



THE IMPACT OF RESIDENTIAL HEATING AND COOKING ON AIR QUALITY IN EUROPE

THE HEALTH ARGUMENT FOR CLEAN HEATING AND COOKING

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epra  **european
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alliance**

About EPHA

EPHA is a change agent – Europe’s leading NGO alliance advocating for better health. We are a dynamic member-led organisation, made up of public health civil society, patient groups, health professionals, and disease groups working together to improve health and strengthen the voice of public health in Europe.

EPHA's work on Global Public Health

EPHA's work on Global Public Health focuses on the deadliest environmental threat to our health: air pollution, which currently amounts to 4.2 million deaths every year. EPHA oversees and disseminates evidence-based studies on the health costs of air pollution, from road transport to heating and cooking. The damaging effects that the burning of fossil fuels have on air quality and in hastening the climate crisis, are grave peril to human and planetary health.

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EXECUTIVE SUMMARY

Buildings, particularly through energy consumption for heating and cooking, are an important source of air pollution in Europe. While the green transition requires a deep transformation of the very spaces that people inhabit, it will bring major human and planetary health benefits, as well as economic ones. **Phasing out fossil and biomass heating and cooking, and switching to heat pumps powered by renewable electricity could eliminate the current 29 billion euros per year in health costs** caused by air pollution due to residential heating and cooking in the EU-27+UK.¹

Air pollution represents the leading environmental health risk in Europe,² being a major cause of stroke, lung cancer and premature mortality, among others. Although outdoor air quality is regulated at the EU level, many citizens are exposed to values that surpass the legal limits.³ The legal limits are moreover set above the levels recommended by scientific evidence. Meanwhile, indoor air quality remains outside the regulatory framework, despite people spending over 90% of their time indoors.

While transport has rightfully been recognised as an important source of air pollution, heating and cooking have unjustly been largely ignored and little regulatory action has been taken. This is problematic, because in a majority of European countries, residential buildings are a bigger source of health costs than transport.⁴

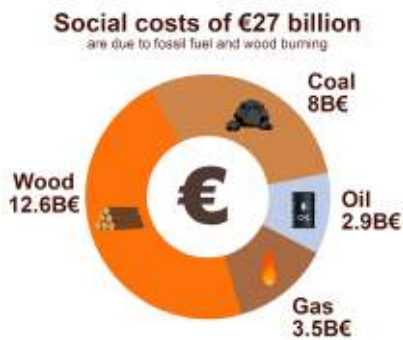
A new study (CE Delft, 2022) shows that the outdoor pollution of **heating and cooking in Europe has caused 29 billion euros in health costs in 2018**, of which over 27 billion is the direct result of fossil fuel and biomass combustion inside people's homes. This translates into a cost of 130 euros per year for an average European household.

1 CE Delft. 2022. *Health-related social costs of residential heating and cooking in the EU27 and UK*. <https://cedelft.eu/publications/health-related-social-costs-of-air-pollution-due-to-residential-heating-and-cooking/>

2 European Environmental Agency. 2021. *Europe's air quality status 2021-update*. <https://www.eea.europa.eu/publications/air-quality-in-europe-2021/air-quality-status-briefing-2021>

3 European Environmental Agency. 2021. *Exceedance of air quality standards in Europe*. <https://www.eea.europa.eu/ims/exceedance-of-air-quality-standards>

4 CE Delft. 2022. *Health-related social costs of residential heating and cooking in the EU27 and UK*. <https://cedelft.eu/publications/health-related-social-costs-of-air-pollution-due-to-residential-heating-and-cooking/>



Coal and wood are the main culprits, but the combustion of gas and oil in homes is also an important contributor to Europe's health costs. Out of the total health-related costs, **gas combustion in European homes is responsible for at least 3.5 billion euros in health damages, and oil combustion for 2.9 billion euros**. A switch from gas boilers to heat pumps can lower the health costs of a household by a factor of 3 and bring health costs down to zero when renewable electricity is used.

Phasing out fossil and biomass heating and cooking, and switching to heat pumps and electric or induction cooking powered by renewable electricity, could completely eliminate the current 29 billion euros per year in health costs caused by outdoor air pollution due to residential heating and cooking in the EU-27+UK.⁵ The switch to hydrogen for heating is not expected to deliver similar health benefits, since the combustion of hydrogen still results in significant NO_x emissions and associated health impacts.

Meanwhile, cooking with fossil fuels or biomass not only impacts the outdoor air, but also the indoor air quality. Gas stoves used for cooking can be a large source of toxic pollutants indoors, at levels exceeding ambient air standards. Cooking for half an hour on a gas stove could raise indoor NO₂ levels to twice the safe limit advised by the World Health Organisation. **Children are particularly at risk; those living in a home with gas cooking have a 42% increased risk of current asthma.**⁶ At the moment, however, the EU product policy framework for cooking appliances (Ecodesign) does not set NO_x pollutant limits. Research organisations, such as the TNO, therefore advise households to use an electric cooking stove rather than a gas stove in order to help avoid such pollution indoors.

From a health perspective, there are two important policy paths towards clean heating and cooking: regulating air quality levels and regulating known sources of air pollution. There are currently windows of opportunity for acting on both levers at the EU level.

⁵ CE Delft. 2022. *Health-related social costs of residential heating and cooking in the EU27 and UK*. <https://cedelft.eu/publications/health-related-social-costs-of-air-pollution-due-to-residential-heating-and-cooking/>

⁶ Lin Weiwei, Bert Brunekreef, Ulrike Gehring. 2013. Meta-analysis of the effects of indoor nitrogen dioxide and gas cooking on asthma and wheeze in children. *International Journal of Epidemiology* (Dec) 42(6): 1724–1737. <https://academic.oup.com/ije/article/42/6/1724/737113>



RECOMMENDATIONS

- 1** The **Ambient Air Quality Directives** revision should reflect the scientific evidence on health and air quality: the EU's air quality standards should be aligned with the 2021 WHO Global Air Quality Guidelines⁷ by 2030 at the latest. Moving forward, air quality standards should automatically be updated to reflect the latest scientific evidence.
- 2** The measures under the **Ecodesign Directive** should give more weight to health considerations, including by setting stringent pollutant limits for heating and cooking appliances and by phasing out the sale of health damaging products (such as gas stoves and fossil fuel boilers).
- 3** With the proposed revision of the **Energy Performance of Buildings Directive** (EPBD), indoor air quality should become an integral part of building planning and development, including by introducing higher ventilation requirements for buildings with gas hobs. There should be a European ban on incentives for fossil fuel boilers as soon as possible, by 2025 at the latest.
- 4** **Health and climate policies** should be better integrated for maximum co-benefits. For example, stricter conditions and sustainability criteria should be used to considerably limit the use of biomass, the burning of which has significant negative health consequences.
- 5** The **health community and the public should be empowered** to take action on air quality. There is a clear role for health workers to play in awareness campaigns and in informing decision-makers' positions in order to build a regulatory environment that protects everyone's health.
- 6** **Vulnerable households** must be protected and supported through targeted policies and dedicated funds.

