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CON+AIR: Addressing Conflicts of Climate and Air Pollution

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Rialtas na hÉireann
Government of Ireland

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EPA RESEARCH PROGRAMME 2014–2020

CON+AIR: Addressing Conflicts of Climate and Air Pollution

(2016-CCRP-MS.38)

EPA Research Report

Prepared for the Environmental Protection Agency

by

EnvEcon

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Executive Summary

The CON+AIR project presents two counterfactual scenarios for emissions and concentrations of air pollutants in Ireland in the year 2030. The “problematic pathway” (PP) depicts a scenario in which air quality deteriorates whereas the “solution pathway” (SP) depicts a scenario in which air quality improves. The results are compared with the Irish “with measures” (WM) scenario and the European Union National Emission Ceilings Directive. In addition, a marginal damage evaluation of the emissions is carried out.

Emissions of nitrogen oxides (NO_X), particulate matter with a diameter of < 2.5 mm ($PM_{2.5}$), sulfur oxides (SO_X) and non-methane volatile organic compounds are modelled using an integrated assessment approach based on the GAINS model. The modelled emissions are spatially distributed and then their interaction with climate patterns is simulated to estimate concentrations of NO_X, nitrogen dioxide (NO_2), $PM_{2.5}$, particulate matter with a diameter of < 10 μm (PM_{10}) and ozone (O_3). The EMEP and EPISODE dispersion models are used to estimate air pollutant concentrations at a national level and for the Dublin region respectively.

In the PP there is an almost 100 PJ (petajoule) increase in final energy demand over the WM scenario. In contrast, the SP uses around 50 PJ less than the WM scenario. Fundamental drivers such as population and economic growth contribute significantly to the increase in energy demand in the PP whereas improvements in energy efficiency are important in the SP. There is a large increase in the use of renewables in the residential sector in the PP. For the transport sector an additional 17 PJ of diesel is consumed in the PP over the WM scenario.

$PM_{2.5}$ emissions from the residential sector are nearly three times greater in the PP than in the WM scenario. This is brought about, inter alia, by the increased use of biomass, low technical standards, such as flues not being installed properly, and problems with fuel quality, such as wood not being sufficiently dry. Emissions of NO_X from the transport and buildings sectors increase in the PP compared with the WM scenario, whereas they decrease for the industrial sector compared with the WM scenario.

For the residential sector, the reasons for the difference in emissions between the PP and the SP include a reduction in the use of solid fuels as a result of improved energy efficiency and lower indoor temperatures; less deployment of biomass boilers and a switch from the use of open fireplaces to stoves for those who still use solid fuels; an improvement in fuel quality; and certification of flue installation and mandatory annual chimney sweeps. These measures are implemented via a combination of regulations and an expansion of the Sustainable Energy Authority of Ireland Better Homes scheme.

For the transport sector, the policies and measures implemented in the SP include increased take-up of electric vehicles (brought about by support schemes for the purchase of electric vehicles for the small public service vehicle and public sector fleets, e.g. Garda vehicles, and increased numbers of home chargers and on-street chargers); a reduction in the number of internal combustion engine (ICE) vehicles as a result of the introduction of a token NO_X tax, equalisation of the price of petrol and diesel fuel and differentiated parking fees; a reduction in overall levels of driving from the roll-out of the BusConnects scheme, an expansion of tram and suburban rail lines, town planning that increases urban living and an increase in the number of people working from home; and a new National Car Test emissions test and publication of an Irish EQUA Index for cars.

Emissions in the industry and services sectors in the SP are lower than in the PP, mostly because of efficiency improvements that reduce the energy demand and due to better emission control technologies, which are tied to the Support Scheme for Renewable Heat (SSRH).

Annual average concentrations of O_3 (accumulated O_3 exposure over a threshold of 40 ppb = 80 μg/m³; AOT40) and NO_2 decrease in all three scenarios whereas that of $PM_{2.5}$ increases in the PP. The main reason for the $PM_{2.5}$ increase in the PP is changes in domestic heating. For both NO_2 and $PM_{2.5}$, the highest concentrations are found in urban areas, but main roads are also high concentration areas. In general, O_3 is found to be highest in the southern part of Ireland,

although concentrations are below the European Union long-term objective of 3000 ppb/h in all regions. For PM_{10}, sea salt is the dominating aerosol source.

The marginal damage benefit of implementing the SP over the PP is found to be €146 million, most of which comes from the mitigation efforts for $PM_{2.5}$.

1 Introduction

Under the auspices of the Ambient Air Quality and Cleaner Air for Europe (CAFE) Directive (2008/50/EC), the National Emissions Ceiling Directive (2016/2284/EU) and the United Nations Economic Commission for Europe's (UNECE) Convention on Long-range Transboundary Air Pollution (CLRTAP), Ireland faces a substantial, dynamic and recurring challenge with regard to air pollution management and control. In parallel with legally binding air pollution requirements, Ireland must also respond to stringent legally binding agreements set under the United Nations Framework Commission on Climate Change (UNFCCC), in particular acting on the national contribution required for European-level commitments in relation to greenhouse gas emission reductions.

With this in mind, the CON+AIR project addresses the challenges that arise where climate policy CONflicts with AIR (CON+AIR) policy. The principal objective is to identify and evaluate potent and viable technical and non-technical interventions that can reduce tensions between climate policy and air policy in Ireland. The measures are evaluated with regard to their relative contributions to the National Emissions Ceiling Directive, ambient air quality limit values, and cost and impact (health) outcomes. The background to the work is a study by Kelly *et al*. (2017) that identified significant potential pressures for air pollution management in Ireland associated with specific strategies identified for delivering progress on climate targets. Specifically, the study identified biomass use in the industrial and residential sectors as being a major source of increased particulate matter with a diameter of $<2.5\,\mu m$ ($PM_{2.5}$) and volatile organic compound emissions, with transport sector "dieselisation" also noted as a source of higher air pollutant emissions in the underlying analyses.

This study will assess in detail a "high-tension" scenario for the year 2030, called the "problematic pathway" (PP), which has a specific focus on greater residential/industrial biomass use and also an increasing penetration rate for diesel vehicles in the road transport sector. The PP scenario depicts an alternative plausible pathway for growth, energy choices, technologies and behaviour in Ireland that would be expected to result in a tangible increase in Irish air pollution emissions out to 2030. Specifically, the PP scenario is expected to deliver appreciably higher levels of air pollutant emissions relative to the official 2017 national "with measures" (WM) emissions forecasts for 2030 (EPA, 2018). The main areas of change are anticipated as being increased emissions of nitrogen oxides (NO_X) from the Irish road transport sector and increased emissions of $PM_{2.5}$, non-methane volatile organic compounds (NMVOCs) and sulfur oxides (SO_X) from the residential heating sector.

The "solution pathway" (SP) scenario is then a response to the PP that comprises a portfolio of sector-specific and cross-cutting policies and measures (PAMs) that combine to mitigate PP emissions of four main air pollutants (NO_X, $PM_{2.5}$, NMVOCs and SO_X) in Ireland in 2030. This scenario informs policy by identifying the plausible means through which the tensions of climate policy and air policy in Ireland might be alleviated. At the time of writing there are a number of important and ambitious national strategies that are under development including the National Air Pollution Control Programme, the National Energy and Climate Plan, the National Clean Air Strategy and the National Mitigation Plan (Climate). It is hoped that this work can provide relevant input to these long-term plans.

For the project, the Irish team, EnvEcon, partnered with NILU (Norsk institutt for luftforskning) of Norway to combine national expertise in climate and air modelling and policy research with a highly experienced international air pollution modelling team. The air pollutants considered are NO_X, $PM_{2.5}$, NMVOCs, SO_X and ozone (O_3). The impact outcomes are tested through a combination of the GAINS Ireland system, the EMEP and EPISODE models, and desk research by an international team drawing on national and international evidence, experience and stakeholder input. Specific deliverables include:

- PP and SP reports;
- this final report clearly detailing the applied methodology and findings of the study;
- maps of concentration changes and tables of total national emission changes from the analysis;

- a short-form high-quality policy brief to convey the key messages to both the public and the policy spheres;
- a final event (February 2019) to communicate and discuss the outcomes of the research with stakeholders.

In this final report the project methodology is presented in Chapter 2, the PP and SP are presented in Chapter 3, the PAMs used in the SP are presented in Chapter 4 and summary recommendations are presented in Chapter 5.

2 Methodology

There are two steps in the research method used in the CON+AIR project to estimate emissions and concentrations of NO_X, $PM_{2.5}$, SO_X and NMVOC air pollutants[1] in 2030:

1. an integrated assessment approach is used to build air pollutant emission scenarios;
2. dispersion modelling is used to establish air pollutant concentrations.

