SUSTAINABLE ENERGY AUTHORITY OF IRELAND

National Energy Projections to 2030

Understanding Ireland's energy transition

November 2018

Highlights

2020 Target shortfall

- It is anticipated that Ireland will fall short of its mandatory European target for an overall 16% renewable energy share by 2020, with overall achievement estimated to be between 12.7% and 13.9%.
- This is likely to require the purchase of statistical transfers, as provided for in the EU Renewable Energy Directive.
- Ireland's energy efficiency goal of 20% energy savings from efficiency by 2020 will be missed – with the level of achievement expected to be 16%.
- Non-ETS emissions are anticipated to be between 0% and 1% below 2005 levels by 2020 compared to the target of 20% below, which was mandated in the *EU Effort Sharing Decision* (EPA, 2018). Any emissions target shortfall will also require compliance purchasing.

Opportunities to use less and use cleaner energy

- Increased ambition and delivery targets supporting a sustainable energy transition were included in the recently announced 2018–2027 National Development Plan (NDP) (Irish Government, 2018).
- Additional spending on efficiency could lead to warmer, healthier and cheaper-to-run homes and buildings, as well as emissions reductions. This has the potential to bring the anticipated level of achievement in energy efficiency to almost 25% in 2030 with the NDP ambition.
- A goal of 55% renewable electricity by 2030, supported by a range of measures including the Renewable Electricity Support Scheme (DCCAE, 2018a) is modelled in this analysis. Together with the recently launched Support Scheme for Renewable Heat, increased biofuel blends in transport and a target of 500,000 electric vehicles, overall renewable energy shares could increase to between 24% and 26% by 2030.

Challenges for 2030

- Ireland's 2030 commitment on energy efficiency and renewable energy targets will be detailed in the upcoming first National Energy and Climate Plan, a draft of which is due in December 2018.
- The existing package of policies and measures will need to be further developed to achieve the ambition outlined in the National Development Plan.
- Increasing the deployment rates of sustainable energy technologies and practices across the entire economy is essential to achieving targets. This includes meeting our commitment to the Paris Agreement on climate change. Given the cumulative nature of emissions in the atmosphere, and targets for 2030 that reflect that, immediate and significant action is essential.

Executive summary

This report presents an overview of SEAI's 2018 National Energy Projections from 2017 to 2030. It illustrates possible future trends in energy supply and demand relative to European Union (EU) and national energy targets. The projections are based on the macroeconomic relationships between energy use, economic growth, energy prices and energy policies and measures. The results are underpinned by the Economic and Social Research Institute's (ESRI) latest economic outlook[1], the most recent energy balances and an assessment of the anticipated impacts of sustainable energy polices, measures and ambitions compiled by SEAI (ESRI, 2017a&b) (SEAI, 2017).

The projections anticipate strong growth in energy demand over the period to 2030, in line with anticipated economic growth in the Irish economy. Scenarios based on low oil prices, evident at the time this modelling exercise began, coupled with anticipated additional energy-demand sources, such as from data centres, lead to an expectation of increasing energy requirements. More recent increases in energy prices, if sustained, could temper such growth in the longer term. Given the volatility of oil prices globally, a sensitivity analysis is included in this report to provide a greater understanding of the impact of oil price on energy demand. A range of possible target achievement outcomes for 2020 and 2030 are presented based on the following scenarios[2].

1. ***Baseline* and *Advanced* scenarios** – 2018 National Energy Projections as provided to EPA to inform their '*With Existing Measures* (*WEM*)' and '*With Additional Measures* (*WAM*)' scenarios respectively[3]
2. ***Advanced* (*WAM + shares adjusted*) scenario** – as per the *Advanced* scenario but with the shares of final demand for electricity, heat and transport adjusted to match historic shares[4]
3. ***NDP+ low oil price* scenario** – a scenario modelling the anticipated impact of relevant *National Development Plan* (*NDP*) targets and ambitions ***plus*** additional policy effort, as listed below
4. ***NDP+ high oil price* scenario** – illustrating the effect of higher oil prices on demand and the knock-on effect on estimates of achievement on renewable energy shares

The *Baseline* scenario includes the anticipated impact of energy policies and measures in place prior to the end of 2016. The *Advanced* scenario builds on this to include all pre-*NDP* announced and active policies and measures, increased biofuel blend rates in transport, co-firing of biomass with peat in peat-fired electricity generation post-2020, additional interconnection, offshore wind and ocean energy. The *NDP+ low and high oil price* scenarios include the following targets and ambitions, additional to the polices and measures modelled in the *Advanced* scenario:

- An extended Support Scheme for Renewable Heat to a maximum budget of ~€600m
- 55% renewable electricity achievement in 2030
- Increased biofuel blends in transport fuels (10% ethanol and 12% biodiesel by 2030)
- Enhanced energy efficiency policies and measures – including additional savings from homes, business and the public sector
- 170,000 existing oil boiler homes switching to electric heat pumps as their main heating source
- Closure of all three peat plants by 2028 (they run until 2030 in the *Advanced* scenario)

It should be noted that ongoing policy development will be required to facilitate achievement of the ambitions and targets detailed in the *NDP+* scenarios.

1 Economic and Social Research Institute (ESRI), October 2017, Quarterly Economic Commentary, available from: https://doi.org/10.26504/qec2017aut Latest available at the time of modelling.

2 Detailed input assumptions for the scenarios modelled are provided in Annex A, tables 3 to 5.

3 As reported in GHG Emissions Projections Summary Report (EPA, 2018).

4 The *Advanced (WAM + shares adjusted)* scenario maintains the sectoral shares of demand across heat, transport and electricity in the short term to reflect the historic trend. It is verified by 2017 balance data.