⁷ WHO World Health Organization. 2021. *WHO Global Air Quality Guidelines: Particulate Matter (PM_{2.5} and PM₁₀), Ozone, Nitrogen Dioxide, Sulfur Dioxide And Carbon Monoxide.* <https://www.who.int/publications/i/item/9789240034228>



CONTEXT

Recent months and years have seen mounting scientific evidence and growing public awareness of the damages done to our health by air pollution. This must now be accompanied by adequate EU policy instruments to tackle the threat we are facing. Ambitious EU air quality standards must protect the health of all citizens across the continent, while sectoral policies should meaningfully integrate health considerations and support the achievement of health and environmental goals by targeting emission sources.

Air pollution represents the fourth greatest health risk factor for global deaths⁸ and the leading environmental health risk in Europe,⁹ being thus a major cause of premature death.¹⁰ The World Health Organization (WHO) reports that, in the European Region, air pollution is estimated to have caused about 33% of cases of childhood asthma, 17% of lung cancer cases, 12% of cases of ischemic heart disease, 11 % of all strokes, and 3% of chronic obstructive pulmonary disease (COPD) cases.¹¹ Furthermore, there is mounting evidence that no level of air pollution is safe, with a recent Health Effects Institute study highlighting the significant detrimental health impacts that appear even at low levels of air pollution.¹²

Meanwhile, Europe still meets most of its heating demand with fossil fuels, mainly gas, which is not only detrimental for the climate, but also for our health. Buildings - such as houses, schools, hospitals, offices - still account for 36% of the EU's energy-related greenhouse gas emissions.¹³ At the same time, heating and cooking with fossil fuels and biomass are a major source of air pollution: In 2019, residential, commercial and institutional buildings in the EU were responsible for 53% of fine particulate matter pollution and 8% of nitrogen oxides emissions.¹⁴ Both climate change and human health can thus be tackled by addressing the same culprits. In doing so, it is essential that policies aimed at protecting one also consider the other, in order to be most efficient and reap the most benefits.

As buildings have been largely ignored hitherto as a source of air pollution, this paper aims to bring attention to the health impacts of heating and cooking with fossil fuels and biomass as well as suggest paths towards better indoor and outdoor air quality in Europe. There are two important policy paths towards improved air quality: regulating both emission levels and known sources of air pollution, such as heating and cooking appliances. There are currently windows of opportunity for acting on both levers at the EU level.

8 Health Effects Institute 2020. *State of Global Air 2020*. <https://www.stateofglobalair.org/>

9 European Environmental Agency. 2021. *Health Impacts of Air Pollution in Europe, 2021*. (Updated 6 Dec 2021). <https://www.eea.europa.eu/publications/air-quality-in-europe-2021/health-impacts-of-air-pollution>

10 World Health Organisation. n.d. *Air Pollution Exposure and Noncommunicable Diseases*. First WHO Global Conference on Air Pollution and Health. Accessed on 24 Feb 2022. https://www.who.int/airpollution/events/conference/AP_exposure_and_NCDs_background.pdf?ua=1

11 European Environmental Agency. 2020. *Healthy Environment, Healthy Lives: How the Environment Influences Health and Well-being in Europe*. Luxembourg: Publications Office of the European Union. <https://www.eea.europa.eu/publications/healthy-environment-healthy-lives>

12 Dominici, Francesca, Antonella Zanobetti, Joel Schwartz, Danielle Braun, Ben Sabath, Xiao Wu. 2022. "Assessing Adverse Health Effects of Long-Term Exposure to Low Levels of Ambient Air Pollution: Implementation of Causal Inference Methods." Research Report 211. Boston: Health Effects Institute. <https://www.healtheffects.org/publication/assessing-adverse-health-effects-long-term-exposure-low-levels-ambient-air-pollution-0>

13 European Commission. 2020. *In Focus: Energy efficiency in buildings*. https://ec.europa.eu/info/news/focus-energy-efficiency-buildings-2020-feb-17_en#:~:text=Collectively%2C%20buildings%20in%20the%20EU,%2C%20usage%2C%20renovation%20and%20demolition

14 European Environmental Agency. 2021. *Sources and Emissions of Air Pollutants in Europe*. <https://www.eea.europa.eu/publications/air-quality-in-europe-2021/sources-and-emissions-of-air>.

THE HEALTH IMPACTS OF AIR POLLUTION CAUSED BY HEATING AND COOKING



The main pollutants that result from heating and cooking using fossil fuels and biomass include particulate matter (PM), nitrogen oxides (NO_x), ammonia (NH₃), sulphur dioxide (SO₂), carbon monoxide (CO), methane (CH₄) and non-methane volatile organic compounds (NMVOCs). PM₁₀ (coarse particulate matter) and PM_{2.5} (fine particulate matter), NO₂, SO₂ and CO levels are regulated at the EU level under the Ambient Air Quality Directives.

PM is a collective term for solid and liquid particles in the air. The smaller the particles, the deeper they can penetrate into the human body and the more dangerous to health they are: PM₁₀ (particles with a diameter of 10 microns) can penetrate the lungs, while PM_{2.5} and PM_{0.1} (ultrafine particulate matter) can enter the blood system. PM is associated with increased morbidity and mortality and is harmful even at very low concentrations¹⁵. In 2019, 307 000 premature deaths were attributed to chronic exposure to PM_{2.5}.¹⁶ A 2021 study by the Joint Research Centre conducted in 150 European cities found that the residential sector is responsible for an average of 13% of PM levels in urban areas, with the highest percentages observed in Ljubljana, Slovenia (45%) and Turin, Italy (41%).¹⁷

NO_x are harmful to health both directly and indirectly. Long-term exposure to high levels of NO_x may contribute to the development of asthma and potentially increase susceptibility to respiratory infections, while short-term exposure can aggravate asthma, potentially leading to more hospital admissions and visits to the emergency room.¹⁸ NO_x are also one of the major precursors to ground level ozone, which in turn can cause breathing problems, trigger asthma, reduce lung function and cause lung diseases.¹⁹ Recent scientific evidence reveals that NO_x are harmful at much lower concentrations than believed before. As such, the 2021 WHO Air Quality Guidelines recommend NO_x maximum levels that are 75% lower than the ones included in the 2005 Guidelines.

