Ireland's Greenhouse Gas Emissions Projections

2018-2040

June 2019

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Key Insights

- There is a long-term projected decrease in greenhouse gas emissions as a result of inclusion of new climate mitigation policies and measures that formed part of the National Development Plan (NDP) which was published in 2018. This is evident in the *With Additional Measures* scenario which assumes full implementation of the programmes, policies and measures included in the NDP.

- Fossil fuels such as coal, peat and gas continue to be key contributors to emissions from the power generation sector. However a significant reduction in emissions over the longer term is projected as a result of the expansion of renewables (e.g. wind), assumed to reach 41-54% by 2030, with a move away from coal and peat.

- A growth in emissions from the transport sector continues to be projected which is largely attributed to fuel consumption from diesel cars and diesel freight. A decrease in emissions over the longer term, most notably in the *With Additional Measures* scenario, is largely attributed to assumed accelerated deployment of 500,000 electric vehicles and the impact of greater biofuel uptake.

- Agriculture emissions are projected to continue to grow steadily over the period which is mainly a result of an increase in animal numbers particularly for the dairy herd.

- The implementation of additional energy efficiency measures included in the National Development Plan will see a significant reduction in emissions in the residential, commercial/public services and manufacturing sectors over the projected period.

- The projections reflect plans to bring Ireland onto a lower carbon trajectory in the longer term. However, Ireland still faces significant challenges in meeting EU 2030 reduction targets in the non ETS sector and national 2050 reduction targets in the electricity generation, built environment and transport sectors. Progress in achieving targets is dependent on the level of implementation of current and future plans.

- The 2019 emission projections do not consider the impact of new policies and measures that will be included in the forthcoming Government Climate Plan[1]. It is anticipated that emission projections prepared later in 2019 to inform the preparation of Ireland's final National Energy and Climate Plan (due by 31st December 2019)[2] will include the additional impact of the Government Climate Plan.

[1] https://www.dccae.gov.ie/en-ie/climate-action/topics/climate-disruption-plan/Pages/default.aspx
[2] https://www.dccae.gov.ie/en-ie/energy/consultations/Pages/Ireland%E2%80%99s-Draft-National-Energy-and-Climate-Plan-2021-2030.aspx

Executive Summary

- This report provides an updated assessment of Ireland's total projected greenhouse gas emissions out to 2040 which includes an assessment of progress towards achieving its emission reduction targets out to 2020 and 2030 set under the EU Effort Sharing Decision (Decision No 406/2009/EU) and Effort Sharing Regulation (Regulation (EU) 2018/842).
- The EPA has produced two scenarios in preparing greenhouse gas emission projections; a *With Existing Measures* scenario and a *With Additional Measures* scenario.
- Total emissions are projected to increase from current levels by 1% and 6% by 2020 and 2030 respectively under the *With Existing Measures* scenario. Under the *With Additional Measures* scenario emissions are estimated to decrease by 0.4% and 10% by 2020 and 2030 respectively.
- In 2020 the sectors with the largest contribution of emissions are Agriculture, Transport and Energy Industries with 34%, 21% and 20% share in total emissions respectively under the *With Additional Measures* scenario. In 2030 this is projected to change to 38%, 22% and 16% for these sectors respectively which reflects the growth in emissions from agriculture and reduction of emissions from power generation.
- In terms of compliance with the EU's Effort Sharing Decision (Decision No 406/2009/EC) 2020 targets, Ireland's non-Emissions Trading Scheme[3] emissions are projected to be 5% and 6% below 2005 levels in 2020 under the *With Existing Measures* and *With Additional Measures* scenarios, respectively. This compares to the target of 20% below 2005 levels by 2020.
- Ireland has exceeded its annual binding limits in 2016 and 2017. Over the period 2013-2020 Ireland is projected to cumulatively exceed its compliance obligations by approximately 10 Mt CO_2 equivalent under the *With Existing Measures* scenario and 9 Mt CO_2 equivalent under the *With Additional Measures* scenario.
- Agriculture and transport dominate non-ETS sector emissions accounting for 75% and 80% of emissions in 2020 and 2030 respectively.
- In terms of 2030 reduction targets the EU Effort Sharing Regulation (ESR) requires that Ireland reduce its non-ETS emissions by 30% on 2005 levels by 2030. The latest projections indicate that Ireland will exceed the carbon budget over the period 2021-2030 by 52 - 67 Mt CO_2 equivalent with the gap potentially narrowing to 7 - 22 Mt CO_2 equivalent if both the ETS and LULUCF flexibilities described in the Regulation are fully utilised[4].
- The projected gap to the 2021-2030 ESR target is strongly affected by the choice of fuel price projections used. A sensitivity analysis using lower fuel price projections from the UK Department for Business, Energy and Industrial Strategy (BEIS) was performed to investigate this impact. The results show that in a low fuel price scenario, Ireland will exceed the carbon budget over the period 2021-2030 by 86 – 101 Mt CO2 equivalent or by 40 - 56 Mt CO2 with full use of the ETS and LULUCF flexibilities (see table 2.3 for further detail).

[3] These sectors cover agriculture, transport, built environment (residential, commercial/institutional), waste and non-energy intensive industry

[4] The Effort Sharing Regulation maintains existing flexibilities under the current Effort Sharing Decision (e.g. banking, borrowing, buying and selling between Member States). It also provides for two additional flexibilities – use of ETS allowances and credit from action undertaken in the Land Use, Land Use Change and Forestry (LULUCF) sector.

1. Introduction

The Environmental Protection Agency (EPA) produces national greenhouse gas emission projections on an annual basis. These projections are compiled to meet EU reporting obligations (Monitoring Mechanism Regulation No 525/2013[5]) and to inform national policy development, and update those published in May 2018[6]. The EPA has been designated by Government with the responsibility to develop, prepare and publish periodic projections of greenhouse gas emissions for Ireland, and acts as the national entity with overall responsibility for the preparation and reporting of emissions projections. The preparation of EPA projections is a collaborative process with input from a range of State bodies and Government Departments. In particular, key data providers Teagasc provide projected animal numbers and other key parameters related to the agriculture sector and energy projections are provided by Sustainable Energy Authority of Ireland (SEAI) and the Economic and Social Research Institute (ESRI).

This report provides an updated assessment of Ireland's total projected greenhouse gas emissions out to 2040. It describes progress towards achieving emission reduction targets set under the EU Effort Sharing Decision (Decision No 406/2009/EU) up to 2020 and a longer-term assessment on the projected situation in relation to the 2021-2030 carbon budget that is currently anticipated under the EU Effort Sharing Regulation (Regulation (EU) 2018/842).

Ireland's 2020 target is to achieve a 20% reduction of non-Emissions Trading Scheme (non-ETS) sector emissions (i.e. agriculture, transport, residential, commercial, non-energy intensive industry, and waste) on 2005 levels with annual binding limits set for each year over the period 2013-2020. New 2030 targets for EU Member States were adopted by the European Council in 2018. Irelands 2030 target under the Effort Sharing Regulation is a 30% reduction of emissions compared to 2005 levels by 2030[7]. There will be binding annual limits over the 2021-2030 period to meet that target.

Over the longer-term Ireland's National Policy Position on Climate change has set a target of an aggregate reduction in carbon dioxide (CO_2) emissions of at least 80% (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors. The long-term vision of low-carbon transition is also based on, in parallel, an approach to carbon neutrality in the agriculture and land-use sector, including forestry, which does not compromise capacity for sustainable food production.

2. Approach

Greenhouse gas emissions are projected out to 2040[8] using two scenarios; *With Existing Measures* and *With Additional Measures*.

- The *With Existing Measures* scenario assumes that no additional policies and measures, beyond those already in place by the end of 2017 (latest national greenhouse gas emission inventory), are implemented.

- The *With Additional Measures* scenario assumes implementation of the *With Existing Measures* scenario in addition to, based on current progress, further implementation of Government renewable and energy efficiency policies and measures including those set out

[5] Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No. 280/2004/EC

[6] http://www.epa.ie/climate/emissionsinventoriesandprojections/nationalemissionsprojections/

[7] https://ec.europa.eu/clima/policies/effort/proposal_en

[8] The Monitoring Mechanism Regulation (Regulation (EU) No. 525/2013) currently requires Member States to report greenhouse gas emission projections out to 2035. Energy projections have been projected out to 2040 as part of Ireland's preparations of the National Energy and Climate Plan.

in the National Renewable Energy Action Plan (NREAP)[9] and the National Energy Efficiency Action Plan (NEEAP)[10] and more recently Ireland's National Development Plan 2018-2027[11].

2019 emissions projections take into account projected activity data provided by a number of key data providers including:

- Updated energy projections provided by the Sustainable Energy Authority of Ireland (SEAI) in Q4 2018 and Q1 2019. The energy projections were prepared by SEAI, ESRI and University College Cork. The ESRI used macro-economic projections from late 2017 which were produced using the COSMO model[12] and which underpin the majority of the energy demand.

  Determination of anticipated progress in the implementation of energy related policies and measures was coordinated by the SEAI in discussion with the relevant Government Departments prior to the energy projections being finalised.