Anticipated 2020 achievements

Table 1 summarises estimated achievements across energy efficiency and renewable energy shares (RES)[5] of electricity, heat and transport for 2020. Estimates of 2020 target progress can be compared to the following:

- the 20% energy efficiency target (31,925 GWh primary energy equivalent savings by 2020)
- 40% target for the renewable electricity in gross final demand (RES-E)[6]
- 12% target for renewable energy share of heat (RES-H)
- 10% (EU binding) target for renewable transport (RES-T), and
- overall 16% Renewable Energy Share (RES) target
- a 20% reduction in non-ETS emissions on 2005 levels (non-ETS target also includes non-energy-related agriculture and waste emissions) and at least a 21% in ETS emissions from 2005 levels

Table 1: Summary table of scenario results for 2020

	Achieved to end-2017 (provisional)	Baseline (WEM)	Advanced (EPA WAM)	Advanced (WAM + shares adjusted)	NDP+ low oil price	NDP+ high oil price
Energy Efficiency %	12.9	14.0	15.9	15.9	15.9	15.9
RES-E %	30.1	37.2	37.7	*	38.3	38.4
RES-H %	6.9	7.5	7.4		8.4	10.9
RES-T % *(regulation)*	4.1 (7.2)	3.5 *(7.3)*	4.3 *(9.2)*		4.8 *(9.2)*	4.8 *(9.2)*
Overall RES %	10.6	**11.5**	**11.9**	**12.6**	**12.7**	**13.9**

***** RES-E, RES-H and RES-T shares as per *Advanced* (*EPA WAM*); however, overall RES varies to the *Advanced* scenario as demand is adjusted to reflect historic shares of final demand for electricity, heat and transport.

Based on these scenarios, achievement of **between 12.7% and 13.9% overall RES is estimated for 2020,** indicating a likely shortfall on the 2020 overall 16% renewable energy target. Any shortfall will require the purchasing of statistical transfers from EU member states who have exceeded their mandatory 2020 RES targets[7]. For the period post-2020, where the level drops below 16%, additional measures must be put in the place to close the gap to target.

5 RES is the acronym for renewable energy share, and is the terminology used in the EU Renewable Energy Directive (Directive 2009/28/EU) to describe the level of renewables penetration required in each of the end-use sectors.

6 includes transmission and distribution system losses

7 A mechanism introduced in the Renewable Energy Directive (2009/28/EC) which under Article 6 makes it possible for EU Member States to agree to statistically transfer a specified amount of energy from renewable sources from one Member State to another.

2030 ambition

In response to the anticipated target shortfall, the Government has recently announced a scaling up of ambition on sustainable energy activity. The anticipated impact of the ambitions and targets announced in the *National Development Plan* (*NDP*)[8] 2018–2027 (Irish Government, 2018), together with those described in *EU Clean Energy for All Europeans – unlocking Europe's growth potential*[9] and Ireland's *National Mitigation Plan*[10] have been modelled in this exercise in the *NDP*+ scenarios.

Table 2: Summary table of scenario results for 2030

%	Achieved to end-2017 (provisional)	Baseline	Advanced	NDP+ low oil price	NDP+ high oil price
Energy Efficiency %	12.9	16.9	22.1	24.7	24.7
RES-E % (normalised)	30.1	37.1	43.2	~55%	~55%
RES-H %	6.9	9.7	8.8	19.4	24.9
RES-T % (regulation)	4.1 (7.2)	3.4 (11.7)	6.1 (15.4)	10.0 (23.5)	10.3 (24.7)
Overall RES %	10.6	13.7	14.3	24.0	26.0

In the *Baseline* scenario, the overall renewables contribution grows from 11.5% in 2020 to 13.7% by 2030. Under this scenario, which underpins the EPA's *With Existing Measures* (*WEM*) scenario[11], Ireland would likely miss its 2020 cumulative emissions non-Emissions Trading Scheme[12] reduction target by around 17 Mt CO_2eq, and the 2030 (Effort Sharing Regulation) target by 52 Mt CO_2eq (EPA, 2018).

In the *Advanced* scenario, which illustrates future trajectories including the anticipated impact of actions described in the 2017 *National Mitigation Plan*, the overall renewables contribution grows from 11.9% in 2020 to 14.3% in 2030. Under the *Advanced* scenario (which underpins the EPA's *With Additional Measures* (*WAM*) scenario), Ireland potentially misses its 2020 cumulative emissions reduction target by around 16.3 Mt, and the 2030 (Effort Sharing Regulation) target by 47 Mt CO_2eq (EPA, 2018).

More ambitious scenarios encompassing the anticipated impact of ambitions and targets stated in the NDP, ***plus*** assumptions of 55% RES-E, additional spend on the Support Scheme for Renewable Heat and a higher biofuel blend by 2030, have a significant impact on the estimated overall RES in 2030. These scenarios could reach **between 24% and 26% overall RES by 2030** with concerted action on policy development and delivery. The high-end estimate is based on higher (EU Reference Scenario[13]) prices which drive energy demand down and hence overall RES (percentage of demand) up.

Increasing the deployment rates of sustainable energy technologies and practices across the entire economy is essential to achieving targets. This includes meeting our commitment to the Paris Agreement on climate change. Given the cumulative nature of emissions in the atmosphere – and targets for 2030 which reflect that – immediate and significant action is essential.

Ireland's 2030 commitment on energy efficiency and renewable energy targets will be detailed in the upcoming first *National Energy and Climate Plan*, a draft of which is due in December 2018.

8 Available from: http://www.per.gov.ie/en/national-development-plan-2018-2027/

9 EU, November 2016. Clean Energy for All Europeans – unlocking Europe's growth potential. Available from: http://europa.eu/rapid/press-release_IP-16-4009_en.htm

10 (DCCAE, 2017a) Available from: https://www.dccae.gov.ie/en-ie/climate-action/publications/Pages/National-Mitigation-Plan.aspx

11 The EPA combine the results of the SEAI energy projections with agricultural and waste sector emissions for the basis of their annual greenhouse gas emissions projections. The 2018 emissions projections indicate that from 2017 onwards, in the absence of additional emissions reduction measures, Ireland will not meet the annual emissions reduction targets out to 2020 which are required under the EU's Effort Sharing Decision.