Children are one of the vulnerable groups most affected by exposure to NO_x, particularly indoors. Their vulnerability is linked to their higher breathing rates, greater levels of physical activity indoors and their immature respiratory and immune systems.²⁰ These health impacts then can have ripple effects on their development, with children suffering from asthma having higher levels of school absence and worse educational outcomes, including leaving school earlier and

15 World Health Organisation. 2021. *Ambient (outdoor) Air Pollution*. [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)

16 European Environmental Agency 2021. *Health Impacts of Air Pollution in Europe, 2021*. (Updated 6 Dec 2021). <https://www.eea.europa.eu/publications/air-quality-in-europe-2021/health-impacts-of-air-pollution>

17 Joint Research Centre. 2021. *Atlas maps main sources of air pollution for 150 European cities*. European Commission. https://joint-research-centre.ec.europa.eu/jrc-news/atlas-maps-main-sources-air-pollution-150-european-cities-2021-11-17_en

18 United States Environmental Protection Agency. n.d. "Nitrogen Dioxide (NO₂) Pollution: Nitrogen Dioxide Basics." Accessed on 24 Feb 2022. <https://www.epa.gov/no2-pollution/basic-information-about-no2>

19 World Health Organisation. 2021. *Ambient (outdoor) Air Pollution*. [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)

20 Seals, Brady, Andee Krasner. 2020. *Gas Stoves: Health and Air Quality Impacts and Solutions*. Rocky Mountain Institute, Physicians for Social Responsibility, Mothers Out Front, Sierra Club. <https://rmi.org/insight/gas-stoves-pollution-health>

achieving lower examination grades.²¹ They have also been observed to have increased distress and anxiety levels,²² and a higher risk of suicide.²³ Children living in a house equipped with a gas stove, a major source of NO₂, are about 20% more likely to experience respiratory illness, than households with lower long-term NO₂ levels.²⁴ Meanwhile, using electric (including induction) stoves does not result in NO₂ emissions, thus allowing to reduce harmful pollutants from the environment.

SO₂ can cause irritation of the eyes, affect the respiratory system, and make breathing difficult.²⁵ People suffering from asthma are particularly sensitive to the effects. SO₂ may also contribute to the formation of PM. In terms of its environmental impacts, SO₂ can contribute to acid rain, which harms sensitive ecosystems.²⁶

CO is a colourless and odourless toxic gas, making it particularly dangerous, because it cannot be detected by the human senses. In high concentrations, it can be lethal. In lower doses, it can cause dizziness, confusion or unconsciousness.²⁷

While all heating techniques based on fossil fuels or biomass emit all the above-mentioned pollutants, each specific technique-fuel combination results in a particular mix of emissions.²⁸ Coal-based heating is the highest contributor to emissions in terms of grams per gigajoule(g/GJ) across the board for residential heating: For stoves, as well as small condensing and non-condensing boilers, coal use is responsible for the highest levels of CO, NMVOC, NO_x, PM_{2.5} and SO_x. Gas-based techniques are dangerous to health primarily due to the associated NO_x emissions, while CO and PM_{2.5} are the main air pollutants resulting from biomass-based heating.

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- 21 Fleming, Michael, Catherine A. Fitton, Markus F.C. Steiner, James S. McLay, David Clark, Abert Kind, Daniel F. Makay, Jull P. Pell. 2019. Educational and Health Outcomes of Children Treated for Asthma: Scotland-wide Record Linkage Study of 683716 Children." *European Respiratory Journal* 54(3). <https://erj.ersjournals.com/content/54/3/1802309#ref-16>
- 22 Bonilla, Sheila, Sarah Kehl, Kenny Y C Kwong, Tricia Morphey, Rital Kachru, Craig A Jones. 2005. "School absenteeism in children with asthma in a Los Angeles inner city school." *The Journal of Pediatrics* (Dec) 147(6):802-6. <https://pubmed.ncbi.nlm.nih.gov/16356435/>
- 23 Carpintier, Melissa Y., Larry L. Mullins, Jill C Van Pelt. 2007. "Psychological, Academic, and Work Functioning in College Students with Childhood-onset Asthma." *Journal of Asthma* (Mar) 44(2):119-24. <https://pubmed.ncbi.nlm.nih.gov/17454326/>
- 24 Hasselblad, Vic, David M. Eddy, Dennis J. Kotchmar. 1992. "Synthesis of Environmental Evidence: Nitrogen Dioxide Epidemiology Studies." *Journal of the Air & Waste Management Association* 42(5):662-671. <https://www.tandfonline.com/doi/abs/10.1080/10473289.1992.10467018>
- 25 World Health Organisation. 2021. "Ambient (outdoor) Air Pollution." [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)
- 26 United States Environmental Protection Agency. n.d. "Sulfur Dioxide (SO2) Pollution: Sulfur Dioxide Basics." Accessed on 24 Feb 2022. <https://www.epa.gov/so2-pollution/sulfur-dioxide-basics>
- 27 United States Environmental Protection Agency. n.d. "Carbon Monoxide (CO) Pollution in Outdoor Air: Carbon Monoxide (CO) Basics." Accessed on 24 Feb 2022. <https://www.epa.gov/co-pollution/basic-information-about-carbon-monoxide-co-outdoor-air-pollution>
- 28 CE Delft. 2022. "Health-related social costs of residential heating and cooking in the EU27 and UK.", table 9 <https://cedelft.eu/publications/health-related-social-costs-of-air-pollution-due-to-residential-heating-and-cooking/>



THE HEALTH COSTS OF AIR POLLUTION CAUSED BY HEATING AND COOKING



While there has been a growing understanding of the harmful health impacts of emissions from heating and cooking, another important framework for assessing the magnitude of the problem is to calculate the resulting economic impact. **The health consequences of air pollution result in individual suffering as well as in economic losses due to healthcare spending, lower life expectancy and lower productivity.** These represent social costs and are a helpful metric because they allow for one way of factoring in health-related externalities into policy decisions. Given the economic impact resulting from negative health outcomes linked to air pollution, inaction is not only ethically indefensible, but also expensive.

A new CE Delft study has found that, in 2018, the total health-related social costs of outdoor air pollution due to domestic heating and cooking activities by households in the EU27+UK amounted to 29 billion euros.²⁹ This translates into a cost of 130 euros per year for an average European household. Over 90% of these are caused by direct emissions - i.e. emissions occurring at the household level. These are the result of burning fossil fuels or biomass, as electricity-based heating and cooking techniques do not generate direct emissions. Out of these total health-related costs, **gas combustion in European homes is responsible for 3.5 billion euros in health damages.** This is an underestimation of the total costs of air pollution caused by heating and cooking, since health costs related to indoor air pollution could not be calculated due to data unavailability.

