



Burning biomass: the impact on European health

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... increased biomass use in the electricity sector could lead to up to 1,100 additional deaths per year, along with large numbers of cases of bronchitis and hospital admissions.

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A conservative estimate is that exposure to smoke from domestic biomass-use led to 40,000 deaths across the EU in one year.

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Air quality legislation does not fix the problem: The more material is burned, the greater the health effects.

New research by a leading independent expert, commissioned by Fern, draws attention to serious impacts on human health of burning solid biomass, mainly wood, for heating and power generation in the European Union. It points to evidence that tens of thousands of EU citizens are dying prematurely every year as a result of exposure to air pollution from burning solid biomass. Other health impacts include cancers, cardiac and respiratory complaints, asthma attacks and working days lost to ill health.

We are publishing the report now as the EU is preparing to agree a proposed revision of the Renewable Energy Directive (REDII) to apply after 2020. If approved in its current form, the revised directive will inevitably lead to the continuation of high levels of biomass burning and thus exposure to the dangerous health impacts of biomass emissions.

Air pollution is not considered in the Commission's Impact Assessment, because it is argued that it is dealt with by other EU legislation. However, this overlooks the fact, supported by the World Health Organisation and other experts in the field, that there are no thresholds for the pollutants of concern here. Increased emissions of pollution will damage health whether or not there is compliance with legislated limits. These impacts thus need to be accounted for and considered in the development and implementation of the revised legislation.

The EU is already increasingly dependent on solid biomass to meet renewable energy targets, especially for heating. Analysis in the report suggests that in 2020 solid biomass will account for nearly three quarters (72.6 per cent) of renewable heating and cooling across the EU, and more than a tenth (12.7 per cent) of renewable electricity generation.

This reliance on solid biomass to meet the EU's energy needs makes little sense on environmental grounds (for example, it leads to carbon dioxide (CO₂) emissions and has damaging impacts on forests).^{1,2,3,4} In Fern's view, the case collapses completely once the negative consequences for European health are factored in, an issue that until now has received almost no attention in the debate on bioenergy.

The research we commissioned was carried out by Dr Mike Holland who has more than twenty years' experience of quantifying the impacts of air pollution from power systems. His full report with details of the methodologies used is available at: www.fern.org/report/biomassandhealth.

¹ See open letter signed by 190 scientists to European policy makers, published in Euractiv (September 2017) <http://www.euractiv.com/section/energy/opinion/need-for-a-scientific-basis-of-eu-climate-policy-on-forests/>; Open letter signed by scientists in the Guardian (December 2017) <https://www.theguardian.com/environment/2017/dec/14/eu-must-not-burn-the-worlds-forests-for-renewable-energy>; and Fern (2016) Briefing note "Why burning trees for energy is no solution to climate change" <http://www.fern.org/climate%26bioenergy>

² See European Environmental Agency (2016) European forest ecosystems – state and trends (EEA report No 5/2016)

³ Chatham House, 2017: <https://www.chathamhouse.org/publication/woody-biomass-power-and-heat-impacts-global-climate>

⁴ A 2017 report by the European Academies Science Advisory Council described the idea of biomass energy being carbon neutral as simplistic: http://www.easac.eu/fileadmin/PDF_s/reports_statements/Forests/EASAC_Forests_web_complete.pdf.

Health impacts of biomass power stations

Dr Holland's report includes the first attempt at an assessment of the health impacts of industrial biomass burning on an EU wide scale. It is an essential area of study because while domestic heating will remain the main use of biomass energy, industrial scale power generation is likely to be the area of fastest growth in demand for biomass between now and 2030. A review of over 100 current and proposed biomass facilities in Europe found that many new plants, or plants converted from fossil fuel combustion, would only generate electricity and not make use of waste heat via Combined Heat and Power technology. Some of the converted plants, in particular, may be extremely large, creating substantial demand for wood resources.

The main focus of Dr Holland's analysis was an assessment of 27 biomass burning power plants in the EU for which some emissions data was available. Ten of these plants were former coal power stations that have been converted to run on biomass or to be co-fired with a mixture of biomass and coal. The other 17 plants were purpose built biomass plants. The former coal plants accounted for the bulk of the negative health impacts, due to factors such as their much greater size and generally higher levels of harmful sulphur emissions, which were partly linked to continued coal burning in co-fired sites.

