Renewable energy

Renewable energy in Europe: key for climate objectives, but air pollution needs attention

The European energy system is undergoing rapid changes to set the EU economy on a low-carbon and resource-efficient path. Renewable energy is instrumental to this transformation. EU efforts to double the share of renewable energy in its consumption have paid off, having reduced significantly the amount of fossil fuels used and their associated greenhouse gas emissions. Concerning air pollutant emissions however, the outcomes were not always positive: in countries where biomass burning has increased considerably since 2005, emissions of certain air pollutants have also increased. This briefing presents an estimate of the impact of renewable energy consumption on fossil fuel use, greenhouse gas emissions (GHG) and air pollution since 2005.

Key messages

- Over the past two decades, renewable energy consumption has increased rapidly throughout Europe in response to dedicated policies and measures, and falling costs.
- Had the EU's renewable energy share not grown since 2005, it would have been necessary to burn a significant amount of fossil fuels to meet energy needs. In this case, EU greenhouse gas emissions would have been 11 % higher in 2018, jeopardising the achievement of EU climate mitigation targets.
- Since 2005, the increasing substitution of polluting fossil fuels for renewable energy across the EU led to a 7 % drop in total sulphur dioxide (SO_2) and a 1 % drop in nitrogen oxide (NO_x) emissions in 2017.
- By contrast, particulate matter (PM) directly released into the air and emissions of volatile organic compounds (VOCs) increased because of the growth in biomass burning since 2005. $PM_{2.5}$ increased by 11 %, PM_{10} by 7 % and VOCs by 4 %.
- To maximise the climate and health co-benefits of the energy transition, policymakers need to be aware of the interplay between renewable and non-renewable energy sources and pay attention to potential impacts from biomass burning.

The assessment in this briefing is based on a detailed analysis presented in the report Renewable energy in Europe 2019 — recent growth and knock-on effects. Information on national renewable energy policies and measures in Europe and on progress to achieving energy targets is also available. Data on emissions of greenhouse gases and air pollutants are available in dedicated data viewers.

Renewable energy use has increased rapidly throughout Europe since 2005

Over the last two decades, the EU's renewable energy share has increased continuously at the EU level and in most Member States in response to:

- dedicated climate and energy policies, especially the 2020 targets for renewable energy sources under the 2009 Renewable Energy Directive (EU, 2009)
- increased competitiveness, following fast technological progress and significant cost reductions, as shown in a 2019 IRENA report (IRENA, 2019).

According to the EEA's preliminary estimates, the share of energy from renewable sources stood at 18.0 % of gross final EU energy use in 2018 — twice as high as in 2005. This rapid growth has transformed the EU's energy production base much faster than in other world regions.

It also brought the EU's 20 % renewable energy target for 2020 within reach and helped the EU to stay firmly on track to achieve its greenhouse gas (GHG) emission reduction target for 2020. Thanks to a relatively stable demand for energy, growth in renewable energy sources means non-renewable sources, especially fossil fuels, are being replaced across all sectors.

Today, renewable energy shares continue to vary widely among EU countries, ranging from over 30 % of gross final energy consumption in Austria, Denmark, Finland, Latvia and Sweden to 10 % or less in Belgium, Cyprus, Luxembourg, Malta, and the Netherlands.

Renewable energy is predominantly used for heating

In 2018, across the EU, half of all renewable energy sources were used for heating (49 %), followed by electricity generation (43 %), according to the EEA's preliminary estimates. A much smaller proportion was used in transport (8 %).

About one fifth of all heating consumed in the EU in 2018 originated from renewable energy sources. Biomass has supplied about 80 % of all renewable heating, mainly solid biomass burning. However, since 2005, biogas, heat pumps and solar thermal applications have developed faster than solid biomass burning, albeit starting from a much smaller base.