What is more, **in the majority of European countries (18 out of the 28 analysed)**³⁰, **the health costs associated with outdoor air pollution stemming from the residential building sector are higher than those due to transport.** This is also taking place in the context of transport-related health costs having decreased more over the past decade than those linked to residential heating. To further illustrate how harmful polluting heating practices can be to our health, CE Delft calculated that, on average, in Europe, while driving a diesel car for one year causes health costs equal to 210 euros, using a wood burner is over 3,5 times more costly for health, the associated costs being 750 euros per year. The use of a non-condensing gas boiler has lower health costs, but still three times as high compared to using a heat pump.

The highest costs observed are in urban settings and in Central and Eastern European Countries (CEECs). The former is explained by two main factors: more emissions arise in urban areas,³¹ and more people are affected by air pollution given higher population density. The latter observation however is more surprising, given that social costs are weighted depending on national GDPs. The fact that, despite having generally lower GDPs, CEECs still carry the highest burden in terms of health costs from air pollution reveals once again the disparities

²⁹ CE Delft. 2022. "Health-related social costs of residential heating and cooking in the EU27 and UK." <https://cedelft.eu/publications/health-related-social-costs-of-air-pollution-due-to-residential-heating-and-cooking/>

³⁰ These countries are Ireland, Belgium, Slovenia, Croatia, Denmark, Estonia, Slovakia, Finland, Hungary, Greece, Portugal, Bulgaria, Czechia, Latvia, Poland

³¹ 76% of exceedances of EU air quality standards occur in urban and suburban areas. European Environmental Agency. 2022. "Managing Air Quality in Europe." (Updated 18 Feb 2022). <https://www.eea.europa.eu/publications/managing-air-quality-in-europe/managing-air-quality-in-europe>

across the continent, with citizens in Central and Eastern Europe constantly breathing in more polluted air, becoming sicker and more unwell, and incurring higher social costs as a result.

In the EU27+UK, **over 30% of the health costs from ambient air pollution due to residential heating and cooking are coming from the use of wood burners** - and that is despite them only representing 14% of total energy consumption. Over half of European households use non-condensing boilers based on fossil fuels and biomass for their heating needs. These in turn account for 58% of the social costs, or slightly more than 16 billion euros. Meanwhile, the social costs associated with electricity-based heating are linked to indirect emissions (i.e. those not produced at the household level) and reveal that decarbonising the energy mix remains key in order to achieve the full potential of clean technologies.

Alternative techniques are therefore key in achieving European health and climate goals. Significant attention has been paid in recent policy debates to the future deployment of hydrogen boilers, yet **many of the hopes invested in the potential of hydrogen may be misplaced**. The CE Delft study draws attention to the fact that all hydrogen boilers using air for combustion will generate NO_x, which, as discussed above, is a health harmful pollutant. The high levels of uncertainty regarding the exact NO_x emission levels to be expected is further cause for concern. Moreover, what would now be categorized as **“green hydrogen” boilers would in fact cause health costs that are comparable with those of oil boilers**. With at least 13 European countries planning to phase out oil boilers (in all or new buildings) by 2050,³² from a health perspective, it is difficult to justify EU policies supporting hydrogen boilers. Hydrogen may represent a partial solution in other sectors facing major challenges in decarbonization.

However, **for heating, clean techniques that produce no direct emissions are already on the market, and, with a clean energy mix, these will lead to virtually no health costs**. Heat pumps use electricity to transfer ambient heat to buildings from the air, the ground or water sources. There are no emissions at the household level, and there would be no indirect emissions either once electricity is decarbonized. Moreover, they are a very efficient technology. Their uptake could thus contribute to a decrease in energy demand, which is crucial if the clean transition is to take place in the expected and necessary timeframe. The novelty of heat pumps in some European markets, as well as the high upfront costs may create challenges, which can nonetheless be addressed via dedicated policy instruments. District heating, if based on clean energy, efficient and more economical, should also be explored as part of the way forward.

While the impact of indoor air pollution has become more prominent in the public conversation in recent times, the new **CE Delft study exposes significant data gaps that researchers face when attempting to analyse indoor air quality, emission sources, and exposure effects**. Previous research points to significant health impacts, particularly regarding higher chances of asthma in children living in homes with a gas stove,³³ which indicates that the magnitude of the problem may be bigger than initially believed. Moreover, all direct emissions from heating and cooking originate indoors, and indoor air pollution has relatively few opportunities to spread over a large area, as buildings are fairly closed environments. This means that humans exposed to indoor air pollution may breathe in a larger portion of the emissions before these may be filtered away. Ventilation is one of the factors that determine how efficiently and how quickly this happens.

However, poor households may be trapped between ventilating properly but suffering from cold, and not ventilating in order to preserve heat but having humidity and mould in the house.

32 ECOS, Coolproducts for a Cool Planet. 2022. “EU Commission paralysis delays phase-out of fossil fuel boilers.” <https://www.coolproducts.eu/eu-ambition/eu-commission-paralysis-delays-phase-out-of-fossil-fuel-boilers/#:~:text=Out%20of%20the%2027%20EU,Norway%2C%20Slovakia%2C%20and%20Sweden>

33 Lin, Weiwei, Bert Brunekreef, Ulrike Gehrin. 2013. “Meta-analysis of the effects of indoor nitrogen dioxide and gas cooking on asthma and wheeze in children.” *International Journal of Epidemiology*, 42(1):1724-1737. <https://academic.oup.com/ije/article/42/6/1724/737113>

Both options are associated with negative health outcomes, including asthma, respiratory infections, blood pressure increases and cardiovascular diseases.³⁴

This points to the importance of regulating known sources of pollution at source. Gas stoves, for example, can be a large source of toxic pollutants indoors, at levels exceeding ambient air standards. Cooking for half an hour on a gas stove could raise indoor NO₂ levels to twice the safe limit advised by the World Health Organisation.³⁵ **Children are particularly at risk; those living in a home with gas cooking have a 42% increased risk of current asthma.**³⁶ At the moment, however, the EU product policy framework for cooking appliances (Ecodesign) does not set NO_x pollutant limits. Research organisations, such as the Netherlands Organisation for applied scientific research (TNO), therefore advise households to use an electric cooking stove rather than a gas stove in order to help avoid such NO_x pollution indoors.³⁷

Social disparities need to be considered carefully when discussing indoor air quality. Furthermore, there is an important need for more reliable and comparable data to be collected and analysed in the European context.

