National Energy Projections 2024

National Energy Projections

2024 Report

November 2024

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SEAI is funded by the Government of Ireland through the Department of the Environment, Climate and Communications.

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Foreword – William Walsh, CEO, SEAI

The projections presented in this report highlight that while we have made some good progress on energy-related emissions, we are far from being on track for success. Even if we achieve the most optimistic scenario detailed in this report, and hit all Climate Action Plan targets, it is likely that gaps to our energy and climate obligations will remain. A significant expansion of incentives, information and regulation is required to enable us to comply with legally binding climate and energy obligations to 2030 and beyond.

Delivering on key actions

New analysis presented in this report illustrates that any delays in deployment, even by a year or two, will have a big impact on results across all our legally binding obligations for 2030. Based on our projection of achievement against the EU Energy Efficiency Directive (EED) and Renewable Energy Directive (RED) targets, it's clear that we need to double down on reducing our energy demand and on deploying renewable sources of energy. This means scaling up our efforts on both energy efficiency (using less per unit output) *and* energy sufficiency (simply, using less), while at the same time deploying unprecedented rates of renewable technology.

Momentum and what's missing?

Government has made great strides in recent years on the legislative front, adopting very strong binding targets into legislation. History shows us that big changes like this take time to build momentum, unless an emergency approach is taken. Financial supports are at their highest level ever, and several Government taskforces are actively working to drive the key technologies listed above, but it follows from these projections that we must do even more. So, what is missing?

At COP28, the International Energy Agency championed international support for an acceleration on clean energy. Through their global analysis, they found that meeting international climate targets was possible with a tripling of renewables deployment and a doubling of energy efficiency. These targets were agreed by nearly 200 countries, including Ireland. To achieve these targets, it is essential to develop comprehensive and mutually supportive policy packages, and to consider more deeply how regulation, information and incentives work together to cause rapid change.

For Ireland, this calls for a further expansion and acceleration of policy development to drive faster and deeper renewable and efficiency technology penetration. Given the short time available to reach our targets by 2030, strong policies must be implemented now.

Based on the findings of this report, we see an urgent need for strong regulation, for example:

- requiring greater efficiency of rented dwellings while protecting renters from price hikes;
- specific tariffs to promote heat pump adoption;
- significant financial commitments to district heating development;
- policy to signal the end of oil and gas boilers for heating;
- greater disincentives on large polluting SUVs.

Beyond technology change, it is increasingly clear that the only transition that works for society will be a just one. This means supporting those least able to afford the change to become fossil free first, while regulating those who can afford to pay and ensuring that profit making entities are required to be responsible for their climate impact.

Hope is a doer

I'm calling on everyone who can afford to engage with available grants, loans and other incentives to get off fossil fuels as fast as possible. If you don't know where to start, please get in touch with us. Beyond that, as citizens we need to come together in ways akin to how we did in response to the COVID pandemic to support each other and to call on those in power to make climate their number one issue.

The time has come to consider our collective priorities, values and vision for the future of Ireland.

In addition to our current technology strategy, we must begin to embrace measures that seek to meet a wide range of personal and societal needs at a reduced rate of consumption. This will require planning policy to 2050 and beyond which innovates Ireland's economic, market and social systems to meet the needs of people while living within planetary boundaries.

At SEAI, we continue to support Government with expert analytical advice and insights to encourage and support broader and deeper policy packages in all sectors to get us off fossil fuels – and fast. This report provides further basis for strong Government policy action. Our future, and that of future generations, depends on it.

Key Insights

This report presents the main findings of SEAI's latest National Energy Projections. These are the result of the 2024 national energy and climate modelling cycle, which culminated in the EPA Greenhouse Gas Emissions Projections published in May 2024[1]. The National Energy Projections examine future energy use in Ireland under different scenarios and account for factors such as economic growth and the anticipated impact of Government energy policies. The results provide an assessment of how we are likely to perform against our national and EU climate and energy targets.

Shortfall projected for all targets

Even in scenarios where most of the ambitious targets set out in the latest Climate Action Plan are fully achieved, there are significant projected gaps to our legally binding national and EU obligations.

What is immediately evident from this year's projections is that there are significant projected gaps to all legally binding national and EU targets. This includes national carbon budgets with corresponding sectoral emissions ceilings, and EU obligations on renewable energy, energy efficiency and greenhouse gas emissions.

- Even with full delivery of the Climate Action Plan (CAP), it is likely that the energy sector will not keep within its share of Ireland's national legally binding carbon budget for the first two budget periods.
- Ireland could overshoot its Energy Efficiency Directive 2030 target by approximately 20% in the most ambitious scenario, mostly due to growth in energy demand overwhelming the energy efficiency gains from planned and implemented measures.
- Ireland is projected to miss its 2030 overall renewable energy share target under the Renewable Energy Directive (RED) in all scenarios. If all renewable capacity delivery targets in the Climate Action Plan 2024 are achieved, the margin would be small (less than 1%). But in scenarios where we examine the impact of delays in delivery of key targets, the margin increases by up to 12 percentage points.

It is evident that, to date, the sustainable energy policy package under development, and as detailed in Ireland's Climate Action Plans, is neither sufficient nor delivering quickly enough to keep pace with necessary target trajectories. Without a significant bolstering of existing policies, and the addition of new policies and measures, which include expanding incentives, enhancing information, and applying regulation, we are unlikely to meet our national and EU obligations. It is critically important that every effort is made to ramp up both public and private sector capacity to deliver what has been set out in plans so far, and to address underlying issues that could further slow progress.

[1] EPA 'Ireland's Greenhouse Gas Emissions Projections 2023-2050'. 2024. [Online]. Accessed from: https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/irelands-greenhouse-gas-emissions-projections-2023-2050.php

Risk of falling further behind

There is a risk of delayed achievement across a range of Climate Action Plan targets, including for renewable electricity, biomethane, electric vehicles, district heating, heat pumps and building energy efficiency upgrades. If even some of these risks materialise, it would result in target failure, increased greenhouse gas emissions, less renewable energy, and more energy demand. Actions to address these risks are critically important.

This year, to explore the consequences of delayed achievement of these core targets, SEAI has developed several "risk" scenarios in addition to the standardised With Existing Measures (WEM) and With Additional Measures (WAM) scenarios. These risk scenarios aim to address the gap between current (existing and implemented) policy trajectories and the most ambitious planned policies scenario. The impact of delayed target achievement is modelled for several core measures including the deployment of wind and solar capacity, district heating networks, retrofitting and renewable heating technology in buildings, and bioenergy.

If even some of these risks materialise, it would result in target failure against both national and international obligations, exposing Ireland to significant, near-term, compliance costs, and the forfeit of the multiple benefits of the sustainable energy transition here in Ireland. The Department of Public Expenditure, NDP Delivery and Reform has previously estimated the cost of non-compliance with 2030 EU targets to be in the €3.5 to €8 billion range [2], and this estimate is only inclusive of costs under the Effort Sharing Regulation, so these figures could increase further.

The risks considered here are not exhaustive, many more are possible. For example, there are ambitious targets to decarbonise industry energy use, but while there are low carbon alternative technologies available today for many industry applications, uptake to date has been slow. Reduction in transport energy demand is critical, but the continuing trend for larger vehicles is undoing much of the progress that is being made in active and public transport, as is the continuously increasing demand for goods that increases the activity of hard-to-decarbonise goods vehicles.

[2] Estimating the Potential Cost of Compliance with 2030 Climate and Energy Targets. DECC and DPER, Feb 2023 https://assets.gov.ie/246850/5982d0ec-1590-4caf-8c40-ce8bf178f5fc.pdf

Committing to systemic change

Unprecedented technology change must be combined with strong policies and measures to reduce energy demand in all sectors and to disincentivise behaviours and practices that incur wasteful energy use in all parts of society.

Our projections indicate that even with a massively scaled effort for technology deployment across all sectors, it is now likely too late to meet our legally binding 2030 obligations at EU and national levels through technology change alone. It must be paired with innovation of the economic, market and social systems which drive continued growth in energy demand.

In addition to our current technology strategy, we must begin to embrace measures that seek to meet a wide range of personal and societal needs at reduced rates of consumption of materials and energy.

- We must invest in infrastructure and services that support people to live more energy efficient lifestyles.
- We must limit the establishment of new large-energy-users between now and 2030.
- We must be prepared to disincentivise wasteful consumer behaviours.
- We must seek to build a policy environment that paves the way for sustainable circular economy goods and services.
- We must expand our focus beyond near-term targets for 2030 to the ultimate goal of a sustainable, and net-zero, circular economy.

Contents

1 National energy projections overview

SEAI delivers the National Energy Projections annually, in collaboration with the Environmental Protection Agency (EPA). SEAI's National Energy Projections are modelled using the Irish Government's National Energy Modelling Framework (NEMF) which is developed and maintained by SEAI.[3] The SEAI National Energy Projections are used to plan and assess policies and measures to achieve Ireland's national and EU energy and climate obligations and targets.

The EPA projections for greenhouse gas emissions from energy use are calculated directly from the SEAI National Energy Projections. These emissions projections are used to track progress against our national and EU greenhouse gas reduction obligations and are submitted to the EU to meet EU reporting requirements.

The cycle of consultation with key stakeholders, refinement of input assumptions, and model development undertaken to produce these projections, is a continuous process. The projections presented in this report are the result of the 2024 national energy and climate modelling cycle, which culminated in the EPA Greenhouse Gas Emissions Projections published in May 2024.[4]

The projections are produced for a time horizon out to 2050. In this report, however, we focus primarily on the period to 2030, as this is the period on which the main EU and national targets and obligations, and so policies and measures, are currently focused.

Throughout this report, alongside data on energy use, we present data on greenhouse gas emissions. In all cases, data on greenhouse gas emissions is taken from the latest EPA greenhouse gas emissions projections. The EPA projections for greenhouse gas emissions from energy are calculated directly from the SEAI National Energy Projections, therefore the energy and greenhouse gas emissions data is consistent.

1.1 Policy inputs

The Climate Action Plans published by Government are the definitive source of information on government policies and measures on climate and energy. The Climate Action and Low Carbon Development (Amendment) Act 2021 requires the government to produce a Climate Action Plan (CAP) each year which must set out sector-specific actions that are required to comply with the carbon budget and sectoral emissions ceilings. The policies and measures in this and other Government policy documents inform the assumptions for the modelled scenarios in the projections. For a more detailed list of input assumptions, see Appendix 3.

[3] For more information on the NEMF see Appendix 5

[4] EPA 'Ireland's Greenhouse Gas Emissions Projections 2023-2050'. 2024. [Online]. Accessed from: https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/irelands-greenhouse-gas-emissions-projections-2023-2050.php

1.2 Data inputs and freeze date

The National Energy Projections are built upon a large volume of input data, including historical data on Ireland's energy use, economic data and the current delivery and uptake of energy efficiency and renewable energy technologies.

The modelling for scenarios presented in this report was carried out in late 2023 and during the first quarter of 2024. The freeze date for data inputs to the model was the third quarter of 2023.

The data presented in this report for energy use up to and including 2022 is actual historical data. The data presented in this report for 2023 and later years is modelled data.

1.3 Modelling scenarios

SEAI typically models two levels of policy achievement for the National Energy Projections in line with National Emissions Projections reporting:

- a 'With Existing Measures' (WEM) scenario; and
- a 'With Additional Measures' (WAM) scenario.

The WEM scenario is a projection of future energy use based on the estimated impact of policies and measures currently implemented and actions committed to by Government. To become part of the WEM scenario, a policy or measure must be in place by the end of 2022[5]. The stated ambition must be commensurate with the resources or legislation already in place or committed to by Government Departments or Agencies. This scenario does not assume the implementation of any new policies or measures post-2022.

This year's WEM scenario considers the 2023 Climate Action Plan (CAP23) which was published at the end of 2022, but not the 2024 Climate Action Plan (CAP24) which was published in 2023. It accounts for the anticipated impacts of the subset of measures contained in the 2023 Climate Action Plan (CAP23) which have been implemented.

It is important to note that, even where measures have been implemented, the targets set in the CAP23 are not automatically assumed to be met. For example, it is not assumed that the CAP23 target for 945,000 electric vehicles (EVs) is fully achieved in the WEM as, together with stakeholders, it was agreed that there was a significant risk that the supports implemented at that time might not fully deliver the target and that additional measures may be necessary.

The WAM scenario is more ambitious. It is a projection of future energy use based on the estimated impact of measures outlined in the latest Government plans at the time the National Energy Projections are compiled. This includes all policies and measures included in the WEM scenario, plus those included in the latest Government plans but not yet fully implemented. The WAM scenario takes into account CAP24. In nearly all cases, this scenario assumes that the CAP targets will be fully achieved.

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[5] 2022 was the cut off year as it was the last historical reporting year at the time that the projections were carried out. The cut off is carried forward annually.

Where current levels of support are unlikely to be sufficient to deliver the target, it is assumed that unspecified additional policies and measures will be implemented in time to ensure target achievement. Such cases have been highlighted in this report. For example, the WAM scenario includes the modelled impact of achieving the target of 945,000 EVs on the road by 2030 as per CAP24.

This year, in addition to the WEM and WAM projections, SEAI has modelled several risk scenarios to examine the potential impact of delays in achieving some of the most significant targets set in CAP24. These point to areas where immediate action to accelerate and strengthen existing policies and measures is essential to mitigate the risk of falling short of 2030 targets.

More details on the main policy assumptions for each scenario are provided in Appendix 3.

2 Compliance with EU climate and energy targets

2.1 Key messages:

- Under all scenarios modelled, Ireland is projected to miss its agreed overall 2030 targets for energy efficiency, renewable energy share and greenhouse gas emissions reductions.
- Ireland is projected to miss its agreed final energy consumption target under the Energy Efficiency Directive (EED) by a significant margin of 20% to 30%.
- Ireland is projected to miss its 2030 overall renewable energy share target under the Renewable Energy Directive (RED) in all scenarios. If all renewable capacity delivery targets in the Climate Action Plan 2024 are achieved (WAM scenario), the margin would be small (less than 1%) but the WEM and risk scenarios illustrate that if there are delays in delivery, the margin could increase by up to 12 percentage points.
- Interim targets for overall renewable energy share for 2025 and 2027 are also expected to be missed in all scenarios.

2.2 Introduction

Ireland is obliged to contribute to EU level targets contained in the EU Climate and Energy Framework. The EU framework is separate from the national carbon budgets process and contains independent obligations to reduce greenhouse gas emissions, increase the share of renewable energy sources and reduce total final energy demand significantly by 2030. The binding targets are set at an EU level and distributed proportionally across member states. If Ireland falls short of its commitments to its EU targets for 2030 (or any interim targets) then, as was the case for the 2020 EU targets, there may be a requirement to pay compliance costs or implement mandated additional measures to close the gap.

As under the 2020 EU climate and energy package, there are three main sets of targets under the 2030 framework[6]:

- Targets to improve energy efficiency and reduce total energy consumption;
- Targets to increase the share of renewable energy;
- Targets to reduce greenhouse gas emissions.

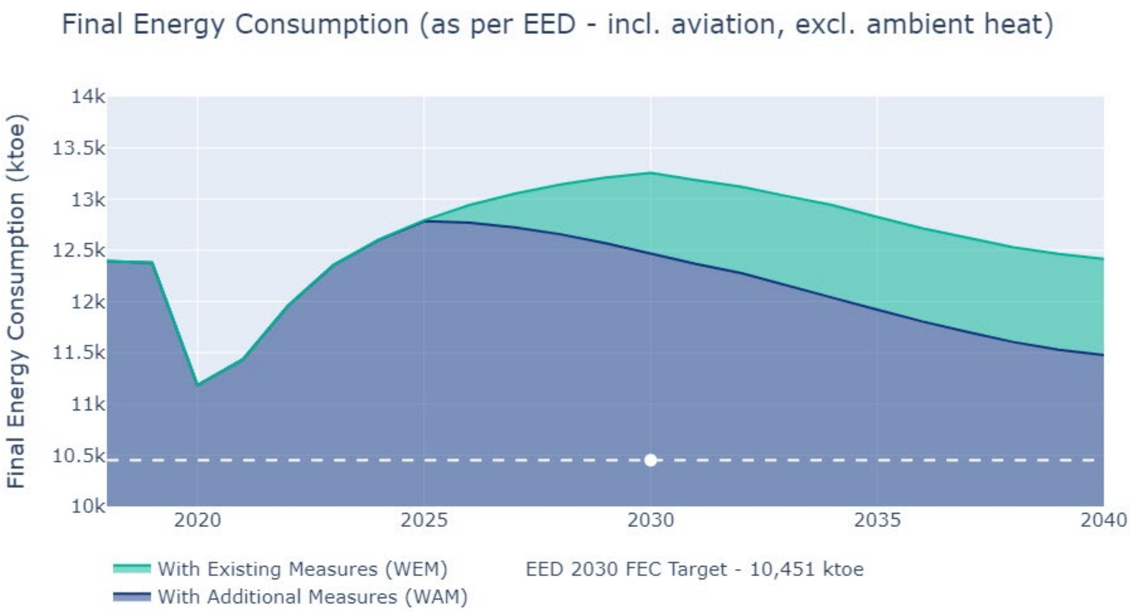
[6] For more information see: https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2030-climate-energy-framework_en

2.3 EU Energy Efficiency Directive target

The recast European Energy Efficiency Directive (EED) entered into force in October 2023. Article 4 of the directive sets a binding target to limit final energy consumption at EU level in 2030 to 763 Mtoe. [7,8] In February 2024, the Irish Government approved its contribution to the EED Article 4 target, notifying a Final Energy Consumption (FEC) of 10.451 Mtoe in 2030. This target represents an ambitious 12.6% reduction from 2022 levels for Ireland.

The EED target for 2030 differs fundamentally from the 2020 EED target. For 2020, the target was to demonstrate improvements in energy efficiency, relative to counterfactual scenarios where no efficiency measures were carried out. By this approach, it was possible to demonstrate the required energy efficiency savings while at the same time increasing total final energy use in the country. This is no longer the case. For 2030, the target is for an absolute reduction in final energy use. This means that achieving energy savings from energy efficiency measures will not suffice if they are outweighed by growth in energy demand. Figure 1 and Table 1 below show the target and projections for final energy consumption.

Figure 1: Projected progress towards EU Energy Efficiency Directive



[7] The EU's target for the reduction of energy consumption by 2030 will be 11.7%, compared to projected consumption in the 2020 Reference Scenario. The primary energy consumption target is indicative, while the final energy consumption target is binding. The result of this is that the EU's final energy consumption in 2030 will not amount to more than 763 Mtoe.

[8] Under the Directive, final energy consumption does not include the ambient energy used by heat-pumps but does include international aviation.

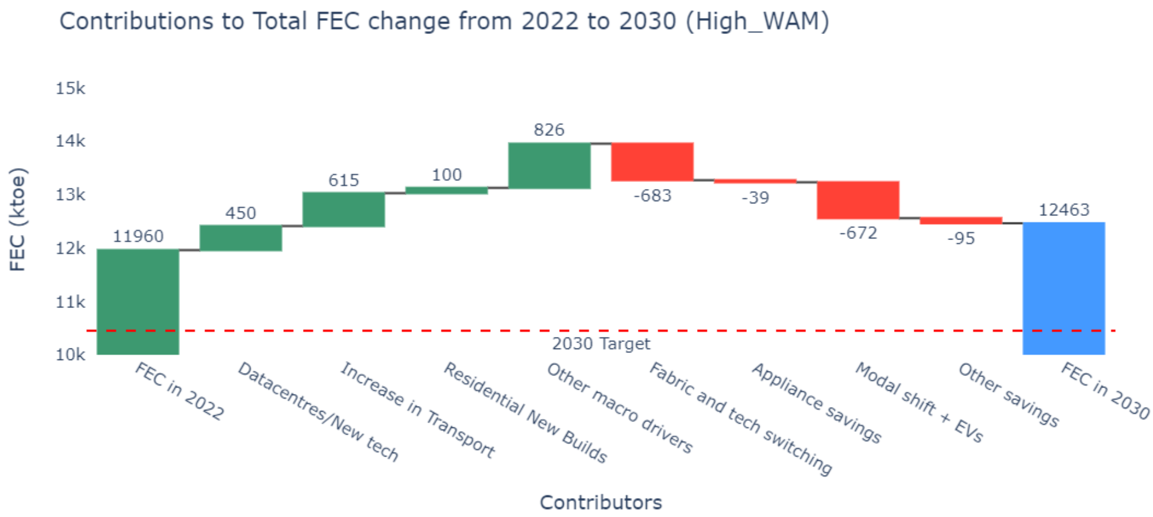
Table 1: Projected progress towards EU Energy Efficiency Directive

2030 Energy Efficiency Directive final energy target (ktoe)	2022 Actual (ktoe)	2030 Projected (ktoe)	
		WEM	WAM
EED Final energy*	11,969	13,255	12,463
Gap to Final energy target of 10,451 ktoe		2,804	2,012
*Under the EED definition, final energy consumption includes international aviation and excludes ambient energy.			

The EED final energy consumption target for Ireland is exceeded in all scenarios. In the WEM scenario, it is exceeded by 2,804 ktoe (27%) and in the WAM scenario, it is exceeded by 2,012 ktoe (19%). These projections indicate that it will be extremely challenging for Ireland to meet the 2030 final energy limit even by 2040 without significant additional measures to reduce consumption across the energy economy.

Figure 2 illustrates the challenge in overcoming growth in energy demand to achieve Ireland's target for reduction in total final energy consumption. FEC in 2022 is shown on the left, projected FEC in the WAM scenario in 2030 is shown on the right. The bars in-between show the projected additions to energy demand (green in the figure) and reductions in energy demand due to policy action (red in the figure).

Figure 2: Contributions of measure types to EED FEC target

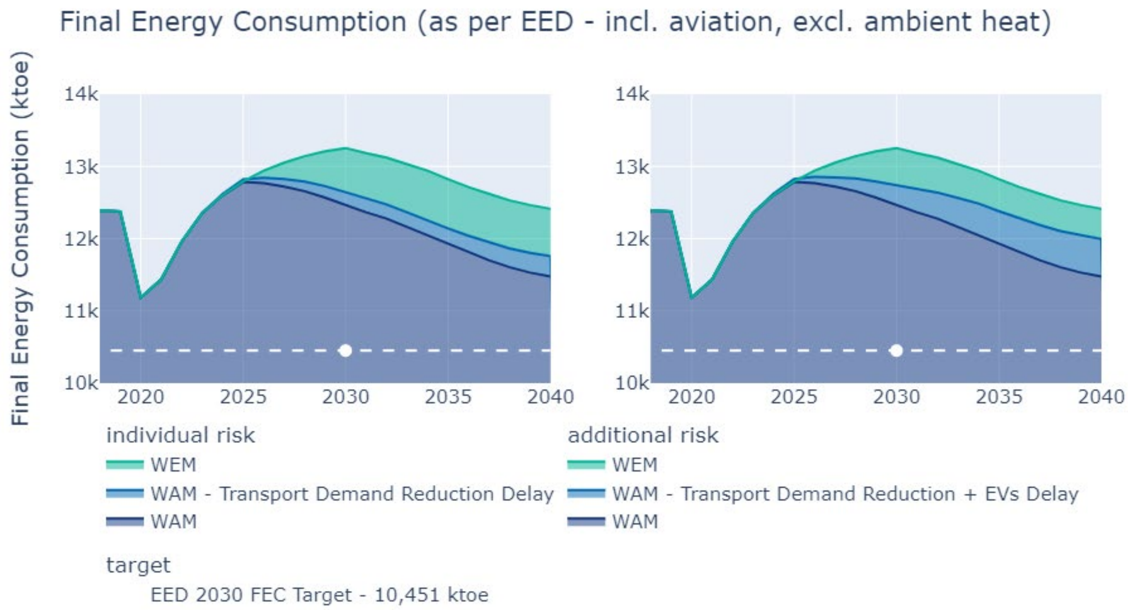


Energy efficiency actions such as fabric retrofit measures, heating technology switching, electric vehicle adoption and demand reduction measures such as "avoid and shift" in transport have an impact on reducing FEC. However, they are projected to be balanced out by underlying macroeconomic growth and from the addition of new large-energy-users.

This effect is shown to lead to an overall increase in FEC to 2030 as energy efficiency policies only start delivering greater impact after 2025 and are projected to be outpaced by growth in the near term.

Figure 3 shows the further impact on progress toward the EED FEC target, when one or more of the underlying measures in the WAM are delayed. The middle trajectory shows the FEC in the selected risk scenarios. On the left, a small delay in transport demand reduction measures from WAM levels back to CAP21 levels[9] and a higher growth in international aviation[10] leads to a significant increase in the trajectory from WAM closer to WEM, growing in impact to 2040. On the right, adding to this demand reduction is a delay in the uptake of electric vehicles (EVs) from WAM to WEM levels[11], which increases the projected overshoot of the 2030 EED FEC target to 22% (from 19% overshoot under the WAM).

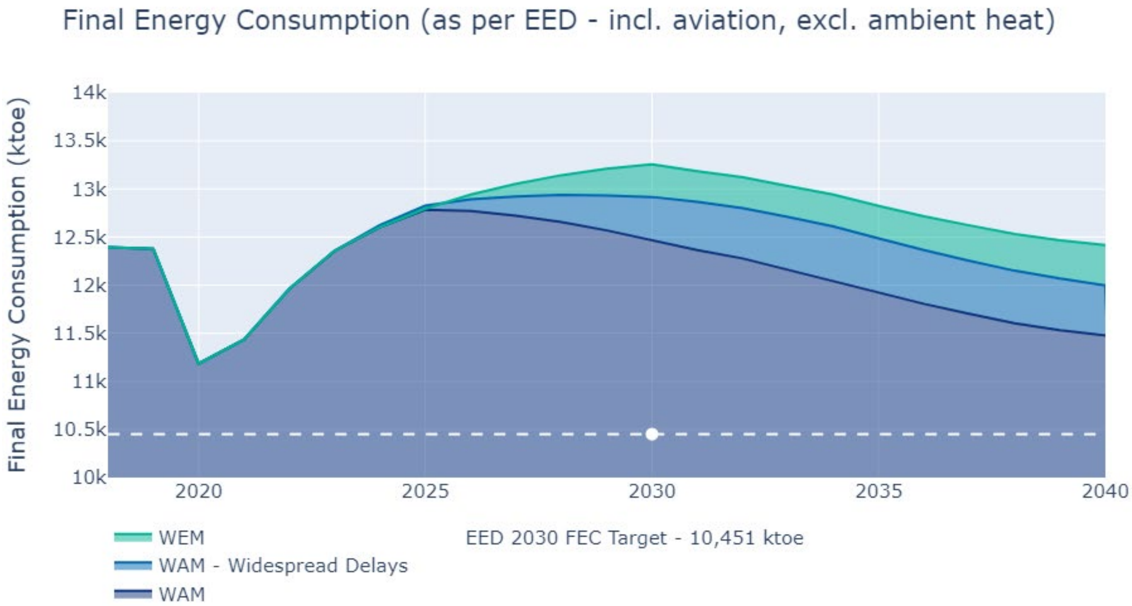
Figure 3: Impact of individual risks of delayed achievement on progress to EED target



[9] 10% reduction in private vehicle kilometres from 2019 to 2030 in the risk scenario versus a 12% reduction in the WAM scenario.
[10] EUROCONTROL "High" forecast for aviation activity in the risk scenario versus EUROCONTROL "Base" activity increase in the WAM scenario.
[11] 743k EVs in WEM scenario versus 945k EVs in the WAM scenario.

Figure 4 shows the combined impact of widespread delays across several key targets that are assumed to be fully achieved in the WAM scenario. This includes the delay in transport demand reduction and electric vehicle uptake shown in Figure 3, and additional delays in the deployment of district heating networks[12] and the delayed uptake of heat pumps and retrofits[13]. The combined effect of these widespread delays increases the projected overshoot of the 2030 EED FEC target to 24%, compared to 19% overshoot in the WAM scenario. This would set Ireland on a trajectory much closer to the WEM scenario with respect to EED progress.