The integrated assessment approach for air pollution emission modelling is based on the GAINS model (Amann *et al*., 2011; Kelly *et al*., 2017). Total emissions per sector are calculated based on the following variant of both the IPAT (impact, population, activity, technology) equation (Chertow, 2000)[2] and the Kaya identity (O'Mahony, 2013):

$$\Sigma E_{ijk} = A_{ijk} D_{ijk} I_{ijk} F_{ijk} \qquad (2.1)$$

where E = emissions, A = activity, D = duration of use, I = energy intensity, F = emission factor, i = sector, j = sector-specific technology and k = air pollutant species. For the transport sector, A is the number of vehicles on the road, D is the annual distance they are driven, I is the size of the engine and F is how the emissions of greenhouse gasses or air pollutants expected for a km driven or unit of fuel used. In terms of biomass use in the residential sector population, A is the number of fireplaces, stoves or boilers *in situ* in the stock of houses, D is the duration of their use (in hours per day and days per year), I is the variant of fireplace, stove or boiler, e.g. ecodesign stove, and F is emissions per unit of fuel used. For any sector, the product of A, D and I gives the final energy demand.

Estimated emissions from the different sectors are spatially distributed across the country and then their interaction with climate patterns is modelled to estimate pollution concentrations. National emissions from the road transport sector are spatially distributed at road network level based on annual average daily traffic values (AADTs) and commonly available information from existing geographical data, census data, traffic data and vehicle fleet data (Fu *et al*., 2017). Residential emissions are distributed at a small area level based on both primary and secondary fuel use patterns across Ireland, which were calculated using census data and Central Statistics Office (CSO) Household Budget Survey data. Industrial emissions are spatially distributed using MapEire's prepared normalised 1 km × 1 km grids, which are based on relevant spatial data sets and statistics, and include the share of emissions to be allocated to each grid cell (Nielsen and Plejdrup, 2016).

Two dispersion models are used to estimate concentrations of air pollutants in 2030 based on the emission scenarios. The EMEP model (Simpson *et al*., 2012) is run at the national scale for Ireland to estimate air pollutant concentrations at a grid of 2 km × 2 km. The EPISODE dispersion model (Slørdal *et al*., 2003) is used for the specific case of simulating air quality in Dublin at a grid size of 100 m × 100 m. For this project, the EMEP model is primarily used to estimate O_3, nitrogen dioxide (NO_2) and $PM_{2.5}$ concentrations and the EPISODE model is used to estimate NO_2 concentrations. Tropospheric O_3 is photochemically produced in the presence of NO_X, CO and hydrocarbons.[3] These interactions are simulated in the EMEP model.

Emissions of NO_X and $PM_{2.5}$ (and hence concentrations of same) deteriorate in the PP scenario modelled in this work. This deterioration is mainly driven by increased combustion of diesel and wood in response to a growing economy, Irish settlement

1 Concentrations of O_3 are also estimated for 2030.

2 In the IPAT formulation, I = impact, P = population, A = activity and T = technology. The idea is that the impact on the planet of a social practice can be decomposed into trends in population change, the activity of the population, e.g., housing, length of shower, length of car trip, and the efficiency of the technology used in the activity.

3 The unit measure used for O_3 is the AOT40 (accumulated ozone exposure over a threshold of 40 ppb = 80 µg/m³). For vegetation it is the accumulated excess of hourly O_3 concentrations above 80 µg/m³ between 08:00 and 20:00 CET (Central European Time) in the months of May, June and July, i.e. the growing season. This indicator is designed for the protection of crops and natural vegetation. The European long-term AOT40 target is 3000 pbb/h.

patterns and climate change. The drivers of this change are:

- population and economic growth;
- "dieselgate" and battery electric vehicle (EV) policy;
- the Irish legislative and regulatory framework;
- increased construction of housing and urban sprawl;
- increased carbon taxes and global oil prices;
- climate change.

Emissions of NO_X and $PM_{2.5}$ improve (compared with both the PP and the WM projection) in the SP scenario modelled in this work as a result of the implementation of packages of PAMs. These are outlined in the following chapter and include PAMs that reduce the overall energy demand through efficiency. Figure 2.1 (Williams, 2012) gives examples of PAMs that can have an air quality benefit but not a climate change benefit or vice versa or enhance both. In the PP, PAMs that improve climate change mitigation are prioritised whereas, in the SP, PAMs that improve both climate change and air quality are prioritised.

The data used for Equation 2.1 are obtained from various sources but are also estimated based on trends in underlying drivers. The CSO, for example, provides scenarios of population growth for Ireland out to 2030, whereas the Economic and Social Research Institute (ESRI) provides scenarios of economic growth for the same period. These data can be used to estimate the number of dwellings that will need to be built over the coming decade to meet the demand for housing and the number of vehicles that will be on the road (if vehicle ownership per capita stays the same or grows to the Western European average). Growing affluence from higher gross domestic product (GDP) can lead to, for example, cars with larger engines, more driving, more vehicles, bigger homes (which

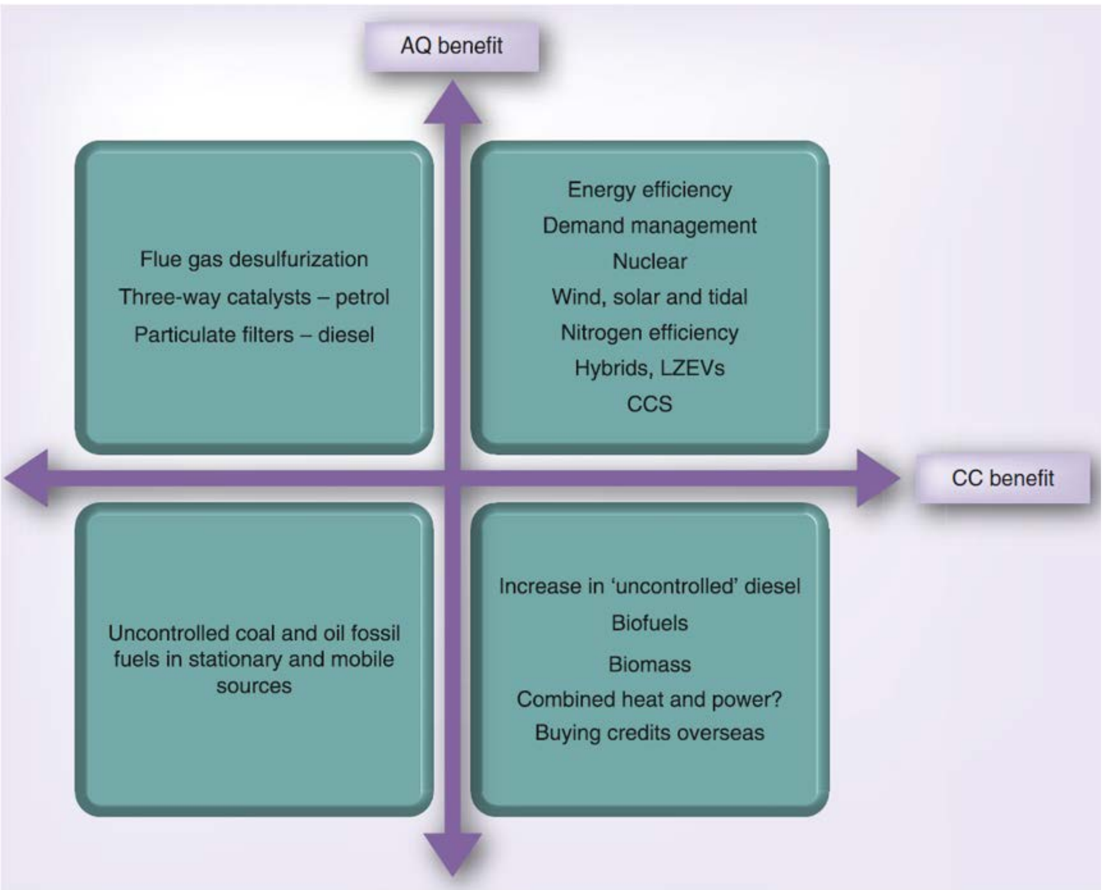

Figure 2.1. Energy policy options and their respective benefits for climate change (CC) and air quality (AQ). CCS, carbon capture and storage; LZEV, low or zero emission vehicles. Reprinted from *Carbon Management*, Vol. 3, M. Williams, Tackling climate change: what is the impact on air pollution?, pp. 511–519. Copyright 2012, with permission from Taylor & Francis Ltd. http://www.informaworld.com

implies more space to be heated) and higher indoor temperatures.

Emission factors (EFs) obtained from COPERT (EEA, 2016) are used for values of *F* in Equation 2.1 to estimate air pollutants that result from the combination of activity, duration of use and technologies. When applied to total energy use for an energy carrier for a country for 1 year they are known as Tier 1 EFs. When they are applied to a particular energy carrier when used with a particular technology they are known as Tier 2 EFs. A Tier 2 estimation should obviously be more accurate than a Tier 1 estimation, given its increased level of granularity, i.e. there are EFs for types of diesel cars and how much they are driven, not just for diesel fuel itself.