- Agricultural projections provided by Teagasc (Agriculture and Food Development Authority) in April 2018 which considers the impact of Food Wise 2025[13] for the agriculture sector.

[9] http://www.dcenr.gov.ie/energy/en-ie/Renewable-Energy/Pages/Action-Plan.aspx
[10] https://www.dccae.gov.ie/en-ie/energy/topics/Energy-Efficiency/energy-efficiency-directive/national-energy-efficiency-action-plan-(neeap)/Pages/National-Energy-Efficiency-Action-Plan-(NEEAP).aspx
[11] https://www.gov.ie/en/campaigns/09022006-project-ireland-2040/
[12] https://www.esri.ie/projects/modelling-the-irish-economy/
[13] http://www.agriculture.gov.ie/foodwise2025/

Comparison to 2018 Emissions Projections

There are substantial differences to the approach used in producing this year's emissions projections compared to the 2018 emissions projections that were published in May 2018[1]. The fuel prices that were used in projecting the energy demand that underpins the 2019 emissions projections are higher than those used in the 2018 emissions projections. This change was introduced in line with EU reporting recommendations to use the 2016 EU Reference Scenario fuel prices, allowing for comparability across EU Member States.

In contrast, the 2018 emissions projections fuel price data were sourced from the UK Department for Business, Energy and Industrial Strategy (BEIS). These are significantly lower than the 2016 EU Reference Scenario. For example, in the 2018 emissions projections the projected oil price was €34.7/boe in the year 2025 compared to €85.1/boe used for projecting oil demand in the 2019 emissions projections. As fuel consumption is significantly influenced by fuel price the 2019 energy demand is lower than the energy demand underpinning the 2018 emissions projections. This has seen a reduction in emissions for some sectors (e.g. transport) in the 2019 emissions projections.

Table 2.3 investigates projected compliance with the EU Effort Sharing Regulation 2021-30 and includes a low fuel price sensitivity scenario showing the projected impact on compliance that could result. This highlights the need for a conservative approach to calculating the expected mitigation requirement as fuel prices, if lower than projected, can result in significant extra demand and consequently GHG emissions. See Appendix to this report for further information on the fuel prices and macro-economic assumptions that underpin the 2019 emissions projections.

The 2019 emission projections also include the impact of new climate mitigation policies and measures that formed part of the National Development Plan, published in early 2018. The impact of these measures was not reflected in the 2018 emissions projections as data was not available at the time of their preparation. The emissions projections in 2019 consequently see a greater impact from polices and measures over the longer term and a greater reduction in emissions, particularly the case in the *With Additional Measures* scenario.

[1] http://www.epa.ie/pubs/reports/air/airemissions/ghgprojections2017-2035/#d.en.64043

The 2019 emission projections do not include the impact of new policies and measures that will be included in forthcoming Government Climate Plan[14]. Technical data associated with such policies and measures will need to be determined by lead Government Departments and Agencies for inclusion in future EPA emissions projections following publication of the plan. It is anticipated that emission projections prepared later in 2019 to inform the preparation of Ireland's final National Energy and Climate Plan (due by 31st December 2019)[15] will include the additional impact of the Government Climate Plan.

3. Key Trends – Emissions projections out to 2030

2019 greenhouse gas emissions projections show total emissions increasing from current levels by 1% and 6% by 2020 and 2030 respectively under the *With Existing Measures* scenario. Under the *With Additional Measures* emissions are estimated to decrease by 0.4% and 10% by 2020 and 2030 respectively.

[14] https://www.dccae.gov.ie/en-ie/climate-action/topics/climate-disruption-plan/Pages/default.aspx
[15] https://www.dccae.gov.ie/en-ie/energy/consultations/Pages/Ireland%E2%80%99s-Draft-National-Energy-and-Climate-Plan-2021-2030.aspx

Figure 1 shows the expected trend in total greenhouse gas emissions under both scenarios. The fluctuating trend, particularly after the end of 2025 in the *With Additional Measures* scenario is largely influenced by the changing profile of the energy industries sector and associated changes in fuel type used for power generation. This is described in more detail further below.

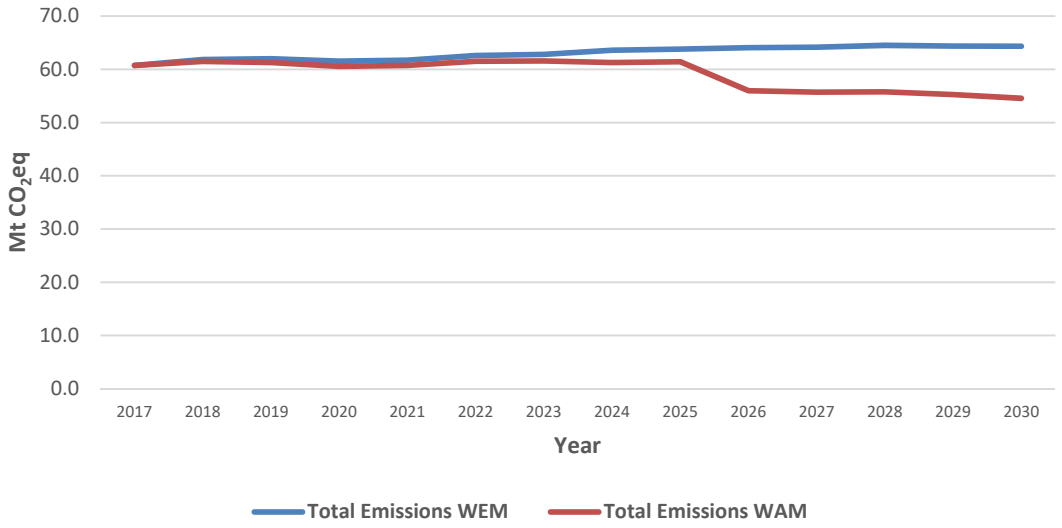

Figure 1 – Total Greenhouse Gas Emissions under the *With Existing Measures* (WEM) and *With Additional Measures* (WAM) scenario out to the year 2030

Figure 2 shows the sectoral percentage share throughout the projected time period under the *With Additional Measures* scenario. In 2020 the sectors with the largest contribution of emissions are Agriculture, Transport and Energy Industries with 34%, 21% and 20% share in total emissions respectively. In 2030 this is projected to change to 38%, 22% and 16% for these sectors respectively as shown in Figure 3.

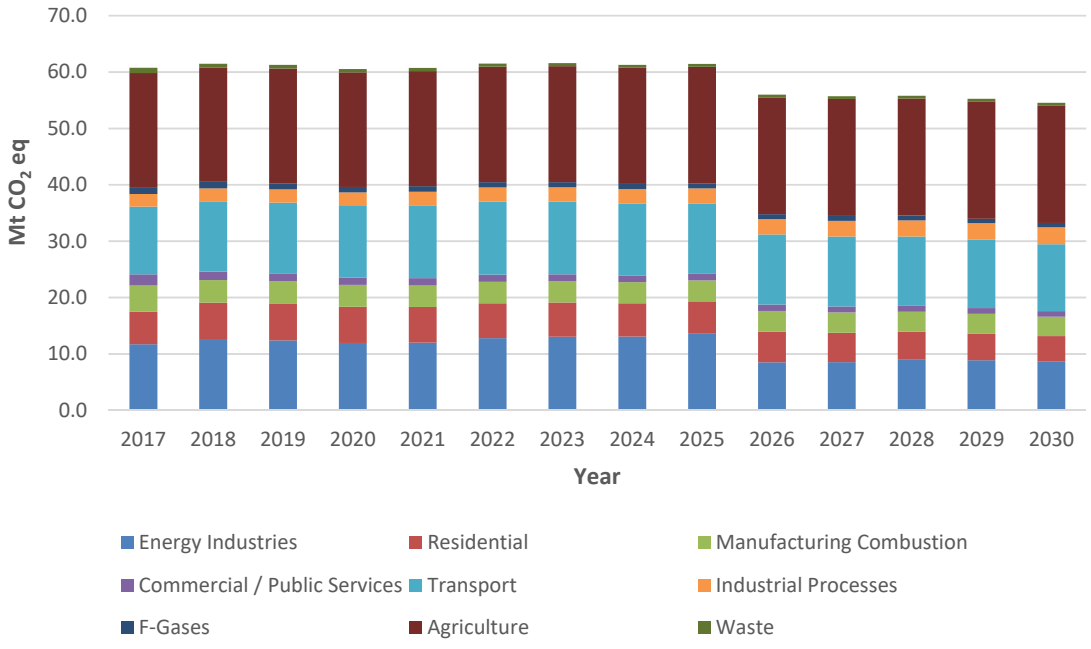

Figure 2 – Total Greenhouse Gas Emissions Projections by sector out to the year 2030 under *With Additional Measures* scenario