Figure 4: Impact of widespread delays on progress to EED target



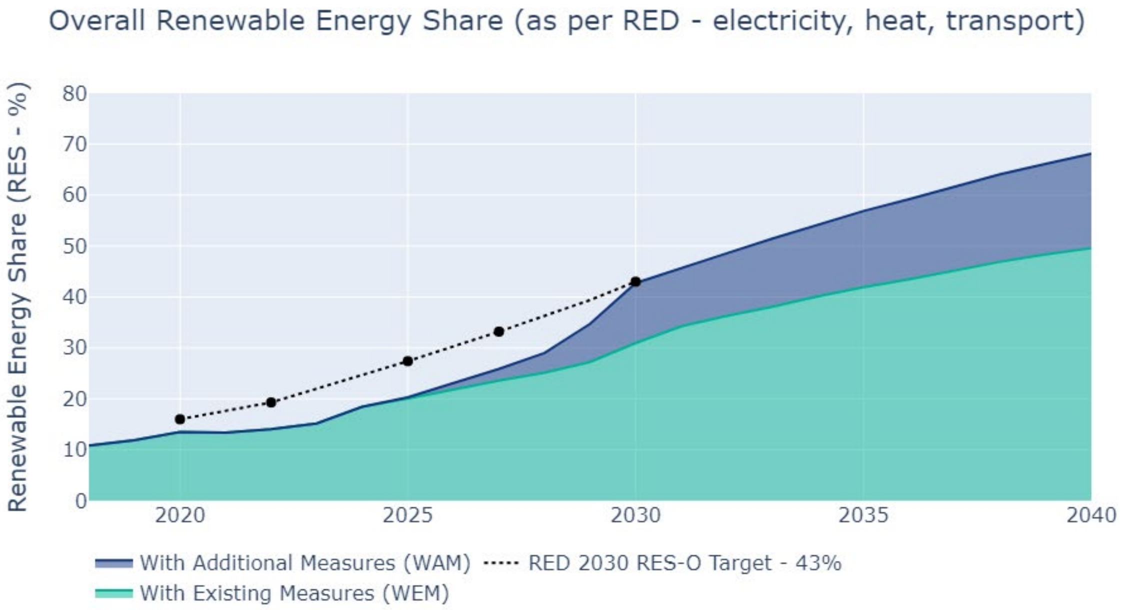
[12] 0.36 TWh of district heat by 2030 in the risk scenario versus 2.7 TWh of district heat by 2030 in the WAM scenario.
[13] The risk scenario assumes that supports for heat pumps and efficiency upgrades remain at current levels whereas the WAM scenario assumes that they are increased to meet the CAP targets for 400k heat pumps and 500k energy efficiency upgrades to B2 level or carbon equivalent.

2.4 EU Renewable Energy Directive Target

The EU Renewable Energy Directive (RED) sets out a target for renewable energy share (RES) in gross final energy consumption.[14] The existing EU wide target set in REDIII[15] is 42.5% RES by 2030. Ireland's expected national contribution to this EU binding target for 2030 RES is 43.0%. There are also interim targets for 2022, 2025 and 2027, as shown in Figure 5 and Table 2.

The overall RES in the WAM scenario is 12% higher than in WEM by 2030, due mostly to an assumption of achieving CAP targets for 80% renewable energy share in electricity generation and 5.7 TWh of biomethane by 2030.

Figure 5: Projected progress towards EU target for Ireland for overall renewable energy share



[14] The revised EU Renewable Energy Directive sets a number of additional targets for different sectors, but for this report we focus on the headline target for overall renewable energy share.
[15] The first Renewable Energy Directive (2009/28/EC) set targets for 2020. This Directive was revised in 2018 (EU/2018/2001) and recast to set targets for 2030. This recast Directive became known as REDII.
Given the need to speed up the EU's clean energy transition, the Renewable Energy Directive EU/2018/2001 was revised in 2023. This became known as REDIII. The amending Directive EU/2023/2413 entered into force on 20 November 2023. It sets an overall renewable energy target of at least 42.5% binding at EU level by 2030 - but aiming for 45%. For more information see: https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en

Table 2: Projected progress towards EU target for Ireland for overall renewable energy share

Current REDII target for overall renewable energy share (RES) for Ireland		WEM	WAM
2025	Projected overall RES	20.1%	20.3%
	REDIII overall RES target for Ireland	27.6%	
	Gap to target	-7.6%	-7.3%
2027	Projected RES	23.6%	25.9%
	REDIII target	33.6%	
	Gap to target	-10.0%	-7.7%
2030	Projected RES	30.9%	42.7%
	REDIII target	43.0%	
	Gap to target	-12.1%	-0.3%

The WAM scenario shows Ireland falling just short of the 2030 EU target for overall RES of 43% under REDIII. The WEM scenario shows Ireland achieving just 31% overall RES, falling 12 percentage points short of the 2030 target.[16] The WAM scenario also shows Ireland missing the interim overall RES targets for 2025 and 2027. This is due to the profile of renewable generation capacity additions, with a large portion of the increase in renewable energy only expected to happen later in the decade, particularly for biomethane. This illustrates how crucial the timing of renewable capacity is to Ireland's progress on RES.

Figure 6 shows the further impact on progress towards the RED target when there is a delay in achievement of one or more of the targets that are assumed to be fully achieved in the WAM scenario. On the left, a delay in the deployment of biomethane capacity[17] leads to a projected shortfall of the 2030 overall RES target of 3 percentage points. On the right, a delay in the deployment of offshore wind capacity alone[18] would result in a projected shortfall of 6 percentage points from the RED target, with Ireland only reaching 37% RES-O by 2030 and not passing its 43% 2030 target until 2034.

[16] Here we have assumed that all projected biomass energy use will qualify to count towards the overall RES target. In order to be counted towards the REDII and REDIII targets, biomass used in facilities over a certain size needs to have its sustainability certified and verified. The system of verification is currently being put in place in Ireland, but is not yet operational. Therefore, currently a share of the biomass being used in Ireland cannot be counted towards REDII targets. This is an evolving situation, and we will update our assumptions on the share of biomass that can be counted as more information becomes available.

[17] 1.9 TWh of biomethane delivered by 2030 in the risk scenario versus 5.7 TWh in the WAM scenario.

[18] 0 GW of new installed offshore wind capacity by 2030 versus 4 GW by 2030 in the WAM scenario.

Figure 6: Impact of individual risks of delayed achievement on progress to RED target

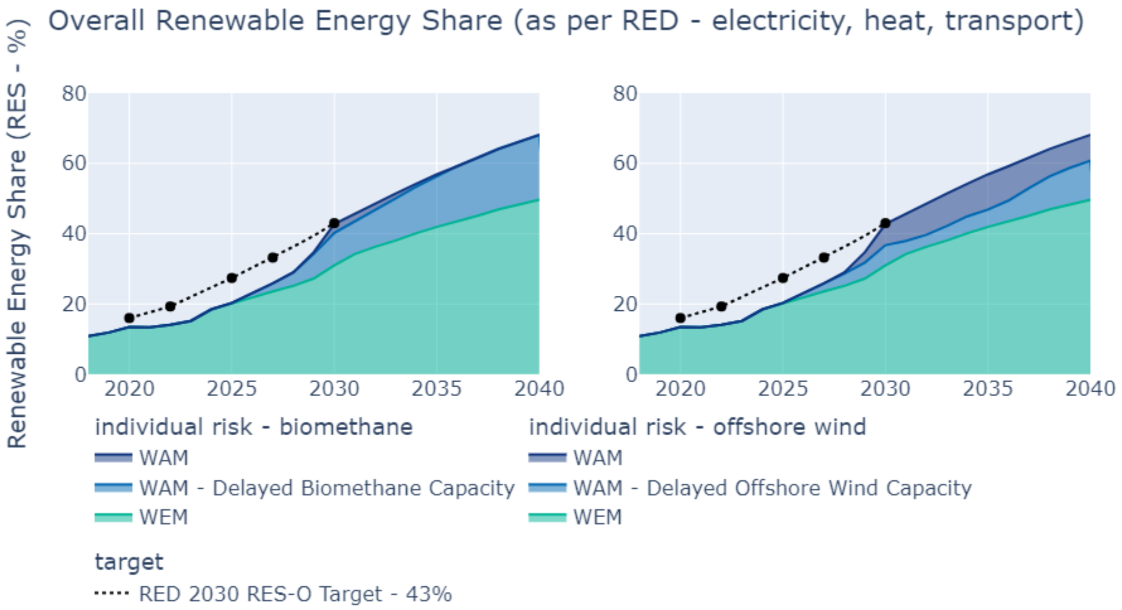
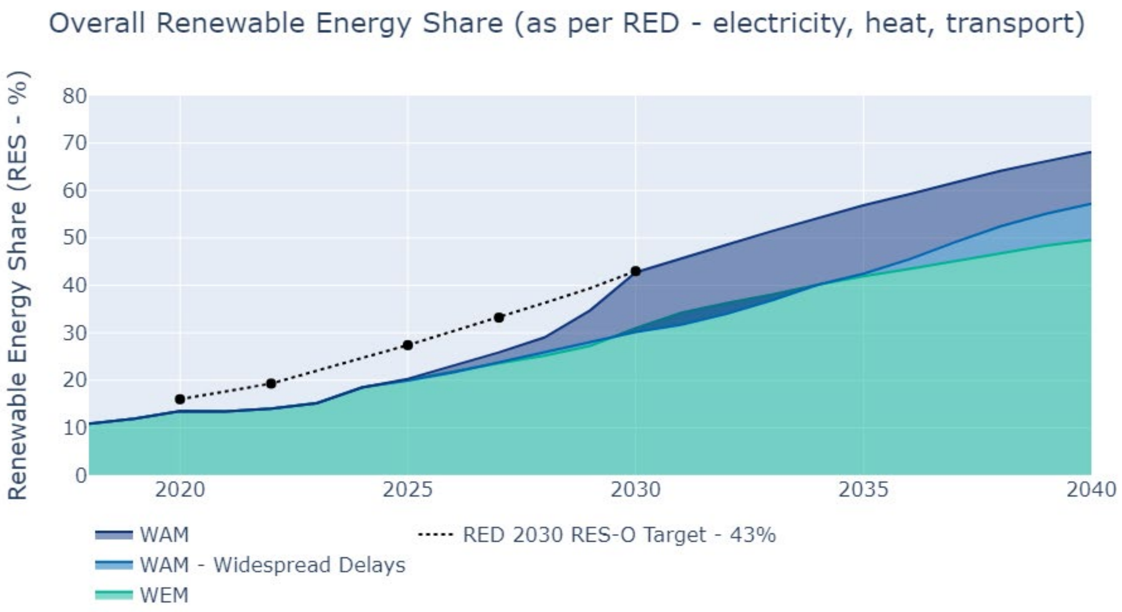


Figure 7 illustrates the combined impact of widespread delays across several key targets that are assumed to be fully achieved in the WAM scenario. This includes the delays in biomethane and offshore wind shown in Figure 6, and additional delays in the deployment of installed capacity for onshore wind and solar[19], a delay in the deployment of district heating networks[20], and delays in transport demand reduction and EV uptake[21]. The combined effect of these widespread delays increases the projected shortfall of the 2030 RED RES target dramatically to 13 percentage points below the target, more in line with WEM in 2030 and not passing the 43% 2030 target until 2036.

[19] The risk scenario assumes 6.2 GW of onshore wind and 5.1 GW of solar PV by 2030 versus 7.2 GW and 6.5 GW, respectively, in the WAM scenario.
[20] 360 GWh by 2030 versus 2.7 TWh in WAM.
[21] As outlined in the previous section on EED.

Figure 7: Impact of widespread delays on progress to RED target



2.5 EU greenhouse gas emissions reduction targets

The European Green Deal set a target for the EU to reduce greenhouse gas emissions in 2030 by 55% compared to 1990 levels. This target is implemented by the EU Emissions Trading System,[22] the EU Effort Sharing Regulation,[23] and the Land Use, Land Use Change and Forestry Regulation.[24] For more information on Ireland's projected performance against EU greenhouse gas emissions reductions targets, see the latest EPA Greenhouse Gas Emissions Projections Report.[25]

[22] For more information see: https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en
[23] For more information see: https://climate.ec.europa.eu/eu-action/effort-sharing-member-states-emission-targets_en
[24] For more information see: https://climate.ec.europa.eu/eu-action/land-use-sector_en
[25] EPA 'Ireland's Greenhouse Gas Emissions Projections 2023-2050'. 2024. [Online]. Accessed from: https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/irelands-greenhouse-gas-emissions-projections-2023-2050.php

3 Compliance with national climate obligations

3.1 Key messages:

- Even in scenarios where the vast majority of the very ambitious targets set out in the latest Climate Action Plan (CAP) are fully achieved, there are significant projected gaps to our legally binding national carbon budgets and sectoral emissions ceilings.
- Both the first and second national carbon budgets are projected to be exceeded in all scenarios. By 2030, total greenhouse gas emissions are projected to be 27% and 17% over the carbon budgets in the WEM and WAM scenarios, respectively.
- The amount by which the second carbon budget is projected to be exceeded is down from last year's 2023 greenhouse gas emissions projections. However, the reduction is almost all due to recalculations of emissions from the Land Use, Land Use Change and Forestry (LULUCF) sector as a result of new scientific research on emissions from grasslands and wetlands, rather than due to a reduction in actual greenhouse gas emissions.
- The second carbon budget period requires a significantly faster rate of emissions reduction than the first. Any exceedance of the first carbon budget will make it extremely difficult to comply with the second carbon budget.

3.2 Total greenhouse gas emissions

The Climate Action and Low Carbon Development (Amendment) Act established legally binding carbon budgets[26] that limit total cumulative greenhouse gas emissions in Ireland between 2021 and 2030. The total budget has been apportioned across the main greenhouse gas emitting sectors[27].

The focus of this report is on energy use and on the emissions that result in burning of fossil fuels for energy. However, because the carbon budgets relate to total greenhouse gas emissions (energy and non-energy related), this section presents data and analysis for total greenhouse gas emissions from all sectors. Data on greenhouse gas emissions are taken from the latest EPA greenhouse gas emissions projections.[28]

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[26] Each carbon budget period covers five years. The first carbon budget period (CB1) is from 2021 to 2025 and the second carbon budget period (CB2) is from 2026 to 2030.
[27] A more detailed description of Ireland's national energy and climate targets is provided in Appendix 4.
[28] EPA 'Ireland's Greenhouse Gas Emissions Projections 2023-2050'. 2024. [Online]. Accessed from: https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/irelands-greenhouse-gas-emissions-projections-2023-2050.php

Section 3.3 provides the data and analysis on greenhouse gas emissions from energy use and industrial process emissions[29], and Appendix 2 provides data for the main energy sectors (electricity, transport, built environment and industry). The remaining non-energy sectors are agriculture, LULUCF and other emissions. Because these sectors do not relate to energy use, we do not cover them in detail in this report. For more information on these non-energy sectors, refer to the EPA report Ireland's Greenhouse Gas Emissions Projections 2023-2050. For context, the greenhouse gas emissions from energy and industrial processes accounted for 55% of the 2018 baseline total, and by 2030 they are projected to make up 46% and 47% of total emissions in the WEM and WAM scenarios, respectively.

The carbon budgets for total greenhouse gas emissions are shown in Table 3. If the indicative trajectory for the carbon budgets had been followed every year, emissions in 2030 would have needed to be 51% lower than in 2018. However, this indicative trajectory has already been exceeded in the first two years of CB1. Where any exceedance occurs, steeper reductions are required thereafter to compensate, leading to a larger reduction required by 2030.

Table 3: Overall national carbon budget obligation and related indicators

Overall carbon budget	
2018 baseline emissions (single year) ($MtCO_2eq$)	68
CB1 ceiling 2021-2025 (five-year cumulative) ($MtCO_2eq$)	295
CB2 ceiling 2026-2030 (five-year cumulative) ($MtCO_2eq$)	495
Indicative average annual % reduction required in CB1*	-4.6%
Indicative average annual % reduction required in CB2*	-9.6%
Initial indicative reduction required by 2030 (relative to 2018)*	-51%
**Assuming indicative target trajectory met in all years*	

Figure 8 shows the *cumulative* emissions trajectories for all greenhouse gas emissions over the first two carbon budget periods for the WEM and WAM scenario. The black horizontal dashed lines show the sectoral ceilings for the first two budget periods. The chart illustrates the years in which the sectoral ceilings are reached in each scenario. The cumulative exceedance by the end of the second budget period is noted for each scenario in Table 4.

[29] Industry emissions are comprised of two components, emissions from fossil fuel combustion for energy use (referred to as "Manufacturing Combustion" emissions in the National Greenhouse Gas Inventories) and process emissions such as those from mineral and chemical industries. Although process emissions are not the result of burning fossil fuels for energy, the sectoral ceiling for industry covers both components, and so they are included under energy sector emissions for this analysis.

In the WEM scenario, total greenhouse gas emissions exceed the first carbon budget by 9% by 2025. This overshoot means that 13% of the CB2 budget is consumed before the CB2 period begins. The second sectoral ceiling is then breached during 2028, with the exceedance reaching 27% by 2030. The WAM scenario exceeds the CB1 ceiling by 6% and this overshoot means that 9% of the CB2 budget is consumed before the CB2 period begins. In this scenario the CB2 ceiling is exceeded by 17% by 2030.

Although this level of projected carbon budget exceedance is very high, it is down significantly from last year's 2023 greenhouse gas emissions projections. However, the reduction is almost all due to recalculations of emissions from the LULUCF sector, as a result of new scientific research on emissions from grasslands and wetlands, rather than due to a reduction in actual greenhouse gas emissions. Details on the recalculations in LULUCF can be found in Chapters 6 and 10 of Ireland's National Inventory Report 2024. [30] There has also been some reduction in the projected overshoot in the energy sector, as discussed in Section 3.3.

Figure 8: Cumulative greenhouse gas emissions from all sectors

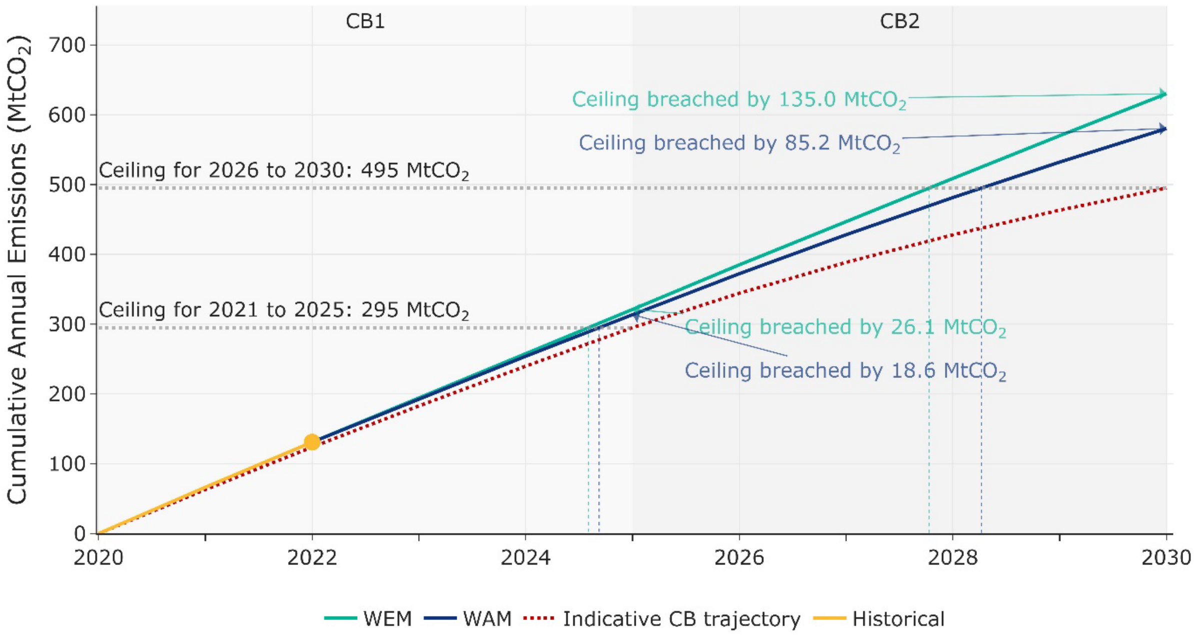


Table 4: Projected exceedance of overall national carbon budget obligation

Total greenhouse gas emissions from all sectors	WEM	WAM
Projected CB1 exceedance ($MtCO_2eq$)	26.1 (9%)	18.6 (6%)
Projected CB2 exceedance (including CB1 carry over) ($MtCO_2eq$)	135.0 (27%)	85.2 (17%)

[30] EPA 'Ireland's National Inventory Submissions 2024'. 2024. [Online]. Accessed from: https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/irelands-national-inventory-submissions-2024.php

Figure 9 shows the *annual* greenhouse gas emissions projected from all sectors for the first two carbon budget periods for the WEM and WAM scenarios. It also illustrates the indicative annual emissions trajectory required to stay within the carbon budgets from 2021 to 2030. Dashed lines are used to illustrate a revised CB2 trajectory that would be required to meet the CB2 carbon budget if the WEM or WAM scenarios were followed in CB1. The resulting revised average annual reduction rate for CB2 and the revised total reduction by 2030 compared to the 2018 baseline are shown in Table 5.

Figure 9: Annual greenhouse gas emissions from all sectors

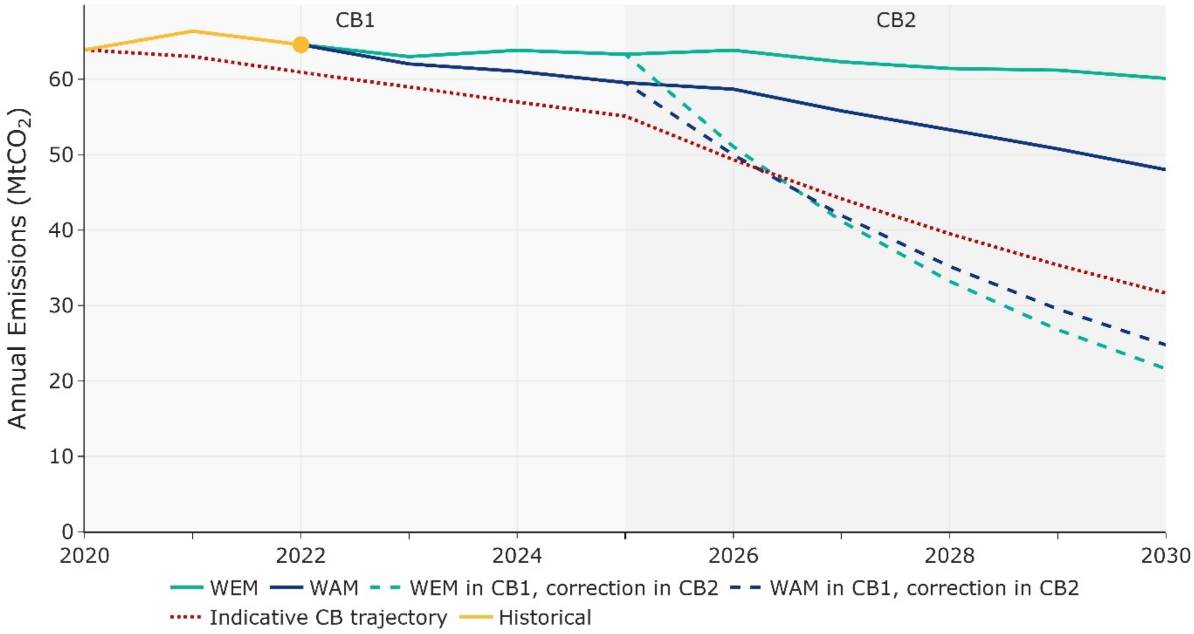


Table 5: Emissions reduction required to keep within overall national carbon budget obligation

Total greenhouse gas emissions from all sectors	WEM	WAM
Projected average annual change in emissions for CB1	-0.6%	-1.8%
Indicative average annual change in emissions required in CB2 to stay within the CB2 budget if named scenario followed in CB1	-19.3%	-16.1%
Revised indicative reduction required by 2030 compared to 2018 to stay within CB2 budget if named scenario followed in CB1	-67% to -76%	-63% to -69%

If the WAM trajectory is followed until 2025, total greenhouse gas emissions would need to fall by between 63% and 69% by 2030 to keep within the second carbon budget period, depending on the trajectory taken within CB2. If the WEM trajectory is followed until 2025, total greenhouse gas emissions would need to fall by between 67% and 76% by 2030 to keep within the second carbon budget period, depending on the trajectory taken within CB2[31].

[31] The final reduction depends on the trajectory taken within CB2. A linear trajectory requires a greater reduction by 2030 than a geometric trajectory, as a geometric trajectory assumes more improvement made in the early years of the period.

These projections present a stark reality. Achieving economy wide emissions reductions of over 70% by 2030 is not feasible. Unless greenhouse gas emissions are reduced sharply before the end of 2025, it is highly unlikely that we will be able to stay within budget to 2030. Given that the weight of effort in the carbon budgets is loaded on the second carbon budget period to begin with, any exceedance of the first carbon budget will make it extremely difficult to comply with the second carbon budget. The importance of early corrective action is clearly demonstrated; the earlier we can reduce annual emissions, the greater the impact on the growth of cumulative emissions.

3.3 Greenhouse gas emissions from energy use and industrial processes

In this section, we examine greenhouse gas emissions from all energy use in the context of the sectoral ceilings. Because the sector ceiling for industry includes both energy use and process emissions, it is necessary to also include the process emissions from industry.[32] Energy use and industrial processes were responsible for 54.7% of total national emissions in 2022. The combined sectoral ceilings for energy sectors including industrial process emissions are shown in Table 6[33].

If the indicative trajectory for the carbon budgets had been followed every year, emissions in 2030 would have needed to be 54% lower than in 2018. However, this indicative trajectory has already been exceeded in the first two years of CB1. Given this exceedance in early years, steeper reductions are required for the remaining years of the CB1 period and CB2 periods, thus leading to a larger percentage reduction required by 2030.

Table 6: Sectoral ceilings and related indicators for energy use and industrial processes

Sectoral ceiling for energy use and industrial processes	
2018 baseline emissions (single year) ($MtCO_2eq$)	38
CB1 ceiling 2021-2025 (five-year cumulative) ($MtCO_2eq$)	160
CB2 ceiling 2026-2030 (five-year cumulative) ($MtCO_2eq$)	269
Indicative average annual % reduction required in CB1*	-4.7%
Indicative average annual % reduction required in CB2*	-9.4%
Initial indicative reduction required by 2030 (relative to 2018)*	-54%
**Assuming indicative target trajectory met in all years*	

Figure 10 shows the cumulative emissions trajectories over the first two carbon budget periods for the WEM and WAM scenarios. The black horizontal dashed lines show the sectoral ceilings for the first two budget periods. The chart illustrates the years in which the sectoral ceilings are reached in each scenario. The cumulative exceedance by the end of the second budget period is noted for each scenario in Table 7.

[32] Unlike greenhouse gas emissions from energy use, greenhouse gas emissions from industrial processes do not come from combusting fossil fuels. They are produced by chemical reactions used for industrial processes other than combustion. The majority of process greenhouse gas emissions are from cement production.

[33] For this section we use the combined sector ceilings for the following sectors: Electricity, Transport, Built Environment and Industry. We did not include the emissions from the "Other" sector.

In the WEM scenario, greenhouse gas emissions from the combined energy use and process emissions sectors exceed the CB1 ceiling by 5% by 2025. This overshoot means that 8% of the CB2 budget is consumed before the CB2 period begins. The second sectoral ceiling is then breached during 2029, with the exceedance reaching 17% by 2030. The WAM scenario exceeds the CB1 ceiling by 5% and the CB2 ceiling by 12%.

This level of projected carbon budget exceedance is very high, but it is down from last year's 2023 greenhouse gas emissions projections. The main reduction has been in electricity, where the projected cumulative emissions over the first two carbon budget periods are 17% and 12% lower in the WEM and WAM respectively. This is primarily due to increased levels of interconnection. The improvement in electricity is counteracted by an increase in the projected cumulative emissions from transport over the first two carbon budgets, which are 1% and 10% higher in the WEM and WAM respectively. This is due to revised assumptions on transport demand and the impact of demand reduction measures.

