811	15,453	87	5.3
Croatia	243	88	55	14.7
Turkey	6,689	2,448	94	12.3
Serbia	4,987	1,832	680	21.5
TOTAL	**54,730**	**19,821**	**95**	**6.2**

ANNEX 2

HEALTH RISKS FROM VARIOUS POLLUTANTS, POLLUTANT GUIDELINE VALUES FOR AMBIENT AIR AND EMISSION LIMIT VALUES FOR COAL POWER PLANTS

POLLUTANT	RELATED HEALTH RISKS[120]	GUIDELINE AND LIMIT VALUES[a]
Carbon dioxide (CO_2)	Indirect health impacts from climate change	
High volume hazardous air pollutants		
Sulphur dioxide (SO_2)	Can affect respiratory system and lung functions, aggravation of asthma and chronic bronchitis, makes people more prone to infections of the respiratory tract; irritation of eyes; cardiac disease aggravated ; ischemic stroke risk	WHO AQ Guidelines[121]: 20 µg/m³ (day) 500 µg/m³ (10min) Directive 2001/80/EC: 400 mg/m³ (old plants), 200 mg/m³ (new plants)
Nitrous oxides (NO_x);	Asthma development (suspected), asthma exacerbation, chronic obstructive pulmonary disease, stunted lung development; cardiac arrhythmias, ischemic stroke. Reacts with VOCs in sunlight to form ground- level ozone	WHO AQ Guidelines[89]: NO_2: 40 µg/m³ (year), NO_2: 200 µg/m³ (1h) Directive 2001/80/EC: NO_x: 500 mg/m³ (old plants) NO_x: 200 mg/m³ (new plants)
Particulate matter: coarse particulates (PM_{10}), fine particulates ($PM_{2.5}$)	Respiratory: asthma development (suspected), asthma exacerbation, chronic obstructive pulmonary disease, stunted lung development ($PM_{2.5}$), lung cancer; Cardiovascular: cardiac arrhythmias, acute myocardial infarction, congestive heart failure ($PM_{2.5}$). Nervous system: ischemic stroke.	WHO AQ Guidelines: PM2.5 10 µg/m³ (year), PM10 20 µg/m³ (year) Directive 2001/80/EC: (monthly, total dust) 50 mg/m³ (old plants), 30 mg/m³ (new plants) Directive 2008/50/EC: 25 µg/m³ target $PM_{2.5}$ (year), 50 µg/m³ (day) limit PM10, not to exceed on >35 days
Ammonia (NH_3)	Respiratory irritation, can cause skin and eye burns. Precursor of secondary particulates.	WHO AQ Guidelines: 270 µg/m³ (day)
Hydrogen Chloride and Fluoride (HCl, HF)	Acute irritation to skin, eyes, nose, throat, breathing passages.	

[a] The guideline values listed here refer to ambient outdoor air and are derived from the WHO 2000 Air Quality Guidelines for Europe as well as the 2005 WHO Air quality Guidelines Global Update. The WHO gives recommendations for concentration limits that should not be exceeded, based on a review of the scientific evidence on health effects. The limit values for SO_2, NO_x and PM are in contrast set for the exhaust air from coal power stations and thus have a different order of magnitude. They were taken from the Large Combustion Plants Directive 2001/80/EC which will be substituted by Directive 2010/75/EC from January 2016 on. Other limit or target values are concerning ambient air and have been taken from Directive 2008/50/EC and Directive 2004/107/EC on ambient air.