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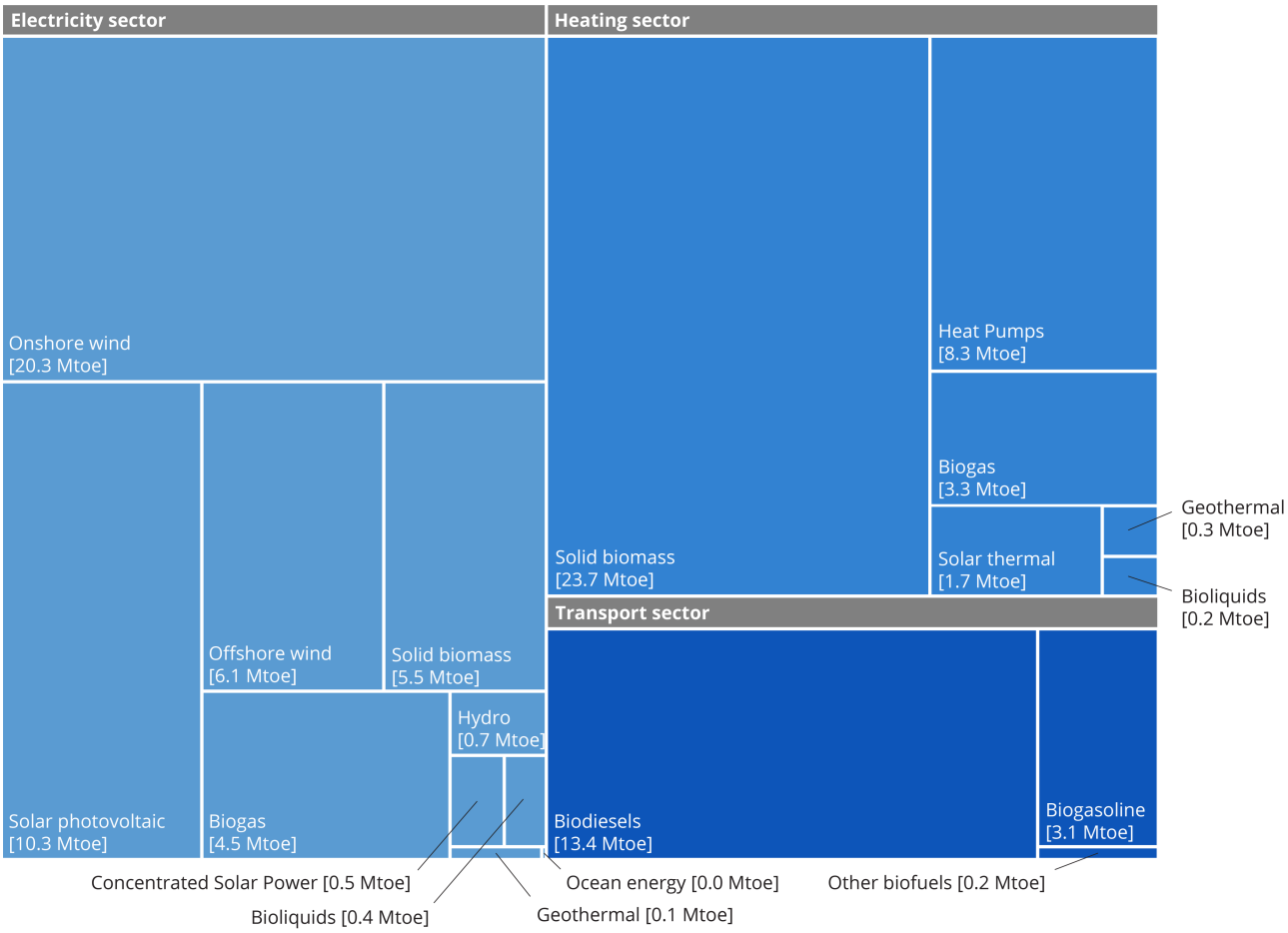
More than 30 % of all electricity consumed in the EU in 2018 originated from renewable energy sources. The growth in renewable electricity since 2005 has been driven by increases in onshore and offshore wind power and solar photovoltaic (PV) electricity, as well as by other renewable energy sources, e.g. solid biomass combustion.

In transport, renewable energy made up 8 % of all energy used in 2018. Biofuels accounted for the bulk of this.

Figure 1 Growth in renewable energy use by technology and sector, 2005-2018



Sources: Eurostat; EEA 'Renewable energy in Europe 2019' dashboard, 2019. More info.