Figure 10: Cumulative greenhouse gas emissions from energy sectors and industrial processes

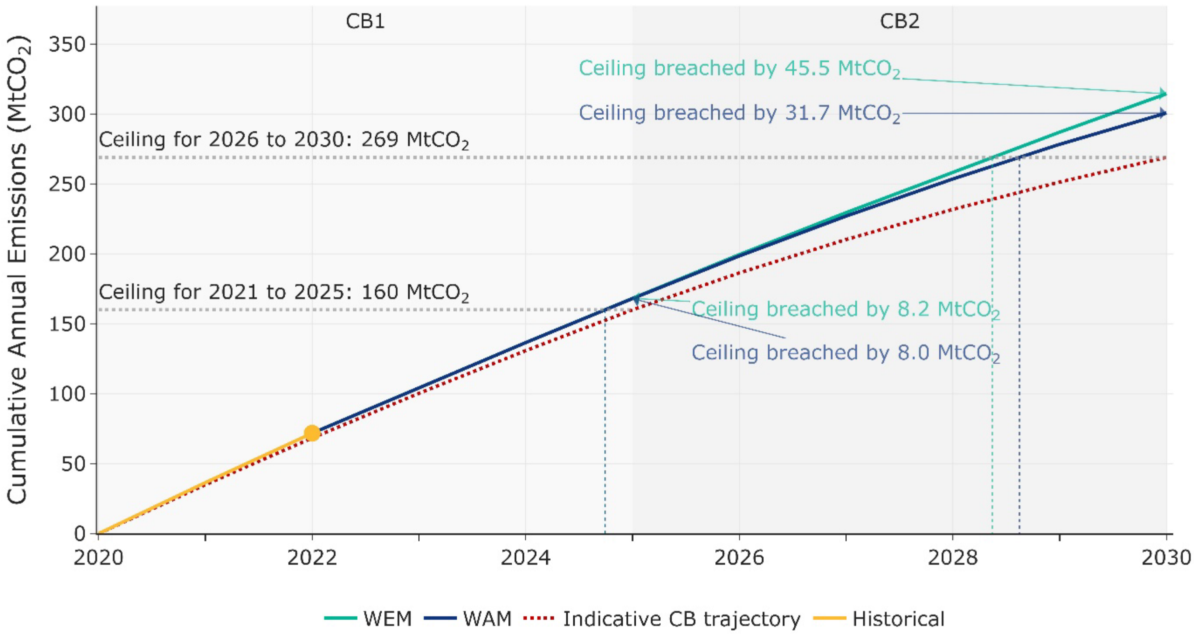


Table 7: Projected exceedance of sectoral ceilings for energy sectors and industrial processes

Total energy and industrial process emissions	WEM	WAM
Projected CB1 exceedance ($MtCO_2eq$)	8.2 (5%)	8.0 (5%)
Projected CB2 exceedance (including CB1 carry over) ($MtCO_2eq$)	45.5 (17%)	31.7 (12%)

Figure 11 shows the *annual* emissions projected from energy use and industrial processes for the first two carbon budget periods for the WEM and WAM scenarios. It also illustrates the indicative annual emissions trajectory required to stay within the carbon budgets from 2021 to 2030. Dashed lines are used to illustrate a revised CB2 trajectory that would be required to meet the CB2 sectoral emissions ceiling if the WEM or WAM scenarios were followed in CB1. The resulting revised average annual reduction rate for CB2 and the revised total reduction by 2030 compared to the 2018 baseline are shown in Table 8.

If the WEM or WAM trajectory is followed until 2025, greenhouse gas emissions from energy use and industrial processes would need to fall by between 62% and 67% by 2030 to keep within the CB2 sector ceiling, depending on the trajectory taken within CB2. This would require an average annual reduction in emissions during CB2 of 14.5% per annum.

Figure 11: Annual greenhouse gas emissions from energy sectors and industrial processes

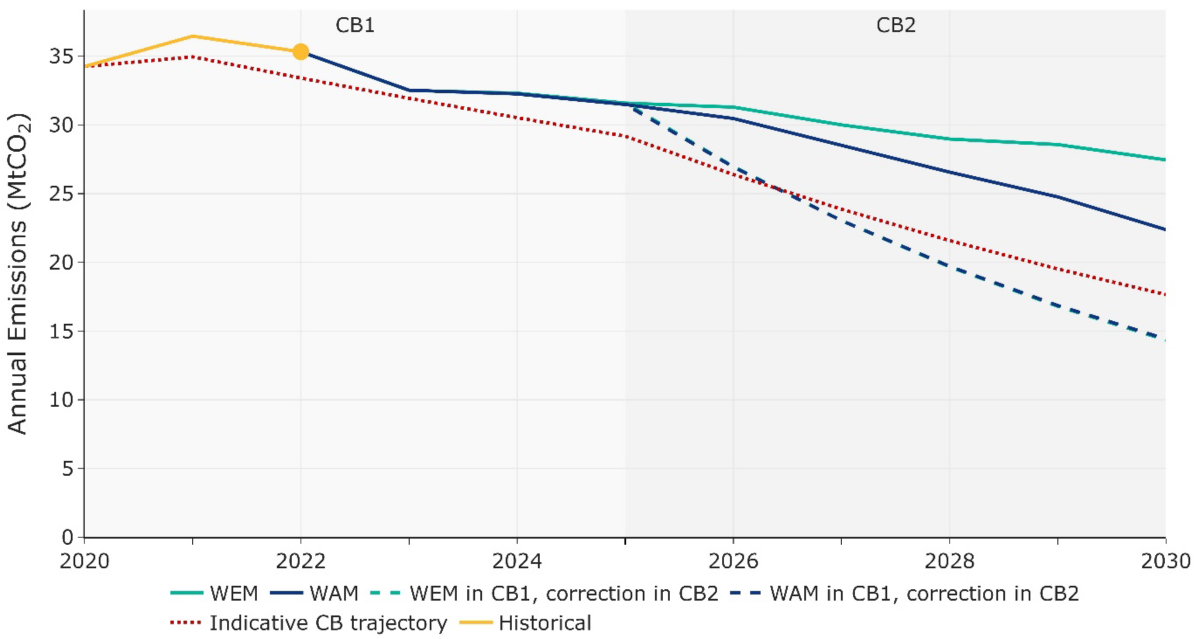


Table 8: Emissions reductions required to keep within sector ceiling for energy and industrial process

Total energy and industrial process emissions	WEM	WAM
Projected CB1 exceedance ($MtCO_2eq$)	8.2	8.0
Projected CB2 exceedance (including CB1 carry over) ($MtCO_2eq$)	45.5	31.7
Projected average annual change in emissions for CB1	2.9%	2.9%
Indicative average annual change in emissions required in CB2 to stay within the CB2 ceiling if named scenario followed in CB1	14.6%	14.5%
Revised indicative reduction required by 2030 compared to 2018 to stay within CB2 ceiling if named scenario followed in CB1	62%-67%	62%-67%

4 Key policies and measures for decarbonising energy use

4.1 Electricity

4.1.1 Key messages

- The fastest pathways for reducing energy-related greenhouse gases across Ireland include significant electrification of heat and transport. Eliminating fossil fuels from electricity generation as quickly as possible is critical to wider decarbonisation success.
- There was a notable reduction in greenhouse gas emissions from the electricity sector in 2023. This reduction in fossil fuel use was primarily driven by an increase in electricity imports. 2023 saw a record level of electricity net imports. This trend has increased further in 2024, where the level of net imports in the first half of 2024 has already exceeded all of 2023. Consequently, the sectoral emissions ceiling for electricity for the first carbon budget period will be much closer to being achieved than previously projected.
- The exact behaviour of the interconnectors in the future remains uncertain, given the multiple factors (both internal and external to Ireland) that influence the direction and scale of cross-border electricity trade. While this uncertainty is likely to persist, its drivers and the range of possible outcomes need to be characterised to understand its effect on national emissions.
- In all modelled scenarios presented in this report, the sum of variable renewable energy (onshore wind, offshore wind, solar) is the largest input to electricity generation by 2030, overtaking natural gas.
- However, because the connection of large offshore wind projects is assumed to happen late in the decade in all scenarios, fossil fuels remain the largest input to electricity generation until 2028 and 2030 in the National Energy Projections and Risk scenarios respectively.
- A delay in the roll-out of all types of variable renewables, e.g. onshore wind, solar PV, and particularly offshore wind, poses large risks. While imports may somewhat aid in mitigating this delay from a national emissions perspective, there is little to no mitigation for our European renewable energy targets.
- Natural gas will be the major source of emissions in the electricity sector by 2030. Gas used for electricity generation is projected to peak in 2026, and then fall by 28%, 37%, and 45% by 2030 compared to 2022, in the Risk, WEM and WAM scenarios respectively. However, delivering natural gas-fired generators in the short-term will mitigate the need to use generators with a higher carbon intensity, such as oil.
- In the modelled scenarios, the electricity sector exceeds the sectoral emissions ceilings for the second carbon budget period. In the second budget period, the exceedance is projected to be 6.8 $MtCO_2eq$ (11%) and 5.2 $MtCO_2eq$ (9%) in the WEM and WAM scenarios respectively.
- In the context of our legally binding national and international climate and energy obligations, the negative consequences versus the benefits of allowing new large electricity users, such as datacentres, to establish in Ireland needs to be considered. If the scale and pace of renewable energy growth cannot exceed that of electricity demand, as was the case in 2023, then renewables are just abating further increases in emissions rather than delivering the absolute reductions in greenhouse gas emissions required.

4.1.2 Electricity decarbonisation

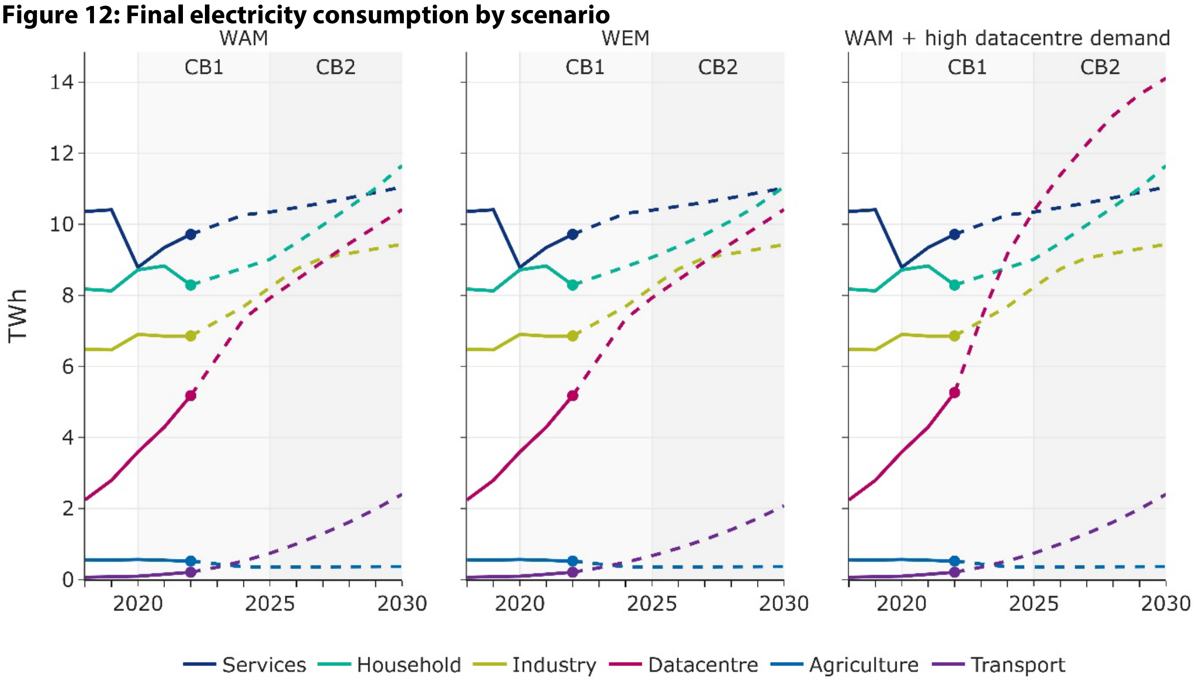
The rate at which we can decarbonise electricity generation is determined by four factors:

- The rate at which electricity demand grows;
- The rate at which we can deploy renewable energy generation capacity and integrate its energy;
- The rate at which we can reduce the carbon intensity of our remaining non-renewable dispatchable generation, e.g. switching from coal and oil to gas in the short-term, and to a lower-carbon fuel in the long-term;
- The scale and direction of cross-border interconnector trades.

4.1.3 Electricity demand growth

Figure 12 shows the projected final electricity consumption, which in the WAM scenario is 45.3 TWh in 2030, an increase of 47% or 14.5 TWh from 2022. Of this increase, 7.9 TWh is anticipated to come from the electrification of heat and transport, 6.6 TWh is anticipated to come from datacentres and other large energy users, with the remaining sources of consumption, such as industry, services and the residential sector remaining approximately constant.

Figure 12: Final electricity consumption by scenario



For the WEM and WAM scenarios, the projected growth in datacentre electricity demand is taken from EirGrid's best estimate Median scenario[34]. EirGrid also produce Low and High growth scenarios. The High scenario assumes that a higher share of the currently contracted datacentre capacity is used (~4 TWh of energy consumption in addition to the growth already assumed in the Median scenario by 2030), though it still assumes that some attrition of contracted datacentre demand will occur. Figure 12 also shows the WAM scenario with the High datacentre growth assumptions included. It is evident that the scale of energy consumption growth from datacentres is likely to significantly eclipse the electricity consumption growth of any other sector.

4.1.3.1 Critical success factors and opportunities

From a national greenhouse gas emissions perspective, increased electricity demand from replacing fossil fuel heating systems with heat pumps or fossil fuelled cars with EVs results in an overall net reduction in emissions. This is because the emissions from the increased electricity demand are more than compensated for by a reduction in emissions in the heat and transport sectors, leading to lower overall emissions. In contrast, increased electricity demand from datacentres and continued growth in the industry, services and residential sectors does not displace fossil fuel use elsewhere in the economy.

If total electricity demand increases ahead of the roll-out of renewable generation capacity it will lead to higher emissions. This will make it extremely challenging for the electricity sector to meet its national greenhouse gas emissions reduction obligations.

The same principle applies with the requirement to reduce total final energy use in line with the EU Energy Efficiency Directive target[35], and the requirement to increase renewable energy share in line with the EU Renewable Energy Directive (RED) target. Increased electricity demand from replacing fossil fuel heating systems with heat pumps or internal combustion engine (ICE) vehicles with EVs results in less energy use overall because of the much higher efficiency of heat pumps and EVs compared to boilers and fossil fuelled cars. In contrast, increased electricity demand from datacentres increases total final energy demand and will make it very challenging to meet both the EED and RED targets. The surge in usage of generative artificial intelligence will compound this issue.

For these reasons, the negative consequences compared to the benefits of allowing large new electricity users to establish in Ireland between now and 2030 need to be considered.

4.1.4 Delivery timeline of renewable electricity generation capacity

Table 9 shows the national targets for variable renewable generation capacity for 2025 and 2030, alongside the National Energy Projections assumptions for each scenario. The installed capacities of solar and wind generation in the WAM scenario were selected to meet the CAP24 Renewable Energy Share in Electricity (RES-E) target of 80% RES-E by 2030 in our model. As well as the RES-E target, CAP24 contains KPIs for higher installed capacities, which are likely required to reduce the gap to the sectoral emissions ceiling.

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[34] EirGrid and SONI, 'Generation Capacity Statement 2023-2032'. Jan 2024. [Online]. Accessed from: https://cms.eirgrid.ie/sites/default/files/publications/19035-EirGrid-Generation-Capacity-Statement-Combined-2023-V5-Jan-2024.pdf

[35] See section 10.3 for more information on the EU Energy Efficiency Directive

For the WEM scenario, we assume a slower rate of delivery of renewable electricity generation, leading to a RES-E share of ~69% in 2030. The risk scenario shown in Table 9 is described in Section 4.1.4.1.

Table 9: Targets and assumptions for year-end renewable electricity generation capacity

Parameter / Variable	Year	CAP24	WEM	WAM	Risk
RES-E (%)	2025	50%	46.4%	47.5%	46%
Onshore Wind Capacity (GW)	*2025*	*6*	*5.6*	*5.8*	*5.2*
Offshore Wind Capacity (GW)	*2025*	*n/a*	*0.03*	*0.03*	*0.03*
Solar PV Capacity (GW)	*2025*	*5*	*2.2*	*2.2*	*2.2*
RES-E (%)	2030	80%	68.9%	80.1%	54.7%
Onshore Wind Capacity (GW)	*2030*	*9*	*6.8*	*7.2*	*6.2*
Offshore Wind Capacity (GW)	*2030*	*5*	*2.7*	*4.0*	*0.03*
Solar PV Capacity (GW)	*2030*	*8*	*5.7*	*6.5*	*5.1*

4.1.4.1 Risk scenario

For each sector, we have examined the risk of delays in achieving some of the most significant and ambitious targets set in CAP24, and the potential resulting impact on EU and national energy and climate targets. For the electricity sector, we examined the potential for delays in the deployment of variable renewable generation capacity. The potential impacts of these risk scenarios on EU and national climate and energy targets are discussed in Sections 2 and 3 respectively.

The risk scenario for variable generation capacity was developed using forecasts from surveys of expert stakeholders. The scenario represents a plausible worst case deployment scenario for each variable renewable technology, as judged by a pool of expert stakeholders in Q1 2024. A report documenting the methodology and results of the surveys will be published by SEAI in late 2024.

Figure 13 - Figure 15 illustrate the assumptions used for the roll-out of offshore wind, onshore wind and solar PV (rooftop through to utility-scale projects) for the National Energy Projections and risk scenarios. As a high-level approximation of project build-out across a given year, the installed capacities are simulated to increase at the end of each quarter (March, June, September, December).[36, 37]

[36] If a quarterly increase would be less than the typical size of a project, it is deferred to a biannual or annual increase as appropriate.
[37] Cumulative capacity limits are placed on each technology to reflect national spatial constraints; however, these limits are not hit prior to 2040.

Figure 13: Offshore wind generation capacity deployment

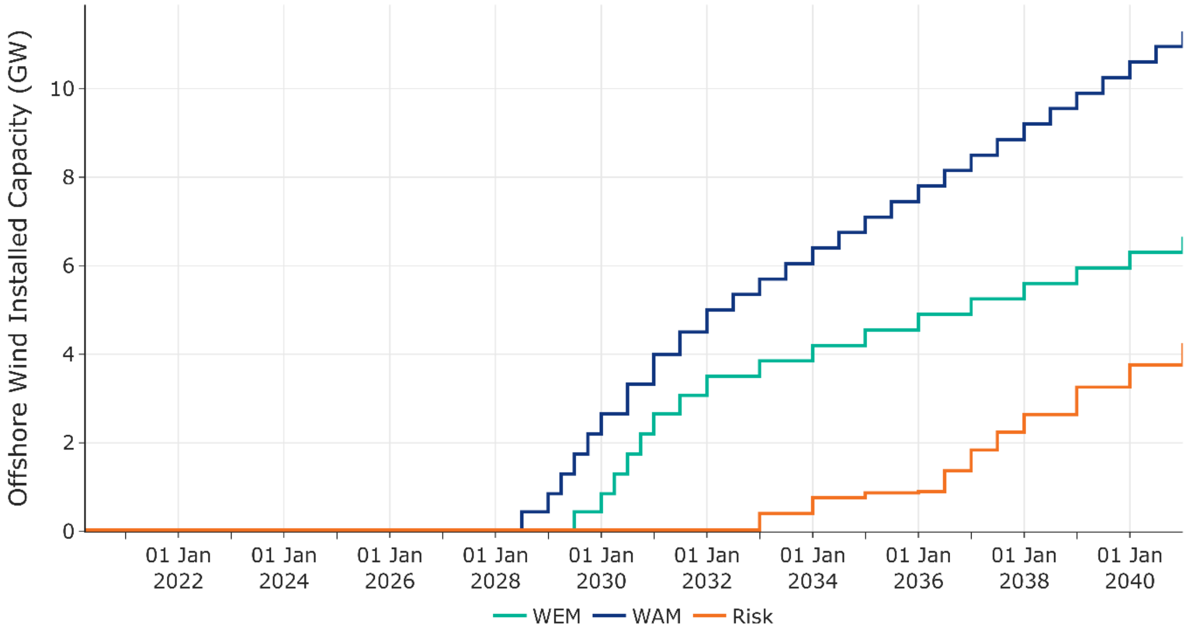


Figure 14: Onshore wind generation capacity deployment

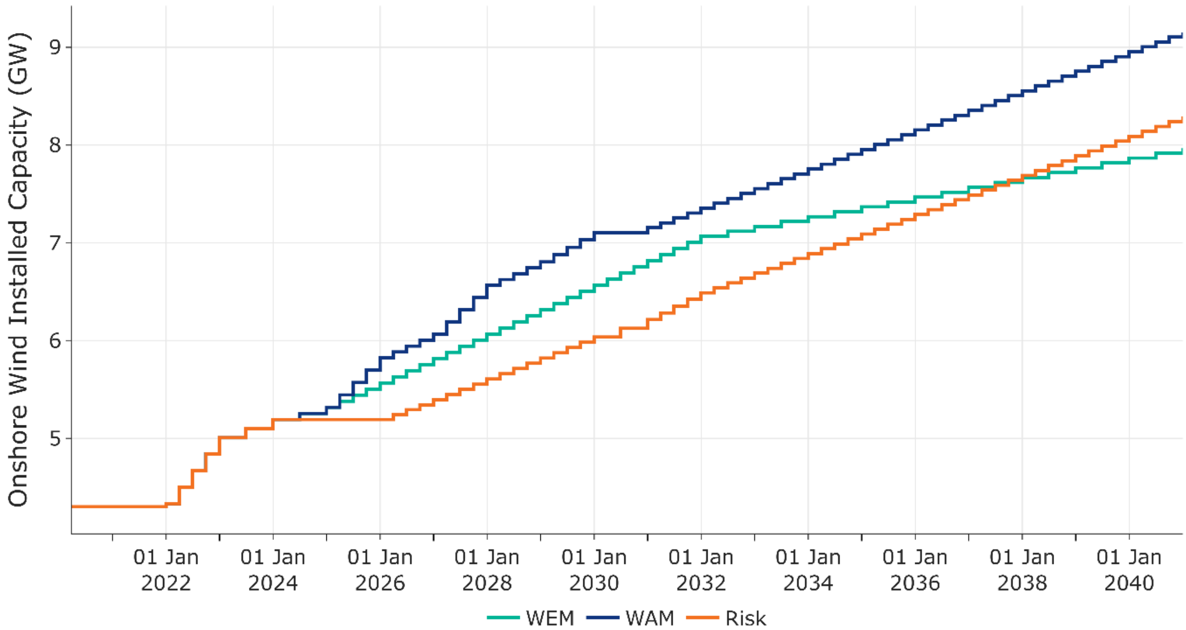
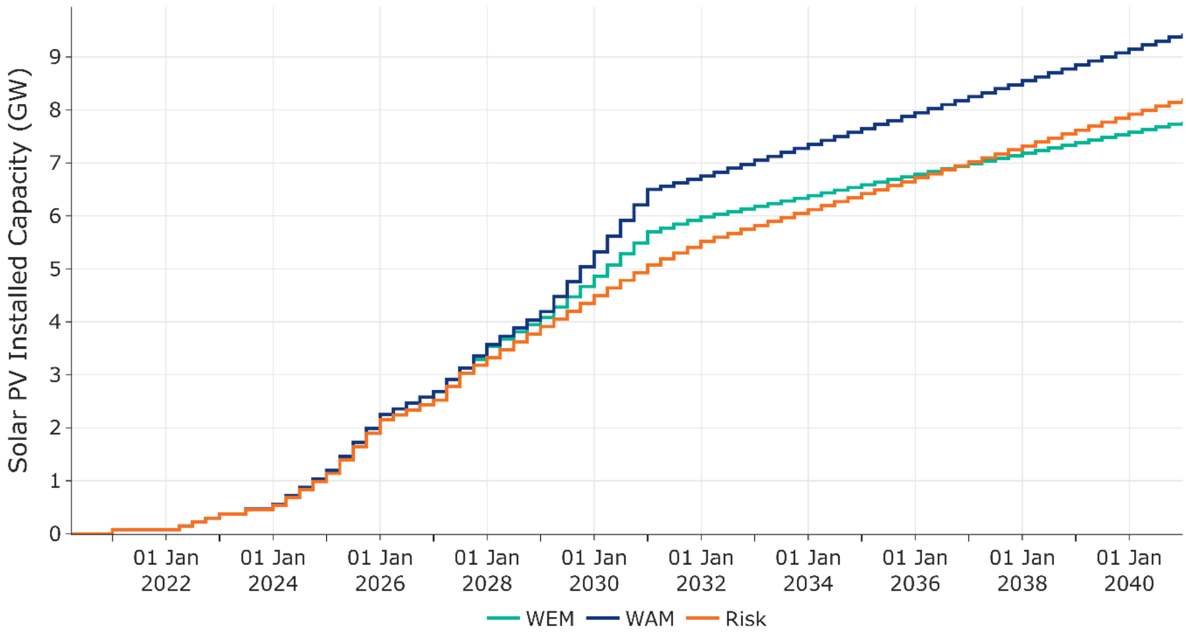


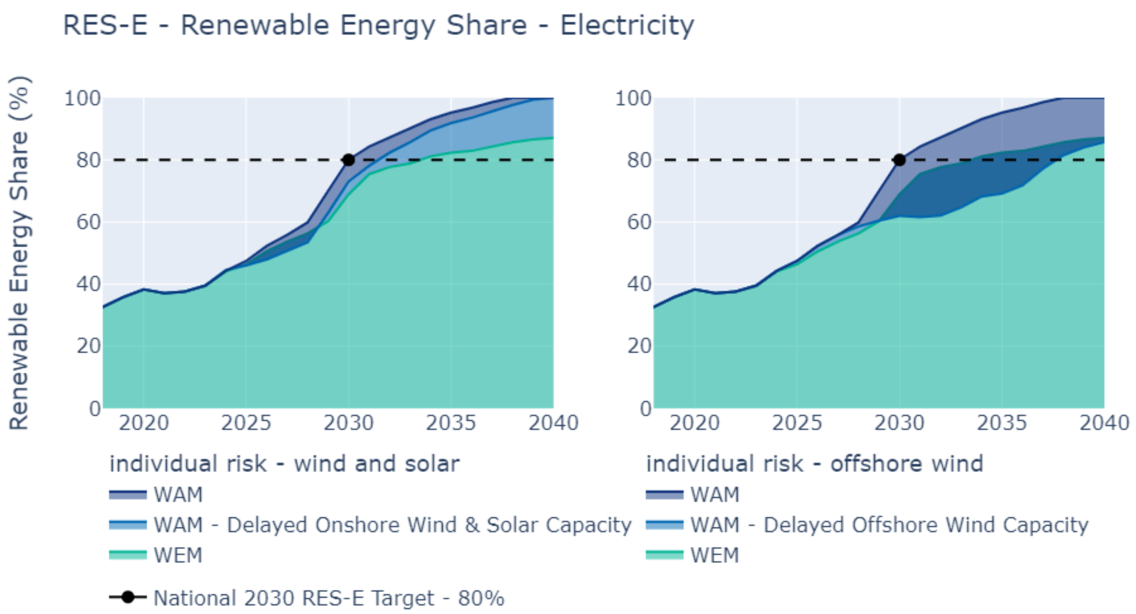
Figure 15: Solar PV generation capacity deployment



The survey results indicate that the risk of under-delivery of CAP24 targets is highest for offshore wind (5 GW under-delivery by 2030), followed by solar PV (2.9 GW under-delivery by 2030) and onshore wind (2.8 GW under-delivery by 2030), which, given offshore wind's high capacity-factor, is most onerous from a RES target achievement perspective.

Figure 16 illustrates the impact of these delayed installed capacities in onshore wind and solar photovoltaic (left subplot in figure) and offshore wind (right subplot in figure) on progress toward Ireland's national target for renewable energy share of electricity of 80% by 2030.

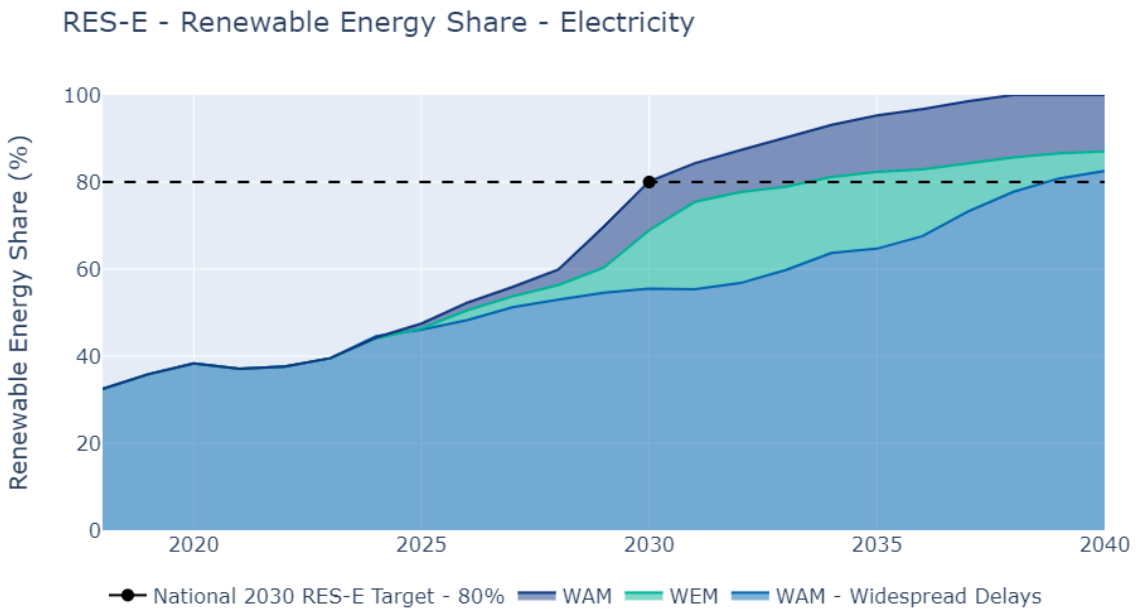
Figure 16: Impact of individual risks of delayed achievement on progress to RES-E target



The risk scenario for onshore renewable electricity generation capacity results in a projected shortfall to the RES-E target of 7 percentage points, with a projected acceleration post-2030. The risk scenario for offshore renewable electricity generation capacity actually falls below the WEM initially, with no new offshore wind installed capacity added by 2030, resulting in a shortfall of 18 percentage points from the 80% RES-E target.