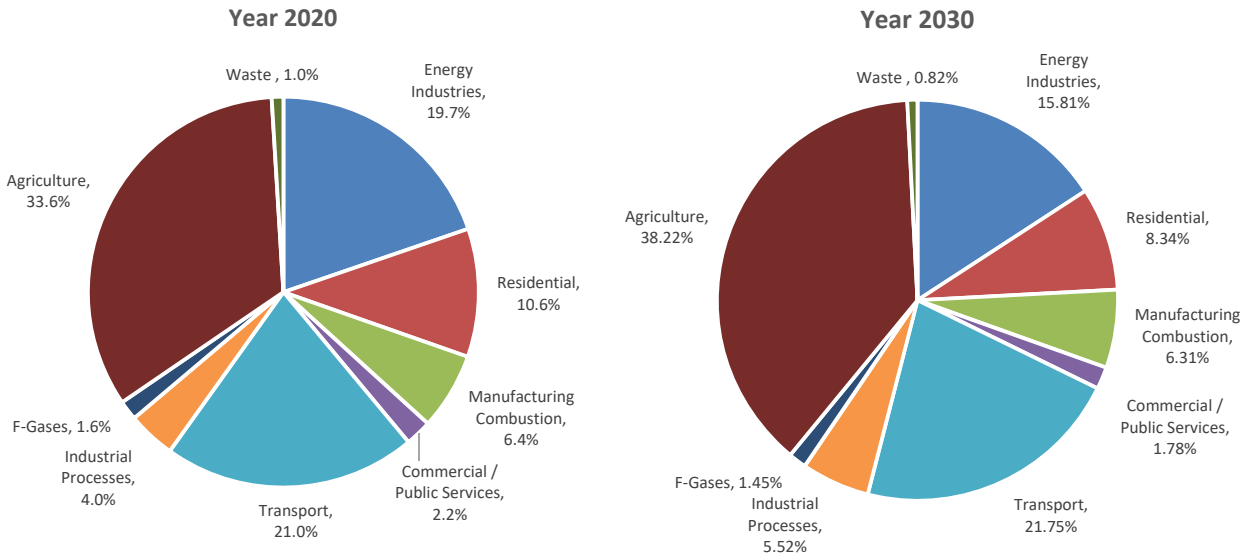

Figure 3 – Total Greenhouse Gas Emissions Projections by sector share under the *With Additional Measures* scenario in in the year 2020 and 2030

Energy Industries

- The majority of emissions within Energy industries come from power generation and are largely covered by the EU Emissions Trading Scheme. In addition emissions from solid fuels, petroleum refining and fugitive emissions are included. Figure 4 below shows the projected trend in emissions from energy industries out to 2030 under the *With Existing Measures* and *With Additional Measures* scenario.

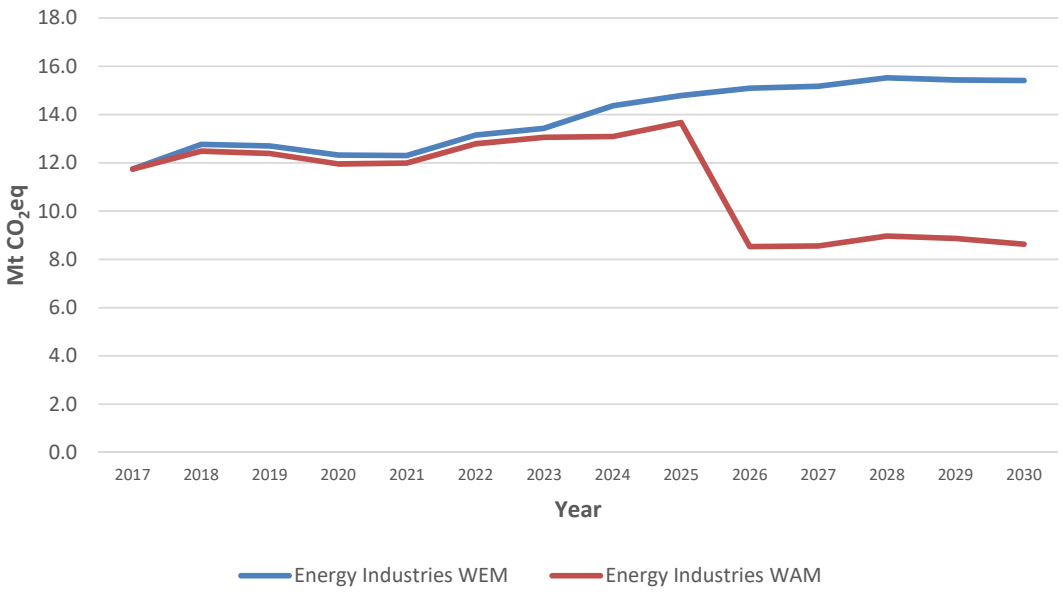

Figure 4 – Greenhouse Gas Emissions Projections from the Energy Industries Sector under the *With Existing Measures* (WEM) and *With Additional Measures* (WAM) scenario out to 2030

- Under the *With Existing Measures*, emissions from Energy Industries are projected to increase by 5% between 2018 and 2020 to 12.3 Mt CO2eq. Over the period 2018 to 2030, emissions from the energy industries sector are projected to increase by 31% to 15.4 Mt CO2eq. The increase in emissions is a result of increase in energy demand and continued use of fossil fuels for electricity generation which is outstripping the impact of the increased use of renewables.

- In the *With Existing Measures* Scenario approximately 39% of electricity generation is projected to come from renewable energy sources by 2020. In 2030 it is estimated that renewable energy generation increases to approximately 41%[16]. Renewable electricity generation capacity is dominated by wind.

- In the same scenario, three peat stations are assumed to run. Two peat stations are assumed to run as 100% peat until the end of 2019 with biomass co-firing share of 30% of capacity from 2020 to the end of 2030 is projected. They are then assumed to close permanently. A third peat station is assumed to run with co-firing of 30% of the total capacity until the end of 2030 and then to close permanently. Coal fired electricity generation is assumed to remain on the system until 2030[17]. These are in line with the assumptions agreed during the preparation of the energy projections[16].

- It is also assumed there will be a roll out of approximately 2.25 million smart meters by 2024, on a phased basis starting in 2019 in line with delivery plan announced by the Commission for Energy Regulation[18] which will result in better energy management and energy efficiency.

- Under the *With Additional Measures*, emissions from Energy Industries are projected to increase by 2% between 2018 and 2020 to 11.9 Mt CO2eq. Over the period 2018 to 2030, emissions from the energy industries sector are projected to decrease by 27% to 8.6 Mt CO2eq.

- In the *With Additional Measures* scenario it is assumed that for 2020 there is a 39% share of renewable energy in electricity generation. In 2030 it is estimated that renewable energy generation increases to approximately 54% of electricity consumption. Additional renewable electricity by 2030 is based on implementation of the National Development Plan which includes the impact of a renewable electricity support scheme[19].

- In terms of the three peat stations, it is assumed that there is 30% biomass co-firing from 2020 to end of 2023 in this scenario. Biomass co-firing share of at least 51% from 2023 to 2030 is then projected for all three plants with 100% biomass from 2030. However output is based on biomass price (without subsidy) therefore low level output and contribution to renewables in electricity is projected. It is therefore assumed that peat ceases by the end of 2030. In addition coal fired power generation is assumed to cease at the end of 2025 in this scenario. The assumptions on the cessation of peat and coal are in line with plans set out in the National Development Plan.

- In terms of inter-connection, it is assumed that the Greenlink 500MW interconnector to the UK to come on stream in 2025 and the Celtic 700MW interconnector to France to come on stream in 2026. Enhanced electricity interconnection is included in the National Development Plan.

[16] Assumptions are based on anticipated progress of implementation of policies and measures as determined by Government Departments during the preparation of the energy projections which was coordinated by the SEAI.
[17] https://www.esb.ie/docs/default-source/default-document-library/dimensions-of-a-solution.pdf?sfvrsn=a9e93bf0_4
[18] https://www.cru.ie/wp-content/uploads/2016/11/CER17279-National-Smart-Metering-Programme-Media-Release.pdf
[19] https://assets.gov.ie/4049/071218131542-81b907e357df447cb8b471788cf6ecfe.pdf

Transport

- The main source of emissions from the transport sector is road transportation, accounting for approximately 96% of emissions in 2017. Freight transport energy demand is strongly influenced by the level of commercial activity in the economy. Personal transport energy demand is influenced by both the level of employment as well as the oil price.

- Under the *With Existing Measures* scenario, transport emissions are projected to increase by 8% over the period 2018 – 2020 to 12.9 Mt CO2eq and 11% over the period 2018-2030 to 13.3 Mt CO2eq.

- The main policy instruments impacting transport emissions are the Biofuels Obligations Scheme[20] and uptake of electric vehicles, with biofuels having the most impact. The Biofuel Obligation Scheme places an obligation on fuel suppliers to blend an increasing percentage of biofuel with their fuel. In terms of biofuels used in road transport fuel in the *With Existing Measures* Scenario it is assumed that the statutory target remains at current level of approximately 9%. In terms of Electric Vehicles, the *With Existing Measures* scenario assumes approximately 250,000 Electric Vehicles on the road by 2030 which is assumed to comprise 75% battery electric vehicles and 25% plug in hybrid electric vehicles. This is in line with the assumptions agreed during the preparation of the energy projections[16].

- Under the *With Additional Measures* scenario, transport emissions are projected to increase by 6% over the period 2018 – 2020 to 12.6 Mt CO2eq and decrease by 1% over the period 2018-2030 to 11.8 Mt CO2eq.