For emissions of NO_X and $PM_{2.5}$, Equation 2.1 is run for the automobile transport and residential biomass use subsectors using Tier 2 EFs. For the rest of the residential sector it is assumed that fuel switching occurs, in the sense that the demand for each respective energy carrier estimated in the WM scenario is reduced by the amount of biomass assumed to be used for the same activity (taking changes in conversion efficiencies into consideration). For the rest of the transport sector, and the industrial and services sectors, a simpler version of Equation 2.1 is used in which total emissions are a function of fuel use and EFs for the fuels, i.e. specific technologies, *I*, or duration of use, *D*, are not considered, i.e. Tier 1 EFs are used. For both the SP and the PP no change is assumed in the WM scenario emissions from the power, agricultural or off-road, e.g. construction, sectors. For emissions of SO_X and NMVOCs, Tier 1 EFs are used in all cases except for NMVOCs from residential sector combustion of biomass, for which Tier 2 EFs are also used.

The completed PP and SP emission scenarios are compared with the Irish WM scenario for 2030. Differences arise because of the respective assumptions used. For example, the WM scenario uses the CSO M2F1 population growth scenario in which fertility continues at the 2010 rate of 2.1% (F1) and net inward migration is +10,000 per year (M2). The PP, on the other hand, adopts the CSO M1F1 scenario, which has the same fertility rate (F1) but assumes net inward migration of +30,000 (M1) per year.

Indicative health outcomes are estimated using tables of PP and SP emissions and aggregate national estimates of marginal damage value (MDV) per tonne of pollutant obtained from EnvEcon (2015).

3 Scenarios to 2030

This chapter presents the overall results of the PP and SP scenarios for final energy demand and air pollutant emissions and concentrations.

3.1 Final Energy Demand in 2030 in the Problematic and Solution Pathways

Figure 3.1 shows the final energy demand in 2015 and also compares outcomes in the WM, PP and SP scenarios for 2030. The latter are estimated using the $A_{ijk}D_{ijk}I_{ijk}$ part of Equation 2.1. It can be observed that the transport sector is consistently the largest user of delivered energy. It can also be observed that there is an almost 100 PJ (petajoule) increase in energy demand in the PP over the WM scenario. In contrast, the SP uses around 50 PJ less than the WM scenario. Much of the reduction for the industry and services sectors in the SP is the result of efficiency improvement and use of the Support Scheme for Renewable Heat (SSRH) to promote advanced emission controls. The drivers outlined in Chapter 2, such as the fundamentals of population and economic growth, contribute significantly to the increase in energy demand in the PP.

3.2 Residential and Transport Sector Energy Demand in the Problematic and Solution Pathways

Figure 3.2 takes the sectoral data from Figure 3.1 and divides it by energy carrier use for the residential and transport sectors. It can be observed that the use of natural gas and electricity dominates in the residential sector whereas the use of diesel dominates in the transport sector. Demand in the residential sector is 27% higher in the PP than in the WM scenario whereas in the transport sector demand is 15% higher in the PP than in the WM scenario. The reduced energy use in the SP occurs despite both the PP scenario and the SP scenario having the same level of population and economic growth development.

There is a large increase in the use of renewables in the PP and the SP in the residential sector. In the PP this is because of an additional use of 34 PJ of wood. Because of this, oil use in the residential sector is lower in the PP than in the WM. It can be observed that the increase in use of renewables in the PP occurs from a very low base of just 3 PJ. In the SP there is less deployment of biomass while, at the same

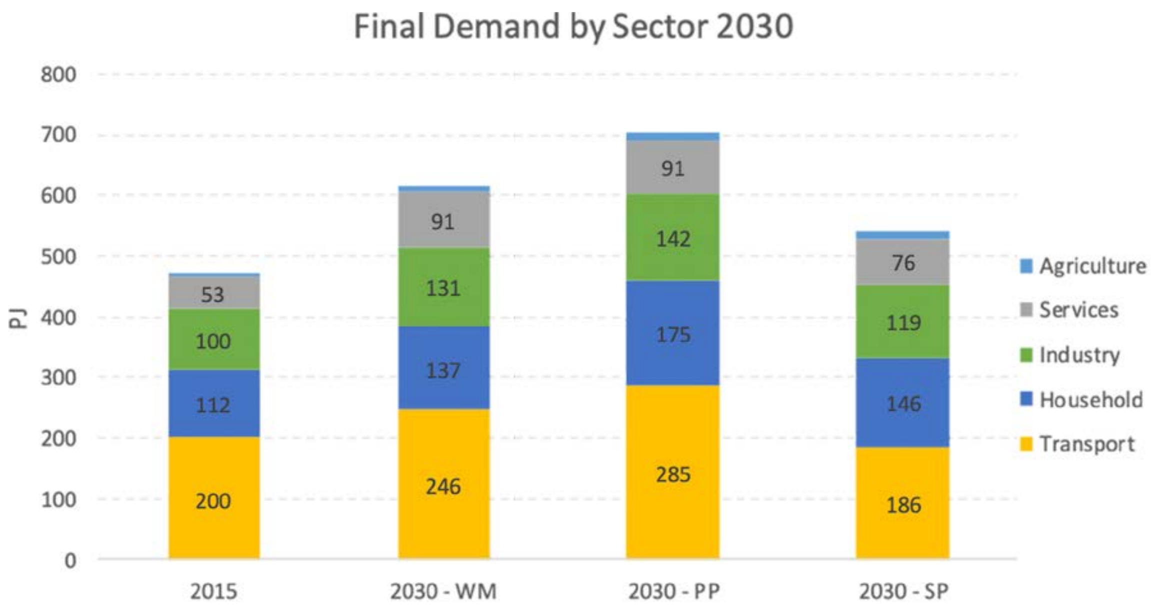

Figure 3.1. Final energy demand per sector in 2015 (measured) and in the WM, PP and SP scenarios in 2030 (estimated).

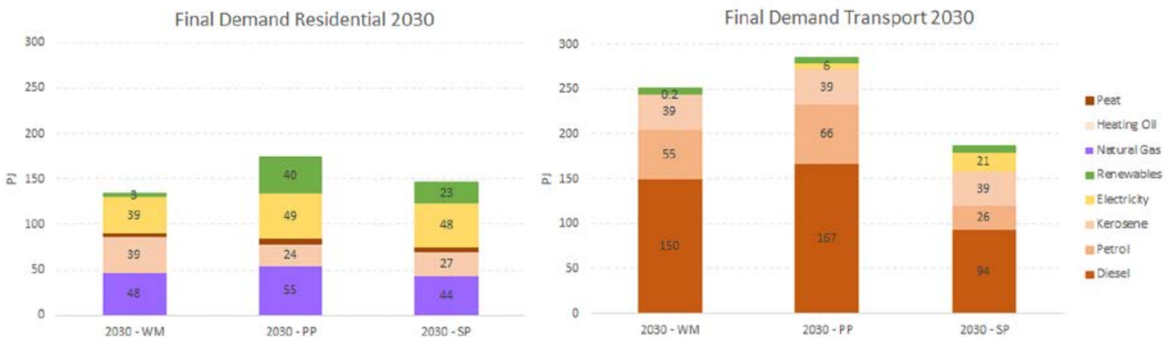

Figure 3.2. Comparison of WM, PP and SP scenarios in 2030 for the residential and transport sectors.

time, efficiency improves. The reduced use of biomass means that the demand for heating oil is marginally greater in the SP than in the PP, whereas total demand is decreased by an improvement in efficiency. This moves the policy direction into the upper right-hand quadrant of Figure 2.1.

For the transport sector an additional 17 PJ of diesel is consumed in the PP compared with the WM scenario. The impact of this and changes in other energy carriers is presented in Figure 3.2. This outcome increases the total energy used in the road transport sector and adds pressure to national emissions targets. In this development, the policy direction is in the lower right-hand quadrant of Figure 2.1 and, thus, although it satisfies climate objectives, it does not satisfy air quality objectives. It can be observed that, in the PP, there is a 6 PJ use of electricity in the transport sector, whereas in the SP this value is 21 PJ. This electricity use arises from an increase in the number of EVs on the road in 2030. In the PP there are 300,000 EVs on the road whereas in the SP there are 1 million.

3.3 Air Pollutant Emissions in the Problematic and Solution Pathways

Combining the EFs described in Chapter 2 and the energy demand scenarios shown in Figure 3.1, air pollutant emissions scenarios for the PP and SP are calculated. Figure 3.3 shows the resultant emissions of $PM_{2.5}$ and SO_X in the PP and SP and also in the WM scenario, as well as measured emissions for 2015. Figure 3.4 shows the same results for NO_X and NMVOCs. For each sector the difference in emissions between the PP and the SP is the result of the change in level of energy use shown in Figure 3.1 and end-of-pipe controls on emissions themselves. It can be observed in Figure 3.3 that the $PM_{2.5}$ emissions from the residential sector are nearly three times greater in the PP than in the WM scenario. This is brought about, inter alia, by increased use of biomass, low technical standards, such as flues not being installed properly, and problems with fuel quality, such as wood not being sufficiently dry. Emissions of $PM_{2.5}$ from the industrial sector are also significantly greater in the PP than in the WM scenario. $PM_{2.5}$ emissions are much lower in the SP because of a large reduction in emissions from the buildings sector.