12 Non-ETS comprises energy-related consumption in the residential, transport, agriculture and waste sectors, as well as small businesses/industry. It also comprises other non-energy related agriculture and waste emissions.

13 European Commission, 2016a

Ireland's energy use and emissions targets

Ireland has a number of energy and emissions targets mandated at EU and national level. Renewable energy targets are based on a percentage of end-use demand[14]. Energy end-use demand can be broadly categorised into three distinct modes of energy use, namely: electricity, transport and heat. There are renewable energy targets for each mode of energy use, as well as an overarching renewable energy target. There are also distinct energy efficiency and greenhouse gas emissions targets.

For **renewable energy**, binding EU targets of 16% of gross final energy use and 10% of energy use in the transport sector[15] must be derived from renewable sources by 2020. In order to achieve Ireland's overall renewable energy target, national sub-targets have also been set in the end-use sectors of heat (RES-H = 12%) and electricity (RES-E = 40%). The pathways to achieving these targets have been set out in the *National Renewable Energy Action Plan* (*NREAP*)[16].

For improved **energy efficiency**, a target has been set to reduce energy demand by 20% of the historic average energy use during the period 2000–2005 through energy efficiency measures by 2020. The current suite of measures is described in detail in Ireland's *National Energy Efficiency Action Plan* (*NEEAP*) and annual reports[17].

The proposed 2030 level of achievement at the national level on renewable energy and energy efficiency will be stated in the upcoming *National Energy and Climate Plan*, a draft of which is due in December 2018.

Ireland must achieve a 20% reduction across all **non-ETS emissions** by 2020 under the EU *Effort Sharing Decision* (*Decision No 406/2009/EC*). A revised Effort Sharing Regulation was adopted in May 2018 determining that non-ETS sectors must reduce emissions by 30% by 2030 compared to 2005. Importantly, the regulation includes binding annual greenhouse gas emission reductions by Member States from 2021 to 2030, thus resulting in a carbon budget for the non-ETS sectors to 2030. Existing flexibilities under the 2009 *Effort Sharing Decision* (e.g. banking, borrowing and buying and selling between Member States) are retained and two new flexibilities added (i.e. the 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.

Ireland's national policy position, established in 2014, provides a high-level policy direction for the adoption and implementation by Government of plans to enable the State to move to a low carbon economy by 2050. Statutory authority for the plans is set out in the *Climate Action and Low Carbon Development Act 2015* (Irish Government, 2015) and mandates an aggregate reduction of at least 80% CO_2 emissions (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors; and 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.

Further, under the legally binding Paris Agreement (adopted by 195 Parties to the UNFCCC in December 2015 and ratified by the EU and Irish Government, triggering entry into force on 4 November 2016), there should be net zero emissions globally by the second half of the century. Ireland will contribute to the mitigation aspects of the Paris Agreement via the Nationally Determined Contributions (NDC) tabled by the EU on behalf of Member States, which commit to a 40% reduction in EU-wide emissions by 2030 compared to 1990. Appropriate trajectories will need to be determined to ensure Ireland does not emit more than its fair share of global emissions and to ensure that the Irish commitment to the Paris Agreement is honoured.

14 Gross final consumption (GFC) comprising all sector energy use and all electricity generated.
15 A mandatory target agreed under the EU Renewable Energy Directive (2009/28/EC).
15 National Renewable Energy Action Plan, Ireland. Submitted to the European Commission under Article 4 of Directive 2009/28/EC. Department of Communications, Energy and Natural Resources, 2010.
17 National Energy Efficiency Action Plan for Ireland #4 (2017–2020). Department of Communications, Energy and Natural Resources (2017) http://www.dccae.gov.ie/en-ie/energy/topics/Energy-Efficiency/national-energy-efficiency-action-plan-(neeap)/Pages/National-Energy-Efficiency-Action-Plan-(NEEAP).aspx

Emissions: ETS and non-ETS explained

One mechanism aimed at addressing climate change at an EU level is the EU emissions trading system (EU ETS),[1] which came into effect in 2005. This is a market-based system to reduce the emissions of climate-damaging greenhouse gases. The ETS sector, which covers around 45% of the EU's GHG emissions, includes electricity-generating power stations, large-scale industrial plants and aviation (since 2012). The EU ETS works on a cap and trade system under which companies can trade to ensure they have enough allowances to cover their annual emissions. The EU target is to reduce EU ETS emissions by 21% by 2020 and 43% by 2030, compared to 2005 levels. Irish companies subject to the cap acquire allowances via allocation and auctioning methods directed by the EU Commission. Further information is available at: https://ec.europa.eu/clima/policies/ets_en

The non-emissions trading (non-ETS) sector comprises energy-related consumption (excluding electricity) in the residential, transport, agriculture and waste sectors, as well as small businesses/industry outside of the EU ETS. It also comprises non-energy-related agriculture and waste disposal emissions. Ireland must achieve a 20% reduction across all non-ETS emissions by 2020 under the EU *Effort Sharing Decision (Decision No 406/2009/EC)*, and a 30% reduction by 2030.

The focus of this report is on energy-related emissions (ETS and non-ETS) only. Outputs from this analysis are combined with emissions data from agriculture and waste emissions by the EPA and reported annually as Ireland's National Emissions Projections. See http://www.epa.ie/climate/emissionsinventoriesandprojections/nationalemissionsprojections/ for details.

Interaction between targets

Energy end-use demand can be broadly categorised into three distinct modes of energy use, namely: electricity, heat and transport. The relative shares of electricity, heat and transport are an important factor in overall renewable energy target achievement.

Renewable energy targets are based on a percentage of end-use demand. Energy efficiency can influence the total energy demand, thus changing the absolute amount of renewable energy to achieve a given target share of renewable energy.

The largest renewable energy share will be achieved in electricity (RES-E), but electricity will also account for the smallest share of energy by mode. The lowest renewable energy share will be in the transport sector, but transport will account for the most significant share of energy by mode. As the majority of energy-efficiency measures relate to energy use for heat, this mode in particular is likely to be impacted by any shortfall in energy efficiency targets.