- For the *With Additional Measures* scenario, it is assumed that the Biofuel Obligations Scheme places a statutory target of approximately 11% from 1 January 2019 on fuel suppliers and approximately 12% from 1 January 2020. Blending levels reaching a 10% blend of ethanol and gasoline (E10) and a 12% blend of biodiesel (B12) by 2030 with statutory blend increasing in two year increments is assumed. This scenario also assumes 500,000 Electric Vehicles on the road by 2030, as outlined in the National Development Plan, with 75% comprising battery electric vehicles and 25% plug in hybrid electric vehicles.

- Other key policies and measures assumed in the transport emissions projections include Vehicle Registration Tax and Motor Tax Rebalancing which have less impact compared to the biofuels over the longer term.

- Figure 5 below shows the projected trend in emissions from the transport sector out to 2030 under the *With Existing Measures* and *With Additional Measures* scenario. The graph also shows a sensitivity assessment performed on the *With Existing Measures* scenario which is based on lower fuel prices[21]. This has the impact of significantly increasing energy demand and associated emissions from the sector (by approximately 29 Mt CO_2eq over the 2018-2030 projected period).

[20] https://www.dccae.gov.ie/en-ie/energy/topics/Renewable-Energy/transport/biofuels/Pages/Biofuels.aspx
[21] https://www.gov.uk/government/publications/fossil-fuel-price-assumptions-2017

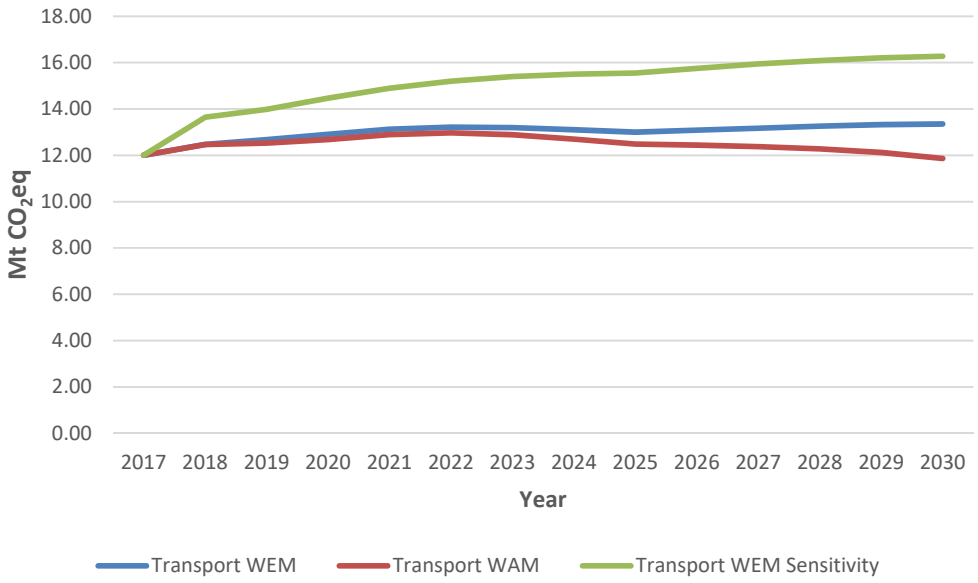

Figure 5 – Greenhouse Gas Emissions Projections from the Transport Sector under the *With Existing Measures* (WEM) and *With Additional Measures* (WAM) scenario out to 2030, including a sensitivity assessment for the WEM scenario based on lower fuel prices.

Agriculture

- Agriculture sector emissions arise from enteric fermentation, manure management and nitrogen and urea application to soils. In addition, fuel combustion from agriculture/forestry/fishing is included within the definition of the Agriculture category.

- Total emissions from agriculture are projected to increase by 1.4% over the period 2018 – 2020 to 20.5 Mt CO_2eq under the *With Existing Measures* scenario. Emissions are projected to increase by 4% over the period 2018 – 2030 to 21 Mt CO_2eq under the *With Existing Measures* scenario. Under the *With Additional Measures* scenario emissions are projected to increase by 1% and 3% from current levels to 2020 and 2030 respectively. The difference between the two scenarios is due to efficiency assumptions that are incorporated into the *With Additional Measures* scenario.

- The data underpinning the agriculture projections include projected animal numbers, crop areas and nitrogen fertiliser application to soils as supplied by Teagasc to the EPA in April 2018. Projections are based on an updated analysis undertaken by Teagasc of the projected national herd population, crop areas and fertilizer use which takes into account Food Wise 2025 policy targets and reflects trends in agricultural production at the time of preparing the projected activity data.

- Dairy cow numbers are projected to increase by 7% between 2018 and 2020 and 11% between 2020 and 2030. Fertiliser nitrogen use is projected to increase by 5% between 2018 and 2020 and 6% between 2020 and 2030. By 2030 it is estimated that dairy cow numbers will have increased to 1.63 million head compared with current levels of 1.38 millions head. There is projected to be a contraction (by 3.2%) in animal numbers in the less profitable 'other cattle' sector between 2020 and 2030. Fertiliser nitrogen use will be approximately 410,400 tonnes in 2030 compared with 369,000 tonnes in 2017. Over the last decade fertiliser use has been subject to considerable fluctuation due to both changes in prices and variability in agronomic conditions, making the

projection of future levels of fertiliser use challenging. Efficiency gains are assumed under the *With Additional Measures* scenario.

- Figure 6 below shows the projected trend in emissions from the agriculture sector out to 2030 under the *With Existing Measures* and *With Additional Measures* scenario. The graph also shows a sensitivity assessment performed on the *With Existing Measures* scenario which is based on a 10% reduction in the dairy and other cattle herds. This has the impact of reducing emissions from the sector by approximately 18 Mt CO_2eq over the 2018-2030 projected period.

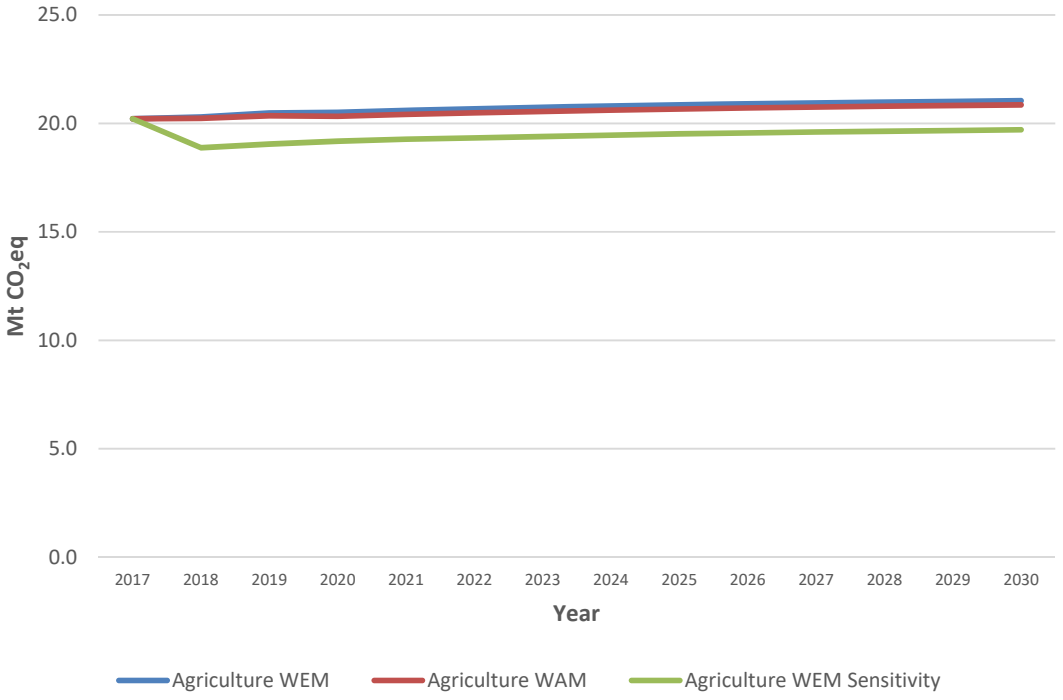

Figure 6 – Greenhouse Gas Emissions Projections from the Agriculture Sector under the *With Existing Measures* (WEM) and *With Additional Measures* (WAM) scenario out to 2030, including a sensitivity assessment for the WEM scenario based on a 10% reduction in the national herd

Residential

- Under the *With Existing Measures* scenario, emissions from the residential sector are projected to increase by 14% to 6.5 Mt CO2eq between 2018 and 2020 and are projected to decrease by 3% between 2018 and 2030 to 5.5 Mt CO2eq.

- The *With Existing Measures* scenario assumes implementation of a range of existing energy efficiency programmes including, for example, Greener Homes and Better Energy Homes Schemes, Better Energy Communities Programme and the impact of building regulations.

- Under the *With Additional Measures* scenario, emissions are projected to increase by 12% between 2018 and 2020 to 6.4 Mt CO2eq and are projected to decrease by 21% between 2018 and 2030 to 4.5 Mt CO2eq. This scenario assumes full implementation of the National Development Plan and further delivery of energy efficiency programmes that include upgrades to homes and supports for domestic heat pumps.