Increasing renewable energy in the mix has cut greenhouse gas emissions

According to a European Commission report, fossil fuel imports cost EU citizens more than EUR 200 billion a year. Replacing fossil fuels with an increasing share of renewable energy sources strengthens the EU's energy security and avoids a significant amount of expenditure. This is currently the case despite renewable energy being partly sourced from other world regions. The growth in renewable energy use since 2005 has reduced the EU's annual primary fossil fuel energy use by 13 % in 2018, according to the EEA's analysis (Figure 2). This annual saving is larger than the consumption of fossil fuels in the United Kingdom in 2018.

By substituting fossil fuels, the growth in renewable energy since 2005 has also avoided generating GHGs from fossil fuel combustion. At current energy demand, without these savings in GHG emissions, the EU's total annual emissions would have been 11 % higher in 2018, jeopardising the achievement of the EU's GHG emission reduction target for 2020.

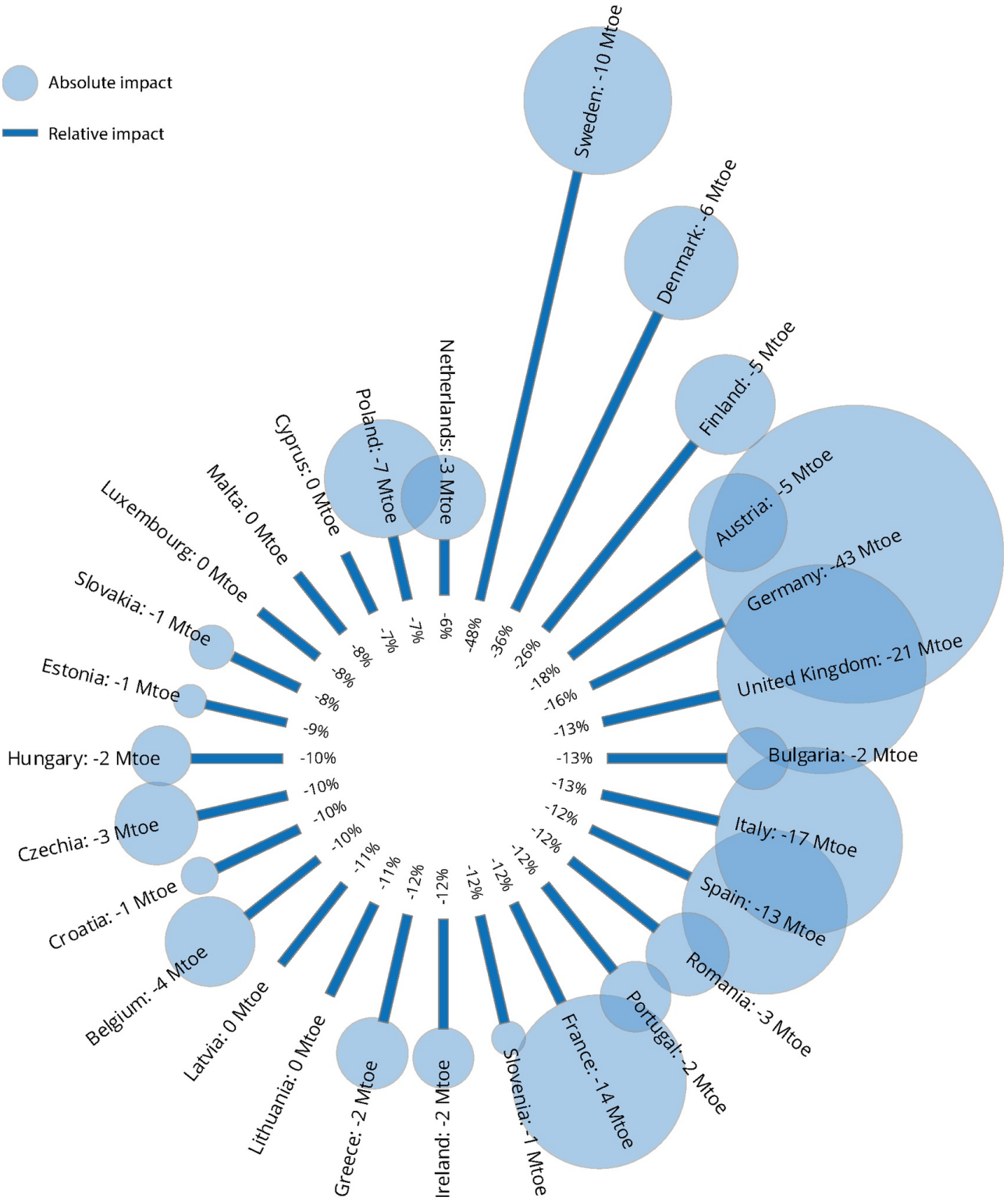
Most of the substitution took place in energy-intensive industrial sectors covered by the EU Emissions Trading System (ETS), contributing three quarters of the total savings in EU GHG emissions in 2018. To date, more rapid progress in decarbonising the EU power sector, compared with transport, heating and industry, confirms the findings.