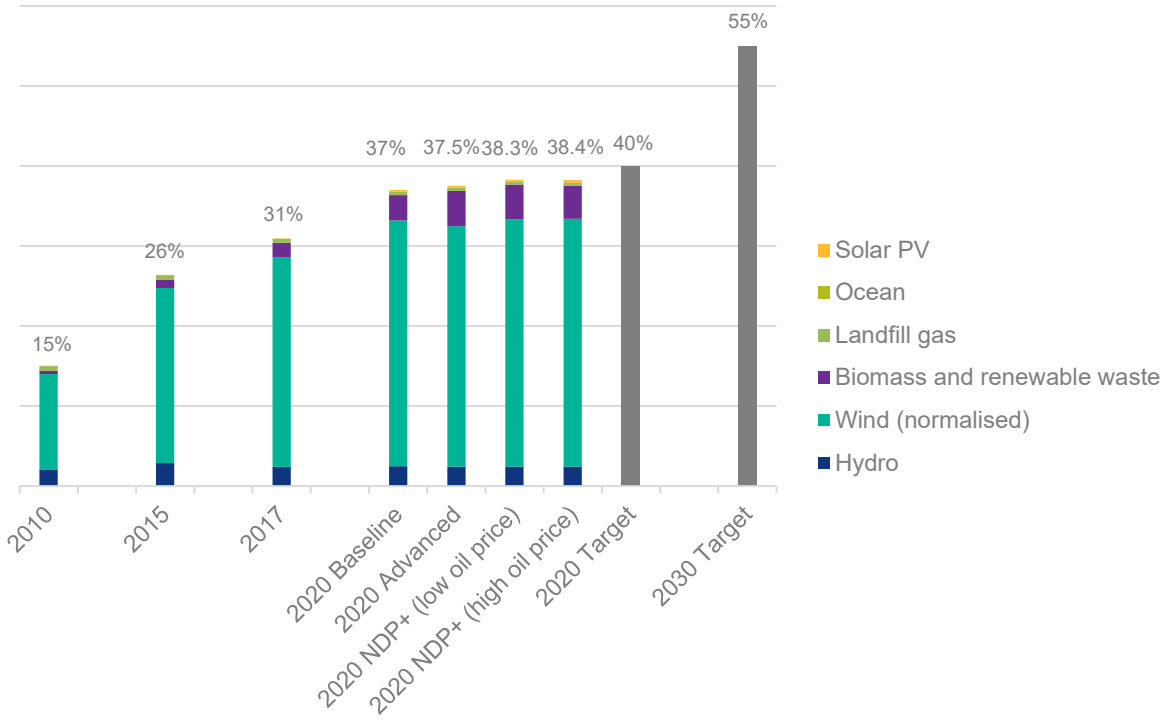
For target achievement it is necessary to progress the renewable energy shares and energy efficiency as much as possible in all energy modes. A shift to electrification of heat and transport will also increase the share of electricity in overall energy end-use, driving progress towards the overall renewable energy target (as electricity has a high renewable energy share). Electrification of heat and transport also assists with greater progress towards the non-emissions trading scheme sectors' greenhouse gas emissions reductions.

Renewable Electricity (RES-E)

Electricity is the smallest sector in terms of energy end-use demand, historically accounting for less than a fifth of final energy demand[18]. Therefore, the 40% renewable electricity target (RES-E) contributes considerably less to the overall renewable energy target when compared to heat and transport contributions. The share of electricity in total final consumption is not anticipated to change significantly from its historical share to 2020, yet approximately half of the total renewables contribution is expected to come from renewable electricity, predominantly from wind energy. It is evident that the significant progress in renewable electricity deployment will need to continue to 2030 but with further contributions required from the heat and transport sectors also.

Progress towards the 2020 renewable electricity target is shown in Figure 1. Wind energy deployment has made the most significant contribution to RES-E to date. The historic build rate (2005–2010) was 180 MW per year. Since 2010 the build rate has increased to an average of over 200 MW per year. In 2017 the installed capacity increased by 335 MW to just over 3.3 GW total installed capacity.

Figure 1: Renewable electricity progress to 2020 target



The existing hydro capacity[19] provides a small contribution towards renewable electricity, but this share is falling as electricity demand increases and the hydro capacity is not anticipated to grow. Biomass contribution consists mainly of *(i)* co-firing of biomass with peat in Edenderry power station *(ii)* combustion of landfill gas *(iii)* the renewable portion of municipal solid waste incineration, and a modest contribution from *(iv)* biomass combined heat and power (CHP) installations. There are also relatively small contributions from rooftop solar PV installations in Ireland.

An increased deployment rate of all renewable electricity technologies is required to meet the 2020 RES-E target of 40%. Post-2020, as electricity demand continues to grow at an anticipated rate of 3% per annum, increasing levels of deployment will be needed just to maintain the share achieved in 2020.

18 Final energy consumption is the energy used by the final consuming sectors of industry, transport, residential, services and agriculture. It excludes the energy sector (electricity generation, oil refining, briquetting, etc.).

19 Primarily from large hydro stations such as Ardnacrushna on the River Shannon and Cathleen's Falls on the River Erne.

A new Renewable Electricity Support scheme (RESS) was approved by the Irish Government in July 2018[20]. The scheme aims to assure a minimum achievement of 55% RES-E by 2030 through an auctions-based mechanism. The scheme will include community-led projects and community capacity building measures. The first RESS auction in 2019 will deliver 'shovel ready' projects, with the expectation of reducing the existing gap of three percentage points to meet 40% RES-E by 2020. While wind energy and particularly offshore wind energy are anticipated to grow under the scheme, it also aims to diversify the renewable electricity portfolio.

For the *Baseline* scenario modelled for this analysis to 2030, it is assumed that Lough Ree and West Offaly peat electricity-generating stations don't receive an extension to planning permission to run post-2023. For Edenderry peat station it is similarly assumed that no extension to planning is given post-2025. These assumptions are consistent with the EPA reporting requirements under the Monitoring Mechanism Regulation (MMR)[21] where only policies in place by the end of the latest inventory year can be included in the *With Existing Measures (Baseline)* scenario.