Manufacturing Combustion

- Under the *With Existing Measures* scenario, emissions from manufacturing combustion are projected to decrease by 16% to 3.9 Mt CO2eq between 2018 and 2020 and 23% between 2018 and 2030 to 3.5 Mt CO2eq. This scenario assumes implementation of existing energy efficiency programmes such as the SEAI Large Industry Programmes, Accelerated Capital Allowances and the Excellence in Energy Efficiency Design (EXEED) programme.

- Under the *With Additional Measures* scenario, emissions from manufacturing combustion are projected to decrease by 17% to 3.8 Mt CO2eq between 2018 and 2020 and 26% between 2018 and 2030 to 3.4 Mt CO2eq. This scenario assumes further roll out of energy efficiency programmes including those listed above.

Commercial and Public Services

- Under the *With Existing Measures* scenario, emissions from the commercial and public services sector are projected to decrease by 30% to 1.37 Mt CO2eq between 2018 and 2020 and by 42% between 2018 and 2030 to 1.1 Mt CO2eq. This scenario assumes implementation of a range of existing energy efficiency programmes including, for example, Public Sector Programme, ReHeat, Excellence in Energy Efficiency Design (EXEED) and Better Energy Communities Programmes in addition to the impact of building regulations.

- Under the *With Additional Measures* scenario, emissions from the commercial and public services sector are projected to decrease by 33% to 1.31 Mt CO2eq between 2018 and 2020 and by 51% between 2018 and 2030 to 0.9 Mt CO2eq. This scenario assumes implementation of the National Development Plan and includes further delivery of energy efficiency programmes.

Other measures impacting key energy sectors

Carbon tax is a cross cutting measure that applies to industry, residential, commercial services, transport and agriculture fuel. The current rate of carbon tax (€20 per tonne of CO_2) is assumed across the projected period.

In terms of Heat, the *With Additional Measures* Scenario assumes implementation of the National Development Plan which includes a full role out of the new support scheme for renewable heat, initiatives in district heating and heat pump deployment.

Other sectors:

There is only one scenario (*With Existing Measures*) for greenhouse gas emissions projections from the Waste sector, Industrial processes and Fluorinated-Gases based on available data.

- Emissions from **Industrial Processes** are projected to increase by 7% to 2.3 Mt CO_2eq between 2018 and 2020 and 35% between 2018 and 2030 to 3 Mt CO_2eq. The majority of emissions come from cement and lime industries and projections are largely underpinned by projected GDP growth.

- **Waste sector** emissions are projected to decrease by 38% to 0.58 Mt CO_2eq between 2018 and 2020 and by 52% between 2018 and 2030 to 0.44 Mt CO_2eq. The waste sector includes landfill, incineration and open burning of waste[22], mechanical & biological treatment and wastewater

[22] Household waste that is burned

treatment. Emissions are primarily attributable to methane emissions from landfill which reduces significantly over the projected period in line with the projected reduction in waste going to landfill.

- Figure 7 below shows the projected trend in emissions from the waste sector out to 2030 under the *With Existing Measures* and *With Additional Measures* scenario. The graph also shows a sensitivity assessment performed on the *With Existing Measures* scenario which is based on a scenario where an additional 350,000 tonnes per year requires landfill management. This has the impact of increasing emissions by approximately 0.7 Mt CO_2eq over the 2018-2030 projected period.

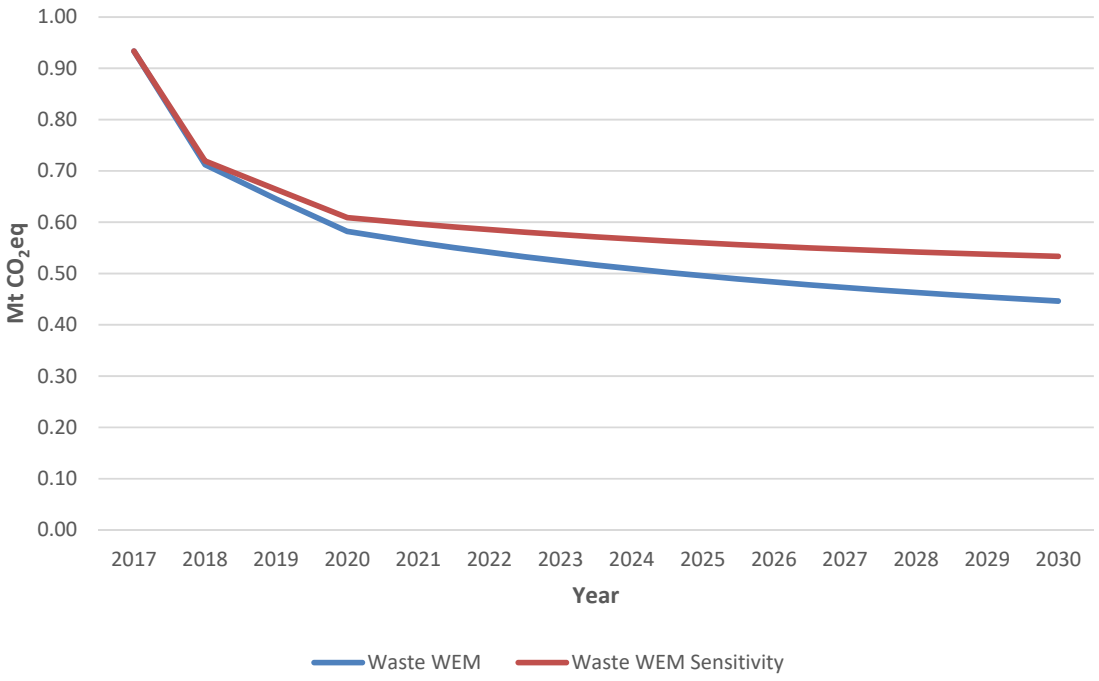

Figure 7 – Greenhouse Gas Emissions Projections from the Waste Sector under the *With Existing Measures* (WEM) and *With Additional Measures* (WAM) scenario out to 2030, including a sensitivity assessment for the WEM scenario based on an increase in municipal solid waste going to landfill

- **Fluorinated-Gas emissions** are projected to decrease by 20% to 0.98 Mt CO_2eq between 2018 and 2020 and 36% between 2018 and 2030 to 0.78 Mt CO_2eq. The relevant source of fluorinated gas emissions in Ireland is production, use and disposal of equipment containing these fluids (e.g. refrigerators, mobile air conditioning systems, metered dose inhalers and electrical switch-gear). The savings associated with the impact of Directive 2006/40/EC[23] are included in the 2019 projections.

[23] Directive 2006/40/EC Relating to emissions from air-conditioning systems in motor vehicles and amending Council Directive 70/15/EEC

4. Projected performance against targets under the National Policy Position on Climate Change

Ireland's National Policy Position on Climate change[24] sets out a low-carbon roadmapping process that will be guided by a long-term vision of low-carbon transition based on:

- an aggregate reduction in carbon dioxide (CO_2) emissions of at least 80% (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors;
- in parallel, an approach to carbon neutrality in the agriculture and land-use sector, including forestry, which does not compromise capacity for sustainable food production.

Figure 8 presents the latest historic and projected emissions for CO_2 only (under the *With Additional Measures* scenario) from the electricity generation, built environment and transport sectors, in addition to the 2050 target pathway based on the long-term vision of low-carbon transition as set out in Ireland's National Policy Position.[25] The graph demonstrates the extent of the challenge in meeting national 2050 targets according to the latest projections.

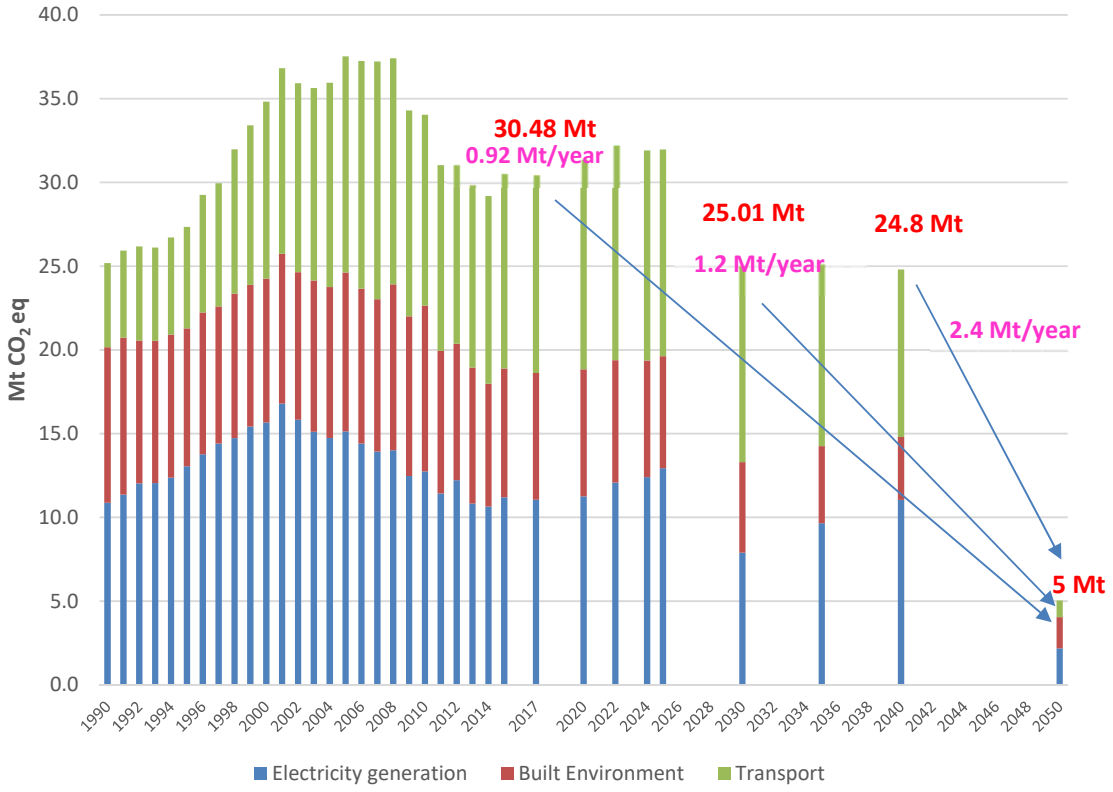

Figure 8. Historic and projected CO_2 emissions from the electricity generation, built environment and transport (EGBET) sectors