Combining the risk of delays in onshore and offshore installed capacity, Figure 17 shows the potential for a shortfall from the national RES-E 2030 target of as much as 24 percentage points, with the 80% target not being reached until 2039. This illustrates just how critical the timely delivery of all planned renewable installed capacity for electricity generation is to the achievement of Ireland's national and EU targets, which also impacts on the capacity to deliver on electrification goals across all sectors.

Figure 17: Impact of widespread delays on progress to national RES-E target



4.1.4.2 Critical success factors and opportunities

- Minimising planning permitting/consenting and grid-connection lead times.
- Maximising the utilisation of existing grid infrastructure.
- Maintaining and improving social acceptance and minimising objections and judicial reviews.
- Avoiding planning or policy decisions that may reduce existing renewable capacity, e.g. the denial of planning permission extensions, or stricter noise and set-back guidelines.
- Timely running of onshore and offshore RESS auctions.

Maximising the value of new renewable generation connections will depend on the success of programmes[38, 39] underway by the system operators and any underpinning regulatory changes.

[38] EirGrid, 'Shaping Our Electricity Future'. [Online]. Accessed from: https://www.eirgrid.ie/shaping-our-electricity-future
[39] ESB Networks, 'National Network, Local Connections Programme'. [Online]. Accessed from: https://www.esbnetworks.ie/who-we-are/national-network-local-connections-programme

The integration of variable renewables into the electricity system is a multi-faceted challenge[40], ranging from network development, incentivising new technologies via market design, and new operational practices.

4.1.5 Cross-Border Interconnection

Cross-border electricity interconnection, given its multiple benefits, is expected to continue to grow across Europe. At present in Ireland, multiple interconnectors are under construction, e.g. Greenlink to Wales and Celtic to France. The importance of interconnection to Irish energy policy has been recently restated[41].

Since April 2023, the flow across the electricity interconnectors to Great Britain has changed notably in comparison with historical trends. Imports have increased significantly, and exports have decreased significantly. During that time, the price of UK Emissions Trading Scheme (ETS) allowances has been less than that of the EU ETS, albeit somewhat offset by the UK Carbon Price Support. Any reversals in interconnector trading behaviour could have a significant impact on target achievement. Future modelling work will aim to characterise the likely behaviour and level of uncertainty associated with interconnector trades.

For the National Energy Projections, we assume that the EU's Carbon Border Adjustment Mechanism (CBAM) comes into full effect from 2026 and that this ultimately results in an alignment of the EU ETS and UK ETS.

4.1.6 Carbon intensity of dispatchable generation

Given their high carbon intensity, the use of coal and oil for electricity generation has a significant impact on the carbon emissions from power generation in Ireland. The construction of new gas-fired generation is critical to achieving the national resource adequacy standard and abating the use of coal generation in the short-term and oil generation in the short and medium term. Switching a given generator's fuel from coal to heavy fuel oil reduces its carbon intensity in the region of ~17%. In comparison, replacing such a generator with a natural-gas-fired aeroderivative gas turbine would yield a reduction of ~44%, and could be ~61% if the more efficient combined-cycle gas turbine technology was used.

4.1.6.1 Critical success factors and opportunities

Given the long design life of power generation plants (nominally 25-30 years), capacity markets will need to quickly adapt to incentivise generation companies to transition to minimise and ultimately eradicate power plant carbon emissions. Policy is needed to address how conventional generation in Ireland is to switch to low-carbon fuels. Potential options include ammonia, hydrogen or bioenergy in solid (biomass), liquid (hydro-treated vegetable oil) or gaseous form (biomethane). However, it is not yet obvious which of these technologies will be most suitable given the cost, sustainability, opportunity costs and risks associated with each.

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[40] ESIG, 'Reports & Briefs'. [Online] Accessed from: https://www.esig.energy/reports-briefs/
[41] DECC, 'National Policy Statement on Electricity Interconnection 2023'. July 2023. Online Accessed: https://www.gov.ie/en/publication/3d96f-national-policy-statement-on-electricity-connection-2023/

4.2 Transport

4.2.1 Key messages

- In all scenarios, transport energy use will still be dominated by oil in 2030, despite assumptions of significant growth in EV numbers and reductions in overall vehicle kilometres of all road vehicles in the WAM scenario.
- In both the WEM and WAM scenarios, the transport sector exceeds the sectoral ceilings for both the first and second carbon budget periods.
- The projected exceedance in the first budget period means that approximately 10% of the second budget will have been consumed before the second period begins.
- By the end of the second budget period, the total exceedance is projected to be 23.4 $MtCO_2eq$ (26%) and 15.8 $MtCO_2eq$ (17%) in the WEM and WAM scenarios respectively.
- It is increasingly unlikely that 100% of all new cars and second-hand imports will be EVs by 2030, in the absence of strong measures to discourage the purchase of new internal combustion engine vehicles.
- Government policy recognises the importance of the "Avoid-Shift-Improve" strategy for decarbonising transport emissions. This strategy prioritises measures to reduce or avoid the need for travel and to shift journeys to more efficient and sustainable modes such as public transport and active travel.
- There was continued progress in 2023 on a range of critical public and active transport infrastructure projects including BusConnects, the Connecting Ireland Rural Mobility Plan and DART+, along with funding for over 1,000 active travel projects all over the country.
- However, there are significant barriers to shifting away from private car use in Ireland. Preferences for private car use are deeply embedded through existing settlement patterns, infrastructure, policies and mindsets.
- Full implementation and delivery of the policies and measures contained in the National Sustainable Mobility Action Plan will be critical to achieving the ambitious targets for modal shift set in CAP24.

4.2.2 Transport decarbonisation

The Government has adopted the "Avoid-Shift-Improve" strategy to decarbonise transport energy use. This framework is summarised in the 'National Sustainable Mobility Policy'[42] as:

- Avoid: Reduce the frequency and distance of trips.
- Shift: Move towards more environmentally friendly modes of transport, such as walking, cycling or using public transport.
- Improve: Decarbonising remaining vehicle energy use.

[42] Department of Transport, "National Sustainable Mobility Policy", 2022, [Online], Accessed from: https://www.gov.ie/en/publication/848df-national-sustainable-mobility-policy/

In this section, we discuss some of the main uncertainties relating to each of these factors.

4.2.3 Transport energy demand

Historically, transport sector energy demand has undergone substantial changes in response to changes in the economy and other shocks such as COVID19 restrictions. This variability means there is inherent uncertainty around future transport energy demand.

In line with the "Avoid-Shift-Improve" hierarchy, CAP24 sets targets to reduce the activity of private cars and goods vehicles, and to increase public transport and active travel journeys. CAP24 sets a target of a 20% reduction of total vehicle kilometres relative to a 2030 business as usual (BAU) scenario.

Table 10 shows the change in transport activity in 2030 compared to 2019 in the WEM and WAM scenarios. Road transport activity levels are based on projections of private car and goods vehicle activity from the National Transport Authority (NTA).[43] The WEM scenario activity is based on the NTA reference scenario which includes the impact of public transport measures that have been committed to, such as Dart+, Bus Connects and Cork commuter rail. The WAM scenario is based on the WEM, plus the impact of the list of demand reduction measures shown in the table. These measures are projected to reduce car kilometres by 21% compared to the WEM scenario (or 12% compared to 2019).

Aviation activity has been highly responsive to the economy in the past and there is significant uncertainty around the potential scale of growth in aviation energy use in the medium to long term. In all our scenarios, we base the growth rate for aviation energy use on modelling carried out by EUROCONTROL[44].

If aviation energy use continues to grow, it will be challenging for the transport sector to deliver its share of reduction in final energy use in 2030 as required by the Energy Efficiency Directive.[45]

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[43] The NTA projections were carried out on behalf of the Department of Transport to demonstrate a pathway to meeting the 2023 Climate Action Plan (CAP23) targets for the sector, but the NTA modelling was carried out separately from the development of the National Energy Projections, and does not align exactly with the WEM and WAM scenario definitions. The WAM scenario included all of the demand reduction measures included by the NTA in their CAP23 scenario, with the exception of the additional demand reduction modelled by the NTA as an increase in fuel prices.

[44] EUROCONTROL, "EUROCONTROL Forecast 2024-2030", 2024, [Online], Accessed from: EUROCONTROL Forecast Update 2024-2030 | EUROCONTROL

[45] The greenhouse gas emissions from international aviation are not counted towards Ireland's national or international greenhouse gas emissions reduction obligations, however the energy use of international aviation is counted for Ireland's EU Energy Efficiency Directive obligation to reduce final energy use.

Table 10: Transport sector activity by scenario

<table>
<tr><th rowspan="2">Scenario</th><th rowspan="2">Activity in 2030 is based on:</th><th colspan="3">Change in activity in 2030 relative to 2019</th></tr>
<tr><th>Cars</th><th>Goods vehicles</th><th>Aviation</th></tr>
<tr><td>WEM</td><td>Road transport:
NTA Reference Case, including:
• DART+
• Bus Connects
• Cork Commuter rail

Aviation:
EUROCONTROL “Base” scenario</td><td>+12%</td><td>+26%</td><td>+31%</td></tr>
<tr><td>WAM</td><td>Road transport:
NTA Reference Case +NTA modelling of impact of selection of demand reduction measures, including:
• Basket of measures modelled in RMS
• Change in speed limits
• Reduction in “Escort to Education” journeys
• Improved rural connectivity
• Inter-regional travel response

Aviation:
EUROCONTROL “Base” scenario</td><td>-12%</td><td>+26%</td><td>+31%</td></tr>
<tr><td>Risk</td><td>Road transport:
CAP21 target of 10% reduction in ICE car activity

Aviation:
EUROCONTROL “High” scenario</td><td>-10%</td><td>+26%</td><td>+43%</td></tr>
</table>

4.2.3.1 Risk scenarios

There are many challenges and systemic barriers to achieving significant levels of modal shift away from private car use in Ireland. These were recognised in CAP23, which highlights the following:

- There has historically been a clear correspondence between travel demand and economic and demographic growth.
- Travel preferences are deeply embedded through settlement patterns, policies and mindsets, which favour private car usage over more sustainable transport modes.
- Dispersed and low-density development has led to high levels of transport poverty in certain regions and for certain cohorts of society.
- There are significant lead-in times associated with the delivery of major transport infrastructure and the roll-out of additional public transport services.
- Public acceptance is vital to deliver the scale of behavioural change required. Demonstrating and communicating the wider societal benefits such as health, air quality, reduced noise pollution and improved place-making will need to form part of a compelling public engagement strategy.

The National Sustainable Mobility Policy and the accompanying action plan aim to overcome these barriers, and to improve and expand sustainable mobility options across the country.

In light of these significant challenges, we chose transport demand reduction as the measure to investigate for the transport risk scenario. Table 10 shows the basis for transport activity for road and aviation transport in the risk scenario and the change in activity in 2030 compared to 2019. For road transport, we assume that the CAP21 target of a 10% reduction in activity of internal combustion engine (ICE) vehicles will be achieved, and for aviation we use the EUROCONTROL "high" demand scenario.

4.2.3.2 Critical success factors and opportunities

Full implementation and delivery of the policies and measures contained in the National Sustainable Mobility Plan and CAP24 will be critical to achieving the ambitious targets for road transport demand reduction set in CAP24.

There has been continued progress on a range of critical public and active transport infrastructure projects including BusConnects, the Connecting Ireland Rural Mobility Plan, DART+, and MetroLink, along with funding for over 1,000 active travel projects all over the country.[46]

4.2.4 EV uptake

One of the high-profile targets contained in recent CAPs is for 100% of new cars to be EVs by 2030 and to have 845,000 e-cars on the road by 2030.

While growth rates for the share of EVs in new vehicles were positive up until the end of 2023, data for the first half of 2024 indicates that the share of Battery-EVs (BEVs) has dropped back to 2022 levels. It is increasingly unlikely that 100% of all new cars and pre-owned-imports will be EVs by 2030 in the absence of strong measures to discourage the purchase of new and pre-owned-imported ICE vehicles.[47] In the absence of such disincentives, it would be reasonable to assume that a cohort of consumers purchasing new cars will continue to opt for ICE vehicles post-2030.

For the WAM scenario, we assumed the CAP24 targets for numbers of EVs were fully achieved. For the WEM scenario, we assumed that the phasing-out of new ICE vehicles would be aligned with the EU target for an effective phase-out of new ICE vehicles by 2035. The resulting EV stock in all scenarios for 2030 is shown in Table 11.

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[46] National Transport Authority, 'Annual Report & Financial Statements 2023'. 2024. [Online]. Accessed from: https://www.nationaltransport.ie/wp-content/uploads/2024/08/NTA-Annual-Report-Financial-Statements-2023-ENG.pdf

[47] Pre-owned-imports refer to second-hand vehicles imported from the UK into Ireland. In some years up to 50% of all new vehicles added to the Irish car fleet have been second-hand vehicles from the UK. It is important that any measures to disincentivise new ICE vehicles also apply to this market.

Table 11: EV stock in 2030 by scenario

	2023 (based on Jan-Oct data)	WEM 2030	WAM 2030
BEV share of new car sales	20%	50%	80%
PHEV share of new car sales	8%	25%	20%
BEV share of pre-owned-imports	4%	17%	33%
PHEV share of pre-owned-imports	8%	33%	60%
Total BEV car stock	61,312	430,296	573,775
Total PHEV car stock	45,188	263,023	271,381
Total EV car stock (BEV+PHEV)	106,500	693,319	845,156
BEV share of total car stock	3%	18%	24%
PHEV share of total car stock	2%	11%	11%
EV share of total car stock	5%	29%	35%

4.2.4.1 Critical success factors and opportunities

Achieving the goal of all new vehicles being EVs by 2030 will require measures to strongly disincentivise the purchase of new and pre-owned import ICE vehicles, combined with tackling barriers to EV use.

Public EV charging infrastructure is a key enabler for greater EV use. The Electric Vehicle Charging Infrastructure Strategy 2022-2025 sets out the ambition and strategy for the delivery of a national EV charging network and the steps that will be taken to deliver this network across the country.

The primary goal for decarbonising private car transport is a reduction in the number and activity of ICE vehicles. As well as incentivising the purchase of new EVs, and disincentivising the purchase of new ICE vehicles, there is also the opportunity to consider measures to accelerate the phase-out of old ICE vehicles. The trend over recent years towards larger SUV style cars should also be disincentivised in favour of smaller, lighter, more efficient vehicles.

4.3 Built environment

4.3.1 Key messages:

- In all scenarios, oil use in buildings declines significantly and by the end of the decade, it is no longer the largest energy source for Irish homes.
- In the WAM scenario, the number of homes using heat pumps is assumed to increase tenfold between 2022 and 2030, at which point more homes would use heat pumps than any other heat source.
- In both the WEM and WAM scenarios, the built environment sector exceeds the sectoral ceilings for both the first and second carbon budget periods.
- By the end of the second budget period, the total exceedance is projected to be 5.7 $MtCO_2$ (9%) and 2.5 $MtCO_2$ (4%) in the WEM and WAM scenarios respectively.
- Despite strong growth in numbers of people availing of Government grants for home energy upgrades and heat pumps in 2022 and 2023, it will be very challenging to continue to grow uptake to the rates required to meet the CAP24 targets.
- There is high uncertainty on the potential roll-out rate for district heating.
- For the CAP24 2030 district heating target to be achieved, a further 88 schemes the size of the Tallaght District Heating Network would need to be identified, planned and delivered by 2030. The scale of this challenge poses a high risk that there will be significant delay in achieving the target and that just a small fraction of the target will be delivered by 2030.
- Removal of fossil fuel heating systems from existing buildings is the critical measure needed to reduce and eventually eliminate greenhouse gas emissions from the built environment. We need to ensure that non-fossil alternative technologies are viable for everyone.

4.3.2 Built environment decarbonisation

The well-established international approach to decarbonising building energy use is to first improve the thermal efficiency of the building, followed by decarbonisation of the remaining heating demand by replacing fossil fuel heating systems with low carbon alternatives. While this is the correct approach, in the past this has led to far more buildings upgrading their thermal efficiency than have replaced their fossil fuel heating system. While there are many benefits to upgrading the thermal efficiency of buildings, for successful decarbonisation the critical measure is to replace the fossil fuel heating system. If we improve the efficiency of a building but leave a fossil fuel heating system in place, there typically remains a significant (though reduced) demand for fossil fuels.

Furthermore, this fossil fuel demand has the potential to increase again over time due to the phenomenon of energy rebound[48] or due to other potential factors such as a fall in fossil fuel prices. Removing fossil fuel heating systems from large numbers of homes and buildings as early as possible is essential to achieve our greenhouse gas emissions ceiling for the built environment.

One of the main recommendations of the SEAI National Heat Study[49] was that, given the limited budgets available to householders and the Government, energy-efficiency measures should be seen primarily as enablers for deploying low-carbon heating technologies. Improving building thermal performance remains a very important policy goal for health, wellbeing, alleviation of fuel poverty and comfort.

4.3.3 Building efficiency upgrades

CAP24 contains a target for the National Retrofit Plan to deliver 500,000 dwelling upgrades to Building Energy Rating (BER) B2, cost optimal or carbon equivalent standard. To achieve this, the annual number of BER B2-equivalent upgrades would need to increase to 75,000 per annum between 2026 and 2030. In 2022, SEAI delivered 27,200 grants for home energy upgrades, of which 8,476 (32%) were to a standard of B2 or better. In 2023, this increased significantly to 47,953 upgrades, of which 17,601 (37%) were to a standard of B2 or better.[50]

For the commercial and public services sector, CAP23 sets an overall greenhouse gas reduction target to come from decarbonising heating in the sector, but it does not present specific targets for numbers of building upgrades or heat pump installations. This results in some uncertainty around how the targeted greenhouse gas savings will be achieved.

For the modelled scenarios, we do not set the total numbers of home energy upgrades as inputs; rather we model an anticipated uptake rate based on payback periods and surveys of consumers' willingness to pay. For the WEM scenario, we include the suite of current grants and supports, for example the grant of €8,000 for external wall insulation in detached homes[51].

This results in a projected uptake of 265,000 dwellings undergoing home energy retrofits by 2030, of which 175,000 reach a BER of B2 or better. In the WAM scenario, we increased the supports within the model to try to achieve the CAP24 targets for home energy upgrades. This resulted in a projected 610,000 home energy upgrades by 2030, of which 301,000 reach a BER of B2 or better. [52]

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[48] The rebound effect, in general terms, describes the observation that potential energy savings from efficiency improvements are offset by a resulting increase in energy service demand. In the case of home energy upgrades, direct rebound happens when households enjoy some or all of the benefits of improved efficiency in the form of a warmer, more comfortable home, instead of reducing their energy bills.
[49] SEAI, 'Net Zero by 2050'. 2022. [Online]. Available from: https://www.seai.ie/data-and-insights/national-heat-study/
[50] Information on SEAI National Home Retrofit Programmes available from https://www.seai.ie/grants/home-energy-grants/home-upgrades/
[51] Further details of current supports are available here: https://www.seai.ie/grants/home-energy-grants/
[52] The methodology for calculating the number of B2-equivalent upgrades is being finalised, so it is not currently possible to estimate the number of B2-equivalent upgrades carried out to date, or the number that will be achieved in the modelled scenarios. These estimates will be updated following finalisation of the methodology.

4.3.3.1 Critical success factors and opportunities

For timely and successful decarbonisation of the building stock, it is critical that building upgrades shift from fabric only upgrades to full replacement of fossil fuel heating systems.

The rollout of a 'National Heat Strategy', underpinned by appropriate spatial planning and focussed on heat pump and district heating deployment, would give further certainty to the market and to consumers as to the most appropriate low carbon alternatives in each geographical area, as well as to the required pace and scale of transition away from fossil fuel heating.

4.3.4 Heat pump deployment

CAP24 maintains the target for the installation of 400,000 heat pumps in existing dwellings by 2030. SEAI estimates that to achieve this, the annual number of heat pump installations in existing buildings (i.e. excluding new builds) will need to increase rapidly to 14,000 installations by 2025, and to over 100,000 installations per annum by 2030. In 2023, SEAI supported the installation of 3,769 heat pumps in existing dwellings, up from 2,272 in 2022. For the first seven months of 2024, SEAI supported the installation of 2,113 heat pumps. Current heat pump installation rates are not in line with what would be required to achieve the 2025 target, and the magnitude of the scale-up required post-2025 presents a substantial risk that the 2030 target will not be achieved without significant additional policy effort.

Again, for the modelled scenarios we do not set the total numbers of heat pumps as inputs, rather we model an anticipated uptake rate based on the lifetime cost of different competing technologies. For the WEM scenario, we include the suite of supports currently in place, for instance €10,500 for installing a heat pump in a detached dwelling, and other relevant supports.[53].

In the WEM scenario, this results in a projected uptake of 240,000 heat pumps in existing dwellings by 2030. In the WAM scenario, we increased the supports within the model to try to achieve the CAP24 targets for heat pumps installed in existing dwellings. This resulted in a projected uptake of 362,000 heat pumps installed in existing dwellings.

4.3.4.1 Risk scenario

There are many barriers to scaling up the replacement of fossil fuel heating systems with heat pumps to the levels required to meet our decarbonisation targets. Some real and/or perceived barriers to heat pump uptake include:

- There is still public unfamiliarity with heat pumps as a new technology.
- There are some common misconceptions about what is needed to install a heat pump that may result in homeowners thinking their property is inherently unsuitable, for instance the misconception that it requires underfloor heating.
- Heat pumps have higher upfront costs than fossil fuel boilers, however current Government grant support of up to €10,500 for heat pump installation has significantly closed the price gap between heat pump installation and a direct oil or gas boiler replacement[54].

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[53] Further details of current supports are available here: https://www.seai.ie/grants/home-energy-grants/

[54] Available by carrying out a complete home energy upgrade through a One Stop Shop. Consists of €6,500 grant for heat pump, €2,000 grant for upgrading central heating system for a heat pump and €2,000 heat pump bonus.

- There is a tendency for homeowners to continue using their existing heating system until it breaks down, at which point it is often crucial for the occupants to restore the heating system as quickly as possible. In such a distressed purchase situation, occupants are likely to prioritise how quickly the system can be replaced and not explore alternatives. In many cases, to allow a heat pump to operate effectively, the thermal performance of the dwelling also needs to be upgraded which significantly increases the lead-in time and hassle of opting for a heat pump in these circumstances.
- The low prices for fossil fuels as compared to electricity. The design of electricity tariffs and energy taxation can put heat pumps at a disadvantage relative to fossil fuel boilers.
- Correct operation of the heat pump system is essential to minimise running costs. However, studies have shown that homeowners are often not provided with adequate training and advice to help them operate their heat pump efficiently.
- Market development and skills shortages.

Because of the scale of the challenge, it is prudent to examine the risk of a delay in the achievement of the ambitious target set in CAP24. As the WEM scenario includes the suite of supports currently in place, we judged that the risk scenarios should assume WEM levels of heat pump uptake.

4.3.4.2 Critical success factors and opportunities

Strategies to address barriers are being actively considered by policymakers to drive increased rates of heat pump deployment.[55] Potential measures to overcome the barriers to heat pump uptake include the following:

- Incentives must be designed to encourage homeowners to proactively consider replacing their existing fossil fuel heating system with a heat pump before it breaks down. Possible measures to incentivise this could include targeted marketing campaigns and boiler scrappage schemes.
- Options to increase barriers to the simple like-for-like replacement of old fossil fuel boilers with new fossil fuel boilers could also be considered. These will likely need to include regulations prohibiting the installation of fossil fuel boilers in existing buildings, other than in some limited and exceptional circumstances, from a certain date in the future. This will be necessary also in the context of Net Zero targets.
- Uncertainty around the operating costs of a heat pump is a further potential barrier that must be addressed. One possible measure could include operational supports for heat pump users to ensure that they do not pay more per unit of useful heat delivered than those with oil or gas boilers.
- In the longer-term, further measures to address operating costs could include reform of the wholesale electricity market to ensure that the increase in low-cost renewable electricity supply translates to electricity retail price reductions for consumers, and reform of taxes and levies on electricity compared to fossil fuel alternatives.

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[55] Necessary actions for decarbonising heat in the built environment are being pursued by the Government's Heat and Built Environment Taskforce For more information see: https://www.gov.ie/en/publication/097fa-heat-and-built-environment-taskforce/#

SEAI has undertaken research to support the deployment of heat pumps nationally, including the 2020 report: *Encouraging heat pump installations in Ireland - Strategies to maximise heat pump installation and the savings produced*[56] and the 2024 report: *Encouraging heat pump adoption in heat pump ready oil-heated homes*.[57, 58] Current research projects include the Heat Pump and Heat Loss Indicator Research Pilot, and the Heat Pump and Heat Loss Indicator Historical Analysis.

Further evidence-based research and trials into accelerating heat pump adoption in Ireland are needed, underpinned by access to robust data and real-world monitoring of actual energy use pre and post heat pump installation. The findings of this ongoing research will further support policymakers to refine the policy mix and drive higher rates of technology deployment and home upgrades.

4.3.5 District heating deployment

CAP24 sets a target of 2.7 TWh of heat to be supplied by district heating by 2030. For the WAM scenario, we assumed that this target would be fully met. CAP23 targets 2.5 TWh of the total target to go to the residential sector, with 0.2 TWh to the commercial and public sectors. SEAI analysis suggests that because district heating is likely to be developed first in the dense centres of towns and cities, and because it is common for district heating schemes to rely on connections to large public or commercial sector heat users as anchor loads, the share of district heating supplied will be more weighted towards the commercial and public sector. We estimate that for the 2.7 TWh to be met, a likely split would be 1.2 TWh from residential and 1.5 TWh from services, equating to approximately 125,000 dwellings and 11,500 commercial and public sector buildings.

In our WEM scenario, we assume that just two sizeable schemes will be in operation by 2030: the Tallaght District Heating Network (TDHN) and the Dublin District Heating Scheme (DDHS). The first phase of the TDHN was opened in early 2023 and there are plans to expand the scheme further. The DDHS is not yet operational but it has been in the planning and development phase for many years and much of the infrastructure is already in place, so it is at a more advanced stage of development than any other large scheme. These two schemes combined aim to deliver approximately 75 GWh/annum, or 0.075 TWh/annum of district heat by 2030. This would amount to 2.8% of the 2030 target. Therefore, for the 2030 2.7 TWh target to be achieved, another 87 schemes of the size of the TDHN would need to be identified, planned and delivered by 2030. The scale of this challenge poses a high risk that there will be significant underachievement of the 2.7 TWh district heating target for 2030. For the level of district heating in the WEM scenario to be increased in future projections, further specific projects will need to be identified and plans published that contain realistic implementation timelines.