It can be observed in the left-hand panel of Figure 3.4 that emissions of NO_X from the transport and buildings sectors increase in the PP compared with the WM scenario, whereas they decrease in the industrial sector. The increases in the residential and transport sectors are directly attributable to an increased use of diesel and combustion of biomass, respectively. The decrease in the industrial sector is due to a decrease in the use of oil and gas in this sector, brought about by fuel switching to biomass. The EFs for oil and gas for NO_X are higher than for biomass. NO_X emissions in Figure 3.3 are lower in the SP than in the PP, mostly because of reductions in emissions from the transport and buildings sectors.

Emissions of NMVOCs, shown in Figure 3.4, are almost 15 kt higher in the PP than in the WM scenario. Two-thirds of this increase is in the residential sector, with one-third in the transport sector. Emissions are also higher in the SP than in the WM scenario because of increased use of biomass in the SP compared with the WM scenario. Emissions of SO_X, also shown in Figure 3.4, are lower in the PP and SP than in the WM

Figure 3.3. Measured $PM_{2.5}$ and SO_X emissions for 2015 and for the WM, PP and SP scenarios to 2030. EU emissions limits for Ireland are also shown.

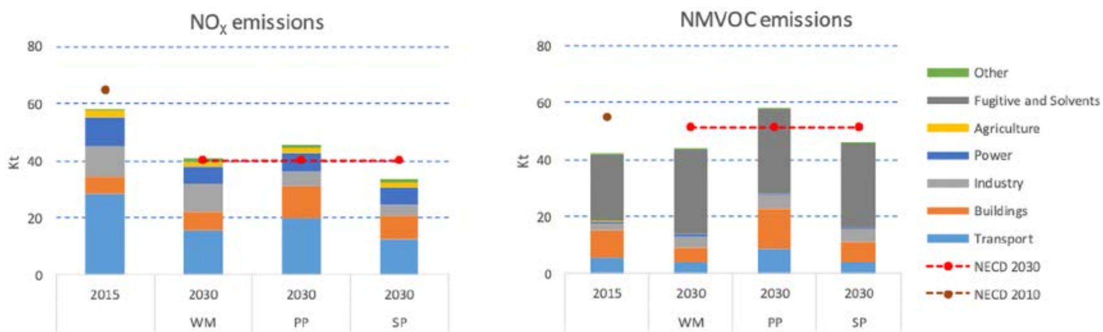

Figure 3.4. Measured NO_X and NMVOC emissions for 2015 and for the WM, PP and SP scenarios to 2030. EU emissions limits for Ireland are also shown.

scenario because of a lower amount of fossil fuels being used in these two scenarios.

In Figures 3.3 and Figure 3.4 the European Union (EU) emissions targets for Ireland under the negotiated compromise of the National Emission Ceilings Directive (NECD) are also shown (brown dots for 2015 and red lines for 2030). The large increase in emissions of $PM_{2.5}$ in the PP means that Ireland would be in breach of the EU emissions ceiling for this scenario. Should the PP turn out to be the actual scenario, the estimated breach would result in Ireland facing substantial financial penalties from the European Court of Justice (Kelly, 2014). Ireland would also be slightly above the allowed limit for NO_X in the PP, and thus in breach of its emission ceiling, in 2030. On the other hand, Ireland would be in compliance with the NECD in 2030 for all four pollutants in the SP. At the same time, all levels of air pollutant emissions have a MDV. These are presented in section 3.5. The PAMs that lead to lower emissions of $PM_{2.5}$ and NO_X in the SP are described in Chapter 4.

3.4 Air Pollution Concentrations in the Problematic and Solution Pathways

3.4.1 National-level air pollutant concentrations calculated using the EMEP model

An EMEP model simulation of AOT40 [accumulated ozone exposure over a threshold of 40 ppb (= 80 μg/m^3); O_3], NO_2 and $PM_{2.5}$ concentrations in 2015 are first presented, followed by the differences between the simulation and values for 2030 in the WM, PP and SP scenarios.

As seen from the left-hand panel of Figure 3.5, the Irish 2015 AOT40 values were below 3000 ppb/h in all regions. The highest model grid value was 2394 pbb/h. In general, AOT40 was highest in the southern part of Ireland. The middle panel of Figure 3.5 shows modelled annual average concentrations of NO_2 in 2015. The highest concentrations are found in urban areas, but the main roads can also be seen as high concentration areas. The average NO_2 value for the

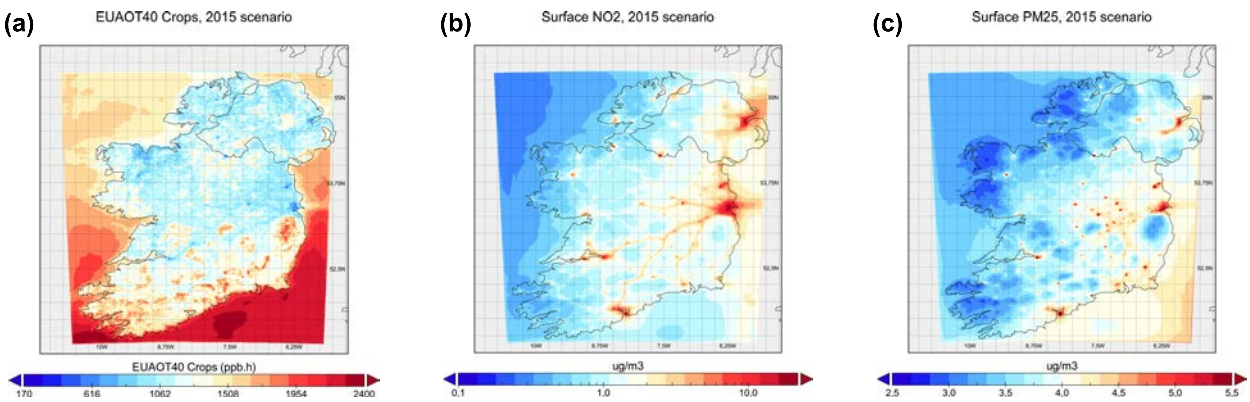

Figure 3.5. EMEP model simulation of (a) AOT40, (b) NO_2 and (c) $PM_{2.5}$ concentrations in 2015.

entire Irish domain is 1.2 μg/m³, whereas for Dublin the annual average concentration (for a single 2 km grid) is 22.2 μg/m³. The right-hand panel of Figure 3.5 shows that the highest $PM_{2.5}$ concentrations are found in urban areas and close to the main roads. The annual average $PM_{2.5}$ concentration for the entire Irish domain is 3.7 μg/m³, whereas the maximum grid value is 10.3 μg/m³. For particulate matter with a diameter of < 10 μm (PM_{10}; data not shown), sea salt is the dominating aerosol source. Thus, the concentrations are highest over the sea and in areas close to the coastline. The annual mean PM_{10} value for the model domain, including the ocean, is 15.9 μg/m³, whereas the maximum annual average grid value is 28.2 μg/m³.

National-level air pollutant concentrations in the respective WM, PP and SP scenarios, calculated using the EMEP model, are presented in Figures 3.6–3.8 with respect to measured values for 2015. The AOT40 level, the measure of O_3, reduces in all three scenarios. The reductions are 20.9, 33.9 and 44.6 ppb/h for the PP, WM and SP scenarios, respectively (see Figure 3.6). However, at the same time, it can be observed in Figure 3.6 that AOT40 values increase along the main roads and within some cities and suburban areas. The modelled AOT40 value increases can reach 660 ppb/h in urban areas for the SP scenario. However, according to the model simulations, the AOT40 value will never exceed the limit of 3000 ppb/h in any region.

The annual average NO_2 concentration also decreases for the PP, WM and SP scenarios (see Figure 3.7). The average NO_2 decreases for the entire grid region are 0.15 μg/m³ for the PP emission scenario, 0.22 μg/m² for the WM scenario and 0.19 μg/m² for the SP scenario. In urban areas the EMEP model predicts that the annual average NO_2 concentration will decrease by up to 13 μg/m³ (SP emission scenario). No areas show an increase in annual average NO_2 concentrations. The pattern is very similar for nitric oxide (NO).

The differences in annual average concentrations of $PM_{2.5}$ are shown in Figure 3.8. The yellow and red colours in Figure 3.8 (middle panel) indicate an increase in $PM_{2.5}$ in the PP emission scenario compared with 2015. The main reason for this increase is changes in domestic heating. The annual average increase for the full grid is 0.07 μg/m³, but for the hotspots an annual average increase of approximately 7 μg/m³ is modelled. For the WM and SP emission scenarios, the EMEP model predicts overall annual average $PM_{2.5}$ decreases of 0.15 μg/m³ and 0.19 μg/m³, respectively.

3.4.2 NO_2 concentrations in Dublin calculated using the EPISODE model

The main contributing factor for the NO_X concentrations seen using the EPISODE model is emissions from traffic, which represent half of the total annual emissions of NO_X in the Dublin region. This results in the obvious pattern in the NO_2 annual mean concentrations map for 2015 (Figure 3.9), clearly showing the roads with higher emissions. Other relatively high contribution sources are shipping emissions at the harbour and residential heating emissions, especially in the city centre and to the north-east. Considering the conclusion in the validation of the EPISODE model that there is an overall underestimation of NO_2 concentrations, the areas shaded in dark orange may represent the areas with the higher air quality risks (the EU legislative air quality limit for annual NO_2 concentrations is 40 μg/m³). This means the city centre, long stretches of the M50 and important nodes at the N4 and N7.