[24] https://www.dccae.gov.ie/en-ie/climate-action/publications/Documents/5/National%20Climate%20Policy%20Position.pdf

[25] Presentation of electricity generation, built environment and transport sectors in Figure 8 is based on EPA's interpretation of the categorisation of the sectors that are included in the national policy document and how they are estimated to align with IPCC reporting categories.

5. Projected performance relative to EU 2020 and 2030 Targets – Non ETS Emissions

The EU's Effort Sharing Decision (Decision No 406/2009/EC) set 2020 targets for EU Member States including Ireland. These targets cover greenhouse gas emissions from sectors that are not included in the EU Emissions Trading Scheme. For Ireland, these sectors cover agriculture, transport, built environment (residential, commercial/institutional), waste and non-energy intensive industry – collectively referred to as non-ETS sector emissions – and Ireland's target is to achieve a 20% reduction by 2020 on 2005 levels.

In addition, there are annual emission limits for the period 2013-2020 to ensure a gradual move towards the 2020 target. Any overachievement of the binding emission limit in a particular year can be banked and used towards compliance in a future year.

Figure 9 shows historic (2013-2017) and projected emission levels (2018-2020) for non-ETS sector emissions under the *With Existing Measures* and *With Additional Measures* scenarios. In addition, it shows the annual compliance/non-compliance in relation to the annual emission limits.

Ireland's non-ETS emissions are projected to be 5% and 6% below 2005 levels in 2020 under the *With Existing Measures* and *With Additional Measures* scenarios, respectively. The target for Ireland is a 20% reduction. Ireland has exceeded its annual binding limits for the first time in 2016 and has again exceeded the annual binding limit in 2017. Further information on the 1990-2017 inventory is available[26].

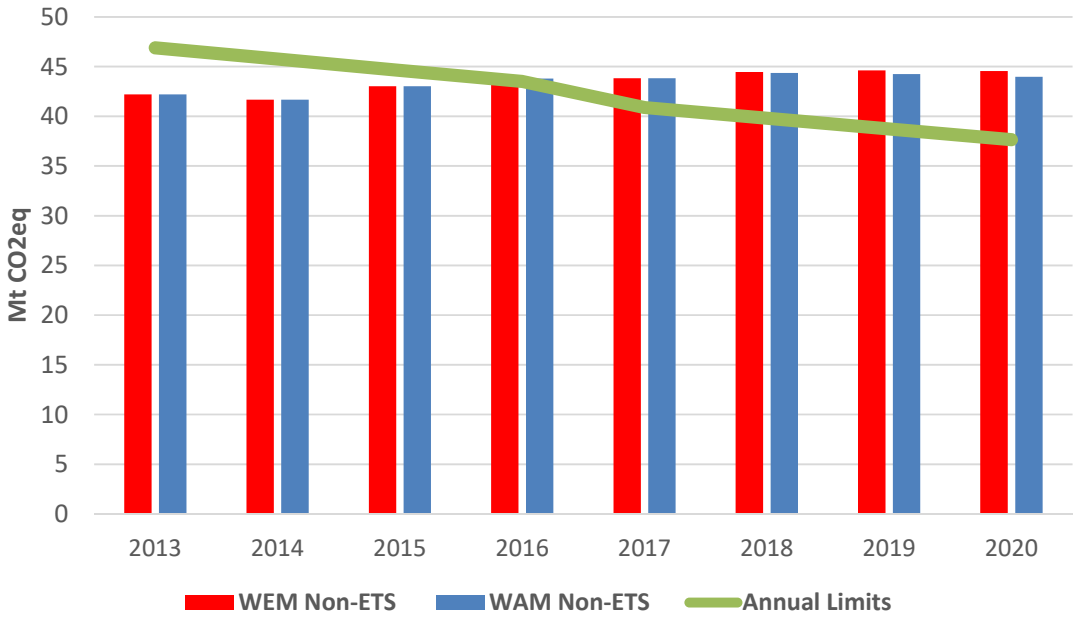

Figure 9. *With Existing Measures* and *With Additional Measures* greenhouse gas emission projections and comparison with the linear reduction pathway required between 2013 and 2020[27]

To determine compliance under the Effort Sharing Decision, any overachievement of the binding emission limit in a particular year (between 2013 and 2020) can be banked and used towards compliance in a future year. However, even using this mechanism Ireland will still be in non-compliance according to the latest projections.

[26] http://www.epa.ie/pubs/reports/air/airemissions/ghgemissions2017/
[27] 1 Mt = 1,000,000 tonnes

Figure 10 shows that over the period 2013-2020 Ireland is projected to cumulatively exceed its compliance obligations by approximately 10.3 Mt CO_2 equivalent under the *With Existing Measures* scenario and 9.2 Mt CO_2 equivalent under the *With Additional Measures* scenario.

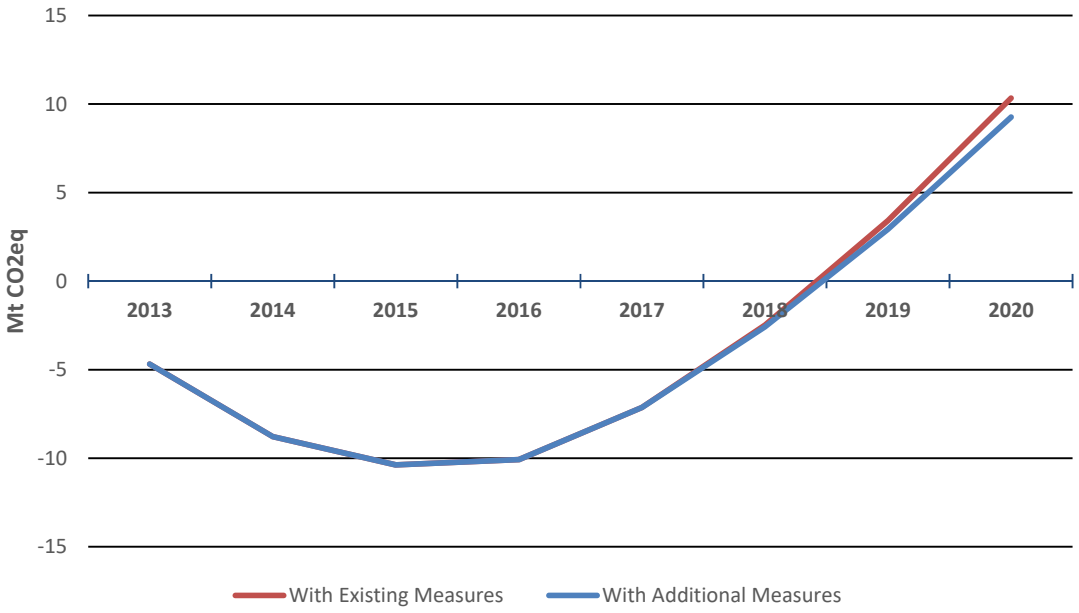

Figure 10. Projected cumulative distance to target for Ireland's Non-ETS emissions 2013 to 2020

Agriculture and transport dominate non-ETS sector emissions accounting for 75% and 80% of emissions in 2020 and 2030 respectively, as shown in Figure 11.