34 Marmot Review Team for Friends of the Earth. 2011. "The Health Impacts of Cold Homes and Fuel Poverty." https://policy.friendsoftheearth.uk/sites/default/files/documents/2019-02/cold_homes_health.pdf ;

World Health Organization. 2009. "WHO Guidelines for Air Quality: Dampness and Mould." <https://www.who.int/publications/i/item/9789289041683>

35 Jeff Brady. 2021. "We need to talk about your gas stove, your health and climate change." National Public Radio. <https://www.npr.org/2021/10/07/1015460605/gas-stove-emissions-climate-change-health-effects?t=1635873375380> ;

Seals, Brady, Andee Krasner. 2020. "Gas Stoves: Health and Air Quality Impacts and Solutions." Rocky Mountain Institute, Physicians for Social Responsibility, Mothers Out Front, Sierra Club. <https://rmi.org/insight/gas-stoves-pollution-health> ; World Health Organization. 2021. "Ambient (outdoor) air pollution." [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)

36 Lin, Weiwei, Bert Brunekreef, Ulrike Gehrin. 2013. "Meta-analysis of the effects of indoor nitrogen dioxide and gas cooking on asthma and wheeze in children." *International Journal of Epidemiology*, 42(1):1724-1737. <https://academic.oup.com/ije/article/42/6/1724/737113>

37 CE Delft. 2022. "Health-related social costs of residential heating and cooking in the EU27 and UK." <https://cedelft.eu/publications/health-related-social-costs-of-air-pollution-due-to-residential-heating-and-cooking/>





AIR POLLUTION FROM HEATING AND COOKING: CURRENT EU POLICY FRAMEWORK AND RECOMMENDATIONS

THE AMBIENT AIR QUALITY DIRECTIVES: REGULATING EMISSION LEVELS

The EU's Ambient Air Quality Directives (AAQDs), which establish standards for a range of pollutants outdoors, are currently under revision. Legally binding limit values have proven to be an efficient tool for improving air quality, but the existing ones are based on outdated scientific evidence and were, even given the information available at the time of their adoption, not strict enough.

The World Health Organization (WHO) Air Quality Guidelines are the gold standard for evidence-based recommendations of limit values for specific air pollutants. The highly anticipated update published in 2021 tightened the standards for six pollutants, including PM, NO₂ and SO₂, which are in most cases significantly below the standards in the AAQDs.

<i>Pollutant</i>	<i>Averaging period</i>	<i>Ambient Air Quality Directives</i>	<i>WHO Air Quality Guidelines 2005</i>	<i>WHO Air Quality Directives 2021</i>
PM _{2.5}	1 year	25 µg/m ³	10 µg/m ³	5 µg/m ³
	24 hours	--	25 µg/m ³	15 µg/m ³
PM ₁₀	1 year	40 µg/m ³	20 µg/m ³	15 µg/m ³
	24 hours	50 µg/m ³	50 µg/m ³	45 µg/m ³
NO ₂	1 year	40 µg/m ³	40 µg/m ³	10 µg/m ³
	24 hours	--	--	25 µg/m ³
	1 hour	200 µg/m ³	--	200 µg/m ³
SO ₂	24 hours	150 µg/m ³	20 µg/m ³	40 µg/m ³
	1 hour	350 µg/m ³	--	--
	10 minutes	--	--	500 µg/m ³

When air pollution levels exceed the EU limits, Member States are required to develop National Action Plans (NAPs) detailing the measures to be taken in order to ensure a return to legal levels in the shortest time possible. In a recently published report from the European Environmental Agency, analysing NAPs from the 2014-2020 period, domestic heating has been identified as the second most important source driving exceedances of air quality standards across Europe.³⁸ It was linked to 14% of total exceedances, and the principal driver of exceedances of PM₁₀.

³⁸ European Environmental Agency. 2022. "Managing Air Quality in Europe." (Updated 18 Feb 2022). <https://www.eea.europa.eu/publications/managing-air-quality-in-europe/managing-air-quality-in-europe>

The EU must follow the science on health and air quality. **EPHA urges the full and legally binding alignment of EU's air quality standards with the 2021 WHO Global Air Quality Guidelines by 2030 at the latest. Legally binding limit values should remain the main EU policy instrument to ensure that the health of all people across Europe is always protected.**

Furthermore, **any future clean air legislation should reflect the latest scientific evidence on the health damage of air pollution and include mechanisms to automatically update air quality standards.** This would send a strong message that the health of European people is truly at the heart of policymaking and not subject to political gambles.

The guidelines for the NAPs that Member States are required to prepare when air pollution levels are higher than the set limits still include language that is reflective of a view of heating and cooking that relies on fossil fuels and biomass: “low emission stationary combustion sources” and “low emission fuels for stationary and mobile sources”. **The revision must indicate the necessity for a shift away from combustion and encourage the use of the least polluting available techniques, such as heat pumps, solar thermal and geothermal energy.**

ZERO POLLUTION ACTION PLAN: THE EUROPEAN VISION AND AMBITION

Under the Zero Pollution Action Plan, the EU has committed to reduce the number of premature deaths caused by air pollution in the EU by a minimum of 55% by 2030 compared to 2005 levels. This ambitious vision for a healthier Europe must now be accompanied by equally ambitious regulation that sets a clear path to achieving the agreed goals. An analysis by the European Environment Agency reveals that only if the AAQDs are fully aligned with the WHO Air Quality Guidelines by 2030, will the EU be able to deliver on this commitment in the Zero Pollution Action Plan.³⁹ Clean heating and clean cooking are both mentioned as areas where action needs to be taken, with the Commission committing to integrating the zero pollution ambition with energy efficiency objectives, eco-design and energy labelling for heat appliances.

More emphasis should be put on prevention through cutting air pollution at every source. The Zero Pollution Action Plan ambition must become reality: **regulations covering known sources of pollution, such as fossil and biomass heating and cooking, should therefore include emission standards compatible with reaching the EU's health and climate goals.** Furthermore, these should also be in line with the levels set out in the AAQDs, thus creating a stable and coherent EU policy framework, with source legislation supporting the achievement of air quality goals.

THE ECODESIGN DIRECTIVE: REGULATING SOURCES OF AIR POLLUTION

Different types of heating and cooking appliances are regulated through the Ecodesign Directive and the Energy Labelling Regulation, with the former progressively removing from the market the least efficient – and most polluting – appliances, while the latter ranks products based on their performance, thus informing consumers' choices. The Ecodesign measures for heating

³⁹ European Environmental Agency. 2021. “Health Impacts of Air Pollution in Europe, 2021.” (Updated 06 Dec 2021). <https://www.eea.europa.eu/publications/air-quality-in-europe-2021/health-impacts-of-air-pollution>

and cooking appliances are currently under review, or are in the process of being reviewed, including the emission limits on air pollutants. However, health considerations are not always properly taken into account.

The Health in All Policies approach, whereby health implications must be taken into account when regulating all policy areas, has been recognized at the European level under various forms since the 1990s, from the Maastricht and Lisbon Treaties to the successive EU Health Programs and the newest EU4Health Programme (2021-2027). Yet the implementation of this principle has proven strenuous.