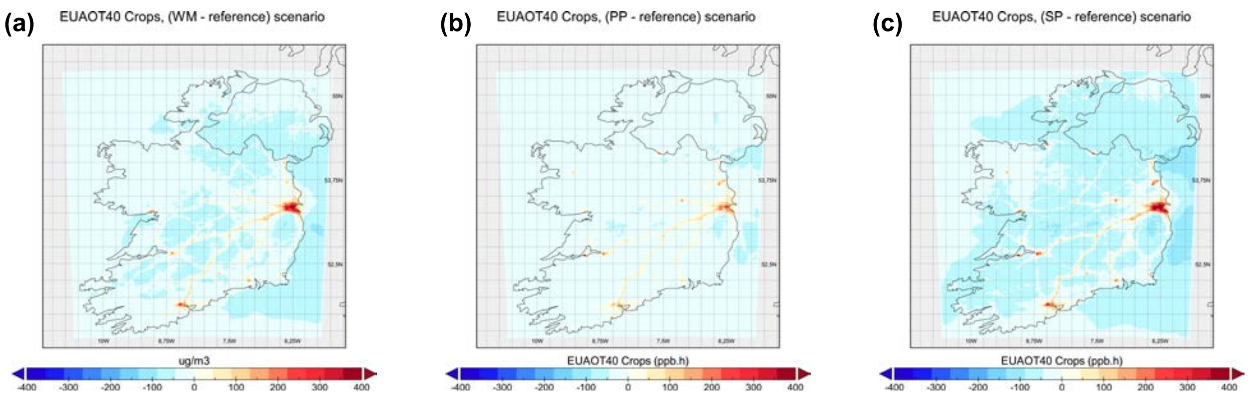

Figure 3.6. Annual average AOT40 (O_3) difference between (a) the WM emission scenario and the 2015 reference emission scenario, (b) the PP emission scenario and the 2015 reference emission scenario and (c) the SP emission scenario and the 2015 reference emission scenario.

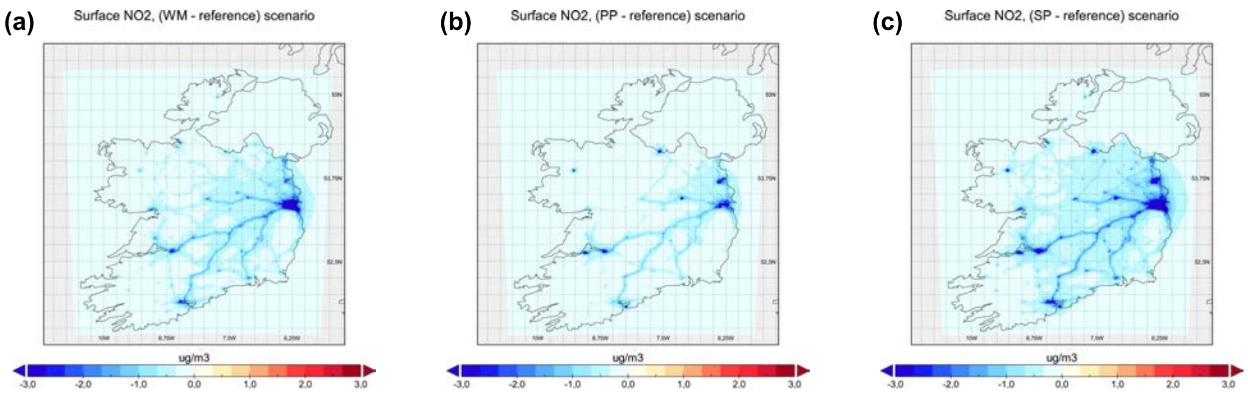

Figure 3.7. Annual average NO_2 difference between (a) the WM emission scenario and the 2015 reference emission scenario, (b) the PP emission scenario and the 2015 reference emission scenario and (c) the SP emission scenario and the 2015 reference emission scenario.

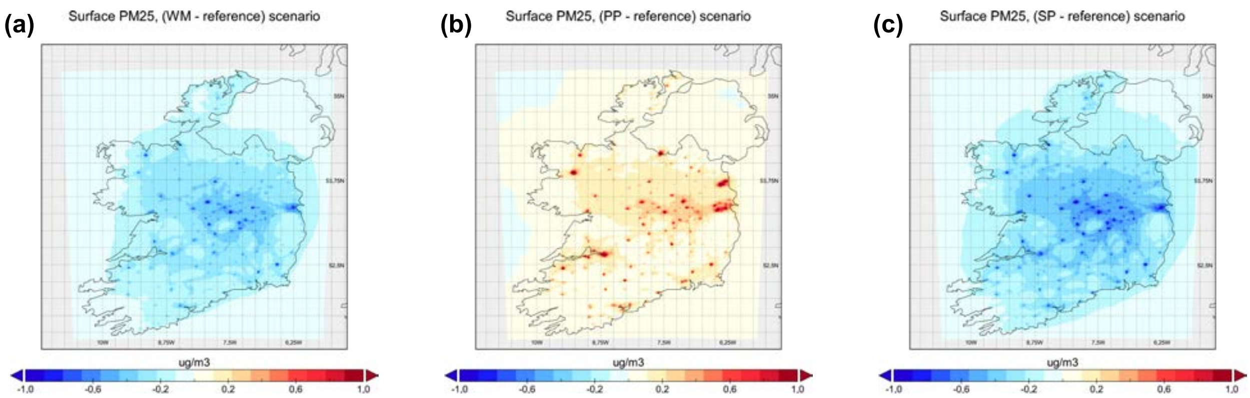

Figure 3.8. Annual average $PM_{2.5}$ difference between (a) the WM emission scenario and the 2015 reference emission scenario, (b) the PP emission scenario and the 2015 reference emission scenario and (c) the SP emission scenario and the 2015 reference emission scenario.

For the three scenarios, the changes in NO_2 emissions from traffic, residential heating and industry in Dublin were modelled. Residential heating emissions increased in all scenarios; however, the decreases in emissions from industry, and in particular from traffic, in the SP mean that, in 2030, we expect a decrease in concentrations in the Dublin region in all scenarios, even in the PP (Figure 3.10).

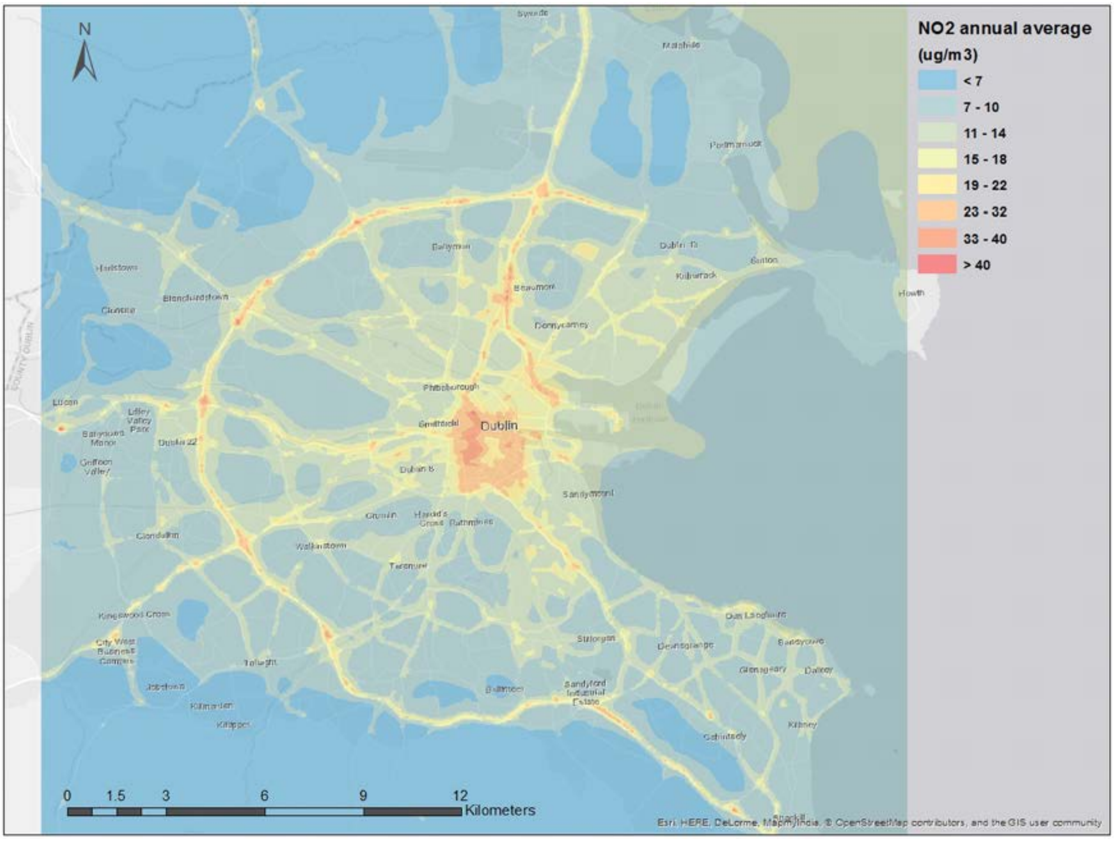

Figure 3.9. EPISODE model annual mean NO_2 concentrations (µg/m³) at the surface for the 2015 reference air quality situation in Dublin. 100 × 100 m² horizontal resolution.