His analysis suggests that more than 1,300 people are currently dying prematurely each year as a result of exposure to air pollution from the 27 facilities considered. Other health impacts include more than 20,000 cases of bronchitis, mostly in children, hundreds of hospital admissions for respiratory and cardiac conditions and nearly two million restricted activity days, including 240,000 lost working days across Europe. Measured in financial terms, health costs linked to biomass burning for power generation run into billions of euros each year, with health costs associated with emissions from former coal and co-fired plants amounting to 137,000 euros per year on average for every megawatt of electrical capacity installed.

Former coal plants have worst record

The former coal and co-fired plants were associated with five times the level of harmful health impacts of the purpose built biomass plants per unit of electricity generated. This was partly due to higher sulphur emissions, but the former coal plants also had higher emissions of oxides of nitrogen and particulate matter (PM). While less polluting than the former coal plants, the 17 purpose built biomass plant had, nonetheless, very significant health impacts, including 48 premature deaths per year, more than 800 cases of bronchitis, 60,000 restricted activity days and 8,500 working days lost to ill health from exposure to biomass emissions.



The Drax biomass dome. The £700 million planned conversion will burn wood pellets rather than coal.

Photo: Department of Energy and Climate Change / Flickr.com / CC

Investments in power generation are long term. Once a power plant is built it is likely to stay in operation for several decades. Looked at over a thirty year timescale, the likely health impacts of emissions from purpose built biomass plants are large: it is estimated that more than 1,400 people will die prematurely due to exposure to air pollution from the 17 biomass plants reviewed over three decades, alongside a range of other ill health effects.

The ten converted or partly converted from coal biomass burning plants looked at included Drax in Northern England, seven sites in Poland and two in Belgium. Emissions from Drax alone are likely to be associated with more than 200 premature deaths a year. One of the Polish sites, Kozienice, is linked to even larger health impacts.

Domestic heating emissions the biggest killer

Dr Holland's report also reviews the evidence of health consequences and costs linked to air pollution from the use of biomass in domestic heating in the EU. This has become more widespread in recent years driven partly by renewable energy policies, but also because wood is often cheaper than alternative heating fuels such as coal and oil. Domestic biomass burning increased in the wake of the 2008 economic crisis.

A study by Sigsgaard et al⁵ estimates that exposure to smoke from domestic biomass use led to 40,000 deaths across the EU28 in 2014. The authors say this is a conservative figure. Dr Holland extends Sigsgaard's analysis to produce a fuller picture of the range of health impacts from domestic biomass burning. In a

⁵ Sigsgaard, T., Forsberg, B., Maesano, I.A. et al., Health impacts of anthropogenic biomass burning in the developed world, *European Respiratory Journal* 2015; DOI: 10.1183/13993003.01865-2014, <http://erj.ersjournals.com/content/early/2015/09/24/13993003.01865-2014>.

single year, he estimates that in addition to the 40,000 deaths across the EU, there were more than 130,000 cases of bronchitis, more than 20,000 respiratory and cardiac hospital admissions, a million asthma symptom days for children aged 5-19, 43 million restricted activity days and 10 million working days lost. All because of exposure to fine particles from domestic biomass emissions.

In money terms, he estimates health costs associated with domestic biomass use in the EU to be in the range of 33 billion euros to 114 billion euros a year (at 2015 price levels). This monetary assessment takes account of factors such as direct healthcare costs, lost productivity in the workplace and welfare losses from the pain, suffering and inconvenience of being unwell, in line with valuations adopted by the European Commission.

The highest levels of potentially harmful air quality due to residential biomass burning are found in rural areas, with especially high concentrations of pollutants occurring in the Alpine valleys, the Po Valley, Oslo and rural areas in Austria and Germany, according to data from the European Environment Agency.⁶ However, the same emissions also lead to significant exposure to pollution within cities.

Future scenarios indicate that there will be little or no increase in the use of biomass for domestic heating. However, policy that supports existing levels of biomass use needs to consider the high externalities associated with the fuel.

Link between health and air quality

The promotion of any combustion technology runs counter to efforts to improve air quality. Biomass burning is recognised as a significant source of fine particles (PM_{2.5}) and polycyclic aromatic hydrocarbons (PAH),⁷ and is also associated with emissions of NO_x and various other pollutants linked to substances present in wood.⁸ Some of these pollutants can react in the atmosphere to form further pollutants, including 'secondary particles' (such as ammonium nitrate and ozone (O₃)), which are also damaging to health.

The World Health Organisation's (WHO) Health Response to Air Pollution in Europe (HRAPIE) study of 2013 identified a number of health impacts of PM_{2.5}, NO₂ and O₃ where evidence of a causal link with pollution was considered sufficiently robust that quantification should be undertaken to inform the development

of EU policy.⁹ The list includes early deaths of adults and infants, respiratory and cardiovascular hospital admissions, bronchitis, asthma, restricted activity days and working days lost.