With Ecodesign and Energy Labelling measures for space heaters, cooking appliances and solid fuel boilers currently (or soon will be) under review, this is a clear opportunity for health considerations to be better reflected in EU legislation. While the Roadmap for the 2020 - 2024 working plan on ecodesign and energy labelling states that “*there is likely scope for further addressing*” pollutant emissions,⁴⁰ this is not yet sufficiently reflected in legislative initiatives. For example, **NO_x limits are unjustifiably high for space heaters and completely absent for gas hobs.** This is directly damaging the health of European citizens.

Phasing out fossil fuels will result in better air quality, as well as environmental and climate benefits. Switching to **clean heating and cooking** leads to **immediate and local health gains** and **global and long-term climate benefits.**⁴¹

The measures under the **Ecodesign Directive** should give more weight to health considerations, including by setting stringent pollutant limits for heating and cooking appliances and by phasing out the sale of health damaging products (such as gas stoves).

The sale of new fossil fuel-based boilers should also be phased out during this decade by setting higher minimum energy efficiency requirements under Ecodesign.

THE REVISION OF THE ENERGY PERFORMANCE OF BUILDING DIRECTIVE: TACKLING INDOOR AND OUTDOOR AIR QUALITY

The Energy Performance of Buildings Directive (EPBD) aims to promote the improvement of the energy performance of buildings within the European Union. With its subject matter to cover both “outdoor conditions” and “indoor requirements”, the EPBD revision currently underway represents an opportunity to tackle multiple aspects of air pollution.

The proposed revision of the Energy Performance of Buildings Directive⁴² includes a number of changes in the right direction, which can pave the way for **indoor air quality to become an integral part of building planning and development, thus putting people and their health at the centre of this process.** For example, the better integration of ventilation systems in the proposed directive revision may lead to improved indoor air quality. Moreover, zero-emission buildings shall be required to have measuring and control devices that will monitor and regulate indoor air quality.

40 European Commission. 2021. “Roadmap: Ecodesign and Energy Labelling Working Plan 2020-2024.” https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12852-Energy-efficiency-and-circular-economy-ecodesign-and-energy-labelling-working-plan-2020-2024_en

41 Shindell, Drew, Muye Ru, Yuqiang Zhang, Karl Seltzer, Greg Faluvegi, Larissa Nazarenko, Gavin A. Schmidt, Luke Parsons, Ariyani Challapalli, Longyi Yang, and Alex Glick. 2021. “Temporal and Spatial Distribution of Health, Labor, and Crop benefits of Climate Change Mitigation in the United States.” Proceedings of the National Academy of Sciences of the United States of America (Nov) 188(46). <https://www.pnas.org/content/118/46/e2104061118.short>

42 European Commission. 2021. “Proposal for a Directive of the European Parliament and of the Council on the energy performance of buildings (recast).” Brussels. <https://ec.europa.eu/energy/sites/default/files/proposal-recast-energy-performance-buildings-directive.pdf>

The EPBD also includes a ban on financial incentives for the installation of boilers powered by fossil fuels. Fossil fuel subsidies, which still exist under some form or another in a number of Member States, are yet another testament to the misalignment between EU values and incentives.

EU legislation should go a step further and **require higher ventilation requirements for buildings with gas hobs**. Moreover, the renovation passport, which is projected to be introduced in all member states and to provide a roadmap for tailored renovation steps, should include benefits related to health and comfort. This can be an important driver for renovation, as well as a tool to increase public awareness on the impact that air quality in their homes has on peoples' wellbeing.

It is important that the definition of air quality in all the instruments listed in the EPBD be both comprehensive and ambitious: the main health-harmful air pollutants, including PM and NO_x should be included, and the standards should follow the latest available scientific evidence.

A proper consideration of the health impacts of fossil fuel burning must lead to withdrawing financial support for harmful practices that also go directly against the 'polluter pays' principle. **EPHA welcomes** the inclusion, under the proposal for the revision of the Energy Performance of Buildings Directive, of **a ban on incentives for fossil fuel boilers and supports a clear end date for this**. However, the proposed deadline, 2027, is not ambitious enough. 2025 should be instead adopted as the date for a European ban on all direct or indirect subsidies. National-level actions should also be taken even earlier wherever possible. The EU should moreover consider banning biomass subsidies, given the health costs associated with using it for heating and cooking. We must make sure that the heating in our homes no longer endangers any lives due to the emissions it produces.

INDOOR AIR QUALITY: LARGELY UNREGULATED

The WHO Air Quality Guidelines apply to both indoor and outdoor air pollution.⁴³ Moreover, the WHO recognized, as long ago as 2000, "*the right to healthy indoor air*", calling for "*those who design, provide, build, maintain and occupy indoor environments [...] to do no harm to indoor air quality in that environment*".⁴⁴ The document further highlights the multidisciplinary approach needed for an effective systematic approach to the issue, while decrying that health and environmental concerns are oftentimes addressed separately. In recent times, the COVID-19 pandemic has led people to spend more time inside their homes due to lockdowns, travel restrictions and personal choices, thus bringing more public attention and interest for indoor air quality. Yet there is currently no EU instrument that creates an overarching framework to address indoor air pollution.

43 World Health Organization. 2021. "New WHO Global Air Quality Guidelines aim to save millions of lives from air pollution." <https://www.who.int/news/item/22-09-2021-new-who-global-air-quality-guidelines-aim-to-save-millions-of-lives-from-air-pollution>

44 World Health Organization. 2000. "The Right to Healthy Indoor Air." Copenhagen: WHO Europe. https://www.euro.who.int/__data/assets/pdf_file/0019/117316/E69828.pdf

Indoor air pollution should be addressed in a more coherent way at the European level. The European Parliament (EP) has however already adopted two resolutions on this issue in recent years. The documents recognize that EU legislation covering indoor air quality is fragmented, calling for the Commission to consider regulating indoor air quality independently or as a part of sustainable buildings legislation.⁴⁵ With the revision of the Energy Performance of Buildings Directive currently underway, there is a window of opportunity for this latter idea to be introduced in EU legislation.

BETTER INTEGRATE HEALTH AND CLIMATE POLICIES FOR MAXIMUM CO-BENEFITS

There is a significant overlap between the sources of air pollution and of greenhouse gas (GHG) emissions. Therefore, there is an opportunity to tackle the twin challenges of climate and health action at the same time. However, there is a danger of missing out on the chance to achieve multiple benefits with one policy if health and climate considerations are not coherently integrated.