Organic pollutants		
Dioxins and furans (e.g.,2,3,7,8-tetrachlorodibenzo-dioxin , short TCDD)	Probable carcinogen (stomach cancer); affect reproductive, endocrine and immune systems. Dioxins accumulate in the food chain.	WHO AQ Guidelines value: TCDD 70 pg/kg weight/month tolerable intake (provisional)
Polycyclic Aromatic Hydrocarbons (PAHs): e.g., Benzo-a-anthracene, Benzo-a-pyrene	Probable carcinogens; may have adverse effects on the liver, kidney, and testes; may damage sperm cells and impair reproduction. PAHs can be attached to small particulate matter and deposit in the lungs.	No guideline value, to be kept as low as possible Directive 2004/107/EC: benzo-a-pyrene: 1ng/m^3 (air)
Non-Methane Volatile Organic Compounds (VOCs)		
Aromatic hydrocarbons: e.g. benzene, xylene, ethylbenzene, toluene	Irritation of the skin, eyes, nose, throat; difficulty in breathing; impaired function of the lungs; delayed response to visual stimulus; impaired memory; stomach discomfort; effects to the liver and kidneys; may cause adverse effects to the nervous system. Benzene is a strong carcinogen.	WHO AQ Guidelines values: Benzene: no safe levels can be determined; toluene: 0.26 mg/m^3; formaldehydes: 0.1 mg/m^3 (30min) Directive 2008/50/EC: Benzene: 5 µg/m^3 (year)
Aldehydes including formaldehyde	Probable carcinogen (lung and nasopharyngeal cancer); eye, nose, throat irritation; respiratory symptoms	
Heavy metals		
Mercury (Hg), in food as Methylmercury	Damage to brain, nervous system, kidneys and liver; neurological and developmental birth defects.	WHO AQ Guidelines value: 3.2 µg/kg weight/week tolerable intake; EU: no emission limit values
Lead (Pb)	Damages nervous system of children; may adversely affect learning, memory and behaviour; may damage kidneys, cause cardiovascular disease, anemia.	WHO AQ Guidelines value: 0.5 µg/m^3 (air) Directive 2008/50/EC: 0,5 µg/m^3 (ambient air)
Antimony (Sb), Arsenic (As), Beryllium (Be), Cadmium (Cd), Chromium (Cr), Nickel (Ni), Selenium (Se), Manganese (Mn)	Carcinogens (lung, bladder, kidney, skin cancers); may adversely affect nervous, cardiovascular, dermal, respiratory and immune systems. The International Agency for Research on Cancer classifies arsenic and its compounds as group 1 carcinogens.	WHO AQ Guidelines: As: no safe level established; Cd 5 ng/m^3 air; Directive 2004/107/EC: As 6ng/m^3; Cd 5ng/m^3; Ni 20ng/m^3 (ambient air)
Radioisotopes		
Radium (Ra)	Carcinogen (lung and bone cancers); bronchopneumonia, anemia, brain abscess	
Uranium (Ur)	Carcinogen (lungs and lymphatic system); kidney disease	

ANNEX 3

TOOL BOX: EU LEGISLATION RELEVANT FOR COAL POWER PLANTS AND TOOLS TO APPLY THEM FOR HEALTH PROTECTION

The EU has a long history of tackling air pollution. There are important laws and legal requirements in place to regulate emissions from power plants, but also to ensure a good overall level of air quality. Given below is a list of laws for reference, which can be used as a tool to check if current coal power plants comply with EU standards, and which may inform discussions about plans for new coal power plants.

Emissions from coal power plants

Coal power plants of at least 50MW thermal power currently fall under the requirements of the Directives on Integrated Pollution Prevention and Control (IPPCD) and Large Combustion Plants (LCPD). From January 2016 onwards, all emissions from large industrial sources including coal combusting thermal power stations (>50MW) will be regulated through the IED (which combines both IPPC and LCPD).

Both laws set legally binding minimum emission limit values (ELVs) for sulphur dioxide, nitrous oxides, and dust (under which particulate matter is subsumed). The IED introduces stricter limits for all these pollutants for most classes of power plants. In order for an operator to get a permit for operating or constructing a combustion plant from the national authorities, it has to be shown that the plant at least complies with those emission limit values that have been set and, for all pollutants applies best available technology (BAT).

Lignite burning plants are a special case, along with any other high sulphur fuelled plants: they fall under the requirement for desulphurisation rates (96 - 97% for plants >300MW) which means that they don't have to comply with the emission limit values for sulphur dioxide.

Unfortunately the new Directive has many loopholes. Existing plants that would otherwise have to be retrofit can evade the legally binding ELVs via several derogations. For example, if the plant is not going to operate more than 17,500 hours of remaining life; if it is not going to operate more than 1,500 hours per annum; if the whole or part of the national sector is not complying. However, plants not only have to comply with these minimum standards.