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[56] SEAI, 'Encouraging heat pump installations in Ireland'. 2020. [Online]. Accessed from: https://www.seai.ie/publications/Heat-Pump-Adoption.-Maximising-Savings..pdf

[57] SEAI, 'Encouraging heat pump adoption in heat pump ready oil-heated homes – Report 1'. 2024. [Online]. Accessed from: https://www.seai.ie/data-and-insights/behavioural-insights/publications/behavioural-energy-and-tr/

[58] SEAI, 'Encouraging heat pump adoption in heat pump ready oil-heated homes – Report 2'. 2024. [Online]. Accessed from: https://www.seai.ie/data-and-insights/behavioural-insights/publications/behavioural-energy-tr-2/

4.3.5.1 Risk scenarios

District heating has never been undertaken at scale in Ireland, although there are a number of smaller schemes in operation. Although district heating is a long-proven technology in many EU countries, this lack of national experience poses challenges for the rapid scale-up of district heating proposed in CAP24. Some challenges include:

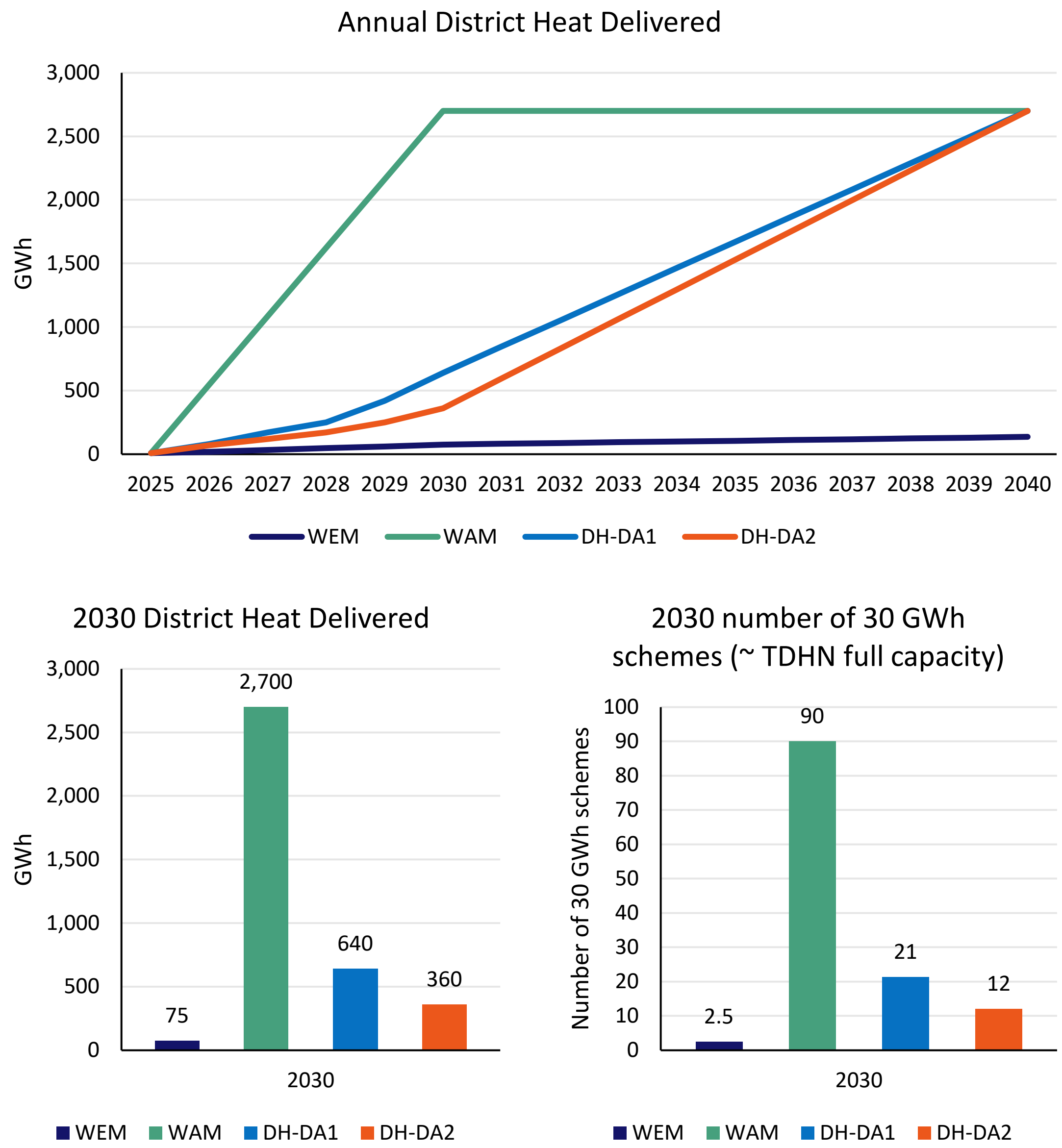
- There is an absence of appropriate legislative and regulatory frameworks for district heating due to the nascent nature of the industry. This is a key barrier to the development of district heating and needs to be addressed as a priority.
- There is a lack of national technical standards and guidance for district heating schemes. This should be addressed as a priority to allow for the training of installers and to ensure compatibility of different district heating systems in future.
- District heating projects require large upfront capital investment and have long payback periods. The market requires clear, strong and stable policy signals aligned with fiscal supports.
- Policies and supports need to be established in tandem to encourage both projects currently in the initial stages of development, but also a future pipeline of projects.

In light of these significant challenges, we examined a number of scenarios to explore the risk of delays to full achievement of the 2.7 TWh district heating target.

Figure 18 shows the assumed trajectories for the amount of heat delivered by district heating in the WEM and WAM scenarios as well as in two further scenarios where there is delayed achievement of the 2030 target. To give a sense of the scale of the infrastructure required, it also shows the number of 30 GWh schemes that would be required to supply the level of heat in each scenario (30 GWh corresponds to the proposed full capacity of the TDHN).

The amount of district heat delivered by 2030 in the first delayed achievement scenario (DH-DA1) is based on the capacity of all the potential real world schemes that SEAI is aware of that have been suggested to date, and assuming that these could be fully delivered by 2030. Given the very early stage of many of these schemes and the large uncertainty associated with them, at this point we would not expect all these schemes to be fully delivered by 2030, therefore we also considered a second delayed achievement scenario (DH-DA2). This scenario was based on a subset of the schemes in the DH-DA1. In all scenarios, we assume that the pace of delivery increases post-2030 so that the 2.7 TWh target is achieved by 2040.

Figure 18: District heating deployment scenarios



4.3.5.2 Critical success factors and opportunities

The District Heating Steering Group was formed under the Climate Action Plan 2021, as part of the Government's commitment to further the expansion of district heating in the State. The Steering Group brought together subject matter experts in renewable heating/energy; land use planning; energy regulation; local Government; and finance; all tasked with coordinating the development of district heating policy.

In August 2023, the Working Group published its first report[59] with key recommendations for consideration which include:

- The Department of the Environment, Climate, and Communications to bring forward proposals for all necessary legislation;
- The appointment, in the long-term, of a single state entity or utility to centralise the development and expansion of heat networks;
- The establishment of a National District Heating Centre of Excellence;
- Exploration of the options to finance district heating schemes, and options to provide financial supports including the range of existing supports for renewable energy and climate related projects.

The following are some of the areas that are currently being progressed:

- The Department of the Environment, Climate and Communications is progressing the development of the Heads of Heat Bill which will outline the framework for district heating development in Ireland.
- The Department of the Environment, Climate and Communications has established a District Heating Working Group under the auspices of the Heat and Built Taskforce[60].
- The District Heating Centre of Excellence has been established within SEAI. The role of the District Heating Centre of Excellence will be to provide support and guidance in the development of district heating.

Further potential measures to accelerate progress are further detailed below:

- Implementing a grant scheme to support the development and implementation of district heating schemes;
- Energy planning at national and regional level to consider decarbonisation pathways for built environment including district heating;
- Rolling out the development and implementation of projects in areas deemed technically and economically viable for district heating. Projects to be taken through a development lifecycle including pre-feasibility, feasibility, business case, detailed design, commercialisation, construction and operation;
- Establishing customer protection for all district heating consumers.

[59] Department of the Environment, Climate, and Communications, 'District Heating Steering Group Report 2023'. 2023. [Online]. Accessed from: https://www.gov.ie/pdf/?file=https://assets.gov.ie/265549/487f6e25-427d-4ba3-acc8-d3b5e6272b46.pdf#page=null

[60] For more information see: https://www.gov.ie/en/publication/097fa-heat-and-built-environment-taskforce/

4.4 Industry

4.4.1 Key messages:

- Fossil fuels are projected to account for between 30% and 46% of energy use in industry in 2030. This compares to the CAP24 target to reduce the share of fossil fuel use to 25-30%.
- In both the WEM and WAM scenarios, the industry sector exceeds the sectoral ceilings for both the first and second carbon budget periods.
- The projected exceedance in the first budget period means that approximately 8% of the second budget will have been consumed before the second period begins. By the end of the second budget period, the total exceedance is projected to be 9.6 $MtCO_2eq$ (18%) and 8.3 $MtCO_2eq$ (15%) in the WEM and WAM scenarios respectively.
- Heat pumps offer an alternative for low-medium temperature heat applications currently delivered by direct fossil fuel burning, especially in situations where there is a requirement for simultaneous heating and cooling or where there are waste heat streams that can be utilised. But uncertainty remains as to the potential scale and pace of uptake.
- Sustainably produced biomethane is seen as especially important for decarbonising industry but the scale of biomethane production to date is of the order of 1% of the 2030 target. Clarity is needed on the proposed support mechanism for biomethane; on feasible ramp-up rates for sustainable biomethane production in Ireland; and in which sectors biomethane is most likely to be used.
- If energy demand in the industry sector continues to grow to 2030 at the rate seen from 2011 to 2019, it would pose a severe challenge to meeting our national and international climate and energy obligations. We need to ensure that any new energy demand in the industry sector does not lock in fossil fuel use for decades to come.
- Early action is crucial for limiting the growth in cumulative emissions to meet our climate obligations. Focusing industry decarbonisation on renewable and electrification technologies that are commercially available today will result in lower cumulative emissions than alternative pathways that wait for technologies that will not be commercially available at scale this decade.

4.4.2 Industry decarbonisation

The Government has recently published the 'Roadmap for the Decarbonisation of Industrial Heat'.[61] This provides business and industry with a high level overview of the pathway to reduce and remove greenhouse gas emissions from the manufacturing sector in Ireland. This roadmap identifies the following high-level approach:

- Energy monitoring and management systems are a low-risk, low-cost starting point for reducing emissions, reducing future investment costs and improving energy performance.
- Industrial heat decarbonisation will rely first on electrification of heat through heat pumps and electric boilers. This will primarily take place where heat use is medium-low or low-grade heat.
- Depending on the specifics of the site, manufacturing processes using heat grades above 150°C will remove fossil fuels by using a range of technologies including biomass, biomethane and improved energy efficiency.
- New greenfield investment and expansions will be required to align with decarbonisation objectives. State agencies will support businesses to ensure that new growth is low carbon and future-ready.

4.4.3 Growth in industry energy demand

Industrial energy use fell during the recession of 2008-2011 but increased by 29% between 2011 and 2020, which equates to 2.9% growth per annum over that period. Industry energy use fell by 4% in 2022, due largely to the exceptionally high fossil fuel prices caused by the Russian invasion of Ukraine. If energy use in the sector was to return to the growth seen from 2011 to 2020, it would pose a severe challenge to meeting the climate and energy obligations for the industry sector and for our national obligations as a whole.

4.4.3.1 Critical success factors and opportunities

- To meet our climate obligations, we need to ensure that new energy demand in the industry sector does not lock in fossil fuel use for decades to come.
- In the context of our legally binding climate obligations, the planning system needs to assess the benefits versus the negative consequences of allowing new large-energy-users to establish in Ireland between now and 2030, or to allow significant expansion of existing large-energy-users.

4.4.4 Electrification of industry heat demand

The 'Roadmap for the Decarbonisation of Industrial Heat' and the SEAI National Heat Study[62] highlight the benefits of electrification of heating demand across all sectors using technologies that are available today. Early action is crucial to limit the growth in cumulative emissions to meet our climate obligations. Alternative decarbonisation pathways such as green hydrogen will not be available at scale this decade.

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[61] Department of Enterprise, Trade and Employment, "Roadmap for the Decarbonisation of Industrial Heat". 2024. [Online]. Accessed from: https://enterprise.gov.ie/en/publications/decarbonisation-of-industrial-heat-roadmap.html

[62] SEAI, 'Net Zero by 2050'. 2022. [Online]. Accessed from: https://www.seai.ie/data-and-insights/national-heat-study/

In particular, heat pumps offer an alternative for low and medium temperature heat applications (current up to about 150 °C), especially in situations where there is a requirement for simultaneous heating and cooling, or where there are waste heat streams that can be utilised. The National Heat Study highlighted that up to 40% of industry heat demand comes from low or medium temperature applications that could be suitable for industrial heat pumps. But uncertainty remains as to the scale and pace of uptake that will be achieved.

4.4.4.1 Critical success factors and opportunities

- We need to ensure that the operating costs of electrification options are competitive with fossil fuel alternatives being used currently.
- Possible measures to address operating costs include electricity market reform, to ensure that the full advantage of the large increase in low cost renewable generation can be passed on to consumers, and reform of taxes and levies on electricity compared to fossil fuel alternatives.
- A particular barrier to the electrification of industrial heat will be the availability and cost of electricity connection capacity for increased industrial electrical loads.
- Possible future measures to alleviate this include a review of how electricity connection capacity (MIC) is allocated. Currently MIC is allocated on a fixed 24-hour basis irrespective of the customer's pattern of electricity demand. If MIC were allocated on a flexible basis, this might free up network capacity for heat electrification and encourage the incorporation of heat storage by industrial users.

4.4.5 Sustainable biomethane supply

CAP24 sets a target of 5.7 TWh of biomethane to be delivered by 2030, 2.1 TWh of which is targeted for use in industry. The 'Roadmap for the Decarbonisation of Industrial Heat' identifies biomethane as an important low carbon alternative for the sector, particularly for high temperature applications.

The Government recently published the National Biomethane Strategy[63], which is Ireland's first major policy statement on biomethane and is an important milestone in the development of an indigenous biomethane industry. The Strategy states that while the majority of Anaerobic Digestion (AD) plants are likely to be 40 GWh or similar scale, there will be a role for smaller farm scale plants of 10-20 GWh scale. This implies the need for between 140 and 200 AD plants to meet the 5.7 TWh target for biomethane production, but that number is uncertain and depends on the profile of smaller versus larger AD plants that will be developed.

Although there are a small number of AD plants already in operation in Ireland, and a central grid injection point for biomethane is also in operation at Cush in Co Kildare, the scale of biomethane injection to date is in the region of 1% of the 2030 target. This presents the challenge of a very large increase in the scale of sustainable biomethane production in a relatively short time period to meet the 2030 target.

The WEM scenario assumes no additional biomethane development, due to the absence of detail on support mechanisms published as of the end of 2022. The WAM scenario assumes full achievement of the 2030 5.7 TWh target.

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[63] Department of Agriculture, Food and the Marine and the Department of Environment, Climate and Communications. 2024. [Online]. Accessed from: https://www.gov.ie/en/publication/d115e-national-biomethane-strategy/

4.4.5.1 Risk scenario

Although AD technology is mature and well established within the EU, even once a support mechanism is in place in Ireland, there will be significant lead-in times for financing, planning, development and construction of the large number of AD plants required. Therefore, the delivery timeline for biomethane is currently highly uncertain. Some challenges include:

- Due to the nascent nature of the industry in Ireland, there is a lack of technical expertise in the construction and operation of AD plants.
- The large number of AD plants that will be required represents major infrastructure development. As with any such development, social acceptance is a critical success factor. Early stakeholder engagement and education is essential for AD development to gain social acceptance.
- The required AD developments and related infrastructure will be subject to consent, including but not limited to planning permissions, licences and permits approved by DAFM, the EPA, Local Authority or An Bord Pleanála as applicable. The Strategy notes that the scale of the ambition for AD construction, together with the many other targets set out in the Climate Action Plan that will require significant infrastructure development, requires significant resourcing for those decision-making bodies which are already operating at full capacity. It states that it is an absolute priority of Government to ensure key agencies for the energy transition are suitably resourced.
- The Strategy also notes that lengthy timelines for planning permission decisions were frequently highlighted by stakeholders as impeding the speedy development of AD and other integrated facilities.

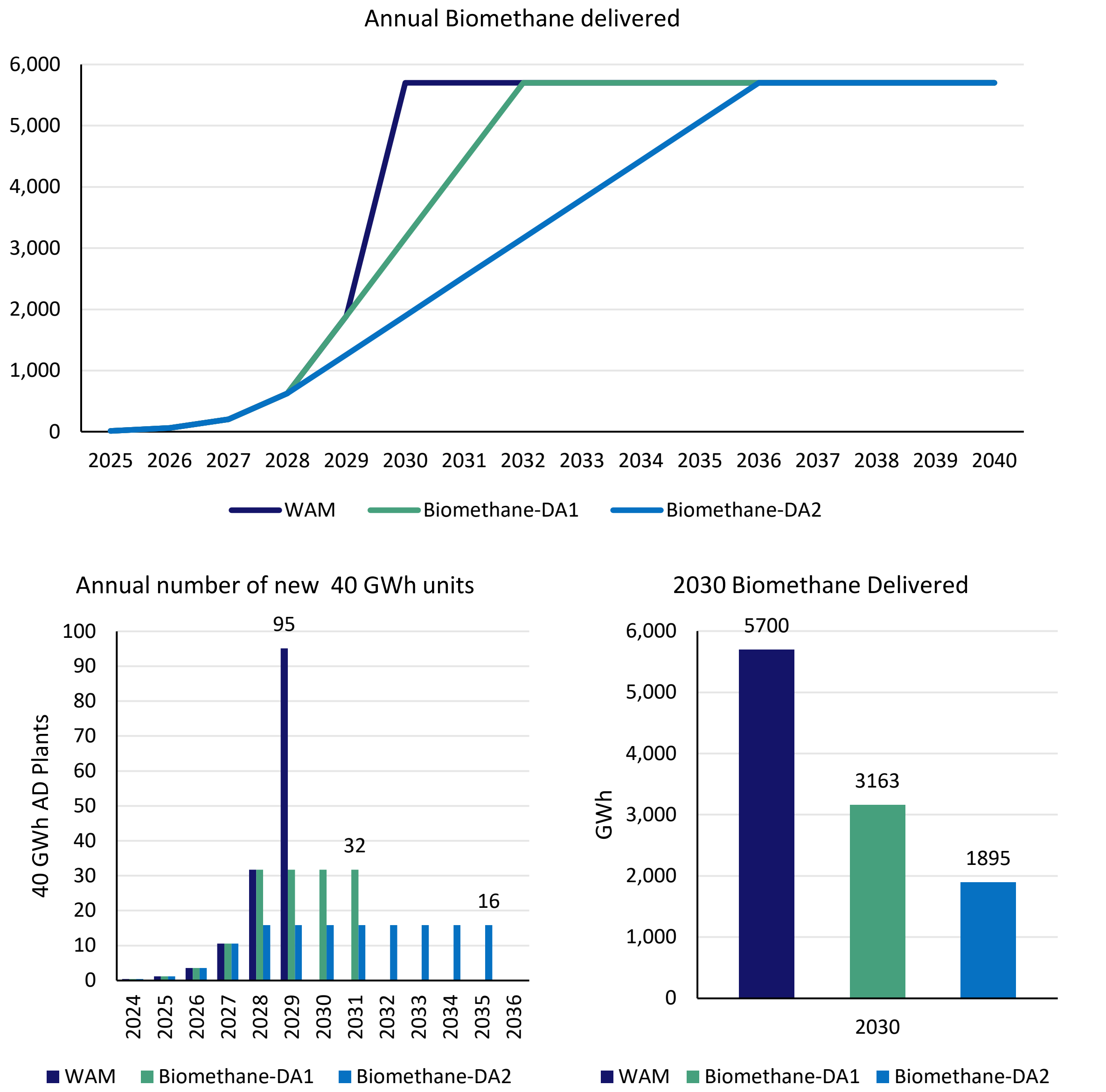
Considering these significant challenges, we examined a number of scenarios to explore the risk of delays to full achievement of the 5.7 TWh biomethane target.

Figure 19 shows the assumed trajectories for the amount of biomethane delivered in the WAM scenario and in two risk scenarios where there is delayed achievement of the 2030 target. To give a sense of the scale of the infrastructure required, it also shows the number of 40 GWh AD plants that would be required to supply the level of biomethane in each scenario. If all AD units are 40 GWh scale, it would require 142 units to meet the 5.7 TWh target.

For the WAM scenario, due to the uncertainty on the potential delivery timeline and lack of information on a real-world pipeline of AD projects, we made the conservative assumption that delivery would be back-loaded to the end of the decade. We assume that the equivalent of one 40GWh unit will be finalised in 2025, 4 new in 2026, 11 new in 2027, 32 new in 2028, and the remaining 95 units would all be delivered in 2029, ready for biomethane production in 2030.

In the delayed achievement scenarios, we assumed the same gradual ramp-up in delivery until 2027 but we then assumed that the maximum delivery of new 40 GWh AD units would reach 32 new units per year in the Biomethane-DA1 scenario and 16 new 40 GWh units in the Biomethane-DA1 scenario, and would continue at this level until the 5.7 TWh target was reached. This level of delivery would result in 3.2 TWh by 2030 in the Biomethane-DA1 scenario and 1.9 TWh by 2030 in the Biomethane-DA2 scenario. The full 5.7 TWh target is achieved in the Biomethane-DA1 and Biomethane-DA2 scenarios in 2032 and 2036 respectively.

Figure 19: Biomethane deployment scenarios



4.4.5.2 Critical success factors and opportunities

The National Biomethane Strategy outlines that biomethane will be supported through a combination of the existing Renewable Transport Fuel Obligation (RTFO), a proposed Renewable Heat Obligation (RHO) and capital grants. The Strategy also highlights the importance of sustainability and has committed to the development of a Biomethane Sustainability Charter. This Charter will apply to all biomethane projects being developed in Ireland in receipt of any form of support or operating under the Renewable Heat Obligation and will cover AD plant developers and owners, those supplying feedstock into AD plants, plant operators, and those farmers acting as off-takers for the digestate.

The Strategy sets out twenty-five actions to be delivered to enable the development of the sector. These include:

- Developing a Biomethane Sustainability Charter to support the delivery of environmentally sustainable biomethane in Ireland;
- Publishing a high-level scheme design of the Renewable Heat Obligation;
- Opening the first competitive Grant Funding Call to contribute up to 1 TWh;
- Reviewing resourcing requirements of key Government agencies to support development of the biomethane industry including EPA licencing, An Bord Pleanála licencing and Planning;
- Exploring the options available for the integration of processed manures from the Anaerobic Digestion Industry back into the circular economy to maximise nutrient recycling and integration into primary production systems in line with current and future requirements of the Nitrates Directive.

The Strategy leaves open the possibility that biomethane may be used for electricity generation. Where biomethane is used to generate electricity, only the energy content of the electricity generated counts towards our binding EU renewable energy targets. Because of the high losses incurred in electricity generation from gas, potentially half of the renewable value would be wasted. In contrast, when biomethane is used for heat or transport, the full amount of biomethane consumed counts towards the target. Therefore, the use of biomethane for electricity generation instead of heat or transport would have a negative impact on Ireland's overall RES.

It is possible that significant quantities of biomethane could be purchased by datacentres for use in off-grid electricity generation. Because grid electricity will be 80% renewable by 2030 and because of the losses incurred in electricity generation, any use of biomethane for off-grid electricity generation would be a highly sub-optimal use of this limited and valuable resource.

Glossary

Term	Description
CAP / CAP21 / CAP23 / CAP24	Climate Action Plan / Climate Action Plan 2021 / Climate Action Plan 2023 / Climate Action Plan 2024
CB1 / CB2 / CB3	Carbon Budget period 1 (2021-2025) / period 2 (2026-2030) / period 3 (2031-2035)
CCAC	Climate Change Advisory Council
DSU	Demand Side Unit; an electricity demand site that EirGrid can instruct to reduce demand
EED	EU Energy Efficiency Directive
EPA	Environmental Protection Agency
ESRI	Economic and Social Research Institute
EV	Electric Vehicle
GW	Gigawatt; a unit of power
HGV	Heavy Goods Vehicle
ICE	Internal Combustion Engine
ktoe	Kilotonne of oil equivalent; a unit of energy
LGV	Light Goods Vehicle
MtCO2eq	Megatonne of carbon dioxide equivalent
NEMF	National Energy Modelling Framework
NTA	National Transport Authority
OECD	Organization for Economic Cooperation and Development
RED / REDII	EU Renewable Energy Directive / Recast EU Renewable Energy Directive
RES	Renewable Energy Share
RES-E	Renewable Energy Share of Electricity
RESS	Renewable Electricity Support Scheme
SEAI	Sustainable Energy Authority of Ireland
TWh	Terawatt-hour; a unit of energy
Vkm	Vehicle kilometre
WAM	With Additional Measures; a modelled scenario
WEM	With Existing Measures; a modelled scenario

Appendix 1: National Energy Projections by sector

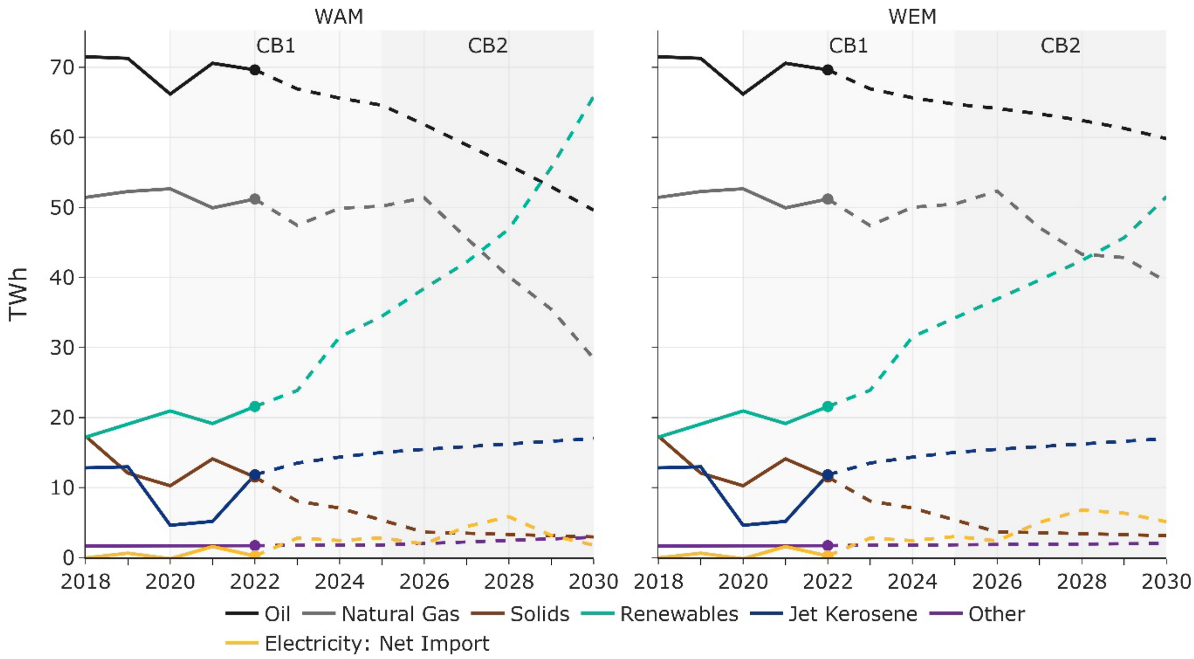
Total energy use

In 2022, 87% of all energy used in Ireland was from fossil fuels, 12% from renewable sources and the remainder from others such as waste and electricity imports. In order to achieve Ireland's national climate objective, virtually all fossil fuel for energy use will need to be eliminated before 2050.

These latest projections of Ireland's energy use show that by 2030, fossil fuels will likely still provide most of our energy, ranging from 70% in the WEM scenario to 62% in the WAM scenario (including jet kerosene). The share of renewable energy in 2030 increases to 26% in the WEM scenario and to 35% in the WAM scenario.

The following sections examine in more detail the energy use of each of the main energy using sectors, namely electricity generation, transport, built environment and industry[64].

Figure 20: Total energy use



[64] Although agriculture is a large source of greenhouse gas emissions, the vast majority are not from energy use. Agriculture accounted for just 2% of energy use in 2021.

Table 12: Total energy use

Energy (TWh)	2022 Actual (TWh)	2030 Projected (TWh)	
		WAM	WEM
Renewables	21.6	65.8	51.5
Electricity imports	0.3	1.8	5.1
Oil (excluding jet kerosene)	68.1	48.1	58.3
Gas	51.2	28.5	39.4
Coal & peat	11.5	3.0	3.1
Other	1.7	2.9	2.0
Total (excluding jet kerosene)	154.4	150.0	159.5
Jet kerosene	11.8	17.0	17.0
Total (including jet kerosene)	166.2	167.0	176.5

Energy use for electricity generation

Note on recent developments on electricity imports

- The projections presented here were modelled in early 2024.
- As discussed in Section 4.1.5, since April 2023 there has been a significant increase in electricity imports across the interconnector with Great Britain.
- The most recent data available, up to June 2024, suggests that electricity net-imports are higher than other years and higher than projected in the WEM or WAM scenarios presented below.
- There is uncertainty as to whether this trend will continue to such an extent in CB2 as the EU CBAM comes into full effect in 2026. Electricity imports from Great Britain will then be subject to the EU CBAM until such time as the EU ETS and the UK ETS become fully linked[65].

The decarbonisation of electricity generation combined with the electrification of energy demand for heating and transport is one of the main strategies for decarbonising energy use in Ireland. In the WEM and WAM scenarios, variable renewables are projected to be the largest input to electricity generation by 2028, with a sharp increase later in the decade due to connection of large offshore wind projects.

In all scenarios, Moneypoint power station is assumed to remain open until the end of 2029. However, coal is assumed to be phased out by the end of 2025 due to a full switch to oil (start-up and generation).