In the *Advanced* scenario, three electricity-generating stations (Lough Ree, West Offaly and Edenderry) co-fire biomass and peat until 2030[22]. This reflects the policy decision in April 2018 to extend the use of two peat stations beyond the end of 2019[23] and includes an assumption that all three stations receive the necessary extension to their current planning permissions to enable them to continue to receive priority dispatch in the electricity generation merit order.

Given the increased use of biomass in the *Advanced* scenario for electricity generation, less biomass is available for use in the heat sector (e.g. by large industries shifting from oil to biomass for heat), increasing prices and thus reducing the incentive for business to shift to renewable heat. This is reflected by a lower uptake of the Support Scheme for Renewable Heat in the models.

Ireland does not currently have any wave or tidal energy-producing installations; however, deployment of 5 MW of ocean energy is modelled in the *Advanced* scenario from 2023 to take account of planned deployment of demonstration projects. Continued use of Ireland's existing hydro resources also contribute to meeting the RES-E target in 2020. Ground-based solar PV could contribute as system costs continue to decline and considering their relatively fast construction time in comparison to other electricity generation sources. Use of biomass for electricity generation through the commissioning of waste-to-energy facilities and the growth in the use of biomass CHP could also help to meet future RES-E targets.

In the *NDP+* scenarios assume increased contributions from biomass, solar PV and wind energy in order to meet an ambition of 55% RES-E by 2030. Offshore wind energy is assumed to grow significantly from 2025 and constitute 27% of total installed wind energy capacity by 2030, driven by the RESS. Furthermore, the continuation of the recent trend of electricity exports is also set to continue and thus increased electricity generation is predicted in the NDP+ scenarios.

Some of the key dependencies on achieving the level of ambition set for 2020 and 2030 are the successful resolution of planning and regulatory issues; continued public engagement on wind; grid roll-out; and the development of appropriate market structures for an electricity system with high levels of renewables – currently being supported by the DS3 programme[24]. Significant mobilisation of private investment will also be needed, and such investment will be heavily reliant on investor confidence. The high-level design for the RESS[25] highlights specific requirements for community involvement in projects supported via the scheme.

20 Full details available from DCCAE: https://www.dccae.gov.ie/en-ie/energy/topics/Renewable-Energy/electricity/renewable-electricity-supports/ress/Pages/default.aspx

21 Monitoring Mechanism Regulation No. 525/2013

22 Lough Ree and West Offaly are assumed to run as 100% peat until the end of 2019 and from 2020 to 2026 co-fire with biomass share of 30%, decrease the use of peat to zero by 2030. Edenderry runs as 58% peat until 2026 then linearly decreases peat use to zero by 2030.

23 Policy decision taken in April 2017 to extend the REFIT 3 biomass support to co-firing in Lough Ree and West Offaly.

24 http://www.eirgrid.com/operations/ds3/

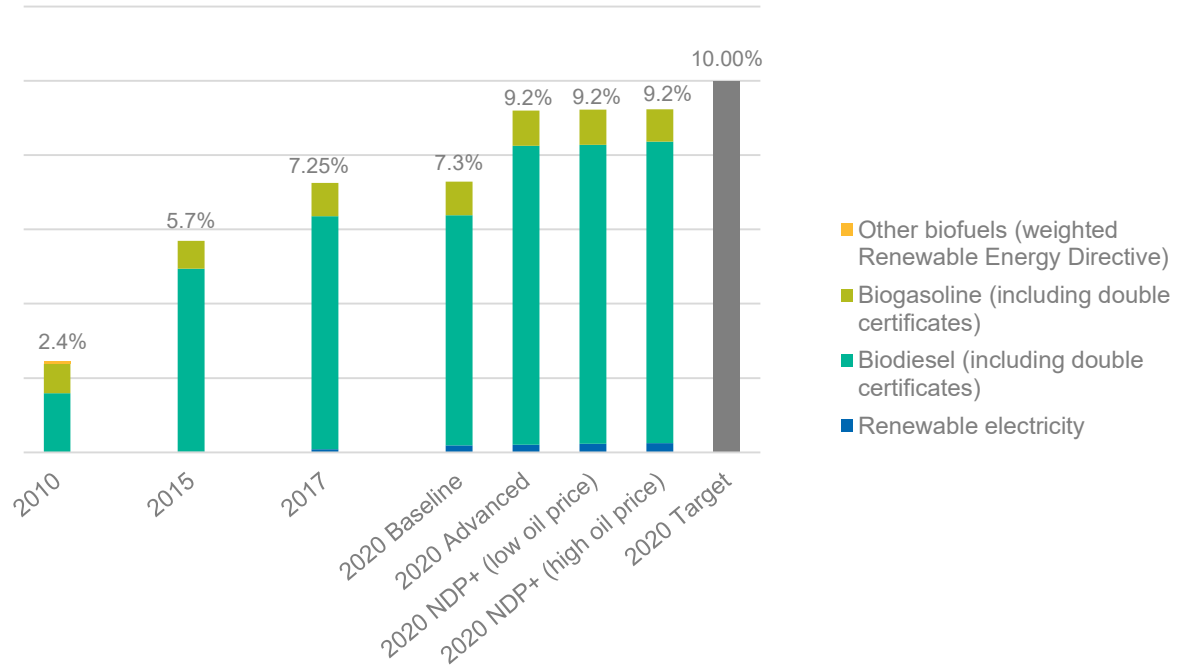
25 More information available from: https://www.dccae.gov.ie/en-ie/energy/topics/Renewable-Energy/electricity/renewable-electricity-supports/ress/Pages/default.aspx

Renewable Transport (RES-T)

The transport sector is currently the largest energy-using sector and is the sector most reliant on imported fossil fuels in the form of petroleum products and biofuels[26]. In the scenarios examined, the share of total energy consumed by the transport sector ranges from 40% to 44%[27]. The variation is driven by the oil price assumptions and the associated macroeconomic growth. 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.