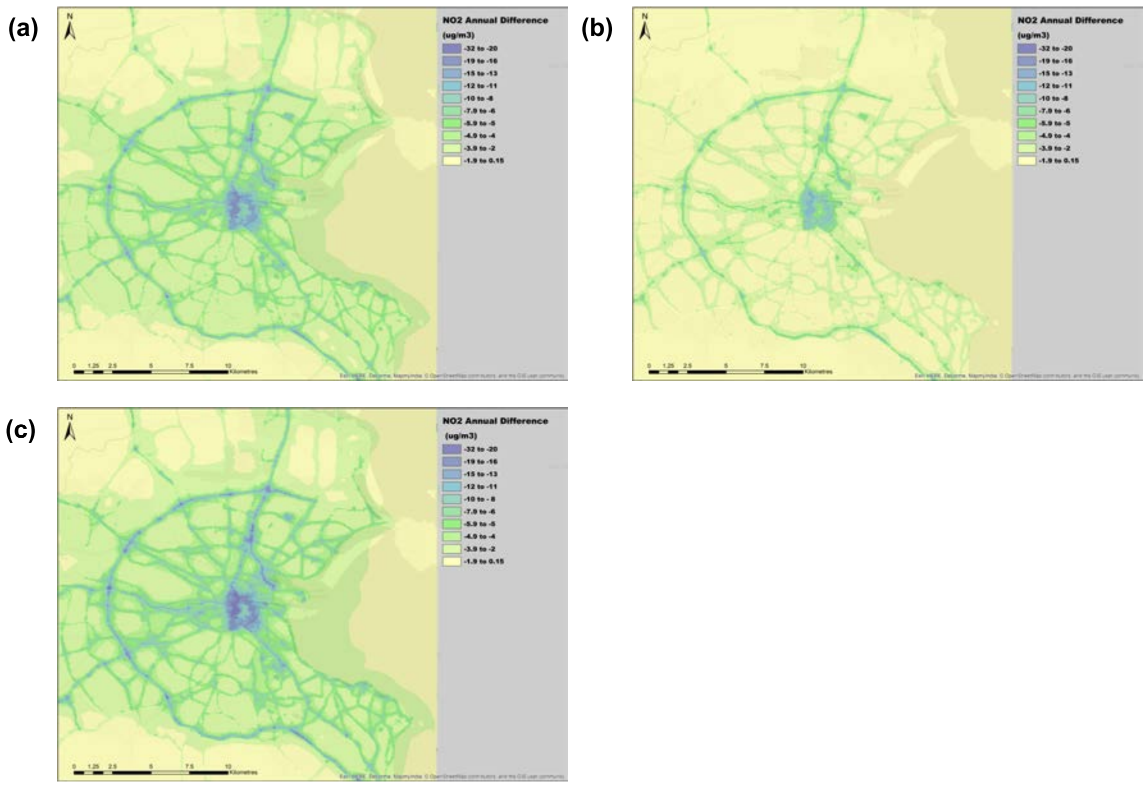

Figure 3.10. Difference in the EPISODE model annual mean NO_2 concentration (µg/m³) between (a) WM, (b) PP and (c) SP and the 2015 reference emission scenario.

3.5 Indicative Health Outcomes

The EnvEcon handbook (EnvEcon, 2015) on estimating the MDV for Ireland has been used to quantify the combined health and environmental impacts of the respective scenarios. Table 3.1 presents the MDV per tonne of respective air pollutant emissions for different Irish geographical units. It can be observed that the MDV for $PM_{2.5}$ in Dublin is relatively high.

Figure 3.11 shows the total MDVs calculated per air pollutant for 2015 and for the WM, PP and SP scenarios. These are calculated by multiplying the values in Table 3.1 by the levels of emissions presented in Figures 3.3 and 3.4. Although the volume of NO_X emissions shown in Figure 3.4 is greater than the volume of $PM_{2.5}$ emissions, i.e. 46 kt versus 24 kt in the PP, as the MDVs for $PM_{2.5}$ are substantially higher, as shown in Table 3.1, the greatest MDV is from $PM_{2.5}$. Similarly, although the MDVs for Ireland non-urban in Table 3.1 are the lowest, because this geographical unit is the largest by far, its damage value is relatively high. It can be observed that the values of damages vary across region and air pollutants. Emissions of

Table 3.1. Aggregate national estimates of MDV per tonne of pollutant (€$_{2010}$ per tonne per annum)

Geographical unit	$PM_{2.5}$	NO_X	SO_2	NMVOCs
Ireland all	7500	1000	4825	875
Ireland non-urban	6600	925	4825	850
Urban large (Dublin)	67,650	9350	10,300	2675
Urban medium (population > 15,000)	22,825	1550	4750	1550
Urban small (population 10,000–15,000)	14,800	1375	5275	1350
Small towns (population < 10,000)	9650	1150	4725	1025

The values for NO_X and SO_2 include secondary PM; the NMVOCs value includes secondary PM and O_3; and the value for $PM_{2.5}$ includes primary PM only.
Source: EnvEcon (2015).

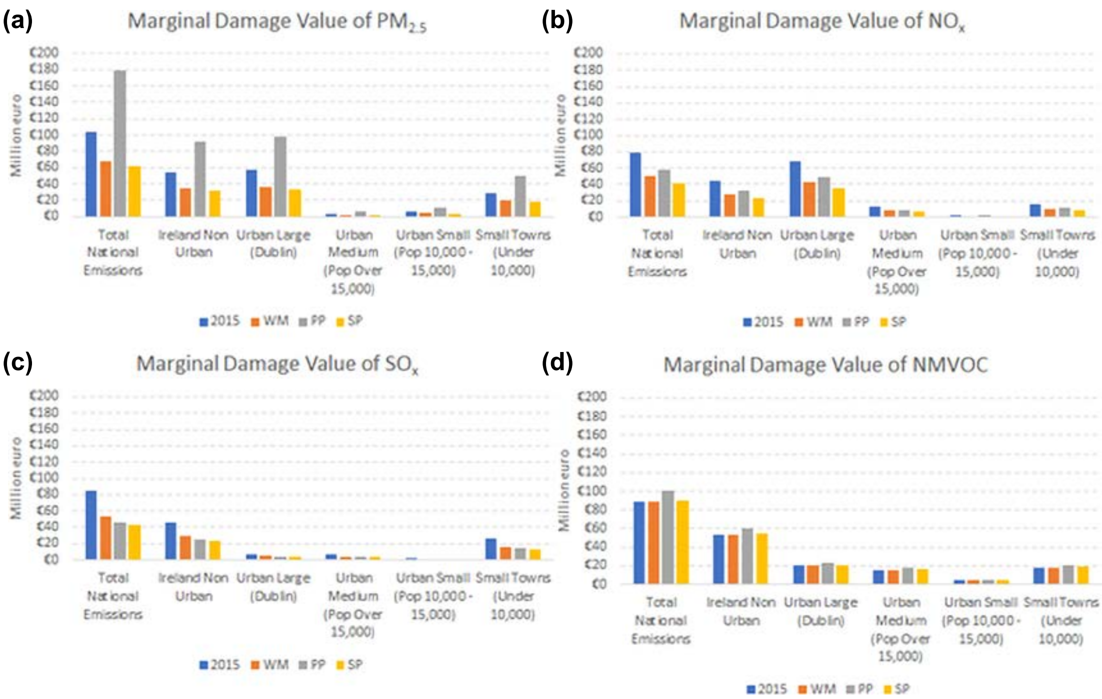

Figure 3.11. The MDV of emissions of (a) $PM_{2.5}$, (b) NO_X, (c) SO_X and (d) NMVOCs for 2015 and the WM, PP and SP scenarios.

$PM_{2.5}$, NO_X and NMVOCs have the highest impact in Dublin, whereas for SO_X the impact in small towns is the highest.

Table 3.2 shows that the benefits of implementing the SP scenario over the PP scenario are €146 million, most of which comes from the mitigation efforts carried out on $PM_{2.5}$.

Table 3.2. Changes in health and environmental costs for the SP compared with the PP scenario

Pollutant	Benefit per annum in 2030
$PM_{2.5}$	€117 million
NO_X	€16 million
SO_2	€3 million
NMVOCs	€10 million
Total	€146 million

4 Policies and Measures Applied in the Solution Scenario

This section presents seven packages of PAMs that are applied to the residential sector and four PAMs that are applied to the transport sector in the SP.