Avoided greenhouse gas emissions by Member State

Germany, Italy and the United Kingdom were the countries where the largest absolute reductions in domestic fossil fuel use and GHG emissions took place in 2018. This was thanks to the largest amounts of renewable energy being used in these countries. However, national fossil fuel use and GHG emissions were reduced most effectively in Denmark, Finland and Sweden, where the renewable energy share increased fastest during this period (Figure 3).

Energy

Figure 2 Effects of increased renewable energy use on national primary fossil fuel consumption (2018)



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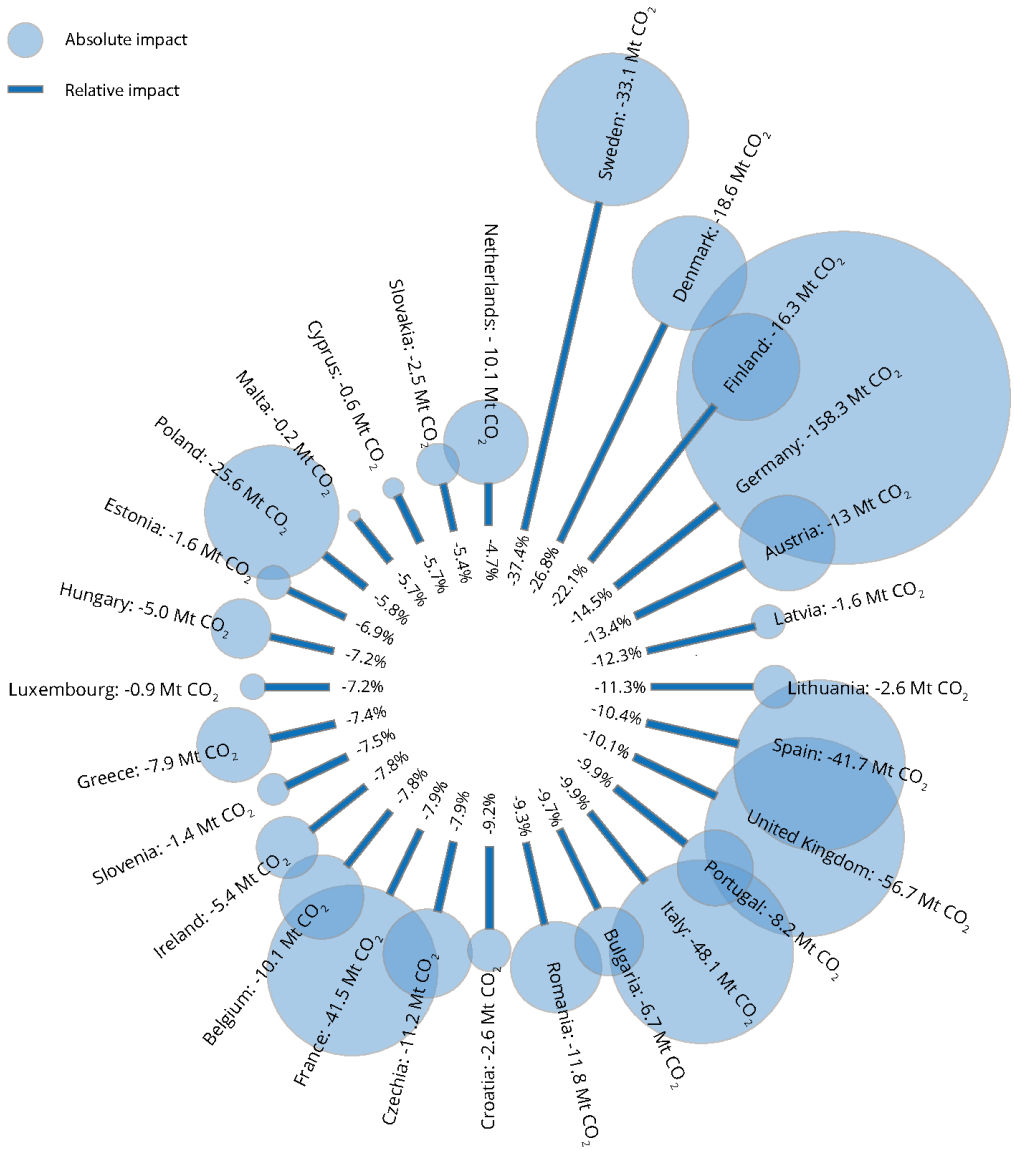
Source: EEA Renewable energy impacts dashboard, 2019; Renewable energy in Europe 2019 - recent growth and knock-on effects (2019). More info.