The use of biomass for heating and cooking is a case in point. Classified as a renewable resource under EU taxonomy⁴⁶ and under the Renewable Energy Directive, biomass has been increasingly used for heating in the EU since 2005, which has been directly linked to an increase in emissions of 11 % for PM_{2.5}, 7 % for PM10 and 4 % for volatile organic compounds (VOCs) in 2017,⁴⁷ all three of which are harmful for human health. Studies in Denmark and Sweden⁴⁸ have found that rural areas with limited traffic but high density of wood burning experience levels of air pollution that are comparable to those resulting from traffic in major cities. Therefore, **stricter conditions and sustainability criteria should be used to considerably limit the use of biomass.**

Secondly, **there is also a strong health argument for climate action.** Heat waves for example, which have become more frequent and severe due to climate change, can lead to negative health outcomes including increased morbidity and mortality from heat stress, heat exhaustion and heatstroke, and an increase of cardiovascular, respiratory and kidney disease. Moreover, high temperatures have been associated with congenital defects and birth complications, and negative impacts on psychological and emotional health.⁴⁹

As the EU is exploring innovative solutions for the threat of climate change, it should take this opportunity to create a vision of a better – and healthier – society. For example, while the current EU Mission to deliver 100 climate-neutral and smart cities by 2030⁵⁰ does mention health improvements as co-benefits of climate action, and the health impacts of climate

45 European Parliament. 2021. "European Parliament resolution of 25 March 2021 on the implementation of the Ambient Air Quality Directives: Directive 2004/107/EC and Directive 2008/50/EC." Brussels. https://www.europarl.europa.eu/doceo/document/TA-9-2021-0107_EN.html; European Parliament. 2019. "European Parliament resolution of 13 March 2019 on a Europe that protects: Clean air for all (2018/2792(RSP))," https://www.europarl.europa.eu/doceo/document/TA-8-2019-0186_EN.html

46 This choice has been disputed by many environmental organisations, noting that newly planted trees may need decades to reabsorb the carbon released by burning the old ones.

47 European Environmental Agency. 2019. "Renewable energy in Europe: key for climate objectives, but air pollution needs attention." (Updated 25 Mar 2021). <https://www.eea.europa.eu/themes/energy/renewable-energy/renewable-energy-in-europe-key>

48 Sigsgaard, Torben et. al. 2015. "Health Impacts of Anthropogenic Biomass Burning in the Developed World." *European Respiratory Journal* 46:1577-1588. <https://erj.ersjournals.com/content/46/6/1577>

49 Van Daalen, Kim. 2021. "The Lancet Countdown on Health and Climate Change: Policy Brief for Europe, 2021." The Lancet Countdown: Tracking Progress on Health and Climate Change, The Lancet Countdown In Europe. <https://epha.org/wp-content/uploads/2021/10/europe-2021-lancet-countdown-policy-brief.pdf>

50 European Commission. n.d. "EU Mission: Climate-Neutral and Smart Cities." Accessed on 25 Feb 2022. https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/climate-neutral-and-smart-cities_en

change, it does not encourage cities to integrate these into their planning. This constitutes a massive lost opportunity, given the hope that these cities will act as innovation hubs and provide solutions that can be scaled up across the EU.

EMPOWER THE HEALTH COMMUNITY AND THE PUBLIC

The majority (54%) of European citizens do not feel well informed about the air quality in their country,⁵¹ despite requirements for member states to provide such information. This is a crucial factor since it has been shown that public acceptance of measures that improve air quality is higher when citizens are informed about air pollution levels and its impacts.⁵² Moreover, people might not be able to estimate the relative importance of various sources of air pollution. In a recent study, the contribution of domestic heating to pollution levels was underestimated by the public in all 7 European countries analysed.⁵³

The **right to access to justice**, as guaranteed under the Aarhus Convention,⁵⁴ is a critical tool that the public, including via civil society representatives, has at its disposal to advance environmental and health goals. The Convention provides for the right of everyone to receive environmental information, including on the state of human health as affected by the state of the environment, and the right to participate in environmental decision-making. Where these two rights are not respected, the respective procedures can be challenged in virtue of access to justice provisions. However, there are oftentimes barriers at the national level which challenge the ability of citizens to exercise this right. The Commission has admitted that the EU does not currently fulfil its obligations under the Aarhus Convention. Adding explicit references and **embedding access to justice in relevant sectoral legislation**, including that on heating and cooking, would help avoid a situation of unequal rights for EU citizens and ensure a level playing field.

Previous experience shows that, in order for information campaigns to be effective, they should not focus only on issues related to air quality. The effects on health, together with advice for practical solutions to reduce air pollution, appear to be two key elements for public engagement on this topic.⁵⁵ In parallel with reaching a broad audience via mass or social media, individual consultations with patients can create the right environment for a more in-depth conversation and more tailored advice. **There is therefore a clear role for medical doctors and other health workers to play in public awareness campaigns and in informing decision-makers positions, in order to build a regulatory environment that protects everyone's health.**

The medical community has long been a strong supporter of the need for better public information on air pollution. Principle 2 of the WHO Right to Health Indoor Air stresses the duty of public health authorities to inform about the relationship between health and indoor air

51 European Commission. 2019. "Eurobarometer: Attitudes of Europeans towards Air Quality." <https://europa.eu/eurobarometer/surveys/detail/2239>

52 European Environmental Agency. 2022. "Managing Air Quality in Europe." (Updated 18 Feb 2022). <https://www.eea.europa.eu/publications/managing-air-quality-in-europe>

53 Maione, Micela, Elisabetta Mocca, Kristina Eisfeld, Yuri Kazepov, Sandro Fuzzi. 2021. "Public Perception of Air Pollution Sources across Europe." *Ambio* 50:1150-1158. <https://link.springer.com/article/10.1007/s13280-020-01450-5>

54 United Nations Economic Commission for Europe. 1998 "Convention On Access To Information, Public Participation In Decision-Making And Access To Justice In Environmental Matters." Aarhus. <https://unece.org/fileadmin/DAM/env/pp/documents/cep43e.pdf>

55 Grossberndt, Sonja, Alena Bartonova, Alberto González. 2021. "Public awareness and efforts to improve air quality in Europe, March 2021" European Environment Agency." https://www.eionet.europa.eu/etcs/etc-atni/products/etc-atni-reports/etc-atni-report-2-2020-public-awareness-and-efforts-to-improve-air-quality-in-europe/@@download/file/ETC-ATNI_2020-2_Task-1_1_2_2_Final%20for%20production_v4-2nd%20publication%2015-06-2021.pdf

quality. As a practical step towards this goal, the WHO is currently developing a training toolkit to strengthen the professional capacity of health workers to engage with and communicate on air pollution and health-related issues.⁵⁶ The EU should support this initiative and adapt it to the European context. For example, gas stoves should be recognized as a primary cause of exceedingly high NO₂ concentrations indoors and asthma guidelines should empower health professionals to address the dangers of indoor air pollution with their patients. Following the Health in All Policies principle, the EU should encourage the continuing education and training of specialists coming from all relevant fields, not only medicine, but also architecture and engineering.