4.1 Residential Sector Solution Pathway PAMs

Table 4.1 shows the seven PAMs that are implemented in the SP in order to reduce the estimated energy demand and emissions of $PM_{2.5}$ in the residential sector. It can be observed that their implementation results in an energy demand reduction of 17 PJ and an almost 9 kt reduction in $PM_{2.5}$ emissions relative to the PP. PAMs 5–7 listed in Table 4.1 reduce emissions substantially in the SP, i.e. from 5.09 kt to 2.35 Kt. They do not reduce energy demand per se but rather control emissions themselves. The PAMs listed also mitigate emissions of NO_X, SO_X and NMVOCs; however, the focus in this section is on $PM_{2.5}$ because of it being the dominant air pollutant. Some detail on each of the seven PAMs is provided in the following sections.

4.1.1 PAM1: fabric first focused efficiency

In the SP a 9% improvement over the PP in the efficiency of heating appliances occurs. This makes the demand for biomass, among other energy carriers, lower by 3 PJ over the PP and, *ceteris paribus*, results in emissions of $PM_{2.5}$ of 10.24 kt in the SP as opposed to 11.12 kt in the PP. In the SP, programmes such as the Better Energy Homes scheme (SEAI, 2018a) are redesigned to have a target of at least a 9% energy saving compared with the WM scenario in 2030. This involves ensuring a diversity of applicants from different income levels and regions.

4.1.2 PAM2: lower indoor temperature

A combination of an information campaign on the difference (in energy and emissions terms) that a degree can make in terms of indoor heating temperature, plus promotion of the Heating Controls Grant (SEAI, 2018b) such that there is a roll-out of thermostats in many homes, ensures that the indoor temperature increase estimated in the PP does not happen.

4.1.3 PAM3: fuel switching to heat pumps

In the SP the budget available for the SEAI Heat Pump System Grant (SEAI, 2018c) is expanded to achieve the target number of “fuel switches”. In the same scheme a grant is made available for upgrading an oil or turf boiler to an automatic feed pellet boiler in dwellings where a switch to an air source heat pump would be prohibitively expensive.

4.1.4 PAM4: less use of open fireplaces

In the SP new programmes are introduced that encourage an end to the use of open fireplaces, through either the sealing of existing chimneys or

Table 4.1. PAMs that reduce biomass energy demand and emissions in the residential sector from the PP scenario (0) to the SP scenario (7)

PAMs		Biomass energy demand (PJ)	$PM_{2.5}$ emissions (kt)
0	PP	37	11.12
1	Efficiency improvement	34	10.24
2	Lower indoor temperature	30	9.23
3	Less deployment of boilers	22	7.08
4	Replace open fireplaces with stoves	21	5.40
5	Improved fuel quality	20	5.09
6	Inefficient boilers phased out	20	2.61
7	Certified installation and chimney sweep	20	2.35

a move away from the use of open fireplaces. This programme is aided by the sealing of open chimneys being included in "fabric first"-focused grants. In addition, by 2025, cheaper air quality sensors are available. In addition to carbon monoxide, radon and smoke alarms, which are already common, this allows both NO_x and PM monitors to be diffused. They highlight problems with using open fireplaces and poor-quality stoves and encourage those who want to use solid fuels to obtain high-efficiency stoves and reduce secondary heating as well.

In addition, in the SP, a campaign focusing on the negative health aspects of indoor and outdoor air pollution from the combustion of solid fuels reduces the percentage of dwellings using solid fuels in stoves and fireplaces by 5%, or 25,000, to 2030. The campaign mentions general principles of energy efficiency and the impact of fossil fuel combustion on climate change but is primarily focused on public health.

4.1.5 PAM5: improved fuel quality

In the SP, by 2030 the following "regime" is in place:

- Biomass fuels for sale must be certified under the Wood Fuel Quality Assurance (WFQA) label. Included in this is also that the WFQA label is linked to a CEN (European Committee for Standardization) standard and its administration is taken over by the Environmental Protection Agency or equivalent independent body.
- Firelighters must be labelled with the emissions that they produce.
- Non-biomass solid fuels must be labelled with the emissions that they produce.

4.1.6 PAM6: inefficient boilers phased out

The policy measures that make up PAM6 are:

- Stoves and boilers deployed for sale must be at the ecodesign level.
- Automatic feed boilers burning pellets are grant aided whereas manual batch-feed appliances are not (see PAM3).
- A unique Irish quality label for combustion devices of < 50 kW is created until such time as the labelling associated with the Ecodesign Directive (2009/125/EC; EU, 2009) comes on stream. Having an Irish label would allow for standards that are higher than those in the Ecodesign Directive to also be advertised.

4.1.7 PAM7: certified installation of stoves and boilers

In the SP, by 2030 the following "regime" is in place:

- Personnel installing stoves and boilers and chimney sweeps are certified.
- The installation of boilers and stoves is itself certified. It is mandatory that the primary air inlet is sourced from outdoors.
- There is a mandatory annual chimney sweep signed off by a certified registered chimney sweep. House insurance is linked to the reporting of the annual chimney sweep. Chimneys not in use are signed off as being sealed.

4.2 Transport Sector Solution Pathway PAMs

This section, first, presents measures implemented in the SP that reduce the use of internal combustion engine (ICE) vehicles (PAM8 and PAM9) and, second, presents approaches to reducing emissions from the remaining ICE vehicle fleet compared with what is estimated for the PP (PAM10 and PAM11). There is a large increase in the number of EVs in the fleet in the SP compared with the WM and PP scenarios and a commensurate reduction in the number of ICE cars.

4.2.1 PAM8: increased numbers of electric vehicles

Figure 4.1 plots the total stock of EVs in the SP. It shows that the diffusion of EVs in the SP follows the first two stages of an S-curve, i.e. it does not reach saturation. This is to be expected given that the number of EVs estimated for 2030 is still not at half the number of vehicles in the entire fleet for that year.

This level of diffusion is achieved by a combination of incentivising EVs while at the same time disincentivising ICE vehicles. The incentivising comes in the form of the current ongoing campaign:

- EV public awareness programme;
- new public procurement framework contract for EVs to allow public bodies to purchase EVs;

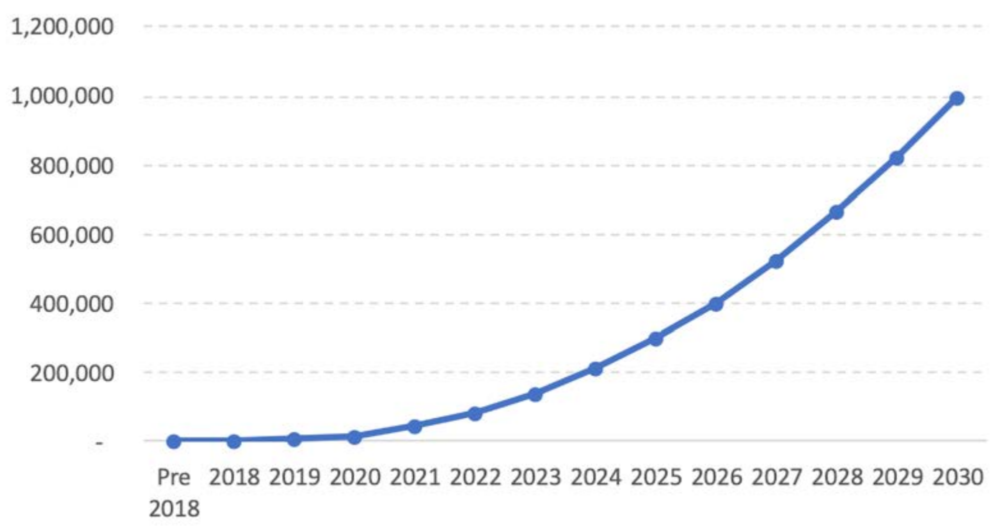

Figure 4.1. Scenario for the number of EVs in the SP, which can be seen to follow the first and second segments of an S-curve.

- EV grant scheme for small public service vehicles (taxi/hackney/limousine);
- new tolling incentive regime to stimulate EV uptake;
- further grant to support the installation of home chargers;
- capital support for the development of existing and new on-street chargers;
- ensuring that, where fees are levied for charging, any EV user can pay to use the infrastructure on an ad hoc basis.

In addition, free parking is provided for EVs.

The disincentivising of ICE vehicles comes from a combination of a token NO_X tax, equalisation of the price of petrol and diesel, increased carbon tax and differentiated parking fees.

4.2.2 PAM9: increased public and non-vehicular transport

There is a reduction in overall levels of driving from the roll-out of the BusConnects scheme, an expansion of tram and suburban rail lines and bicycle lanes, town planning that increases urban living and an increase in people working from home.

4.2.3 PAM10: reform of the roadworthiness test

In the SP there is more stringent roadworthiness testing of emissions, incorporating:[4]

- introduction of an emissions test that measures both NO_X and $PM_{2.5}$ as part of the Irish National Car Test (NCT);
- introduction into the Irish NCT of examination of diesel particulate filter removal.

In addition to this it is mandated that diesel particulate filters should be under warranty.