Additionally, a report from the Royal Colleges of Physicians and of Paediatrics and Child Health in the UK has identified other conditions for which there is some evidence of a link to air pollution, including: low birth weight, stroke, diabetes, obesity and dementia.¹⁰

Renewable Energy Directive

The main EU policy driver for using biomass as a source of energy has been the Renewable Energy Directive (RED) which sets a binding target of 20 per cent of final energy consumption from renewable sources by 2020.

The EU is currently considering REDII which will apply after 2020. The current proposal raises the share of renewable energy to 27 per cent of final energy consumption by 2030. The European Parliament has called for a 30 per cent renewable energy target. If biomass continues to play a significant role in meeting the EU's demand for renewable energy under REDII, exposure to the health risks associated with biomass combustion will inevitably increase.

This new report shows the likely health impacts for three possible scenarios of increases in biomass energy use in industrial scale electricity generation in the EU over the period 2020-2030, depending on what happens with REDII. The scenarios suggest there will be between 435 and 1,100 additional deaths each year as a result of increased exposure to air pollution from solid biomass burning, depending on whether REDII opts for a 27 or 30 per cent renewables target. Other substantial health impacts will include an additional 7,000 to 19,000 cases of bronchitis annually, 16,000 to 40,000 asthma symptom days in children, and 77,000 to 190,000 working days lost. Impacts will accumulate year on year for as long as the additional biomass capacity continues to operate.

Air quality legislation not sufficient

The health consequences of emissions from solid biomass were not covered by any form of impact assessment in the formulation of either the original RED or its successor, REDII. Sustainability criteria for 'forest biomass' in the REDII proposal do not mitigate negative impacts on air quality. The Commission's Impact Assessment argues that the issue is dealt

⁶ European Environment Agency. Air quality in Europe — 2016 report. https://www.eea.europa.eu/publications/air-quality-in-europe-2016/at_download/file

⁷ Polycyclic aromatic hydrocarbons (PAHs) are often expressed in terms of benzo(a)pyrene (BaP), widely accepted as a marker for exposure to PAHs more generally.

⁸ EIONET Review: Air Quality in Europe. https://forum.eionet.europa.eu/nrc-air-quality/library/products-eionet-review/air-quality-europe-2016-report/air-quality-europe_eionet-review/download/en/1/Air%20Quality%20in%20Europe_Eionet%20review.docx

⁹ WHO (2013) Health Response to Air Pollution in Europe (HRAPIE) http://www.euro.who.int/__data/assets/pdf_file/0006/238956/Health_risks_air_pollution_HRAPIE_project.pdf?ua=1

¹⁰ Royal College of Physicians and Royal College of Paediatrics and Child Health (2016) Every breath we take: the lifelong impact of air pollution. <https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution>.



Forests are the lungs of the earth, cutting and burning them for energy not only makes no sense for the climate, it also damages our actual lungs.

with through EU legislation on air quality, through controls on emissions and the setting of ambient concentration limits for pollutants. This was a mistake. RED and REDII clearly do have material consequences for European health from solid biomass emissions, and these consequences should therefore have been subject to quantitative assessments.

Another key point is that the effectiveness of air quality legislation has been undermined by what Dr Holland refers to as a “compliance gap”. He points out that many Member States are well behind schedule in actually implementing measures to improve air quality required under EU legislation. This track record of failures and delays in enforcing air quality standards will reinforce concerns that increased emissions linked to increased use of solid biomass to meet EU renewable energy targets over the coming decade will magnify the already serious health impacts associated with this form of energy.

This report has shown that biomass burning for heating and electricity, which is incentivised by the EU’s renewable energy policy, has serious negative consequences for European health, with significant economic costs. These impacts seem to be

particularly high in the case of biomass burning in converted coal installations. It is a matter of concern that the European Commission has failed to assess these impacts, which have an important bearing on the extent Member States should be allowed to incentivise the use of biomass.

Given the drastic effect that biomass burning is already having on human health, the EU should be wary of further legislation to increase its use. For a future, healthier Europe, renewable energy legislation should not offer subsidies for increased combustion and should seek to end the use of biomass in large scale installations, conversion of coal fired power stations to biomass, and co-firing of biomass with coal.

In the context of the revision of the Directive, it is not appropriate to compare the air pollution performance of biomass with the use of fossil fuels. Biomass is not competing against fossil fuels to fill the gap between current and desired levels of renewable power generation: it is competing against other renewable technologies, which may offer a solution with substantially lower external costs.



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