PRIORITISE VULNERABLE GROUPS

At a time of societal transformation, it is essential that the impact of proposed changes on the most vulnerable population groups be awarded particular attention. The current European context is one where energy poverty is a significant concern: it represents a wide-spread problem in the EU, 34 million Europeans having reported an inability to keep their homes adequately warm in 2018.⁵⁷ The risk of individuals being exposed to energy poverty only seems to be worsening, with the current significant increases in gas prices seeing energy costs for consumers rise dramatically.⁵⁸ Moreover, when new heating techniques become more prevalent and fewer households are connected to the gas infrastructure, the households that remain dependent on gas will each have to shoulder a higher share of the infrastructure costs.⁵⁹

The Social Climate Fund is therefore a crucial aspect of the European Green Deal, especially in the context of the extension of the Emissions Trading System to the building and road sectors. Both carbon pricing and regulatory action must be complemented by subsidy programs in order to secure a socially just transition.

Disadvantaged population groups are often confronted with higher levels of environmental risk factors, including poor housing conditions, which represent a major social determinant of health.⁶⁰ For example, in all but one of the 53 countries in the WHO Europe region, single-parent households below the relative poverty level were the group least able to keep the home adequately warm in 2019.⁶¹ Single-parent households are more often affected by indoor dampness than the general population in the vast majority of these countries as well.⁶²

56 World Health Organisation. n.d. "Capacity Building and Training Materials." Accessed on 25 Feb 2022. <https://www.who.int/activities/capacity-building-and-training-materials>

57 European Commission. n.d. "Energy poverty." Accessed on 25 Feb 2022. https://energy.ec.europa.eu/topics/markets-and-consumers/energy-consumer-rights/energy-poverty_en

58 Sánchez Nicolás, Elena. 2022. "Price hikes prompt scrutiny of fossil fuel revenues." EUobserver. <https://euobserver.com/climate/154351>

59 Sunderland, Louise. 2020. "Opinion: "Getting off gas: future risks for energy poor households"." FORESIGHT Climate & Energy. <https://foresightdk.com/getting-off-gas-future-risks-for-energy-poor-households/>

60 World Health Organization. 2022. "Environmental Health Inequalities: Fact Sheet Series." <https://www.euro.who.int/en/health-topics/environment-and-health/social-inequalities-in-environment-and-health/environmental-health-inequalities-fact-sheet-series-2022>

61 World Health Organization. 2022. "Environmental Health Inequalities: Fact Sheet Series - Inequalities in Ability to Keep the Home Adequately Warm." <https://apps.who.int/iris/bitstream/handle/10665/351890/WHO-EURO-2022-4870-44633-63331-eng.pdf>

62 World Health Organization. 2022. "Environmental Health Inequalities: Fact Sheet Series - Inequalities in Dampness in the Home." <https://www.euro.who.int/en/health-topics/environment-and-health/social-inequalities-in-environment-and-health/environmental-health-inequalities-fact-sheet-series-2022/fact-sheet-inequalities-in-dampness-in-the-home-2022>

Vulnerable groups are likely to live in smaller and more poorly ventilated houses,⁶³ thus are at risk of breathing in higher concentrations of pollutants. Their houses are also likely to be less well insulated and less energy efficient.⁶⁴ Adequate ventilation and insulation are necessary in order to avoid dampness and mould, the adverse effects of which include allergies, respiratory infections and asthma, with indoor dampness being responsible for approximately 15% of new childhood asthma cases in Europe.⁶⁵

At the same time, ventilation and insulation may play an increasingly important role as average temperatures rise and heat waves increase in frequency due to climate change. Therefore, there is a major opportunity for renovations that will lead to triple benefits: mitigation of climate change by phasing out polluting energy sources, lower energy bills as a result of increased efficiency, and increased health and wellbeing. Making a tangible improvement in people's quality of life will in turn boost public support for the transition.

Energy-poor households often use inefficient or more polluting forms of energy, which can themselves contribute to poor mental and physical health.⁶⁶ **These vulnerable households must be protected and supported through targeted policies and dedicated funds** at the national and European level.

Lower income groups are also more at risk of poor health, including a higher incidence of chronic conditions,⁶⁷ which, in turn, can be exacerbated by poor air quality. The clean transition can therefore create favourable circumstances to correct existing health inequalities. Moreover, as these vulnerable population groups are usually living in rented houses, **specific policy instruments should be implemented to empower tenants and inform them of their rights, while requiring landlords to upgrade the building to minimum standards.**

63 World Health Organization. 2018. "WHO Housing and health guidelines." <https://www.who.int/publications/i/item/9789241550376>

64 World Health Organization. 2018. "WHO Housing and health guidelines." <https://www.who.int/publications/i/item/9789241550376>

65 World Health Organization. 2019. "Health Housing: Raising Standards, Reducing Inequalities." <https://cdn.who.int/media/docs/default-source/documents/publications/healthy-housing0c8b2c72-8137-4b15-b3a4-eac6940ae528.pdf>

66 O'Sullivan, Kimberley, Lucy Telfar-Barnard, n.d. "Special Issue "Public Health Impacts of Energy Poverty and Energy Use Behaviours": Special Issue Information." *Multidisciplinary Digital Publishing Institute*. Accessed 25 Feb 2022. https://www.mdpi.com/journal/energies/special_issues/public_health_energy_poverty_behaviours

67 Organisation for Economic Cooperation and Development, European Union. 2020. "Health at a Glance: Europe 2020: State of Health in the EU Cycle - Chronic Disease and Disabilities Among Older People." <https://www.oecd-ilibrary.org/sites/f44c34f1-en/index.html?itemId=/content/component/f44c34f1-en>





CONCLUSION

As the EU and European countries must embark at full speed on the green transition, it is of paramount importance that we consider carefully all the implications of policies that will reshape society. All relevant perspectives should be included to avoid quick solutions that trap us in polluting, health and climate-harming options in the long term.

In the case of heating and cooking, air pollution has been neglected despite clear evidence about the damages it does to health, society and the economy, some of which have been described in this paper. The ways in which indoor and outdoor air quality are impacted by the buildings sector have yet to be properly addressed by EU and national legislation. Moving forward, this conversation should be informed by health professionals acting as a trusted partner to provide reliable information to both policy makers and the public.

The Ambient Air Quality Directives, the Ecodesign Directive and the Energy Performance of Buildings Directive are some of the main legislative files currently discussed at the EU level and that have been identified as relevant to improving air quality by addressing issues in the building sector. However, these are to be seen in the context of the broader need to ensure policy coherence between public health and other policies, in the true spirit of the Health in All Policies approach.



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