Natural gas use increases in all scenarios to 2026 to meet increased demand and to compensate for the assumed phase out of coal, but declines in the second half of the decade as the delivery of variable renewable energy capacity begins to outpace the growth in electricity demand. This increase in demand necessitates additional dispatchable generation capacity to ensure electricity supply reliability standards are maintained. It is anticipated that new conventional generation will be open-cycle gas turbines. The faster roll-out of renewable generation assumed in the WAM scenario leads to faster reduction in gas use in this scenario.

[65] Afry, 'EU CBAM impact study focused on electricity imports from Great Britain'. Mar 2024. [Online]. Accessed from: https://afry.com/sites/default/files/2024-03/afry_eu_cbam_impact_study_summary_report_mar_2024_v200.pdf

Figure 21: Fuel use for electricity generation

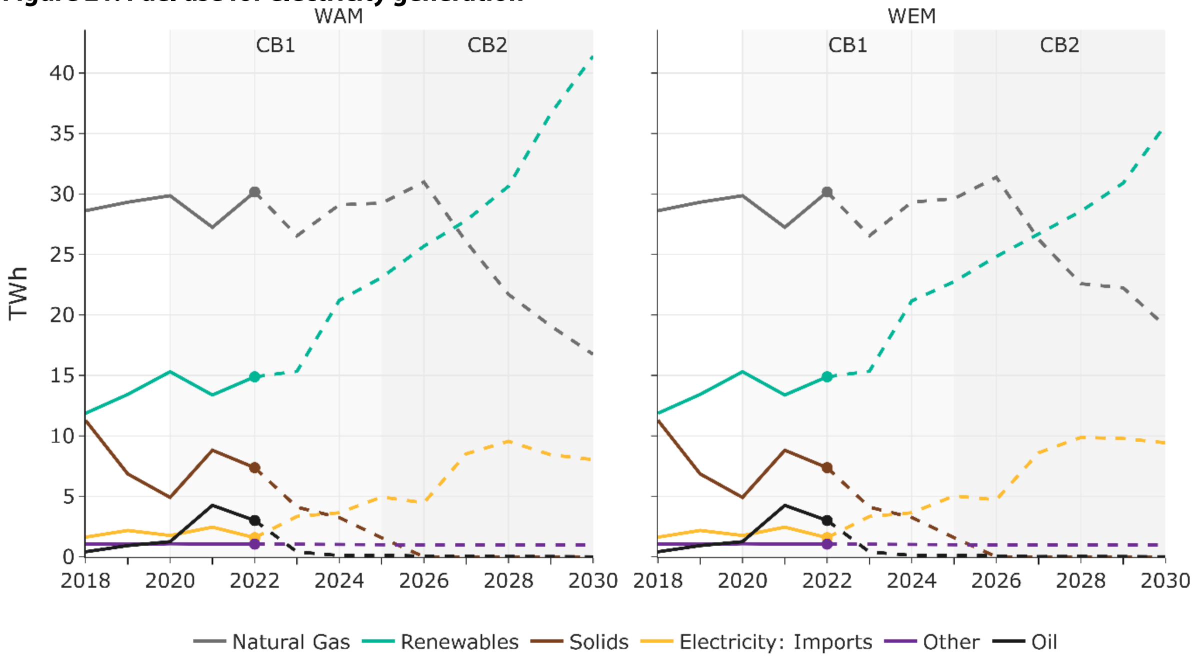


Table 13: Fuel use for electricity generation

Energy (TWh)	2022 Actual (TWh)	2030 Projected (TWh)	
		WAM	WEM
Renewables	14.9	41.4	35.7
Electricity imports	1.6	8.0	9.4
Gas	30.2	16.7	19.1
Coal & peat	7.4	0.0	0.0
Oil	3.0	0.0	0.0
Other	1.0	1.0	1.0
Total	58.0	67.2	65.2

Energy use for transport

In all scenarios, transport energy use will still be dominated by oil use in 2030, despite assumptions of strong growth of EV numbers and a significant reduction in overall car kilometres in the WAM scenario (see Section 4.2.3 for more information on the projected impact of transport demand reduction measures). Oil is projected to account for 64% of transport energy use not including jet kerosene in the WEM scenario and 56% in the WAM scenario.

Jet kerosene is projected to increase its share of transport energy use significantly, from 20% of total transport energy use in 2022 to 26% in 2030 in the WEM scenario and to 29% in the WAM scenario. Including jet kerosene, oil is projected to account for 90% of transport energy use in 2030 in the WEM scenario and 85% in the WAM scenario.

Electricity use for transport increases to 2.1 TWh and 2.4 TWh in 2030 in the WEM and WAM scenarios respectively. The uptake of EVs assumed in each scenario is discussed in Section 4.2.4. There is an increase in electricity demand in the WAM scenario relative to the WEM scenario. This is due to higher numbers of EVs. However, it is counteracted by the decrease in activity due to avoid and shift measures.

It is important to note that EVs are much more efficient than ICE vehicles. Typically, an EV only requires a third as much energy per distance travelled as an equivalent ICE vehicle. Therefore, when an EV replaces an ICE car, it reduces overall transport energy use. This is important to consider when looking at the relatively low share of electricity use in transport, even in 2030. Each unit of electricity used delivers three times the utility of each unit of oil or combustible renewables.

Figure 22: Fuel use for transport

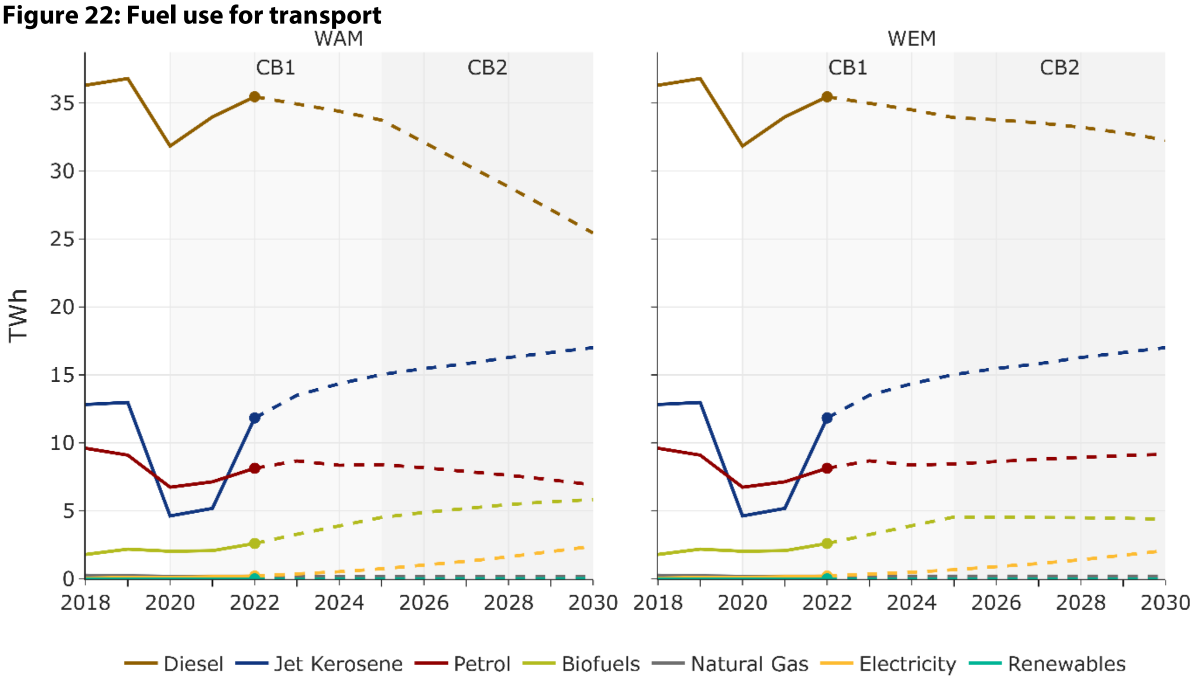


Table 14: Fuel use for transport

Energy (TWh)	2022 Actual (TWh)	2030 Projected (TWh)	
		WAM	WEM
Renewables	2.6	5.8	4.4
Electricity	0.2	2.4	2.1
Oil (excluding jet kerosene)	43.6	32.3	41.4
Gas	0.2	0.2	0.2
Total (excluding jet kerosene)	46.6	40.8	48.1
Jet kerosene	11.8	17.0	17.0
Total (including jet kerosene)	58.4	57.8	65.1

Energy use for households

In 2022, 69% of fuel use in households was from the direct use of fossil fuels, 26% from electricity and just 4% from direct use of renewable energy. Oil was the single largest fuel source in 2022, accounting for 39% of residential energy use, while natural gas accounted for 20%. Coal and peat, the most polluting fossil fuels, accounted for 11% of household energy use but 21% of direct household CO_2 emissions[66].

In the WEM scenario, in 2030 47% of household energy use still comes from direct fossil fuel use. In the WAM scenario, in 2030 direct fossil fuel use is reduced to 41% of total energy use, with electricity and renewable energy accounting for 52% due to the assumed increase in heat pumps, bioenergy and district heating. In the WAM scenario, 34% of all dwellings (717,000 new and existing dwellings) use heat pumps and a further 6% (125,000 dwellings) are assumed to have connected to district heating networks.

In all scenarios, oil use declines significantly and by the end of the decade it is no longer anticipated to be the largest energy source for Irish homes. In the WEM scenario, oil use reduces by 19% by 2030 and in the WAM scenario, it reduces by 27%. In the WAM scenario, the number of dwellings heated by oil falls by 38% between 2021 and 2030, from 723,000 dwellings to 446,000.

Household natural gas use in the WEM scenario is projected to be 4% higher in 2030 than in 2022, but in the WAM scenario, it is projected to be 27% lower due to the higher assumed uptake of heat pumps and district heating in this scenario. In the WAM scenario, the number of homes heated by gas falls by 33% (211,000 dwellings) between 2021 and 2030.

Solid fuel use is projected to reduce by 25% by 2030 compared with 2021 in the WEM scenario and by 30% by 2030 in the WAM scenario.

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[66] Excluding emissions from electricity use, as these are counted as a separate sector for the purposes of carbon budgets.

Figure 23: Fuel use for households

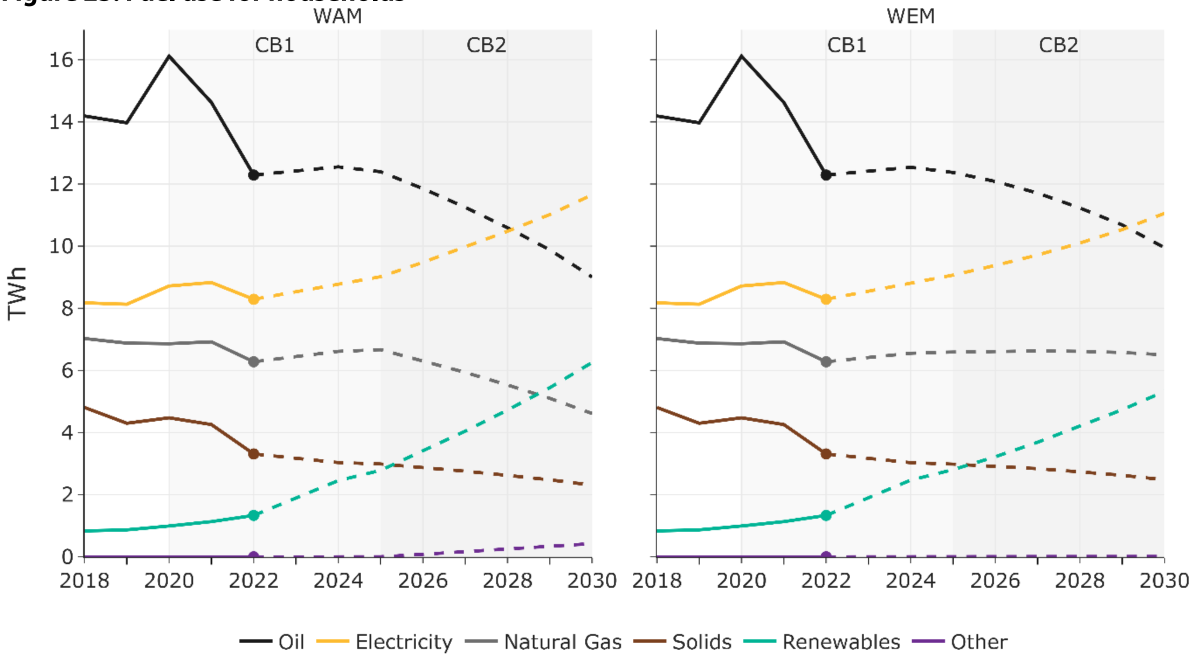


Table 15: Fuel use for households

Energy (TWh)	2022 Actual (TWh)	2030 Projected (TWh)	
		WAM	WEM
Renewables	1.3	6.3	5.3
Electricity	8.3	11.7	11.1
Oil	12.3	9.0	10.0
Gas	6.3	4.6	6.5
Coal & peat	3.3	2.3	2.5
Other	0.0	0.4	0.0
Total	31.5	34.3	35.3

Figure 24: Number of dwellings by main heating type

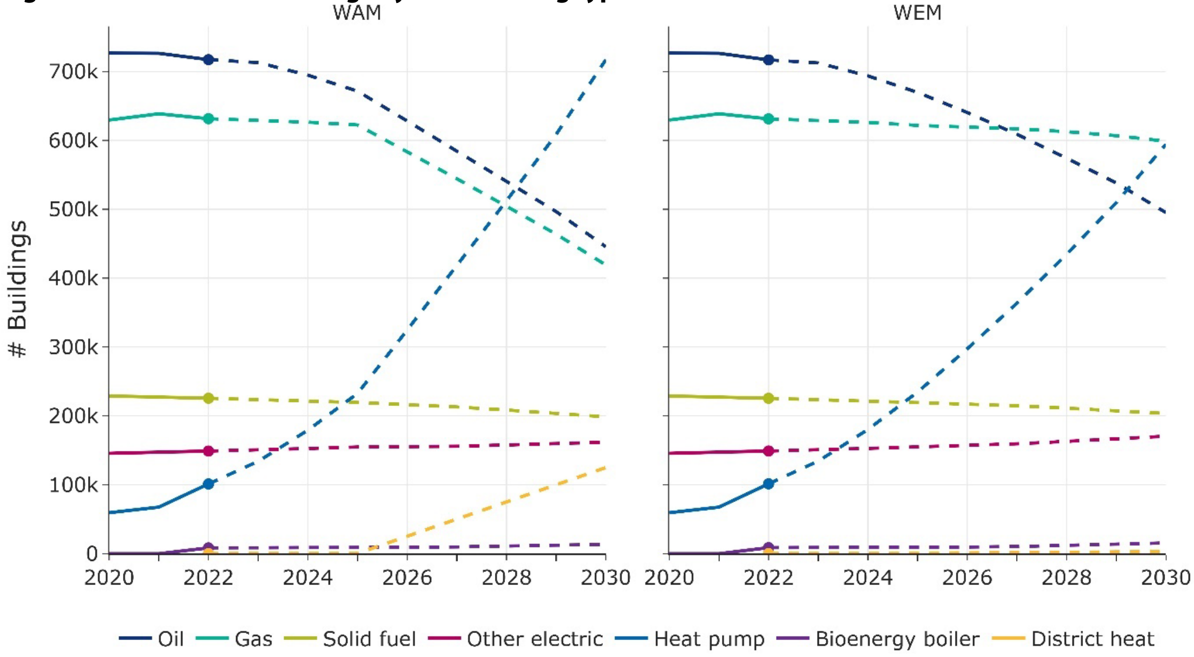


Table 16: Number of dwellings by main heating type

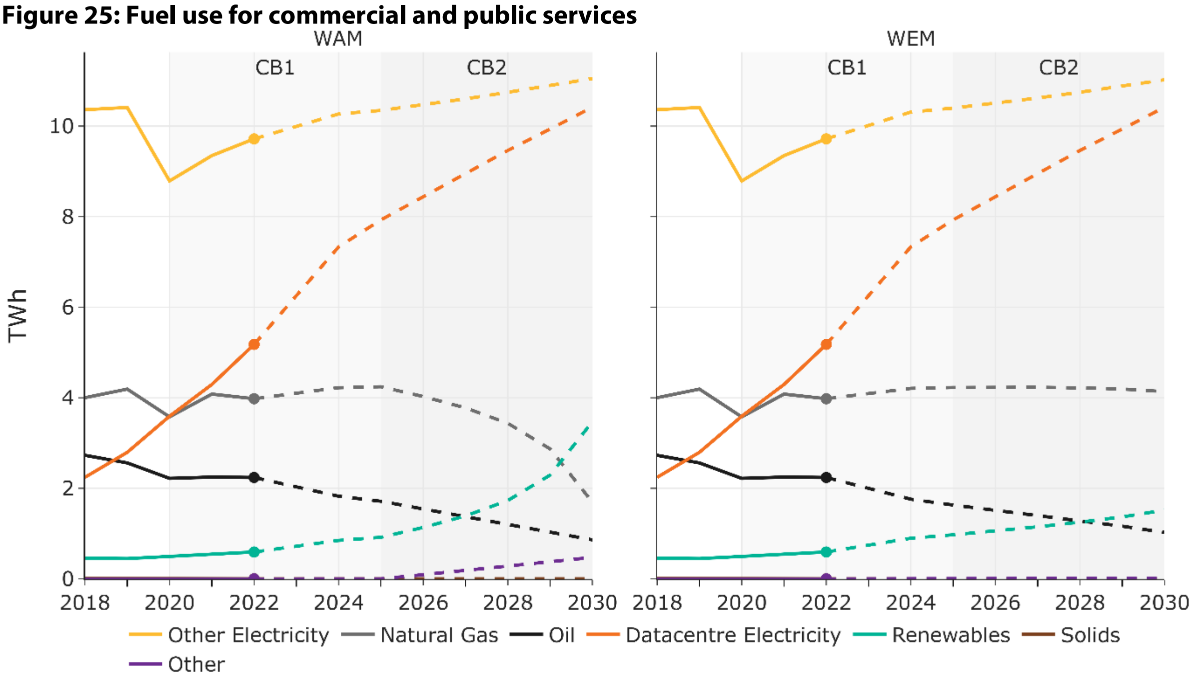
Main space heating source (number of dwellings)	2021 (CSO Census)	2030 (Projected)	
		WAM	WEM
Oil	723,000	445,506	495,045
Gas	630,000	419,122	598,700
Solid fuel	230,000	198,682	203,548
Other electricity	125,000	161,915	170,581
Heat pump	71,000	717,189	594,350
Bioenergy boiler	1,000	13,603	15,551
District heat	0	124,968	3,209
Total dwellings modelled	1,779,000	2,080,985	2,080,985

Energy use for commercial and public services sector

Figure 25 and Table 17 below show projected energy use in the commercial and public services sectors. The energy use of datacentres is accounted for under the commercial services sector but because of the expected level of growth in datacentre energy use, it is useful to consider datacentres separately. See Section 4.1.3 for discussion on projected growth in datacentre electricity use.

Excluding datacentres, electricity accounted for 59% of services energy use in 2022, fossil fuels for 38% and 4% from direct use of renewable energy.[67] The share of fossil fuels by 2030 is expected to fall to 29% in the WEM scenario and to 15% in the WAM scenario, due to higher uptake of heat pumps, district heating and increased use of biomethane in place of natural gas.

Figure 25: Fuel use for commercial and public services



[67] Given that a large share of energy use in the sector is from electricity it is worth noting again that the emissions from electricity use are not counted under services sector, as they are counted separately under the electricity sector.

Table 17: Fuel use for commercial and public services

Energy (TWh)	2022 Actual (TWh)	2030 Projected (TWh)	
		WAM	WEM
Renewables	0.6	3.5	1.5
Datacentre electricity	5.3	10.4	10.4
Other electricity	9.6	11.0	11.0
Oil	2.2	0.9	1.0
Gas	4.0	1.7	4.1
Other[68]	0.0	0.5	0.0
Total	21.7	28.0	28.1

[68] For the services sector the "Other" category consists of non-renewable wastes used for district heating and coal

Energy use in industry

In 2022, direct fossil fuel use accounted for 61% of industry energy demand, electricity 28% and renewables 9%. Renewable energy use in industry is concentrated in two industry subsectors. In 2022, 67% of industry renewable energy use was in the form of wood waste used by the wood and wood products industry, and a further 29% was in the form of biomass and renewable waste used in cement production.

Based on modelled uptake of alternative heating systems in industry, in the WEM scenario the share of fossil fuels drops to 46% by 2030. In this scenario, in 2030 electricity accounts for 34% of industry energy use and renewables for 16%.

The availability of significant quantities of biomethane results in the share of renewable energy use in industry in 2030 increasing to 31% in the WAM scenario. In this scenario, the electricity accounts for 34% of energy use. This results in the share of direct fossil fuel use in industry in 2030 reducing to 30% in the WAM scenario.

Figure 26: Fuel use in industry

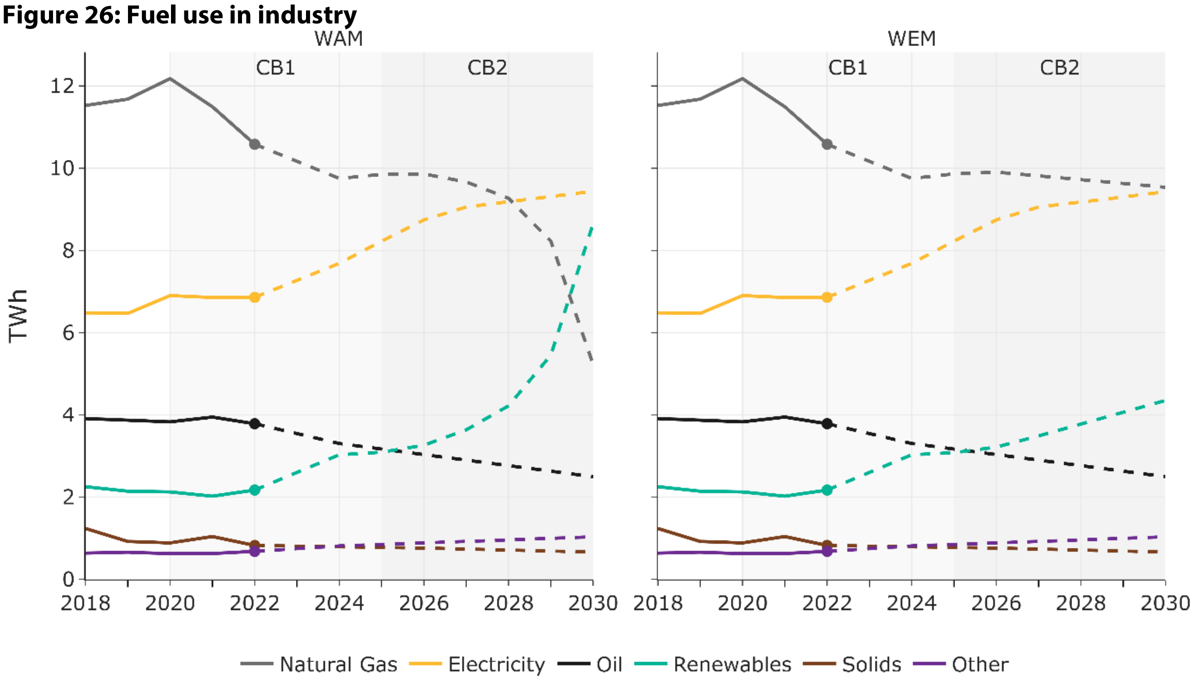


Table 18: Fuel use in industry

Energy (TWh)	2022 Actual (TWh)	2030 Projected (TWh)	
		WAM	WEM
Renewables	2.2	8.6	4.4
Electricity	6.9	9.4	9.4
Oil	3.8	2.5	2.5
Gas	10.6	5.2	9.5
Coal & peat	0.8	0.7	0.7
Other	0.7	1.0	1.0
Total	24.9	27.5	27.5

Energy use in agriculture

Although the agriculture sector is a large source of greenhouse gas emissions, the vast majority of greenhouse gas emissions from the sector result from livestock and fertiliser use, not from energy use. Energy use and the associated greenhouse gas emissions in agriculture are small in comparison to other sectors. Agriculture accounted for just 3% of energy use and energy related greenhouse gas emissions in 2022. CAP23 does not contain any policy measures directed at reducing energy use in the sector; instead the measures focus on livestock and fertiliser use.

Because of this, energy use in agriculture is modelled in less detail than the other major energy using sectors covered above. Our modelling considers decarbonisation options for energy used for heating in the agriculture sector, mostly in the pig and poultry sectors, and also energy used for cooling on dairy farms. Most of the energy use in agriculture is oil used for machinery and we do not currently model low carbon alternatives for this. The WAM scenario shows energy use in the sector increasing by 6% between 2022 and 2030 and the share of oil use remaining at approximately 86%.

For more information on the projected greenhouse gas emissions from the agriculture sector, see the latest EPA Greenhouse Gas Emissions Projections Report[69].

[69] EPA, 'Ireland's Greenhouse Gas Emissions Projections 2023-2050'. 2024. [Online]. Accessed from: https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/irelands-greenhouse-gas-emissions-projections-2023-2050.php

Appendix 2: National Greenhouse Gas Emissions Projections by sector

Greenhouse gas emissions from electricity generation

Note on recent developments on electricity imports

- The projections presented here were modelled in early 2024 based on the most recent data available up to early 2023.
- As discussed in Section 4.1.5, since April 2023 there has been a significant increase in net electricity imports across the interconnectors with the UK.
- The most recent data available up to June 2024 suggests that electricity net-imports are far higher than other years, and higher than projected in the WEM or WAM scenarios presented below.
- This trend looks set to continue for the short term until the end of CB1 and will result in lower fossil fuel use and lower GHG emissions in the electricity sector than shown in the WEM or WAM scenarios below.
- However, there is uncertainty as to whether this trend will continue in the medium to long term to 2030 and beyond.

The sectoral ceilings are also shown in Table 19[70]. If the indicative trajectory for the carbon budgets had been followed every year, emissions in 2030 would have needed to be 75% lower than in 2018. However, this indicative trajectory has already been exceeded in the first two years of CB1. Where any exceedance occurs, steeper reductions are required thereafter to compensate, leading to a larger reduction required by 2030.

Table 19: Sectoral ceilings and related indicators for electricity sector

Sectoral ceiling for electricity sector	
2018 baseline emissions (single year) ($MtCO_2eq$)	10
CB1 ceiling 2021-2025 (five-year cumulative) ($MtCO_2eq$)	40
CB2 ceiling 2026-2030 (five-year cumulative) ($MtCO_2eq$)	20
Indicative average annual % reduction required in CB1*	-4.5%
Indicative average annual % reduction required in CB2*	-19.3%
Initial indicative reduction required by 2030 (relative to 2018)*	-75%
**Assuming indicative target trajectory met in all years*	

[70] Here we use the EPA definition of what emissions are included within the electricity sector carbon budget. This comprises of the line items “Public electricity and heat production”. “Solid fuels and other energy industries” and “Fugitive emissions” from the National Greenhouse Gas Inventory and Projections.

Figure 27 shows the indicative target trajectory for cumulative electricity emissions over the first two carbon budget periods and compares this with the projected cumulative electricity emissions for the WEM and WAM scenarios. The horizontal dashed lines show the sectoral ceilings for the first two budget periods. The chart also shows the years in which the sectoral ceilings are reached in each scenario and the cumulative exceedance by the end of the second budget period in each scenario. The figures for both scenarios are summarised in Table 20.