Progress towards the 2020 RES-T is shown in Figure 2. Most of the renewable transport energy contribution comes from biofuels and this trend is expected to continue to 2030. Currently, all transport fuel contains on average around 4.1% (by energy content) biofuel blended with fossil-based petrol or diesel. Biofuel uptake in Ireland is driven primarily through the Biofuel Obligation Scheme, an obligation on fuel suppliers to blend an increasing percentage of biofuel with their fuel.

Figure 2: Renewable transport progress towards 2020 target



Biofuels are also important in helping Ireland to meet its greenhouse gas reduction targets. All biofuels supplied in Ireland are required under the EU Directive 2015/1513 to deliver at least 60% GHG savings relative to fossil fuel alternatives. In 2017, the average litre of biofuel in the Irish market delivered almost 81% savings (NORA, 2017)[28].

There is a risk that increased demand for biofuels, especially those derived from food and feed crop feedstocks can lead to a phenomenon known as Indirect Land Use Change (ILUC). To address ILUC concerns the European Commission published a Directive in September 2015, containing amendments to the Renewable Energy Directive. The 2015/1513 Directive proposed revised calculation rules for the individual RES-T target, including additional weighting for advanced biofuels (which count double towards the RES-T target) and for the renewable proportion of the electricity used in electric vehicles (which counts five times towards the RES-T target).

26 100% of oil products are imported and 86% of liquid biofuels were imported in 2017.

27 Transport share in gross final consumption (GFC) as specified by the Renewable Energy Directive 2009/28/EC

28 NORA (2017) The Biofuels Obligation Scheme – Annual Report 2017. Available from : http://www.nora.ie/_fileupload/457-18X0074%20-%20BOS%20Annual%20Report%20for%202017.pdf

Significantly, the biofuel additional weightings do not apply to the calculation of the transport contribution to the overall 2020 16% renewable energy target. While it is easier to meet the 10% RES-T target with some contribution from electric vehicles (EVs) and double-counted biofuels as allowed under the Directive, the transport contribution to the overall renewable energy target is less than previously anticipated.

In 2008 the Irish Government set a target of 10% of all vehicles in the transport fleet to be powered by electricity by 2020. This has since been revised to a target of 20,000 EVs in the transport fleet by 2020[29]. There are currently over 6,000 EVs on the roads in Ireland. This year there were 1,769 new EVs registered to the end of August 2018. Provided the strong growth in EV sales continues, a level of 10,000 EVs by 2020 is achievable. As part of this exercise the *Advanced* scenario projects an EV fleet of 10,000 by 2020. Despite their high efficiency, EVs will only make a relatively small contribution to the overall RES-T 2020 target. Nonetheless, they play an important role in the diversification and decarbonisation of the transport fleet as well as improving air quality and noise reduction in urban areas.

Existing supports for EVs are Vehicle Registration Tax (VRT) relief, low motor tax rates, price reductions via grants and demonstration projects. There is a comprehensive network of 1,200 public charge points across the island of Ireland. These have been deployed by ESB ecars since 2010, with the support of the Commission for Energy Regulation, the European Union, Northern Ireland's Department for Infrastructure and Government Departments.

Whilst growing year on year, overall deployment of EVs has been slower than anticipated[30] and at the end of 2017 the number of battery-only EVs in Ireland was approximately 3,000. For the first half of 2018 fully electric vehicles (BEVs), excluding Plug-in Hybrid and Hybrid variants accounted for 0.61%[31] of new car sales. To achieve the stock number of 8,000 battery EVs, modelled in the *Baseline* scenario, it would be necessary for EVs to account for approximately 2% of all new cars sold in Ireland by 2020. In the *Advanced* and *NDP+* scenarios the total number of EVs in the stock reaches 10,000 by 2020 and approximately 500,000 by 2030, in line with the ambition set out in the NDP.

Energy efficiency measures in transport are unlikely to have a significant impact on demand at their current scale. Savings estimates are also being revised given vehicle manufacturer labels have not always been reflected in vehicle on-road performance[32]. Consumer choices of transport mode, and activity in the Irish economy, which impacts on freight consumption and aviation, also significantly influence demand.

In the *Baseline* scenario a blending rate of 3.5% is achieved, based on the assumption that the blending comprises 8 units per 100 litres by 2020 (8.696% by volume as stipulated in Statutory Instrument 225 of 2016). Such blending is assumed to use E5 (a 5% blend of ethanol with gasoline) and a 4.8% blend of biodiesel with road diesel. When the double counting of 95% of the biodiesel is included, the RES-T share is 7.3% by 2020 compared to the mandatory 10% RES-T target.

In the *Advanced* scenario biofuels blending increases to 10 units per 100 litres by 2020 (=11.111% by volume) and thus a RES-T of 4.3% is achieved by 2020. This is based on the proposed revision of the Biofuels Obligation Scheme with a Statutory Instrument currently under consultation, to be introduced in January 2019. Such blending is assumed to use E5 and a 6.3% blend of biodiesel with road diesel. When the double counting of 95% of the biodiesel is included the RES-T share of 9.2% is achieved by 2020, just short of the 10% target.

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29 Department of Transport, Tourism and Sport, 2017, National Policy Framework: Alternative Fuels Infrastructure for Transport in Ireland 2017- 2030. http://www.dttas.ie/sites/default/files/publications/public-transport/english/alternative-fuels-framework/6186npfalternative-fuels300517.pdf

30 During the recession consumers were not making purchasing decisions at the same frequency they would previously have made them; thus there was not a turnover of purchases that could be influenced to choose EVs. In addition, there was a lack of choice of vehicles in the market. Since the Government grants programme commenced in 2011 the share of EVs as a percentage of new car sales has grown from 0.05% in 2011 to 0.3% in 2016, and further to 0.61% in the first half of 2018 (SIMI, 2018). There has also been growth in second-hand EV imports from the UK.