Although the SP is a single-year scenario for 2030, for its implementation, a pathway towards its achievement must be in place from earlier. With this in mind, the EQUA Index scheme for identifying the "dirty diesels" that are on the road, proposed by the AIRUSE project (Querol and Amato, 2017), is implemented. In this scheme, remote sensing equipment installed on roadsides to instantaneously measure exhaust emissions from cars is used to enhance the existing EQUA database. Ratings can be published on official government sites to guide and inform purchase decisions. The EQUA database can be used to establish a sticker scheme such as that currently

4 It is considered beyond the scope of the Irish government reach to address issues around car type approval, although if the desire was there the following two issues should be addressed: (i) ensure that NO_X control technologies operate under a full range of conditions – temperature, air pressure, humidity, time, gear, acceleration, torque, idling, cold start, traffic, etc. – and (ii) ensure that tests of emissions of CO_2 and NO_X occur simultaneously to avoid that the vehicles the manufacturers submit for type approval testing are being optimised seperately for each pollutant that is being tested.

in use in Paris, whereby it is mandatory for a car to display a sticker that indicates its level of emissions. This sticker scheme can optionally be used to restrict access to the most polluting makes and ages of cars during certain times of the day, e.g. between 08:00 and 20:00, such as is applied in Paris.

4.2.4 PAM11: information campaign

In the SP, an information campaign is launched to increase consumer awareness of ecomobility. The campaign includes the following features:

- the ethics of driving a NO_x- or PM-emitting car;
- the role of the diesel particulate filter and implications of its removal, do-it-yourself cleaning or do-it-yourself regeneration;
- how chip tuning can affect emissions;
- the need for low-sulfur engine oil and keeping the engine oil clean;
- the role of AdBlue and similar reagents;
- how popular approaches to pass road worthiness tests impact on emissions, e.g. high revs on the motorway – driving at 100 km/h in third gear on the motorway for half an hour;
- how fuel additives or fuel mixing can affect emissions;
- problems with engine idling;
- information highlighting advantages of diesel versus petrol, i.e. that focus on the driving patterns under which diesel is better than petrol and vice versa;
- public pollution event notifications;
- the use of pram covers to protect infants from air pollution.

The driver theory test is also updated to incorporate these points.

5 Recommendations

Following exploration of the "high-tension" scenario, in which there is increased penetration of biomass in the residential and industrial sectors and an increasing penetration rate for diesel vehicles in the road transport sector, the following are recommendations that can ensure that both climate and air quality goals are met and thus policy conflicts and higher human health impact costs are avoided.

5.1 Residential Sector Recommendations

- Investigate the possibility of aligning EU Structural and Investment Funds, currently used to finance Sustainable Energy Authority of Ireland (SEAI) home energy grants, with specific national efficiency improvement targets for the residential sector.
- Further align SEAI home energy grants with a goal to achieve a sufficient number of "fuel switches" from oil or solid fuel central heating to heat pumps.
- Where a switch to a heat pump is prohibitive, include the possibility of switching to a pellet boiler in SEAI home energy grants.
- Include the sealing of open fireplaces in eligibility criteria for SEAI Better Energy Homes home energy grants.
- Conduct a pilot programme on indoor PM and NO_X monitoring.
- Carry out an information campaign to highlight problems with the low efficiency of open fireplaces.
- Institutionalise the labelling of solid fuels and firelighters.
- Ensure that stoves and boilers deployed for sale are at the ecodesign level.
- Ensure that the installation of stoves and boilers is certified.
- Instigate a mandatory annual chimney sweep for chimneys in use.

5.2 Transport Sector Recommendations

- Incentivise the purchase of EVs while at the same time disincentivising ICE vehicles.
- Reduce the need for automobile travel through the roll-out of the BusConnects scheme in Dublin, an expansion of tram and suburban rail lines in major cities, town planning that increases urban living and an encouragement of the benefits of working from home.
- Modify the Irish roadworthiness test to take account of NO_X and $PM_{2.5}$ emissions.
- Launch an information campaign on the benefits of ecomobility and reform the driver theory test to include the same.

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Glossary and Abbreviations

Glossary

EMEP	Dispersion model run in this project at a grid size of 2 km × 2 km
EPISODE	Dispersion model run in this project at a grid size of 100 m × 100 m
GAINS	An integrated assessment model for estimating air pollution and greenhouse gas emissions

Abbreviations

AOT40	Accumulated ozone exposure over a threshold of 40 ppb (= 80 μg/m³)
CSO	Central Statistics Office
EF	Emission factor
EU	European Union
EV	Electric vehicle
ICE	Internal combustion engine
MDV	Marginal damage value
NCT	National Car Test
NECD	National Emission Ceilings Directive
NMVOC	Non-methane volatile organic compound
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
O_3	Ozone
PAMs	Policies and measures
PJ	Petajoule
PM	Particulate matter
$PM_{2.5}$	Particulate matter with a diameter of < 2.5 mm
PM_{10}	Particulate matter with a diameter of < 10 mm
PP	Problematic pathway
SEAI	Sustainable Energy Authority of Ireland
SO_x	Sulfur oxides
SP	Solution pathway
WFQA	Wood Fuel Quality Assurance
WM	With measures

AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL

Tá an Ghníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaol a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: *Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.*

Eolas: *Soláthraímid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírithe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

Tacaíocht: *Bímid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaol atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaol inbhuanaithe.*

Ár bhFreagrachtaí

Ceadúnú

Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaol:

- saoráidí dramhaíola *(m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola)*;
- gníomhaíochtaí tionsclaíocha ar scála mór *(m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta)*;
- an diantalmhaíocht *(m.sh. muca, éanlaith)*;
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe *(OGM)*;
- foinsí radaíochta ianúcháin *(m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha)*;
- áiseanna móra stórála peitril;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil

- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

Bainistíocht Uisce

- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéil uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

Monatóireacht, Anailís agus Tuairisciú ar an gComhshaol

- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil *(m.sh. tuairisciú tréimhsiúil ar staid Chomhshaol na hÉireann agus Tuarascálacha ar Tháscairí)*.

Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn

- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn.

Taighde agus Forbairt Comhshaoil

- Taighde comhshaoil a chistiú chun brúnna a shainaithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

Measúnacht Straitéiseach Timpeallachta

- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaol in Éirinn *(m.sh. mórphleananna forbartha)*.

Cosaint Raideolaíoch

- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Faisnéis Inrochtana agus Oideachas

- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaol ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaol *(m.sh. Timpeall an Tí, léarscáileanna radóin)*.
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

Múscailt Feasachta agus Athrú Iompraíochta

- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil

Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:

- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- Oifig um Chosaint Radaíochta agus Monatóireachta Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

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CON+AIR: Addressing Conflicts of Climate and Air Pollution

EPA Research
Climate - Water - Sustainability
Identifying pressures • Informing policy • Developing solutions

Authors: Eoin Ó Broin, Andrew Kelly, Gabriela Sousa Santos, Henrik Grythe and Luke Kelleher

Identifying Pressures

Air pollution presents a serious risk to human health and the environment. Ireland faces increasingly stringent and legally binding annual air pollutant emission "ceilings" out to 2030 and beyond, as well as "limit values" for the monitored levels of ambient air quality across the country. The CONAIR project highlights the sensitivity of national compliance to a clearly defined plausible alternative outlook – the "problematic pathway" scenario. This alternative outlook is driven by variables outside policy control (e.g. population and economic growth), as well as varied sectoral pathways (e.g. trends in residential solid fuel use) where policy and technology interventions can have a strong bearing on air pollutant outcomes. In particular, the CONAIR project focuses on the pressures linked to certain climate-related policies (e.g. biomass combustion, indirect encouragement of use of diesel vehicles) and the effect that these can have on national air pollutant levels, associated health impacts and European Directive compliance.

Informing Policy

The CONAIR project delivers analysis that puts scale on the expected impact of the problematic pathway on national emissions of air pollutants. This is important as, too often, policy can become somewhat simplistic and binary in its characterisation of "good" things and "bad" things. The CONAIR project helps to identify the scale of impacts and outcomes associated with a number of relevant variables and thereby offers insight on the issues of most relevance to air pollution emission outcomes in Ireland, and the menu of policies and actions required to address these challenges.

Furthermore, the CONAIR project has delivered the first high-resolution spatial maps of air pollution emissions across Ireland. The project delivered these on a 2km x 2km grid nationwide and on a 100m x 100m scale for NO_2 in Dublin. These high-resolution maps give an indication of the areas most affected by air pollution emission changes in Ireland and offer insight on the locations where additional investment and attention may be merited with regard to the national air pollution monitoring station network in Ireland.

Developing Solutions

The CONAIR project develops and describes a "solution pathway", which is designed to counter the trends and emission outcomes that are detailed in the problematic pathway. The solution pathway does not alter variables outside policy control (e.g. population growth) but instead seeks to identify policy levers and technology controls that can deliver further improvements in emission abatement and associated national air quality. The project quantifies energy, emissions and air pollution concentration outcomes for the problematic pathway and solution pathway and highlights the particular importance of:

- electrification of residential home heating in Ireland;
- shifting away from all low-efficiency combustion heating systems such as open fireplaces;
- standards and inspections with regard to home heating systems, their installation and fuels;
- electrification of the transport sector;
- capacity and levels of service improvement for the public transport sector in major cities;
- substantial investment in non-motorised travel infrastructure;
- long-term strategies to support compact higher density development;
- support for innovative strategies to reduce travel, such as remote working.

In this manner the CONAIR project directly supports the development of related policy in Ireland.

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