Figure 27: Cumulative greenhouse gas emissions from electricity generation

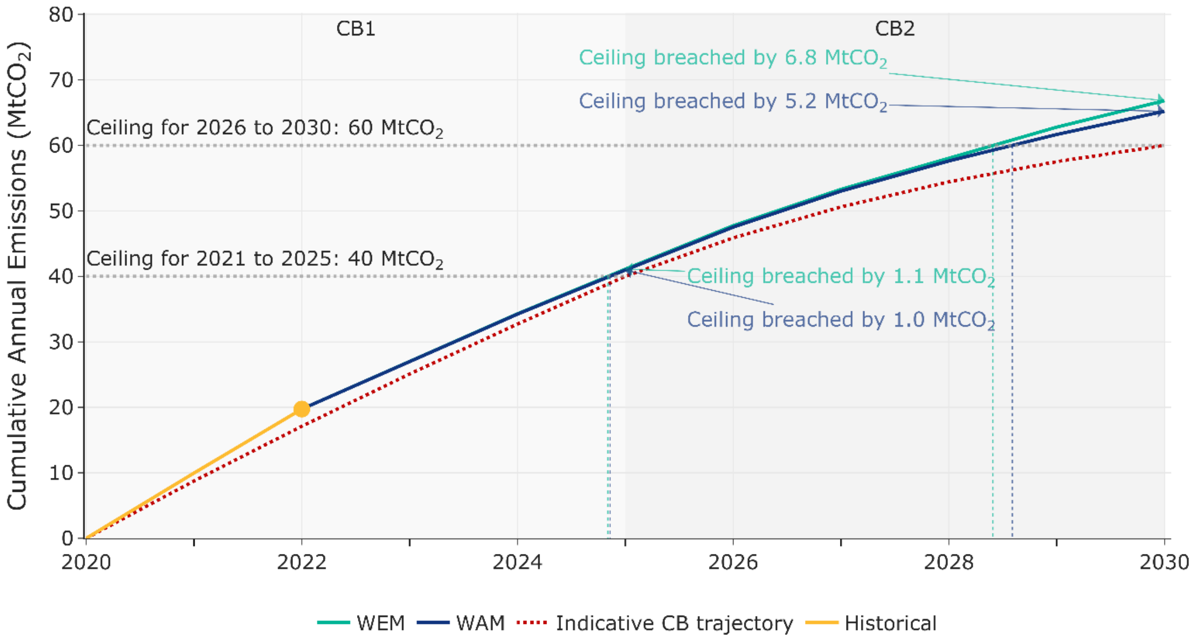


Table 20: Projected exceedance of sectoral ceiling for electricity sector

Electricity sector	WEM	WAM
Projected CB1 exceedance ($MtCO_2eq$)	1.1 (3%)	1.0 (2%)
Projected CB2 exceedance (including CB1 carry over) ($MtCO_2eq$)	6.8 (11%)	5.2 (9%)

In both the WEM and WAM scenarios, cumulative emissions reach the first sectoral ceiling during 2025, leading to an overspend of 3% and 2% respectively for CB1. The second sectoral ceiling is surpassed in 2029 in both scenarios. By the end of the CB2, the cumulative emissions are 11% and 9% over the ceiling in WEM and WAM respectively.

Figure 28 shows the *annual* emissions projected for the electricity sector for the first two carbon budget periods for WEM and WAM scenarios. It also illustrates the indicative annual emissions trajectory required to stay within the carbon budgets from 2021 to 2030. Dashed lines are used to illustrate a revised CB2 trajectory that would be required to meet the CB2 obligation if the WEM or WAM scenarios were followed in CB1. The resulting revised average annual reduction rate for CB2 and the revised total reduction by 2030 compared to the 2018 baseline are shown in Table 21.

Figure 28: Annual greenhouse gas emissions from electricity generation

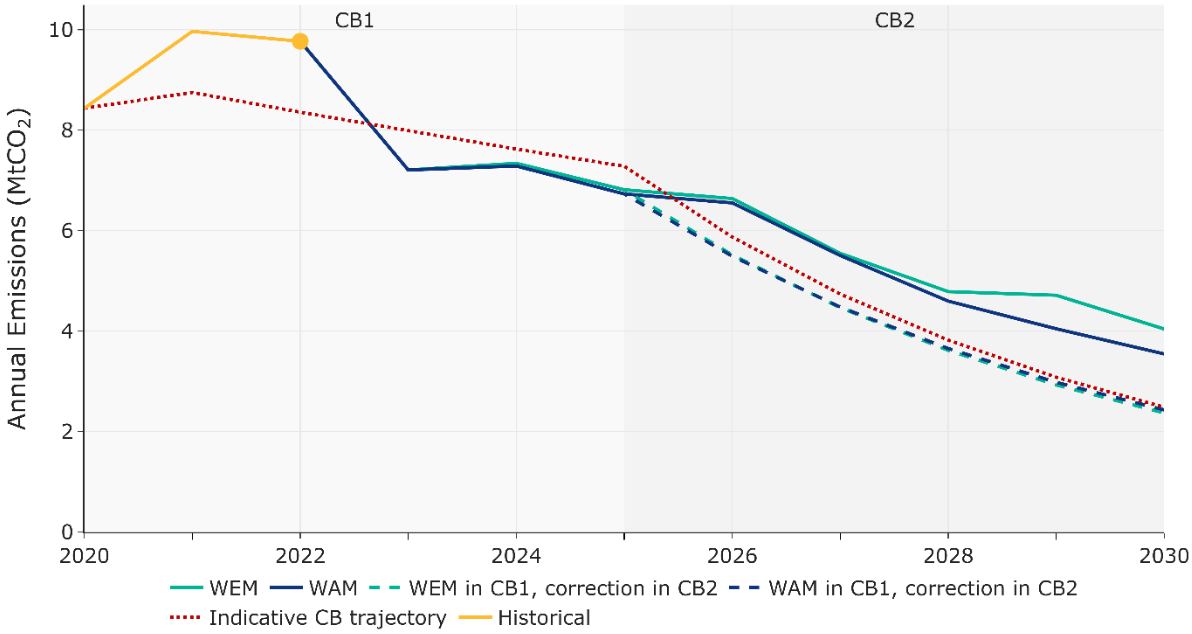


Table 21: Emissions reductions required to keep within sector ceiling for electricity sector

Electricity sector	WEM	WAM
Projected average annual change in emissions for CB1	-5.8%	-6.0%
Indicative average annual change in emissions required in CB2 to stay within the CB2 ceiling if named scenario followed in CB1	-19.0%	-18.4%
Revised indicative reduction required by 2030 compared to 2018 to stay within CB2 ceiling if named scenario followed in CB1	-77% to -83%	-76% to -82%

If the WEM or WAM trajectory is followed until 2025, greenhouse gas emissions from the electricity sector would need to fall between 76% or 83% by 2030 to keep within the CB2 sector ceiling, depending on the trajectory taken within CB2.

Greenhouse gas emissions from transport

The sectoral ceilings for transport are shown in Table 22[71]. If the indicative trajectory for the carbon budgets had been followed every year, emissions in 2030 would have needed to be 50% lower than in 2018. The transport sector was strongly affected by measures taken to combat the COVID19 pandemic in 2020 and 2021, leading to emissions from the sector falling below the target trajectory for the first target year of 2021. Since travel restrictions were lifted, however, emissions have increased. They rebounded above the target trajectory in 2022 and increased further in 2023. Where any exceedance occurs, steeper reductions are required thereafter to compensate, leading to a larger reduction required by 2030.

Table 22: Sectoral ceilings and related indicators for transport

Sectoral ceiling for transport sector	
2018 baseline emissions (single year) ($MtCO_2eq$)	12
CB1 ceiling 2021-2025 (five-year cumulative) ($MtCO_2eq$)	54
CB2 ceiling 2026-2030 (five-year cumulative) ($MtCO_2eq$)	37
Indicative average annual % reduction required in CB1*	-4.0%
Indicative average annual % reduction required in CB2*	-9.7%
Initial indicative reduction required by 2030 (relative to 2018)*	-50%
**Assuming indicative target trajectory met in all years*	

Figure 29 shows the target trajectory for *cumulative* transport emissions over the first two carbon budget periods and compares this with the projected cumulative transport emissions for the WEM and WAM scenarios. The chart illustrates the years in which the sectoral ceilings are reached in each scenario. The cumulative exceedance by the end of the second budget period is noted for each scenario in Table 23.

[71] This section does not include the emissions from electricity consumed by the sector, as those emissions are counted separately under the electricity sector.

Figure 29: Cumulative greenhouse gas emissions from transport sector

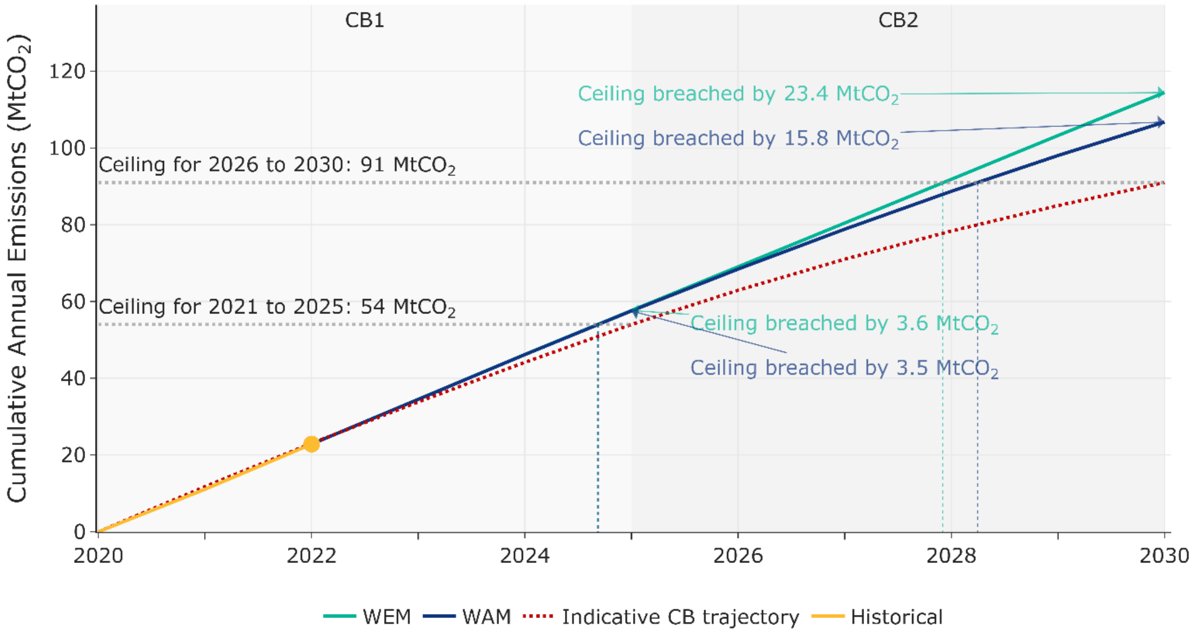


Table 23: Projected exceedance of sectoral ceilings for transport

Transport sector	WEM	WAM
Projected CB1 exceedance ($MtCO_2eq$)	3.6 (7%)	3.5 (7%)
Projected CB2 exceedance (including CB1 carry over) ($MtCO_2eq$)	23.4 (26%)	15.8 (17%)

In the WEM scenario, cumulative emissions reach the first sectoral ceiling during 2025 and overshoot by 7% by the end of 2025. This overshoot means that 10% of the CB2 budget is consumed before the CB2 period begins. The second sectoral ceiling is then breached during 2028, with exceedance reaching 26% by 2030.

The WAM scenario is very similar to the WEM up to 2025, as the higher levels of delivery assumed in this scenario only occur during CB2. The CB1 obligation is also exceeded by 7%. The second sectoral ceiling is breached in 2029, with an exceedance of 17% by 2030.

Figure 30 shows the *annual* emissions projected for the transport sector for the first two carbon budget periods for the WEM and WAM scenarios. It also illustrates the indicative annual emissions trajectory required to stay within the carbon budgets from 2021 to 2030. Dashed lines are used to illustrate a revised CB2 trajectory that would be required to meet the CB2 obligation if the WEM or WAM scenarios were followed in CB1. The resulting revised average annual reduction rate for CB2 and the revised total reduction by 2030 compared to the 2018 baseline are shown in Table 24.

Figure 30: Annual greenhouse gas emissions from transport sector

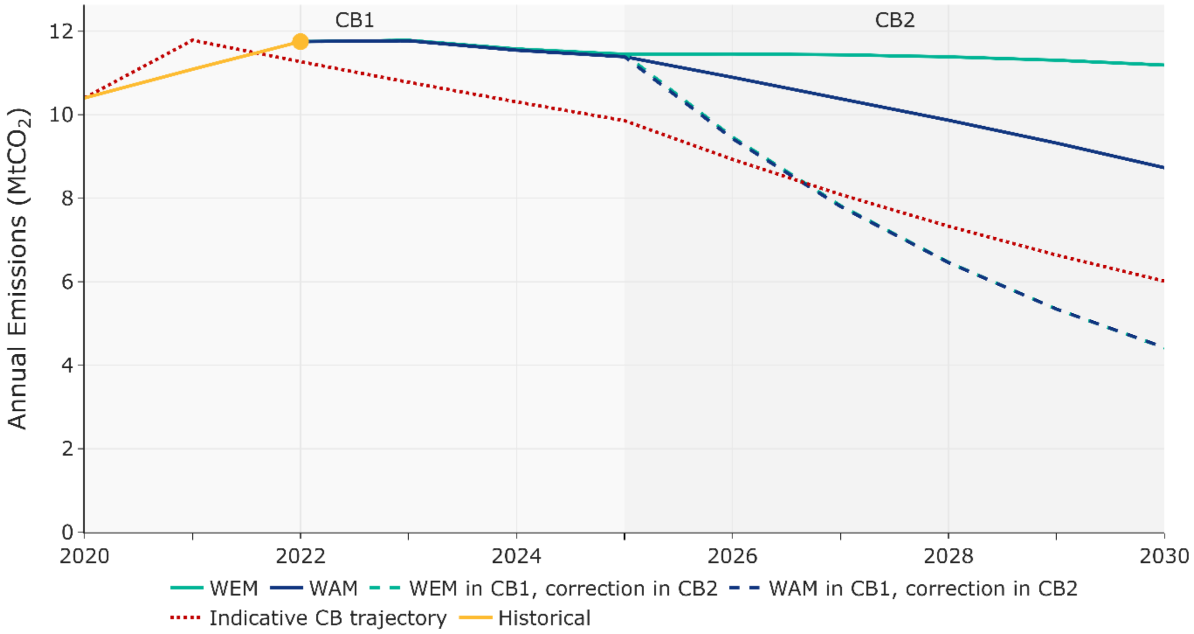


Table 24: Emissions reductions required to keep within sector ceiling for transport

Transport sector	WEM	WAM
Projected average annual change in emissions for CB1	-1.5%	-1.6%
Indicative average annual change in emissions required in CB2 to stay within the CB2 ceiling if named scenario followed in CB1	-17.3%	-17.2%
Revised indicative reduction required by 2030 compared to 2018 to stay within CB2 ceiling if named scenario followed in CB1	-64% to -71%	-64% to -71%

If transport sector greenhouse gas emissions were to follow the WEM or WAM trajectory until 2025, in order to keep within the CB2 sector ceiling, emissions would have to fall 64% to 71% below 2018 levels by 2030, depending on the trajectory followed within CB2. This would require an average annual reduction in emissions during CB2 of over 17% per annum.

Greenhouse gas emissions from the built environment

The sectoral ceilings for the residential, services, and combined residential and services built-environment sectors are shown in Table 25, below[72].

If the indicative trajectory for the carbon budgets had been followed every year, emissions from the built environment in 2030 would have needed to be 41% lower than in 2018. Where any exceedance occurs, steeper reductions are required thereafter to compensate, leading to a larger reduction required by 2030.

Table 25: Sectoral ceilings and related indicators for built environment.

Sectoral ceiling for built environment sectors	Residential	Services	Built Environment (total)
2018 baseline emissions (single year) ($MtCO_2eq$)	7	2	9
CB1 ceiling 2021-2025 (five-year cumulative) ($MtCO_2eq$)	29	7	36
CB2 ceiling 2026-2030 (five-year cumulative) ($MtCO_2eq$)	23	5	28
Indicative average annual % reduction required in CB1*	-5.4%	-3.1%	-4.9%
Indicative average annual % reduction required in CB2*	-3.9%	-9.0%	-4.9%
Initial indicative reduction required by 2030 (relative to 2018)*	-40%	-47%	-41%
**Assuming indicative target trajectory met in all years*			

Figure 31 shows the *cumulative* emissions trajectories over the first two carbon budget periods for the built environment sector for the WEM and WAM scenario. The chart illustrates the years in which the sectoral ceilings are reached in each scenario. Table 26 shows the cumulative exceedance by the end of the second budget period for each scenario.

[72] This section does not include the emissions from electricity consumed by the sector, as those emissions are counted separately under the electricity sector.

Figure 31: Cumulative greenhouse gas emissions from the built environment

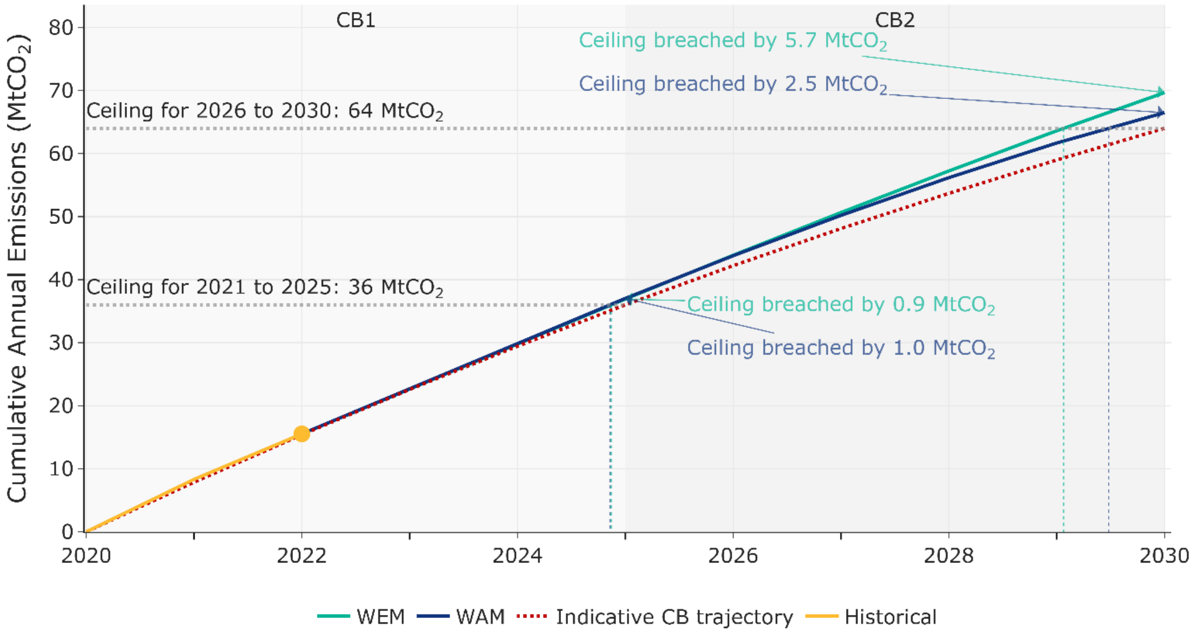


Table 26: Projected exceedance of sectoral ceilings for the built environment

Built environment sector	**WEM**	**WAM**
Projected CB1 Exceedance ($MtCO_2eq$)	0.9 (3%)	1.0 (3%)
Projected CB2 Exceedance (including CB1 carry over) ($MtCO_2eq$)	5.7 (9%)	2.5 (4%)
Built environment - residential sector	WEM	WAM
Projected CB1 Exceedance ($MtCO_2eq$)	1.0 (3%)	1.1 (4%)
Projected CB2 Exceedance (including CB1 carry over) ($MtCO_2eq$)	4.6 (9%)	2.5 (5%)
Built environment - commercial and public services sector	WEM	WAM
Projected CB1 Exceedance ($MtCO_2eq$)	-0.1 (-1%)	0.0 (0%)
Projected CB2 Exceedance (including CB1 carry over) ($MtCO_2eq$)	1.1 (9%)	0.0 (0%)

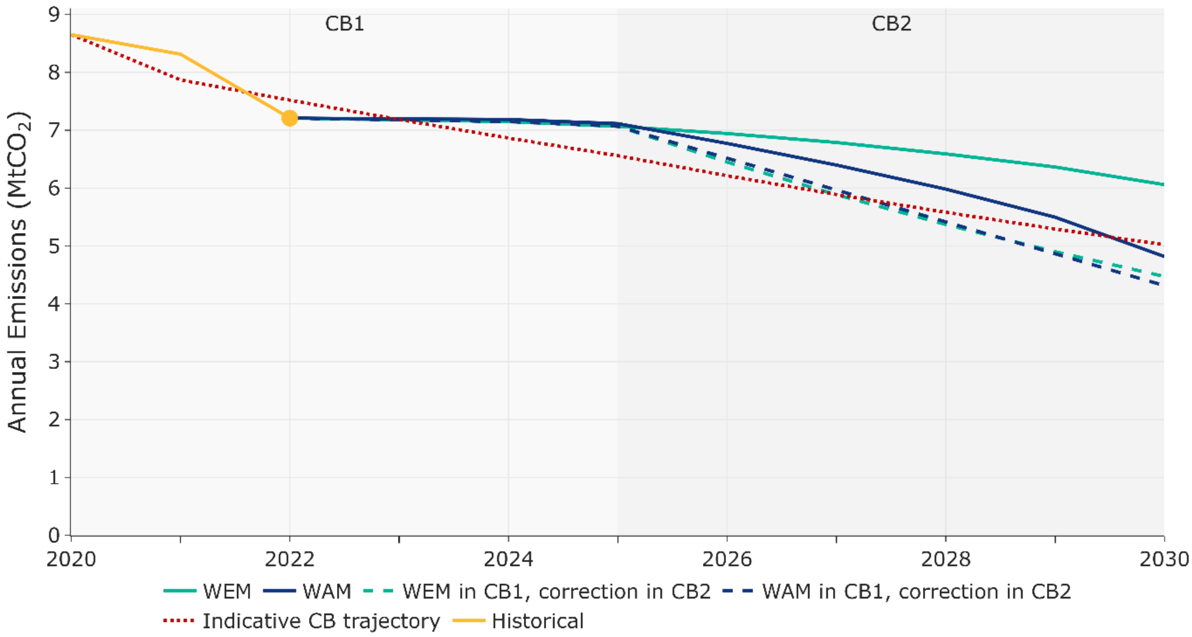
There is little difference between the WEM and WAM built environment sector emissions in the years 2021-2026. It is not until after 2026 that the trajectories diverge significantly, corresponding to the assumed large scale roll-out of district heating and biomethane in the WAM scenario.

In the WEM and WAM modelled scenarios, the CB1 ceiling for the built environment is expected to be exceeded by 0.9 $MtCO_2eq$ (3%) and 1.0 $MtCO_2eq$ (3%) respectively[73]. This corresponds to 3% and 4% of the built environment CB2 budget respectively. Both WEM and WAM modelled scenarios breach the CB2 ceiling for the built environment in 2030, exceeding it by 5.7 $MtCO_2eq$ (9%) and 2.5 $MtCO_2eq$ (4%) respectively.

Of all the energy sectors, the built environment shows the lowest percentage exceedance of CB2 in both WEM and WAM scenarios. This reflects the weight of policy focus on this sector, particularly on the residential sector.

Figure 32 illustrates the *annual* emissions trajectories for the first two carbon budget periods for the built environment sector (residential sector plus commercial and public services sectors) as modelled in the WEM and WAM scenarios. It also shows the indicative annual emissions trajectory required to stay within the carbon budgets from 2021 to 2030. Dashed lines are used to illustrate a revised CB2 trajectory that would be required to meet the CB2 obligation if the WEM or WAM scenarios were followed in CB1. The resulting revised average annual reduction rate for CB2 and the revised total reduction by 2030 compared to the 2018 baseline are shown in Table 27.

Figure 32: Annual greenhouse gas emissions from the built environment



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[73] The built environment sector is unusual in that the WAM scenario shows slightly higher emissions in CB1 than the WEM. This is because in the WAM scenario a higher number of dwellings are earmarked for switching to district heating. These dwellings are assumed not to take up alternative decarbonisation options available in CB1 and instead wait until district heating is assumed to be available later in the decade. This leads to slightly higher emissions in CB1, but lower emissions in the CB2.

Table 27: Emissions reductions required to keep within sector ceiling for the built environment

Built environment sector	WEM	WAM
Projected average annual change in emissions CB1	-3.0%	-2.9%
Indicative average annual change in emissions required in CB2 to stay within the CB2 ceiling if named scenario followed in CB1	-8.7%	-9.1%
Revised indicative reduction required by 2030 compared to 2018 to stay within CB2 ceiling if named scenario followed in CB1	-47% to-49%	-49% to -50%
Built environment - residential sector	**WEM**	**WAM**
Projected average annual change in emissions CB1	-3.0%	-3.0%
Indicative average annual change in emissions required in CB2 to stay within the CB2 ceiling if named scenario followed in CB1	-8.8%	-9.0%
Revised indicative reduction required by 2030 compared to 2018 to stay within CB2 ceiling if named scenario followed in CB1	-48%	-48%
Built environment - commercial and public services sector	**WEM**	**WAM**
Projected average annual change in emissions CB1	-3.0%	-2.6%
Indicative average annual change in emissions required in CB2 to stay within the CB2 ceiling if named scenario followed in CB1	-9.5%	-10.5%
Revised indicative reduction required by 2030 compared to 2018 to stay within CB2 ceiling if named scenario followed in CB1	-48%	-50%

If built environment greenhouse gas emissions were to follow the WEM or WAM trajectory until 2025, in order to stay within the CB2 sector ceilings, emissions would have to fall 47% or 49% below 2018 levels by 2030 respectively.[74] This would require an average annual reduction in emissions during CB2 of 8.7% per annum in the WEM scenario and 9.1% in the WAM scenario.

[74] Assuming a geometric reduction trajectory. The final reduction required would depend on the trajectory taken within CB2. If the WEM or WAM trajectory were followed until 2025 and emissions were to then follow a linear reduction trajectory in CB2, then total greenhouse gas emissions would need to fall by 49% or 50% respectively by 2030 to keep within the second carbon budget.

Greenhouse gas emissions from industry

Industry emissions comprise two components: emissions from fossil fuel combustion for energy use (referred to as "Manufacturing Combustion" emissions in the National Greenhouse Gas Inventories); and process emissions such as those from mineral and chemical industries. The sectoral ceiling for industry covers both components[75].

The sectoral ceilings for industry are shown in Table 28 below.

If the indicative trajectory for the carbon budgets had been followed every year, emissions in 2030 would have needed to be 35% lower than in 2018. However, this indicative trajectory has already been exceeded in the first two years of CB1. Given this exceedance in early years, steeper reductions are required for the remaining years of the CB1 period and CB2 periods, leading to a larger percentage reduction required by 2030.

Table 28: Sectoral ceilings and related indicators for industry

Sectoral ceiling for industry sector (including process emissions)	
2018 baseline emissions (single year) ($MtCO_2eq$)	7
CB1 ceiling 2021-2025 (five-year cumulative) ($MtCO_2eq$)	30
CB2 ceiling 2026-2030 (five-year cumulative) ($MtCO_2eq$)	24
Indicative average annual % reduction required in CB1*	-4.4%
Indicative average annual % reduction required in CB2*	-4.4%
Initial indicative reduction required by 2030 (relative to 2018)*	-37%
**Assuming indicative target trajectory met in all years*	

Figure 33 shows the *cumulative* emissions trajectories over the first two carbon budget periods for the WEM and WAM scenarios. The chart illustrates the years in which the sectoral ceilings are reached in each scenario. Table 29 shows the cumulative exceedance by the end of the second budget period for each scenario.

[75] This section does not include the emissions from electricity consumed by the sector, as those emissions are counted separately under the electricity sector.

Figure 33: Cumulative greenhouse gas emissions from manufacturing combustion and industrial process emissions

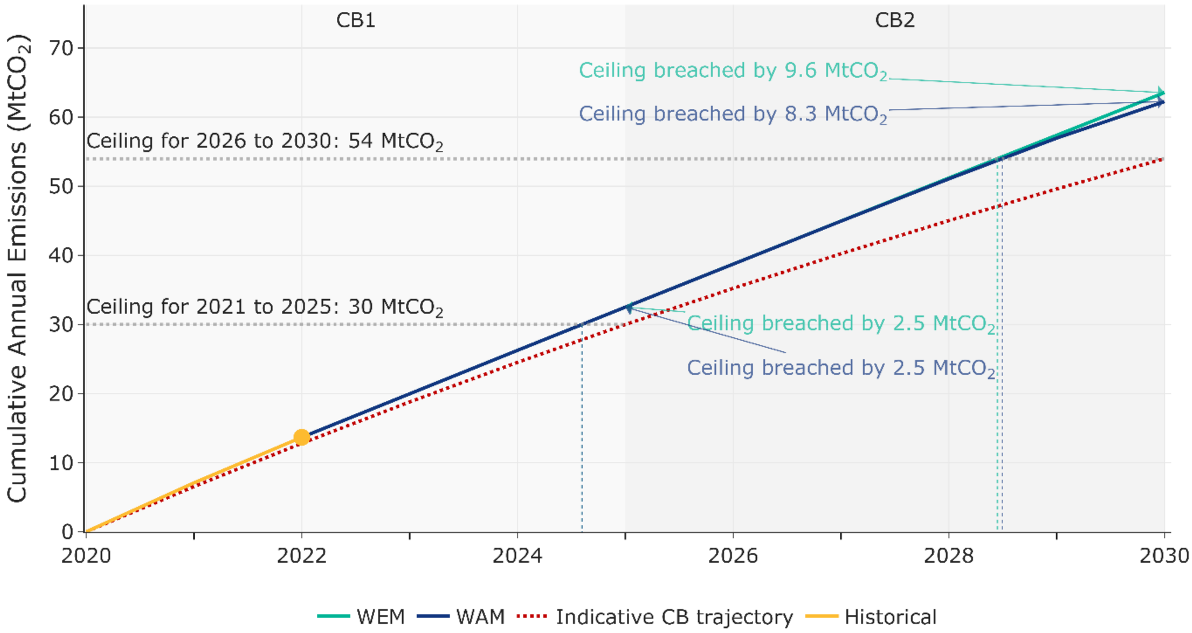


Table 29: Projected exceedance of sectoral ceilings from manufacturing combustion and industrial process emissions

Industry sector	WEM	WAM
Projected CB1 exceedance ($MtCO_2eq$)	2.5 (8%)	2.5 (8%)
Projected CB2 exceedance (including CB1 carry over) ($MtCO_2eq$)	9.6 (18%)	8.3 (15%)

In the WEM modelled scenario, industry emissions show little reduction over the 2021-2030 period. In this scenario, the CB1 ceiling is crossed during 2025 and is exceeded by 8% by 2025. This overshoot means that 10% of the CB2 budget is consumed before the CB2 period begins. The second sectoral ceiling is then breached during 2029, with exceedance reaching 18% by 2030.