Figure 3 Effects of increased renewable energy use on national greenhouse gas emissions (2018)



Source: EEA Renewable energy impacts dashboard, 2019; Renewable energy in Europe 2019 - recent growth and knock-on effects (2019). More info.

Renewable energy use can increase certain air pollutant emissions

Renewable energy sources can contribute to improving air quality and human health, for instance by supplying electricity or heat without combustion. Technologies such as wind power, solar PV electricity, geothermal energy, heat pumps or solar thermal energy are therefore most effective at cutting the air pollutant emissions that are associated with most burning processes. These are sulphur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter (PM_{10} and $PM_{2.5}$, referring to dust particles with very small diameters of equal to or below 10, respectively 2.5 micrometres) and volatile organic compounds (VOCs).

When biomass burning replaces fossil fuel combustion, however, the outcomes are mixed.

The extra consumption of renewable energy sources across the EU since 2005 led to a decrease in all SO_2 and NO_x emissions in 2017, by 7 % and 1 %, respectively. In contrast, there was an increase in EU-wide emissions of 11 % for $PM_{2.5}$, 7 % for PM_{10} and 4 % for VOCs in 2017, as a result of the increase in biomass use since 2005.

The rapid growth in wind power and solar PV electricity since 2005 has lowered the emissions of SO_2, NO_x and PM ($PM_{2.5}$, PM_{10}) across the EU electricity sector. However, emissions of VOCs have increased slightly, because of the growth in electricity generation from biogas. In the heating sector, where biomass has a dominant role, all key air pollutant emissions have increased, except SO_2.

Most Member States saw their PM and VOC emissions increase, due to biomass burning

All countries have reduced their SO_2 emissions, thanks to renewable fuels being either entirely SO_2-free or low in SO_2 emissions (Figure 4).

The results for NO_x emissions vary from a strong decrease to an increase in emissions, depending on the type of renewable energy source and technology prevailing in each country. Strong decreases were driven by increasing shares of wind power and, to a lesser extent, solar PV electricity, which were not offset by increases in NO_x emissions from solid and gaseous biomass use in electricity and heating.