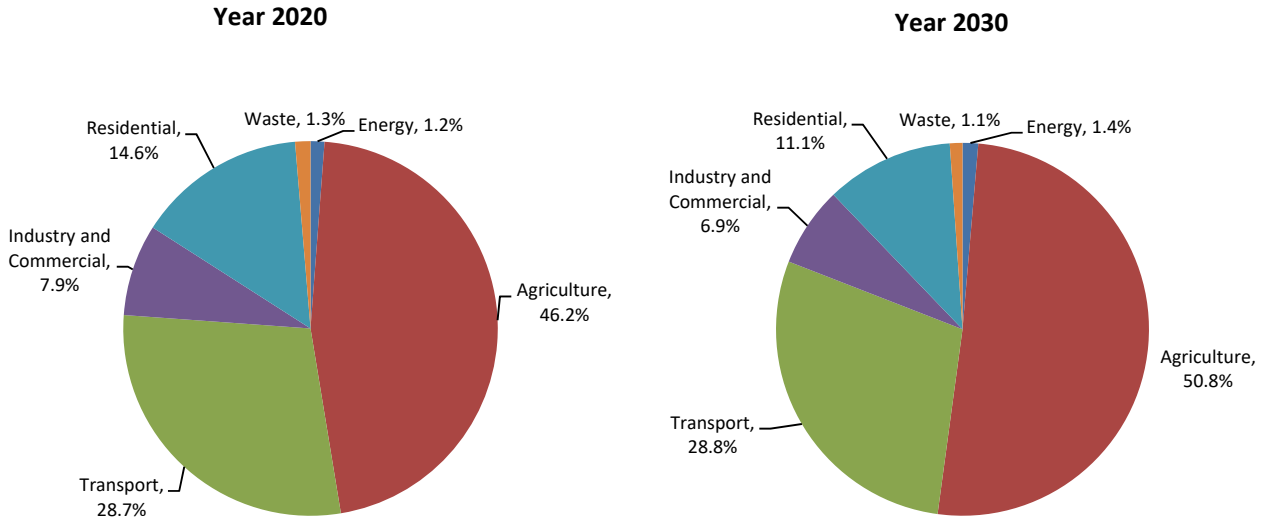

Figure 11. Projected sectoral share of non-ETS greenhouse gas emissions in 2020 and 2030 under the *With Additional Measures* scenario

On 14th May 2018, the European Council adopted a regulation on greenhouse gas emission reductions. The regulation sets out binding emission reduction targets for Member States in sectors falling outside the scope of the EU emissions trading system for the period 2021-2030. The Regulation (Effort Sharing Regulation) maintains existing flexibilities under the current Effort Sharing Decision (e.g. banking, borrowing and buying and selling between Member States) and provides two new flexibilities (use of ETS allowances and credit from action undertaken in the Land Use, Land Use Change and Forestry (LULUCF) sector) to allow for a fair and cost-efficient achievement of the targets.

The latest projections indicate that Ireland will exceed the carbon budget implied by those limits by 52 - 67 Mt CO_2 equivalent with the gap potentially narrowing to between 7 and 22 Mt CO_2 equivalent if both ETS and LULUCF flexibilities are fully utilised. Figure 12 below shows the projected non ETS emissions and estimated Annual Emission Allocations (AEAs) with and without use of flexibilities under the Effort Sharing Regulation (ESR) for the period 2021-2030. See also Table 2.3 in the Appendix below for projected Annual Emissions allocations and annual exceedances.

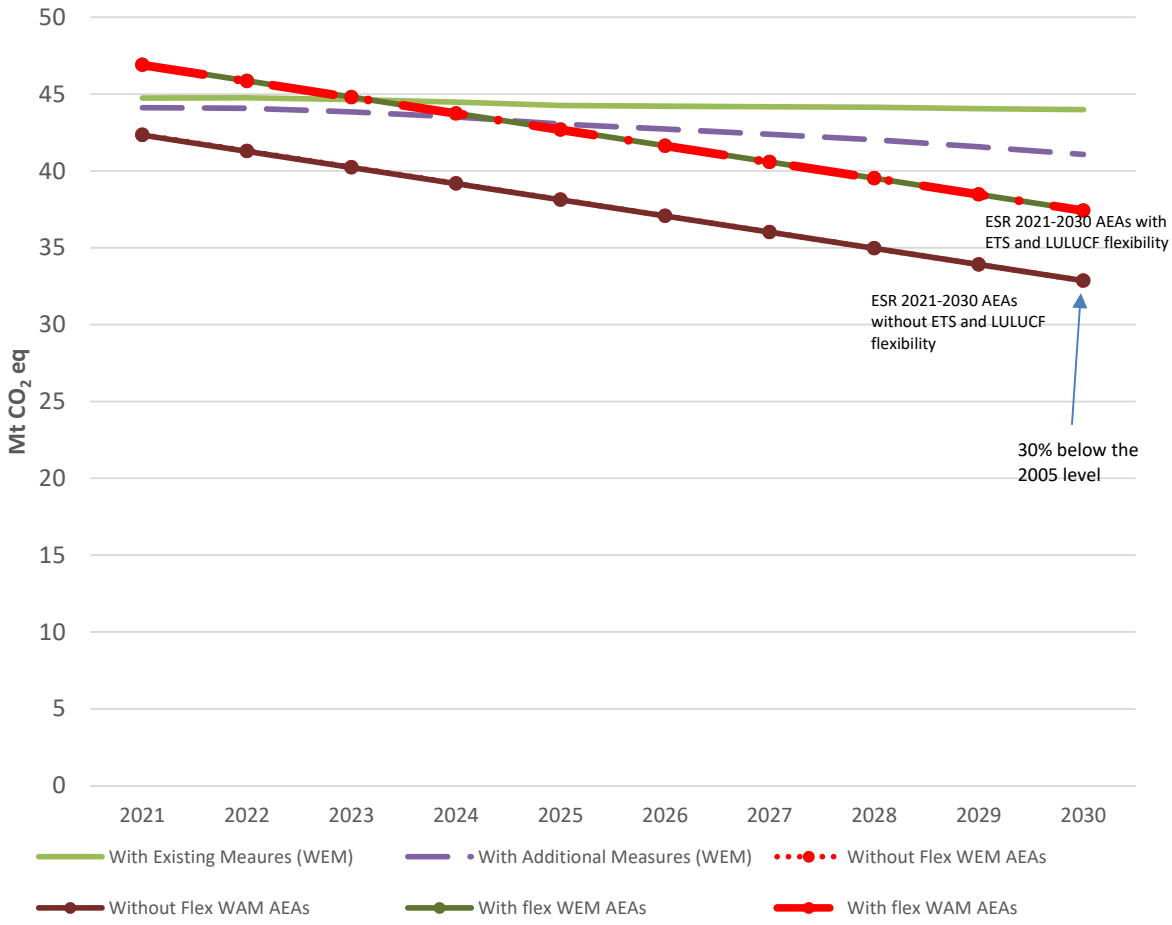

Figure 12. Projected Non ETS emissions and estimated Annual Emission Allocations (AEAs) with and without use of flexibilities under the Effort Sharing Regulation (ESR) for the period 2021-2030[28]

[28] Note: The 2021 to 2030 Annual Emission Allocations (AEAs) are affected by the start point which will be based on an average of 2016 to 2018 emissions. As these emissions are not settled yet (e.g. 2018 inventory is not yet completed), estimation of the AEAs depends on which projection scenario is chosen.

Appendix - Underlying assumptions and additional data

Two emissions projections scenarios are presented which show two potential outlooks to 2040 depending on policy development and implementation. These are called:

- *With Existing Measures*
- *With Additional Measures*

The *With Existing Measures* scenario is based primarily on SEAI's *Baseline* energy projection which incorporates the anticipated impact of policies and measures that were in place (and legislatively provided for) by end of 2017.

The *With Additional Measures* scenario is based primarily on SEAI's *Advanced* energy projection (which includes existing *and* planned policies and measures) that accounts for implementation of the *With Existing Measures* scenario in addition to further implementation of Government policies and measures including those set out in Ireland's National Renewable Energy Action Plan (NREAP)[29] and the National Energy Efficiency Action Plan (NEEAP)[30] and more recently Ireland's National Development Plan 2018-2027[31].

For the *Baseline* energy projections, the Economic and Social Research Institute (ESRI) use macro-economic projections which are produced using the COSMO model. The baseline projections and underlying assumptions are described here in Chapter 1 of "Ireland's Economic Outlook: Perspectives and Policy Challenges", which was published on 5 December 2016[32] but updated to reflect economic trends as described in Quarterly Economic Commentary, Autumn 2017 published on 5 October 2017[33]. See Table 2.1 which include the key macroeconomic assumptions underlying the projections.

The energy projections includes sectoral output figures and other relevant key variables such as price, economic growth, population and housing stock. To produce the finalised *Baseline* energy projections, SEAI amends the output of the energy demand produced by ESRI to take account of the expected impact of energy efficiency measures put in place before the end of 2017 but which are considered too recent to be detectable in any time-series analysis. The *Advanced* energy projections builds on the *Baseline* projections with adjustments made to account for further implementation of additional policies and measures outlined in the NEEAP and NREAP and Ireland's National Development Plan 2018-2027.

The EU Reference Scenario 2016 (constant 2013) fuel prices were used for the ESRI macro-economic projections on which the SEAI energy projections are based. For the BioHEAT Modelling the SEAI decided to linearly interpolate between 2018-2025, starting from the observed 2018 spot price and ending with the 2025 EU reference price projection. This was carried out to smooth out disparities between current prices and short term prices in the EU Reference Scenario 2016.

The model input assumptions for the latest SEAI Energy Projections were finalised in quarter 3 & 4 of 2018. Determination of anticipated progress in the implementation of policies and measures was coordinated by the SEAI in discussion with the relevant Government Departments.