For the WAM scenario, the CB1 trajectory remains close to the WEM scenario up until the year 2029, when annual emissions drop, due to the assumed ramp up of biomethane displacing gas in manufacturing. Because this reduction happens so late in the time period, it makes only a small difference to the cumulative emissions total. The projections indicate that in this scenario, the CB2 ceiling could be breached in 2029 and exceeded by 15% by 2030.

Figure 34 shows the *annual* emissions projected for the industry sector for the first two carbon budget periods for the WEM and WAM scenarios. It also illustrates the indicative annual emissions trajectory required to stay within the carbon budgets from 2021 to 2030. Dashed lines are used to illustrate a revised CB2 trajectory that would be required to meet the CB2 obligation if the WEM or WAM scenarios were followed in CB1. The resulting revised average annual reduction rate for CB2 and the revised total reduction by 2030 compared to the 2018 baseline are shown in Table 30.

Figure 34: Annual greenhouse gas emissions from manufacturing combustion and industrial process emissions

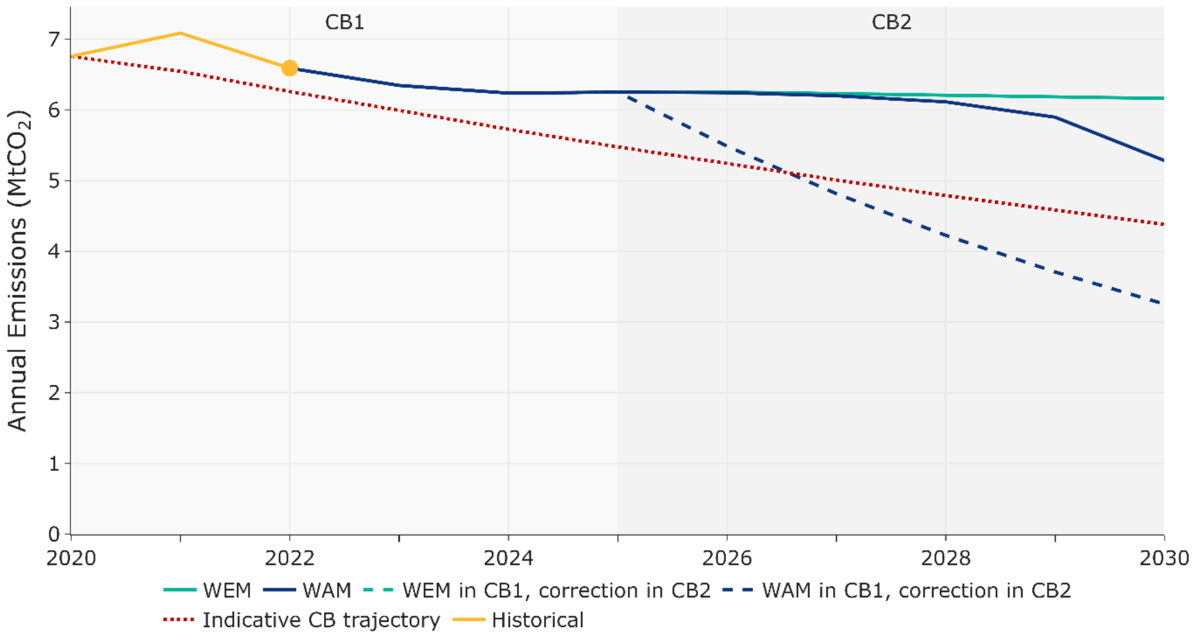


Table 30: Emissions reductions required to keep within sector ceiling for manufacturing combustion and industrial process emissions

Industry sector	WEM	WAM
Projected average annual change in emissions for CB1	-1.8%	-1.8%
Indicative average annual change in emissions required in CB2 to stay within the CB2 ceiling if named scenario followed in CB1	-12.3%	-12.2%
Revised indicative reduction required by 2030 compared to 2018 to stay within CB2 ceiling if named scenario followed in CB1	-53% to -57%	-53% to -57%

If industry greenhouse gas emissions were to follow the WEM or WAM trajectory until 2025, in order to stay within the CB2 sector ceiling, emissions would have to fall 53% below 2018 levels by 2030 [76]. This would require an average annual rate of reduction in emissions of over 12% per annum during CB2.

Table 31 shows the breakdown of emissions trajectories split across the two components of industry emissions, after the anticipated impact of policies and measures applying in each scenario are modelled. Part of the difficulty for industry is the continued growth in process emissions over the timeframe. This growth offsets the reductions made in manufacturing combustion.

Table 31: Projected annual change in industry combustion and process emissions

Industry sector	Projected change in emissions 2018-2030 (WEM)	Projected change in emissions 2018-2030 (WAM)
Manufacturing Combustion	-19%	-38%
Process	+4%	+4%
Industry Total	-12%	-24%

[76] Assuming a geometric reduction trajectory. The final reduction required would depend on the trajectory taken within CB2. If the WEM or WAM trajectory were followed until 2025 and emissions were to then follow a linear reduction trajectory in CB2, then total greenhouse gas emissions would need to fall by 57% by 2030 to keep within the second carbon budget.

Appendix 3: Policy input assumptions for National Energy Projections

Electricity

Main assumptions for RES-E and variable renewable installed capacities

	WEM	WAM	CAP24
RES-E	~70% by 2030	2030 RES-E target (rather than installed capacity targets) from CAP24 modelled	2025: 50% 2030: 80%
Onshore Wind	2025: 5.6 GW 2030: 6.8 GW Derived from best estimate trajectory with some delay assumed	2025: 5.8 GW 2030: 7.2 GW Assumed best estimate trajectory	2025: 6 GW 2030: 9 GW
Offshore Wind	2025: 0.03 GW 2030: 2.7 GW Derived from best estimate trajectory with some delay assumed	2025: 0.03 GW 2030: 4 GW Assumed best estimate trajectory	2030: at least 5 GW
Solar PV	2025 2.2 GW 2030 5.7 GW Assumed best estimate trajectory	2025: 2.2 GW 2030: 6.5 GW Derived from best estimate trajectory, with additional rooftop solar PV in comparison to WEM	2025: up to 5 GW 2030: 8 GW

Main assumptions for conventional generation

	WEM	WAM	CAP 24
Coal	Assume Moneypoint shut down by end of 2029, with primary fuel switching to heavy fuel oil (HFO) by end of 2025 (Source: CRU, Retention of Moneypoint Units [77])	Same as WEM	Phase out and end the use of coal and peat in electricity generation
Peat	Assume Edenderry ED1 100% biomass 2024-2030 and closed thereafter (Source: EirGrid and SONI, GCS2023-2032[34])	Same as WEM	Phase out and end the use of coal and peat in electricity generation
Heavy Fuel Oil	Assume all 592 MW capacity shut down by 2023 (Source: EirGrid and SONI, GCS2023-2032[34])	Same as WEM	N/A
Distillate Oil	Assume all 324 MW capacity shut down by 2035 due to reaching end of life Edenderry gas turbine units switch to natural gas in 2026 (Source: EirGrid and SONI, GCS2023-2032[34])	Same as WEM	N/A
New Gas	Assumed net addition of 1.3 GW of gas capacity:1.4 GW new capacity – 0.09 GW plant closure by 2030 (Source: EirGrid and SONI, GCS2023-2032[34], “risk-adjusted” capacity)	Same as WEM	2030: at least 2 GW of new flexible gas-fired generation

[77] CRU, ‘Security of Electricity Supply – Retention of Moneypoint Units (MP1, MP2 & MP3)’. Oct 2023. [Online]. Accessed from: https://cruie-live-96ca64acab2247eca8a850a7e54b-5b34f62.divio-media.com/documents/Security_of_Electricity_Supply_Retention_of_Moneypoint_Units_Information_Paper.pdf

Main other electricity assumptions

	WEM	WAM	CAP 24
Zero-carbon Gas	Hydrogen: 0 TWh Biomethane: 0 TWh Note: see Section 0 for Biomethane assumptions	Same as WEM	2031-2035: 2 GW of offshore wind dedicated to producing green hydrogen
Interconnection, Flexibility and Storage	Interconnection: Greenlink (01/01/2025) 500MW; North-South (01/01/2027) 1350 MW; Celtic (01/01/2027) 700MW; MARES (01/01/2031) 750 MW DSU: 745 MW by 2030 (Source: EirGrid and SONI, GCS2023-2032[34]) Energy Storage: 1GW with fleet weighted average duration of 1.7 hrs by 2030 (Source: EirGrid and SONI, GCS2023-2032[34])	Interconnection: same as WEM DSU: same as WEM Energy Storage: 1.8 GW with 3.3 hr fleet weighted average duration by 2030; includes 400 MW of 8-hr storage	2025: Required long term storage (4 hrs plus) in place 15-20% demand-side flexibility 2030: Required additional long-term storage (4 hour plus) in place 20-30% demand-side flexibility
Other generation	No growth in CHP, hydro, waste to energy No ocean energy	No growth in CHP, hydro, waste to energy No ocean energy until after 2030	N/A
Large energy users	EirGrid Median datacentre and new technology demand forecast modelled	Same as WEM	Zero carbon demand growth

Transport

Main assumptions for transport activity demand and the impact of avoid shift measures

	WEM	WAM	CAP 24
'Avoid' (Reduction in ICE Vkm) & 'Shift' (behavioural and sustainable transport)	Activity of private cars and goods vehicles based on NTA's Reference Case scenario WEM does not include the impact of the basket of demand reduction measures that were modelled by NTA to illustrate a pathway to achieving 20% reduction in road transport activity targeted in CAP23.	Activity of private cars and goods vehicles based on the NTA's Reference Case scenario plus the impacts of a selection of demand reduction measures taken from a basket of measures that the NTA modelled to illustrate a pathway to achieving the 20% reduction in road-transport activity targeted in CAP23. Not all of the measures modelled by the NTA were included in the WAM, resulting in 12% reduction in total private car kms.	2030 'Avoid' measures: 20% reduction in total vehicle kms 20% reduction in total car kms 20% reduction in commuting car kms 50% reduction in fuel usage To be achieved by 'shift' (behavioural and sustainable transport measures): • 50% increase in daily active travel journeys • 130% increase in daily public transport journeys • 25% reduction in daily car journeys • Shift in Daily Mode Share - 2018: 72% car, 8% public transport, 20% active travel - 2030: 53% car, 19% public transport, 28% active travel • 30% shift of all escort to education car journeys to sustainable modes

Main assumptions for biofuels and electric vehicles

	WEM	WAM	CAP 24
Biofuels	Based on 2021 Policy statement, 2025: E10 and B12 2030: E10 and B12	2025: E10 and B12 2030: E10 and B20	2025: E10 and B12 2030: E10 and B20
Electric Vehicles	EVs increase to following levels in 2030: Total EVs: 742,569 Car EVs: 693,319 (29% total stock) Car BEV: 430,296 Car PHEV: 263,023 LGV EVs: 47,500 LGV BEV: 23,750 LGV PHEV: 23,750 PHEV HGV BEVs: 1,750 No new ICE car or LGV sales post-2035	EVs increase to following levels in 2030: Total EVs: 943,656 Car EVs: 845,156 (35% total stock) Car BEV: 573,775 Car PHEV: 271,381 LGV EVs: 95,000 LGV BEV: 71,250 LGV PHEV: 23,750 PHEV HGV BEVs: 3,500 100% new car sales EV by 2030	EVs increase to following levels in 2030: Car EV: 845,000 LGV EVs: 95,000 HGV BEVs: 3,500

Main other transport assumptions

	WEM	WAM	CAP 24
Alternative Fuel Vehicles	150 Compressed Natural Gas (CNG) vehicles by 2030 from the National Policy Framework.	WEM Plus: 100% of CNG assumed to be from Biomethane, i.e. direct use of AD biomethane assumed.	Advance PSO electric bus fleet procurement, including depot charging upgrades. Ongoing delivery of Destination Charge Point Scheme – including sports clubs and community facilities. Implement the measures in the Renewable Transport Fuel Policy Statement 2023-2025.
Energy Efficiency in Transport	Real world data has shown improvements in technical energy efficiency of ICE vehicles have largely been cancelled out by shift to larger and heavier vehicles over past 10 years. Assumed no improvement in ICE efficiency apart from effects of switching to more efficient BEV and PHEV vehicles.	Same as WEM	Review financial and taxation incentives to further the transition of energy efficient vehicle fleets, considering actions to support and deliver a just and equitable EV transition.

Built environment and enterprise

Baseline demand and SSRH

	WEM	WAM	CAP 24
Projected Demand	Underlying growth in demand based on ESRI I3E macro projection for industry, services and agriculture sectors. For residential, demand based on bottom-up estimate using baseline demand on existing stock from NEMF archetype model with additional demand allowed for new builds, New builds aligned with Central Bank forecasts 2023-2025 then interpolated to Housing for All projections to 2030; post-2030 based on high-migration scenario from ESRI paper. 0.2% obsolescence assumed	Same as WEM	KPI: Reduction of demand due to energy efficiency responses to mitigate reliance on fossil fuels. KPI post-2030: Embedding of sustained reductions in household heat demand.
Support Scheme for Renewable Heat (SSRH)	Current SSRH tariffs simulated to 2034 (modelling supports to newcomers until 2034) Assume >1MW users and ETS archetypes excluded until 2025	Current SSRH tariffs simulated to 2050 Eligibility as in WEM	Target: 70-75% share in renewable heating Action: Implement revised SSRH

District Heating

	WEM	WAM	CAP 24
District Heating	Based on expected completion of schemes currently under development. Flat thereafter. Tallaght – scheme already operating and looking to expand. Based on discussions with CODEMA, assume: increasing to 10.0GWh by end 2026, 30GWh by 2030. Dublin City – hitting delays but looking to complete by 2030; Assume linear increase from 0 GWh in 2025 to 45 GWh in 2030 and 106 GWh by 2040. 75 GWh total 2030 (0.03% of target)	WEM trajectory to 2025 (8.5 GWh) then ramp up to CAP target (2.7 TWh) to 2030. 2.7TWh - Total district heating target (1.2 residential, 1.5 commercial and public services)	2025: Up to 0.8 TWh of district heating installed capacity (Residential 0.7 and commercial/public services 0.1). 2030: Up to 2.7 TWh District Heating (1.5 residential, 1.2 commercial and public services).

Biomethane

	WEM	WAM	CAP 24
Biomethane	0 TWh - evidence of implementation meeting requirements for WEM not available at time of projections.	Assume 5.7 TWh of Biomethane delivered in 2030 as per CAP23 target. (Exponential growth with capacity trebling every year from 2025 to 2030 to achieve target.) Assume all gas used in road transport is biomethane (small amount by 2030) and remaining biomethane split between industry, commercial and public services.	2025: Ag-based supply chain where target is ‘up to’ 1TWh biomethane production. 2030: Ag-based supply chain where target is ‘up to’ 5.7 TWh biomethane production. CAP24 indicated use across heat sector (res, comm/public services, industry.

Domestic Heat Pumps and Residential Energy Efficiency Programmes

	WEM	WAM	CAP 24
Domestic Heat Pumps	Feb 2022 grant rates modelled until 2030 Assume no new oil boilers (from 2022) or gas boilers (from 2025) in new dwellings, based on building regulations.	NEMF modelled heat pump uptake in existing homes as per CAP targets via assumed increase in supports. 'Effective' ban on boilers post-2031 in existing dwellings assumed (public from 2031, commercial from 2034 and industry and agriculture from 2035).	2025: 45,000 heat pumps in existing homes 170,000 heat pumps in new builds 2030: 400,000 heat pumps in existing homes 280,000 heat pumps in new builds Advancing energy and carbon performance requirements of Building Regulations.
Residential Energy Efficiency Programmes	Feb 2022 grant rates modelled until 2030	NEMF modelled retrofit uptake as per CAP targets via assumed increase in supports. Assume cost-optimal savings achieved tracking before and after measures taken up (refinement of B2 equivalent methodology in progress).	2025: Equivalent of 120,000 dwellings retrofitted to BER B2 or cost optimal equivalent 2030: Reaching 500,000 dwellings

Other Energy Efficiency Programmes

	WEM	WAM	CAP 24
Public Sector Energy Efficiency Programmes	Current levels of Community Energy and EXEED grants assumed to continue until 2030. Mandatory energy audits for large organisations.	As in WEM	See District Heating measure See Heat Pump measure See Biomethane measure See Carbon-Neutral Heating measure
Commercial Sector Energy Efficiency Programmes	Current levels of Community Energy and EXEED grants until 2030. Mandatory energy audits for large organisations.	Current levels of Community Energy and EXEED grants until 2033 (i.e. the year before effective ban on new fossil fuel boilers in existing buildings is assumed to come into force) Energy audits as in WEM	See Biomethane measure See Carbon-Neutral Heating measure

Other Energy Efficiency Programmes (continued)

	WEM	WAM	CAP 24
Energy Efficiency Obligation Scheme	Assume 2021 level of savings (that are uniquely attributable to EEOS) continues until 2030.	Assume 60% of Article 8 target will be met through EEOS. (See CAP21 Section 14.2.8 EEOS)	
Building Regulations	All new buildings are NZEB	All new buildings NZEB by 2025. All new buildings ZEB by 2030. (ZEB =new standard which does not cause any on-site carbon emissions from fossil fuels.)	All new buildings NZEB by 2025. All new buildings ZEB by 2030.
Embodied carbon in construction	N/A	Not currently modelled as there is no agreed method for measuring yet. Ultimately, any reduction in cement production will be reflected in the fuel numbers and this is how the saving will be represented in the projections.	2025: Decrease by 10% for materials produced and used in Ireland 2030: Decrease by 30% for materials produced and used in Ireland

Other Energy Efficiency Programmes (continued)

	WEM	WAM	CAP 24
Carbon neutral heating in industry	Modelled implicitly - growth in RES-H is an outcome of the model depending on demand growth and the assumptions on individual renewable heat sources.	Uptake of renewable heating technologies based on SEAI's uptake modelling rather than hard-coding the targets until there is a direct measure to apply in input assumptions. In WAM scenario, share of low carbon energy in industry (electricity + renewables, incl. biomethane) is 67%	2025: 50-55% share in carbon neutral heating 2030: 70-75% share of carbon neutral heating in total fuel demand
Construction Materials and Carbon Capture and Storage (CCS)	N/A	Manufacturing combustion emissions - any reduction in cement production will be reflected in fuel numbers. Industrial processes - from discussions with the cement industry there is no pathway to achieve clinker reduction yet. Projections calculated using growth trajectory provided by industry - 4.7MT cement by 2030 (or 4.07Mt clinker) and flatlined to 2050. The inventory shows that maximum output from the cement industry was 4.4MT (2006/2007).	2025: Decrease by 10% for materials produced and used in Ireland. Products substitution and reduction of clinker content in cement. 2030: Decrease by at least 30% for materials produced and used in Ireland. Products substitution and reduction of clinker content in cement.

Appendix 4: Ireland's national climate and energy targets

In 2021, the Government adopted Ireland's 'Climate Action and Low Carbon Development (Amendment) Act' to support the national transition towards a green economy. This act established a legally binding framework, embedding explicit decarbonisation obligations into Irish law. In line with international consensus, the Act sets the 'National Climate Objective' which aims to see Ireland achieve a climate neutral economy no later than 2050.

To realize the ambition, the Act requires the Government to set a series of legally binding, five-year, economy-wide carbon budgets. These carbon budgets draw focus into the 2020-2030 timeframe. The carbon budgets are proposed by the Climate Change Advisory Council, finalised by the Minister for the Environment, Climate and Communications, and approved by Government. The budgets cover all sectors of the Irish economy, including the energy and non-energy sectors of agriculture and LULUCF[78], setting a limit on the total cumulative emissions that can occur within each budgeting period.

The first carbon budget programme is made up of three successive budgeting periods: 2021-2025 (CB1), 2026-2030 (CB2) and 2031-2035(CB3). The budgets for the first two periods are aligned with an in-year decarbonisation obligation of 51% reduction by 2030, in comparison to 2018 emissions. The third budgeting period remains provisional at the time of this report. The budgets are measured in $MtCO_2eq$[79] and structured so that 'exceedance' in any budgeting period must be carried forward, effectively reducing the budget for the subsequent period. The budgets are shown in Table 32.

Table 32: Carbon budgets

	2021-2026 (CB1) ($MtCO_2eq$)	2026-2030 (CB2) ($MtCO_2eq$)	2031-2035 (CB3) ($MtCO_2eq$)
Budget	295	200	151
Indicative per annum reduction[80]	4.8%	8.3%	3.5%

The burden of decarbonisation has been apportioned across the economy in the form of sectoral emissions ceilings for the following sectors: industry, electricity, transport, built environment, agriculture, LULUCF, and other[81]. A sector ceiling for LULUCF emissions remains to be determined. As such, compliance with currently defined sectoral ceilings may not ensure compliance with the overall carbon budget.

The sectoral ceilings represent the maximum emissions allowable within each sector to keep both within the carbon budget and 2030 decarbonisation obligations. While any exceedance of the carbon budget must be carried forward into the next budgeting period, exceedance of a sectoral ceiling is not necessarily carried forward within that sector. It may be possible for an exceedance within one sector for a budgeting period to be redistributed across other sectors at the onset of the next period. However, for the purpose of the analysis presented in this report, it is assumed that exceedance in any sector rolls forward within that sector. The sectoral ceilings are shown in Table 33.

[78] LULUCF stands for Land Use, Land Use Change, and Forestry
[79] Mega-tonnes of Carbon Dioxide Equivalent. This unit accounts for all greenhouse gases by relating their global warming potential to the impact of one unit mass of carbon dioxide.
[80] Indicative per annum reduction percentages applicable if each year is on trajectory. These will increase as a result of underperformance in early years of carbon budgets.
[81] The Other sector includes emissions from Waste, F-Gases, and Petroleum refining.

Table 33: Sectoral emissions ceilings

Sector	Sectoral Emissions Ceiling CB1 ($MtCO_2eq$)	Sectoral Emissions Ceiling CB2 ($MtCO_2eq$)
Electricity	40	20
Transport	54	37
Buildings (Residential)	29	23
Buildings (Commercial and Public)	7	5
Industry	30	24
Agriculture	106	96
LULUCF	Undetermined	Undetermined
Other	9	8

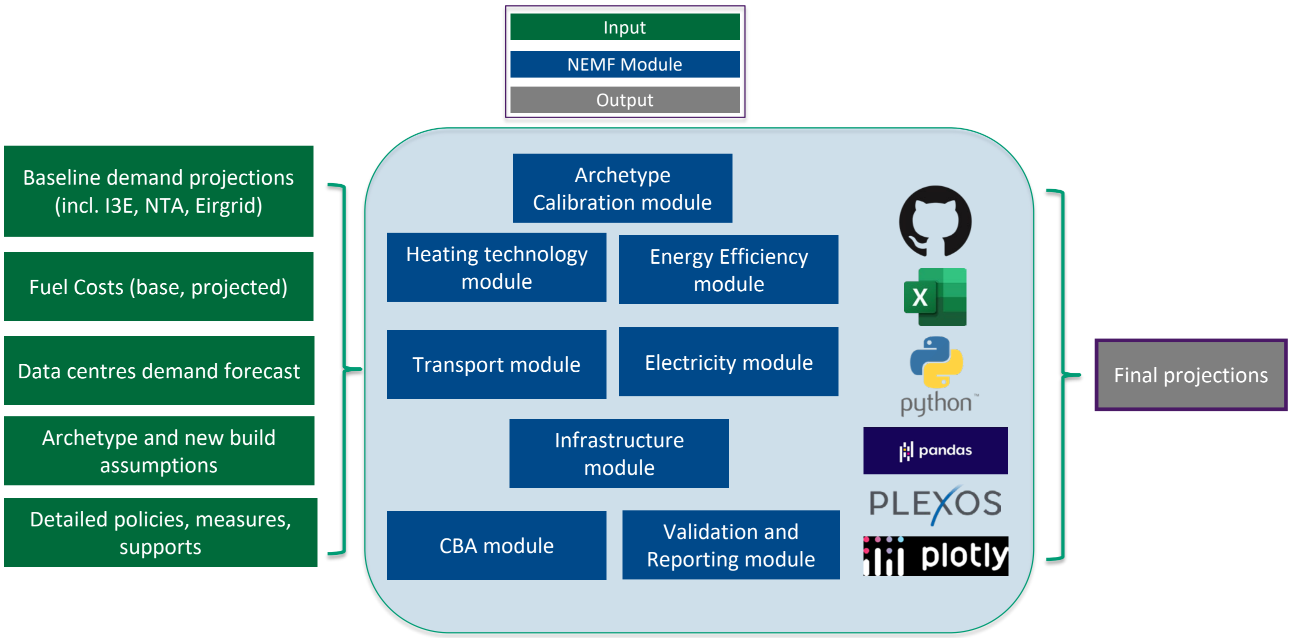
The Low Carbon Development Act requires the Government to produce a Climate Action Plan (CAP), detailing all policies and measures which will be deployed to reach the decarbonisation obligations. The Government is also required to review and update the CAP every year. As the CAP specifies actions to be taken within all sectors, and must be consistent with the carbon budgets, it represents the definitive reference document for Government decarbonisation policy.

When publishing the sectoral emissions ceilings, indicative 2030 in-year emissions reductions for each sector were also published for illustrative purposes. These values are estimated as a reduction in comparison to 2018 emissions. However, these in-year values assume that the indicative carbon budget trajectory is met each year. Given the cumulative nature of carbon budgets, if a sector exceeds the initial assumed trajectory in any year, the indicative 2030 emissions target would need to be further reduced to maintain a compliant trajectory.

Appendix 5: Ireland's National Energy Modelling Framework (NEMF)

The National Energy Modelling Framework (NEMF), developed and maintained by SEAI, is a full national energy-economy model that is used to assess the impacts of packages of energy policies and measures on future energy supply and demand. It combines several SEAI sectoral models to produce policy-rich outlooks for the whole energy system.

A high-level outline of NEMF inputs and modules is shown below.



The NEMF has separate but interlinked modules focused on modelling of the heat, transport and electricity sectors.

The heat sector model is based on a detailed set of archetypes representing all buildings and industries in Ireland. The NEMF contains 680 individual heat demand archetypes, representing a combination of physical and consumer attributes, which in turn provide a detailed description of demand in residential, services and industry sectors, as well as agricultural energy use.

Technology suitability and performance are mapped to each archetype. The NEMF can also be used to examine variation in technology readiness, technical suitability, cost data and performance data to assess various scenarios (including potential decarbonisation paths) in Ireland. The model also contains representations of bioenergy and hydrogen resources and fuel supply chains as well as an infrastructure module that calculates the costs of infrastructure deployment linked to technology uptake.

The model uses this techno-economic data to generate payback and lifetime cost estimates for the various technology options available, accounting for policy incentives, taxes and regulations. This payback and lifetime cost information is used with other data on consumer decision-making behaviour to simulate how much uptake may result in various scenarios and in response to policy measures

Where technology deployment is based on centralised decisions, these are accounted for outside of the consumer decision-making framework; district heating and industrial Carbon Capture, Utilisation and Storage (CCUS) are dealt with in this way.

A detailed description of the methodology, data-sources and assumptions used to generate the archetypes within the NEMF is provided in the National Heat Study report "Heating and Cooling in Ireland Today".[82]

A detailed description of the heating and cooling technologies within the NEMF is provided in the National Heat Study report "Low Carbon Heating and Cooling Technologies".[83]

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[82] SEAI, 'National Heat Study – Heating and Cooling in Ireland Today". 2022. [Online]. Accessed from: https://www.seai.ie/data-and-insights/national-heat-study/heating-and-cooling-in-ir/
[83] SEAI, 'National Heat Study – Low Carbon Heating and Cooling Technologies". 2022. [Online]. Accessed from: https://www.seai.ie/data-and-insights/national-heat-study/low-carbon-heating-and-co/

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