31 Battery electric vehicles only – excludes hybrid electric vehicles.

32 Analysis specific to Irish passenger cars (Dennehy & Ó Gallachóir, 2018).

In the *NDP+* scenarios it is assumed that there are further blending rate increases post-2020 until levels of E10 (a 10% blend of ethanol and gasoline) and B12 (a 12% blend of biodiesel) are reached by 2030. These assumptions are justified on the basis that by 2030 the petrol vehicle stock is anticipated to be compatible with E10 blending levels. Similarly, diesel cars will be compatible with a B12 blend assuming this consists of 7% FAME (fatty acid methyl ester) and 5% HVO (hydrogenated vegetable oil), a so-called 'drop-in fuel'[33].

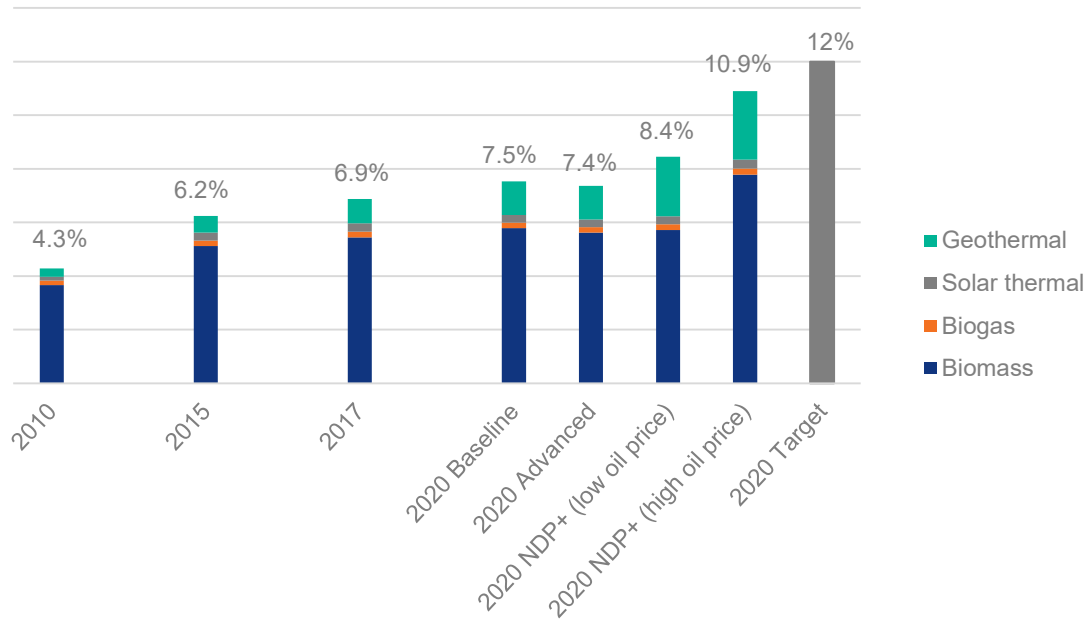
Further measures have also been included in the *NDP+* scenarios that could drive a shift towards zero-emissions capable vehicles in the longer term. As the transport energy demand is different in the *NDP+ low oil price* scenario relative to the *NDP+ high oil price* different shares of RES-T are achieved by 2030. The *NDP+ low oil price* scenario achieves 10.0% RES-T by 2030 (23.5% when including double counting for sustainable sources of biofuels,) whereas the *NDP+ high oil price* achieves 10.3% (24.7% including double counting).

33 A drop-in fuel can directly substitute for an existing fossil fuel without changing or redesigning the technologies using the fossil fuel.

Renewable Heat (RES-H)

To date, the most significant contribution towards the 12% RES-H target has come from the industrial sector, with more modest contributions from the household and services sectors. Industry sub-sectors such as: 'wood and wood products', and 'food and beverage' use production residues as renewable sources of energy. Progress towards the 2020 RES-H target is indicated in Figure 3.

Figure 3: Renewable heat progress towards 2020 targets



Deployment of modern renewable heat such as efficient biomass boilers and solar thermal systems has been supported by grants in the past (e.g. the ReHeat Scheme 2009–2011 targeted at commercial and industrial applications and the Greener Homes Schemes 2008–2011[34] for the residential sector). Solar thermal continues to be supported for households under the Better Energy Homes Scheme[35]. In addition, since 2011 the Building Regulations include a minimum threshold requirement for renewable energy supply for new residential buildings that can be met via renewable heat technologies. A similar requirement has recently been applied to buildings other than dwellings in the 2017 revision to non-domestic building regulations[36].

The following policies and measures will contribute towards achievement of the 2020 RES-H target and longer-term goals:

- the introduction of a Support Scheme for Renewable Heat
- additional biomass CHP installations deployed with the support of the existing Renewable Energy Feed-In Tariff (REFIT) scheme for biomass CHP
- additional RES-H contribution via new homes built in compliance with 2011 and later building regulations
- The renewable ambient energy use by heat pumps can also contribute to the RES-H target. This technology has recently been added to the residential grant scheme.

[34] At the time of publication of this report, a grant for solar heating is included under the Better Energy Homes grant scheme, whereas biomass boilers are not currently supported.

[35] https://www.seai.ie/grants/

[36] 2017 Building regulations: Conservation of Fuel and Energy – Buildings other than Dwellings.

The plans for energy efficiency action in the industrial and commercial sectors will serve to mitigate some of the impact of increased economic growth and associated increasing heat energy demand. The planned improvements to the residential building stock, through tighter (higher energy efficiency) building regulations and retrofits of existing dwellings, could further reduce energy demand in the sector to 2020 and beyond.

The results from the latest projections suggest achievement of 7.5% of final energy demand for heat from renewable sources in 2020 in the *Baseline* scenario. Increased use of biomass for electricity generation (co-fired with peat) reduces the national biomass resource available for business looking to use it for renewable heat applications. It also increases the cost of the biomass resources for heat. Possible biomass price increases due to greater use in electricity generation start at 19% and could increase almost 4-fold for certain biomass sources, thus reducing the incentive for business to shift to renewable heat. This slows the rate of shift to renewable heat in the industry and commercial sectors to 7.4% by 2020 in the *Advanced* scenario. RES-H is anticipated to grow to 8.8% by 2030 in the *Advanced* scenario mainly through more stringent building regulation requirements.