Under IED the role of the BAT Reference Documents which set the benchmark EU standards has been strengthened, such that these references have to be included in permits. However, national authorities can grant exemptions if the application of best available technologies results in disproportionately high costs compared to the environmental benefits. The respective cost-benefit assessment lies with the national authorities. Similarly, other local technical, environmental or geographical factors can be used to justify not meeting the best available technology standards.

TAKE ACTION:

Check the emissions of an existing coal power plant in the publicly accessible database of the European Pollutant Release and Transfer Register (E-PRTR). Your national authority monitors if the plant complies with emission limit values and keeps data from local monitoring sites. Use this information to assess how much the power plant contributes to local air pollution.

Background air pollution

As air pollution comes from many sources and is a local, national and international problem, it is important to look at the overall levels of air pollution, the so called ambient or background concentration.

The 2008 EU Ambient Air Quality Directive merges several previous EU laws on air quality, and sets standards, i.e. concentration limits, for a number of hazardous air pollutants. These standards include both target and limit values. Currently there are limit values in place for pollutants such as sulphur dioxide (SO_2), nitrogen oxide (NO_2) and coarse particulate matter (PM_{10}). For the highly problematic fine particulates $PM_{2.5}$ there is a target value in place. The limit values are legally enforceable, meaning that EU member states have to comply with them (even though they can ask for time extensions).

TAKE ACTION:

Check the air quality situation in your area with the data from the local monitoring station for SO_2, NO_2 and PM_{10}. Have a look at Annex 2 to see about the health effects of air pollutants and where the WHO recommends concentration limits should be. Analyse the situation in your area over a longer time interval. Attract the attention of media and authorities and inform the public if thresholds are exceeded. Coal power plants in the region might contribute to high concentrations. Obtain weather data (wind directions) for the same period in order to determine potential point sources.

Mercury Emissions

Mercury emissions from coal power plants are the largest anthropogenic source of mercury emissions worldwide.

For mercury emission reductions, better filter technologies and associated performance levels are described in the so-called BAT Reference Documents (BREFs), but there are no benchmark standards. Since 2011, the EU has been reviewing the BREFs for large combustion plants. This review is still in progress and the issue of establishing standards for emissions of mercury to air and water is an on-going strongly contested issue.

As other emissions from coal combustion have to comply with binding emission limit values, mercury emissions could be reduced as a side-effect. It is partially removed by dust control devices, by wet flue gas desulphurisation, and indirectly via catalytic systems (SCRs) that primarily remove nitrous oxides. However, elemental mercury can still be emitted as this form is not removed by the standard filters. It is thus often necessary to use a technique designed specifically to remove mercury, e.g. activate carbon injection.

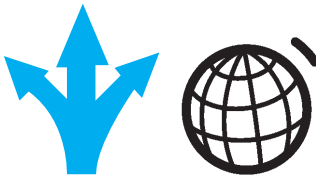
The Water Framework Directive 2008/105/EC sets a binding Environmental Quality Standard (EQS) for mercury discharge in surface waters of 0.05 µg/l as well as an EQS of 20 µg/l for sediments and biota. These limit values have to be applied in permits for coal power plants. Mercury must be included into legislation on emission limit values from power plants, since a large amount of mercury is emitted as a constituent of particulates.

TAKE ACTION:

Check if the permit application for a planned coal power plant is correctly applying the EQS for mercury emissions from the power plant to surrounding water bodies. Technical experts may be able to provide independent calculations. Submit your concerns in the public consultation process. Also legal actions might be applicable.

International commitments of EU and Non-EU European countries

As air pollution is also a transboundary problem, there is an international process in place to tackle it for the western world. The EU and its member states are part of the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP) and its protocols. The Gothenburg protocol set national emission ceilings for sulphur dioxide, nitrous oxides, volatile organic carbons (VOCs) and ammonia for the year 2010 (i.e. reducing emissions by 63%, 41%, 40% and 17%, respectively, compared to 1990 levels). Recently an amendment of the protocol set the reduction targets for these pollutants until 2020 and introduced a new limit for fine particulate matter ($PM_{2.5}$) emissions.