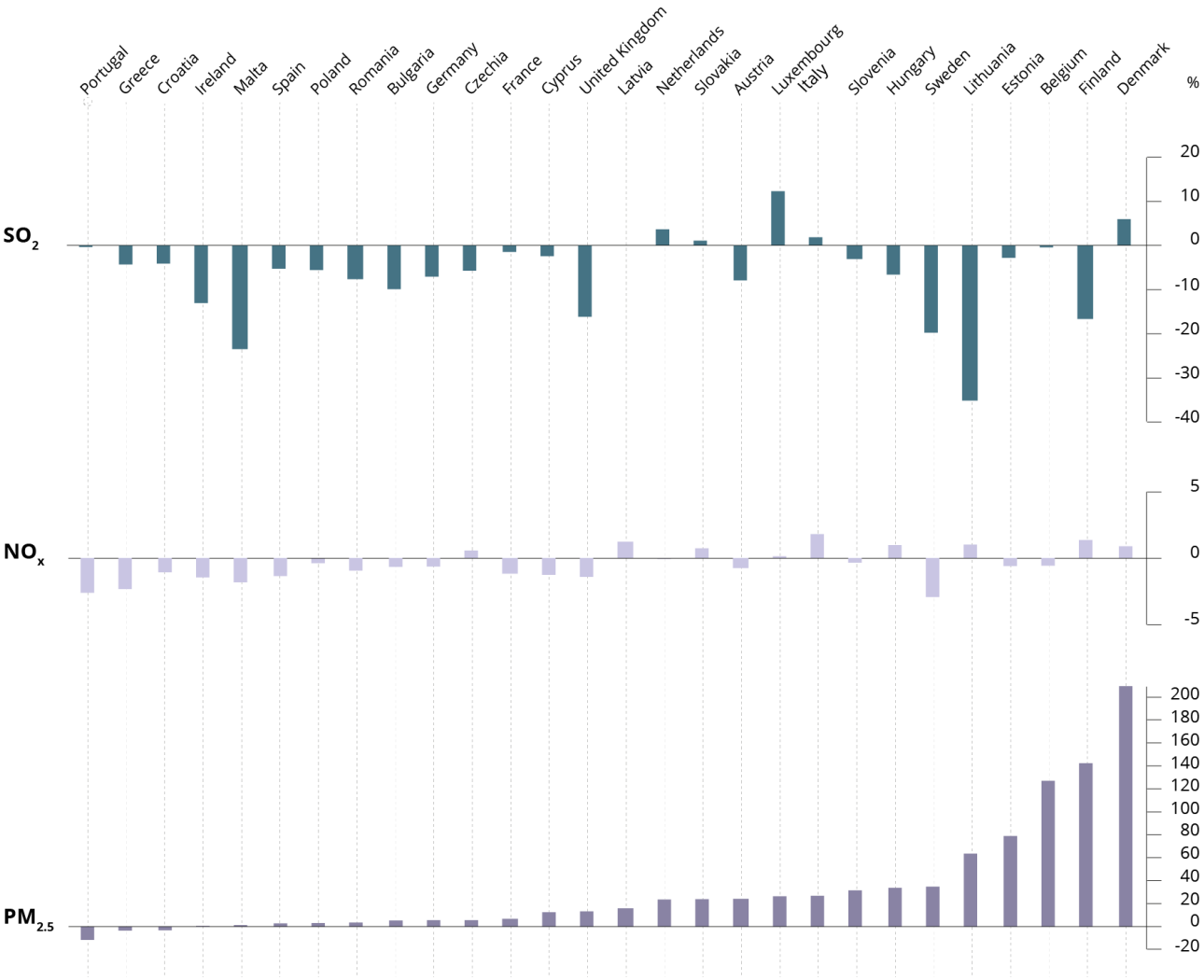
Emissions of PM and VOCs in almost all countries, except Croatia, Greece and Portugal, showed a relative increase against the backdrop of increasing national consumption of biomass over the period.

Trade-offs occur particularly when solid biomass burning for heating increases in households. Industrial emissions from combustion processes are more strictly regulated under EU legislation and have lower air pollutant intensities. Other factors also influence the outcomes of increased renewable use, for example:

- the different composition of renewable fuels and technologies;
- the level of abatement installed compared with the fossil fuel technologies substituted;
- the characteristics of the replaced fossil fuels.

By paying attention to these interactions, policymakers can maximise the climate and health benefits of the energy transition. Insights into the growth of renewable energy consumption by technology, and the associated benefits and trade-offs, should regularly inform political choices regarding the design of national climate and energy strategies and strategies to reduce air pollution.

Figure 4 Effects of RES growth on key air pollutant emissions (relative, 2018)