[29] https://www.dccae.gov.ie/en-ie/energy/topics/Renewable-Energy/irelands-national-renewable-energy-action-plan-(nreap)/Pages/Action-Plan.aspx
[30] https://www.dccae.gov.ie/en-ie/energy/topics/Energy-Efficiency/energy-efficiency-directive/national-energy-efficiency-action-plan-(neeap)/Pages/National-Energy-Efficiency-Action-Plan-(NEEAP).aspx
[31] https://www.gov.ie/en/campaigns/09022006-project-ireland-2040/
[32] http://www.esri.ie/pubs/EO1.pdf
[33] http://www.esri.ie/pubs/QEC2017AUT.pdf

Table 2.1 Key macroeconomic assumptions underlying the projections out to 2030

	2017 – 2020	2021-2025	2026-2030
Average Annual % Growth Rate			
GDP	+3.30%	+2.58%	+2.77%
GNP	+5.06%	+5.09%	+4.99%
Personal Consumption	+3.12%	+1.94%	+1.52%
	2020	**2025**	**2030**
Housing Stock ('000)	2,059	2,237	2,344
Population ('000)	4,866	5,077	5,276
EUETS: Carbon €$_{2013}$/tCO$_2$	15	22.5	33.5
Coal $$_{2013}$/boe	17.7	22.9	27.6
Oil $$_{2013}$/boe	74.9	85.1	93.6
Gas $$_{2013}$/boe	59.7	69.8	76.5
Peat €/MWh	25	25	25

The following is the expected progress by 2020 in terms of Renewable Energy targets under the *With Additional Measures* (*Advanced* energy projection) Scenario:

- 38.9% renewable electricity (RES-E) share (full target is 40%)
- 9.8% renewable heat (RES-H) share (full target is 12%)
- 10.8% renewable transport (RES-T) share (full target is 10%)
- 14.3% Overall Renewable Energy (RES) share (full target is 16%)

The following is the expected progress by 2030 in terms of Renewable Energy targets under the *With Additional Measures* (*Advanced* energy projection) Scenario:

- 53.7% renewable electricity (RES-E) share
- 26.4% renewable heat (RES-H) share
- 25.4% renewable transport (RES-T) share
- 28% Overall Renewable Energy (RES) share

The above information is based on model input assumptions underpinning the *Advanced* energy projection provided by the SEAI.

Agriculture emissions projections are primarily based on agricultural activity projections (animal numbers, nitrogen fertiliser use and crop areas) provided by Teagasc in April 2018.

Table 2.2 shows the breakdown of historical and projected emissions for the non-ETS and ETS sectors (Mt CO_2eq) under the *With Existing Measures* and *With Additional Measures* scenarios.

Table 2.2. Historical and projected emissions for the non-ETS and ETS sectors (kt CO_2eq[34]) for *With Existing Measures* and *With Additional Measures* scenarios

		Non-ETS sector	ETS sector	Total
Historical	**2005**	47098.82	22396.21	69495.03
	2008	46918.03	20383.79	67301.83
	2009	44330.87	17216.36	61547.23
	2010	43750.07	17354.78	61104.84
	2011	41230.35	15758.84	56989.19
	2012	40757.66	16853.87	57611.53
	2013	41713.48	15696.73	57410.21
	2014	41130.01	15968.53	57098.54
	2015	42363.41	16848.41	59211.81
	2016	43517.55	17752.65	61270.20
	2017	43830.35	16913.37	60743.73
	With Existing Measures scenario			
Projected	**2018**	44463.01	17357.08	61850.55
	2020	44568.69	16933.27	61532.48
	2025	44264.39	19512.53	63807.62
	2030	43989.73	20306.00	64326.67
	2035	43394.59	17893.20	61319.01
	2040	42813.54	18802.95	61647.70
	With Additional Measures scenario			
	2018	44361.77	17080.26	61472.49
	2020	43978.22	16524.17	60532.91
	2025	43047.27	18352.96	61430.94
	2030	41076.24	13448.26	54555.44
	2035	39499.58	15671.85	55202.65
	2040	37901.73	17133.05	55066.00

Note: Totals excludes Land Use, Land Use Change and Forestry (LULUCF)

[34] Units: 1,000 kilotonnes (kt) = 1000 gigagram (Gg)
CO_2 Equivalent**:** greenhouse gases other than CO_2 (i.e. methane, nitrous oxide and so-called F-gases) may be converted to CO_2 equivalent using their global warming potentials.

Table 2.3. Projected non-ETS emissions and allowances for the 2021 to 2030 ESR compliance period for *With Existing Measures*, *With Additional Measures* and *Low Fuel Price Sensitivity* scenarios

Mt CO_2 equivalent	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Non-ETS Projections - WEM	44.75	44.76	44.65	44.48	44.26	44.22	44.18	44.14	44.05	43.99	443.47
Non-ETS Projections - WAM	44.12	44.07	43.84	43.51	43.05	42.73	42.39	42.03	41.57	41.08	428.37
Non-ETS Projections – WEM (Sensitivity)*	47.24	47.57	47.78	47.88	47.92	48.06	48.20	48.29	48.31	48.33	479.58
Non-ETS Projections – WAM (Sensitivity)*	46.60	46.87	46.95	46.87	46.64	46.48	46.30	46.04	45.68	45.24	463.66
Projected Annual Emission Allocations (WEM)	42.36	41.30	40.25	39.19	38.14	37.08	36.02	34.97	33.91	32.86	376.08
Projected Annual Emission Allocations (WAM)	42.33	41.28	40.23	39.17	38.12	37.07	36.02	34.96	33.91	32.86	375.94
Projected Annual Emission Allocations (WEM) (Sensitivity)*	42.80	41.69	40.59	39.48	38.38	37.27	36.17	35.07	33.96	32.86	378.27
Projected Annual Emission Allocations (WAM) (Sensitivity)*	42.77	41.66	40.56	39.46	38.36	37.26	36.16	35.06	33.96	32.96	378.12
Gross Exceedance - WEM	2.39	3.46	4.40	5.29	6.13	7.13	8.15	9.17	10.14	11.13	67.39
Gross Exceedance - WAM	1.79	2.80	3.61	4.34	4.93	5.66	6.37	7.06	7.66	8.22	52.43
Gross Exceedance - WEM (Sensitivity)*	4.45	5.87	7.19	8.40	9.54	10.79	12.03	13.22	14.35	15.47	101.31
Gross Exceedance - WAM (Sensitivity)*	3.83	5.20	6.39	7.40	8.28	9.22	10.14	10.98	11.72	12.39	85.54
Total LULUCF Flexibility											-26.80
Total ETS Flexibility											-18.78
Net Exceedance - WEM											**21.81**
Net Exceedance - WAM											**6.86**
Net Exceedance - WEM (Sensitivity)*											**55.73**
Net Exceedance - WAM (Sensitivity)*											**39.97**

* Note: Sensitivity Analysis for this table is performed using fuel prices from the UK Department for Business, Energy and Industrial Strategy (BEIS) which impacts the level of energy demand. These lower fuel prices result in substantially increased emissions due to higher projected fuel demand.

Sectoral Breakdown used

Under Section 3 of this report Ireland's Greenhouse Gas Emission Sectors are categorised as the following for analysis:

1. *Energy Industries* (electricity generation, waste to energy incineration, oil refining, briquetting manufacture and fugitive emissions)
2. *Residential* (combustion for domestic space and hot water heating)
3. *Manufacturing Combustion* (combustion for Manufacturing industries in ETS and non-ETS)
4. *Commercial and Public Services* (combustion for Commercial and Public Services space and hot water heating)
5. *Transport* (combustion of fuel used in road, rail, navigation, domestic aviation and pipeline gas transport)
6. *Industrial Processes* (process emissions from mineral, chemical, metal industries, non-energy products and solvents)
7. *F-Gases*[35] (gases used in refrigeration, air conditioning and semiconductor manufacture)
8. *Agriculture* (emissions from fertiliser application, ruminant digestion, manure management, agricultural soils and fuel used in agriculture/forestry/fishing)
9. *Waste* (emissions from solid waste disposal on land, solid waste treatment (composting), wastewater treatment, waste incineration and open burning of waste).

Further details on the emissions projections, reporting parameters, and the models used for preparing the projections (i.e. COSMO, Plexos Integrated Energy Model, SEAI's Energy Scenario Tool, SEAI BioHeat Model, FAPRI Ireland model) are included in the 2019 submission made under Article 14 of the Monitoring Mechanism Regulation (Regulation 525/2013), available at the following link:

https://cdr.eionet.europa.eu/ie/eu/mmr/art04-13-14_lcds_pams_projections/projections/

Further details on the climate change mitigation policies and measures that are included in the projections scenarios are included in the 2019 submission made under Article 13 of the Monitoring Mechanism Regulation (Regulation 525/2013), available at the following link:

https://cdr.eionet.europa.eu/ie/eu/mmr/art04-13-14_lcds_pams_projections/pams/pams/

[35] These gases comprise HFCs (Hydrofluorocarbons), PFCs (Perfluorocarbons), SF6 (Sulphur Hexafluoride) and NF3 (Nitrogen Trifluoride). They are much more potent than the naturally occurring greenhouse gas emissions (carbon dioxide, methane and nitrous oxide).