TAKE ACTION:

Check what your country has committed to under the CLRTAP Gothenburg Protocol, and if building a new coal power plant could endanger the reduction commitments.

Public access to information

Regulation (EC) No 166/2006 on the establishment of a European Pollutant Release and Transfer Register (E-PRTR) makes accessible to the public detailed information on the emissions and the off-site transfers of pollutants and waste from approximately 24 000 industrial facilities. For example, in 2008 coal fired power plants emitted 21.2 tonnes of mercury.

The EU Ambient Air quality Directive also includes information requirements for the public.

TAKE ACTION:

Check the E-PRTR to find out the emission information on the coal power plant(s) near you. Please consider that emissions can be transported over several hundred kilometres.

Environmental Impact Assessment

New coal power plants with at least 300MW thermal power[132] have to undergo a mandatory Environmental Impact Assessment (EIA) before a building permit can be issued, as foreseen by Directive 2011/92/EU. For smaller power plants, Member States can subject the project to an EIA on a case-by-case basis or by applying general criteria in a screening procedure. The project developers have to document all foreseeable impacts on the environment which should by complying with existing environmental regulation. Public consultation is an important component of the EIA process, which has often been able to hold up or completely stop a coal plant proposal.

TAKE ACTION:

Check if an EIA has been carried out and if a zero-intervention option was included in the assessment.

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About the report

This report produced by the Health and Environment Alliance (HEAL) aims to provide an overview of the scientific evidence of how air pollution impacts health and how emissions from coal power plants are implicated in this. It presents the first-ever economic assessment of the health costs associated with air pollution from coal power plants in Europe as well as testimonies from leading health advocates, medical experts and policy makers on why they are concerned about coal. The report develops recommendations for policy-makers and the health community on how to address *the unpaid health bill* and ensure that it is taken into account in future energy decisions.

HEAL's work on coal, climate change and air quality

HEAL has a strong track record in bringing evidence and knowledge about climate change and health to the forefront of deliberations at EU and international levels as well as engaging public health and health professional communities, particularly in Europe. Information, resources and partnerships are developed in collaboration with our expert member organisations, such as the European Respiratory Society (ERS), European Lung Federation (ELF), European Federation of Allergy and Airway Diseases Patients Association (EFA) and the U.S.-based Collaborative on Health and Environment (CHE).

In 2007, HEAL published a briefing which reviewed the latest scientific evidence on climate change and health from the Intergovernmental Panel on Climate Change (IPCC). This laid the basis for building policy recommendations, focusing on protecting the most vulnerable groups and considering win-win scenarios for public health through climate mitigation measures.

Through its work with the World Health Organization (WHO) in facilitating World Health Day on climate change in 2008, HEAL helped to share health concerns about climate change with major stakeholder groups around the world, including via international organisations of medical professionals, patients, youth and specialist journalists.

Since then, many health and medical groups, citizens and policy-makers have joined us in advocating for health to be at the centre of climate change mitigation and adaptation measures. Public awareness on the health benefits of tackling climate change was further increased through the 2010 groundbreaking report on a 30% reduction target for EU climate policy, which HEAL published jointly with Health Care Without Harm Europe. The report argues that stepping up the EU's climate ambition would bring health benefits of up to 30.5 billion EUR health benefits as a result of cleaner air.

The Unpaid Health Bill: How coal power plants make us sick marks the beginning of a coal and health campaign in which HEAL will work closely with medical, health and climate advocacy groups, especially in countries where coal is a particular threat to health. Launched during the EU Year of Air, this report highlights important opportunities to improve public health through cleaner air.

About HEAL

The Health and Environment Alliance (HEAL) is a leading European not-for-profit organisation addressing how the environment affects health in the European Union (EU). We demonstrate how policy changes can help protect health and enhance people's quality of life.

With the support of more than 65 member organisations, representing health professionals, not-for-profit health insurers, patients, citizens, women, youth and environmental experts, HEAL brings independent expertise and evidence from the health community to different decision-making processes. Members include international and Europe-wide organisations, as well as national and local groups.

HEAL
Promoting environmental policy that contributes to good health

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A report from the Health and Environment Alliance