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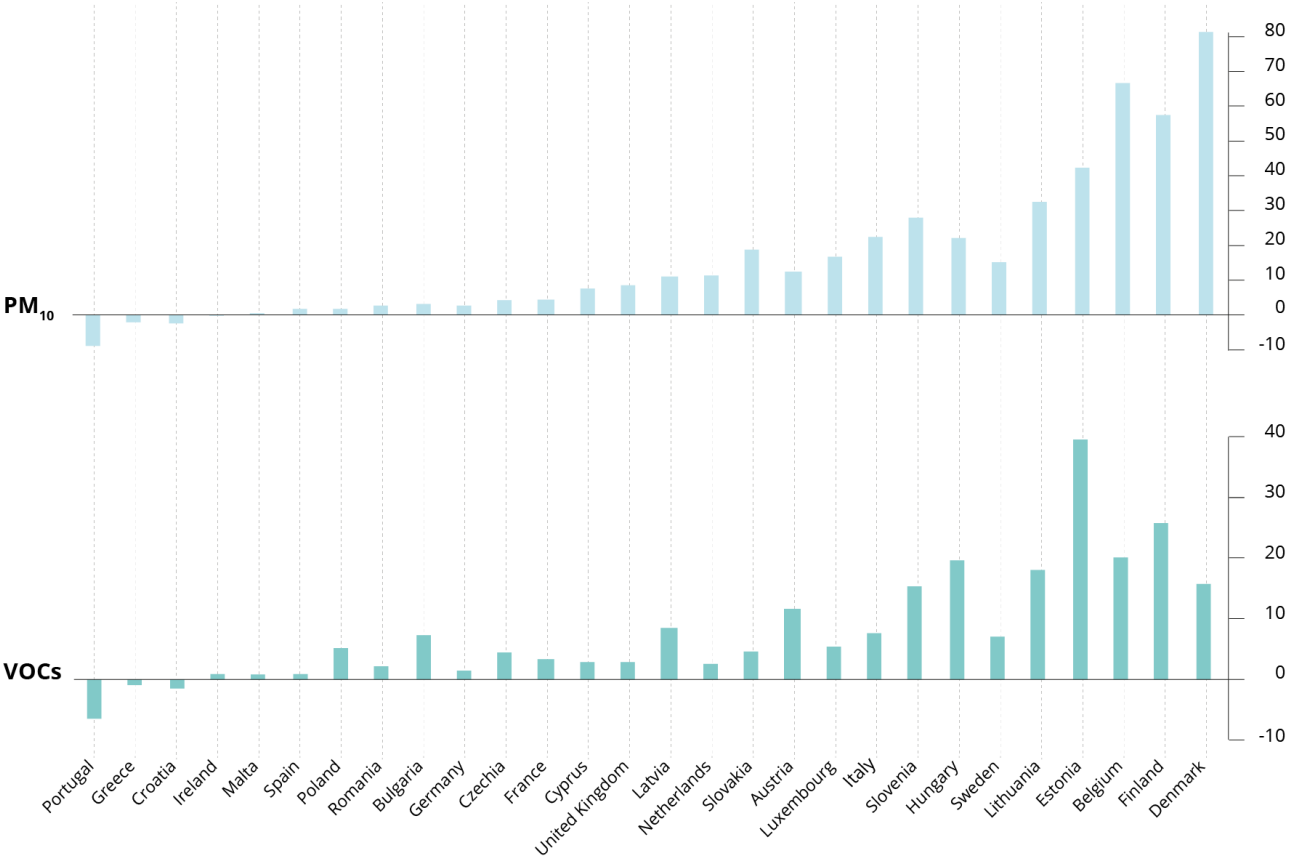

Source: EEA, Renewable energy impacts dashboard, 2019; Renewable energy in Europe 2019 - recent growth and knock-on effects (2019). More info.

Methodological notes:

To estimate the interplay between growth in renewable energy consumption and non-renewable energy sources in the national mixes, the analysis has contrasted the actual development of renewable energy use with a scenario in which RES consumption stagnates at the level reached in 2005, while fossil fuel consumption increases to supply the difference. This would result in a relentlessly higher use of fossil fuels and associated GHG and air pollutant emissions.

Regarding transport, the main hypothesis is that the substitution of fossil fuels by biofuels does not lead to transparently measurable effects (positive or negative) with regard to air pollutant emissions. The overall method and assumptions that underpin this briefing are described in detail in ETC/CME, 2019. The highest

level of confidence for the estimates is at the EU level; country-specific estimates provide valuable indications for the direction and magnitude of benefits and trade-offs from the interplay between renewable and non-renewable energy sources in the energy mix.

Although a zero GHG emission factor was applied to all energy uses of biomass, this should not be interpreted as a default endorsement of biomass sustainability/carbon neutrality. According to the official reporting guidelines, these GHG emissions have to be reported as a memorandum item in GHG inventories, with the assumption that unsustainable biomass production would show as a loss of carbon stock in the land use, land use change and forestry sector, not in the energy sector.

Identifiers

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