The *NDP+* scenarios assume greater and faster roll-out of the Support Scheme for Renewable Heat scheme (over and above that stated in the NDP) leading to a projected 8.4% RES-H by 2020 that grows to 19.4% by 2030 in the *low oil price NDP+* scenario. As a higher oil price leads to less energy demand and greater uptake of renewable heat technologies, the RES-H share in the *high oil price NDP+* scenario reaches 10.9% by 2020 and 24.9% by 2030.

Energy Efficiency

Energy efficiency contributes to meeting several energy and climate goals. All three goals of energy policy, namely security of supply, competitiveness and protection of the environment through reduced greenhouse gas emissions can be progressed through energy efficiency measures. The economic benefits of energy efficiency include direct savings, lower fuel costs and a reduction in the need for investment in supply. Energy efficiency comprises a myriad of individual measures realised through technological, behavioural or economic changes.

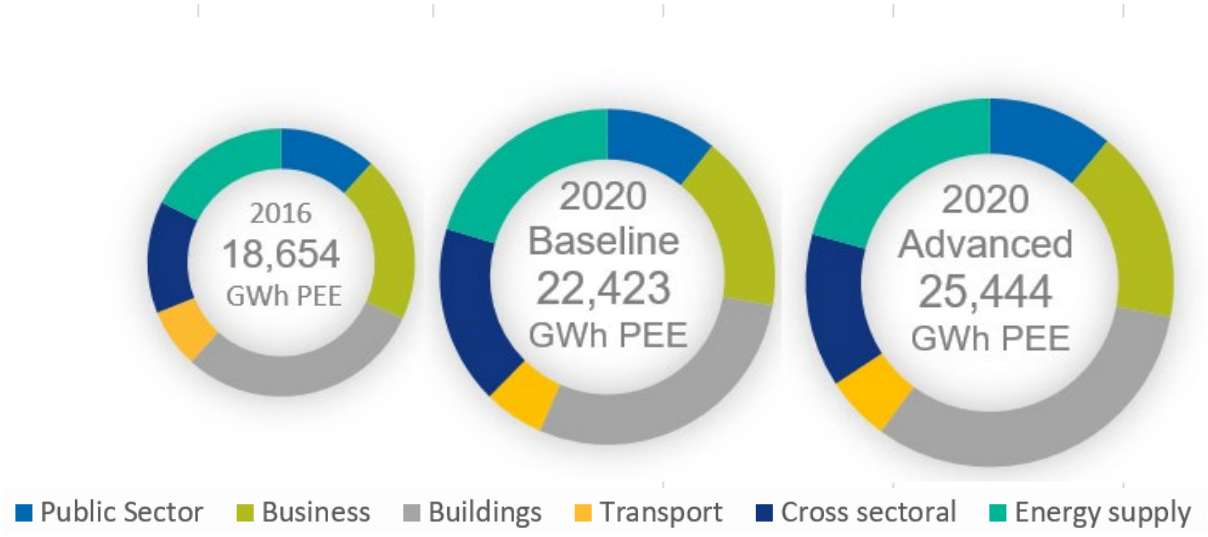
In addition to the standalone efficiency target, less energy demand due to efficiency measures lowers the effort required to achieve the renewable energy targets (e.g. a reduced number of installed wind turbines or biomass boilers would be required). Conversely, a shortfall in energy efficiency would mean that greater deployment of renewable energy technologies will be needed to meet the 2020 targets.

By the end of 2017 approximately 13% of the energy efficiency target of a 20% reduction on the average historic consumption between 2001 and 2005 had been achieved. These savings were achieved through a broad suite of programmes and measures across all energy-using sectors of the economy. Grant programmes for energy efficiency across the residential, commercial and industrial sectors have been introduced; energy management systems and processes are promoted to large energy users; public sector energy efficiency programmes have been executed; and Building Regulations have been tightened to require more energy efficient new buildings.

New policy measures are currently being piloted including a deep retrofit pilot scheme and innovative finance measures across the household and business sectors. A closer look is also being taken at the role of behaviour and decision making by SEAI's Behavioural Economic Unit. A detailed list of the measures catalysing activity in energy efficiency is provided in Ireland's latest *National Energy Efficiency Action Plan #4*[37].

37 Available from: https://www.dccae.gov.ie/documents/NEEAP%204.pdf

Figure 4: Energy efficiency progress towards targets



In the *Baseline* scenario an energy efficiency improvement of 14% relative to the 2001–2005 baseline is expected, and in the *Advanced* scenario achievement of 16% energy efficiency is anticipated, both falling short of the 20% target for 2020. This will make longer-term targets more difficult to achieve and points to the need for another step change in the level of deployment of energy efficiency technologies and practices.

Further measures have been announced in the *National Development Plan* (*NDP*) and the measures included in the *NDP*+ scenarios are detailed in Table 5 (Annex 2). However, these measures are not anticipated to impact significantly in the timeframe of the 2020 target, but rather impact post-2020. In the *Advanced* scenario, achievement on energy efficiency amounts to 22%[38]. This is anticipated to increase to 24.7% for the *NDP*+ scenarios by 2030 if a significant step change in the rates and depth of building retrofit can be delivered. An increased commitment on energy efficiency will be stated in the upcoming first *National Energy and Climate Plan*, a draft of which is due in December 2018. This is likely to reflect the potential for further energy savings through efficiency gains on both the supply and demand sides – and will set a very challenging task for policy makers to deliver. Figure 4 indicates the progress towards energy efficiency targets to date and projected achievement for 2020. The target for 2020 is 31,925 GWh. The target for 2030 energy efficiency will be confirmed in the upcoming draft *NDP*.

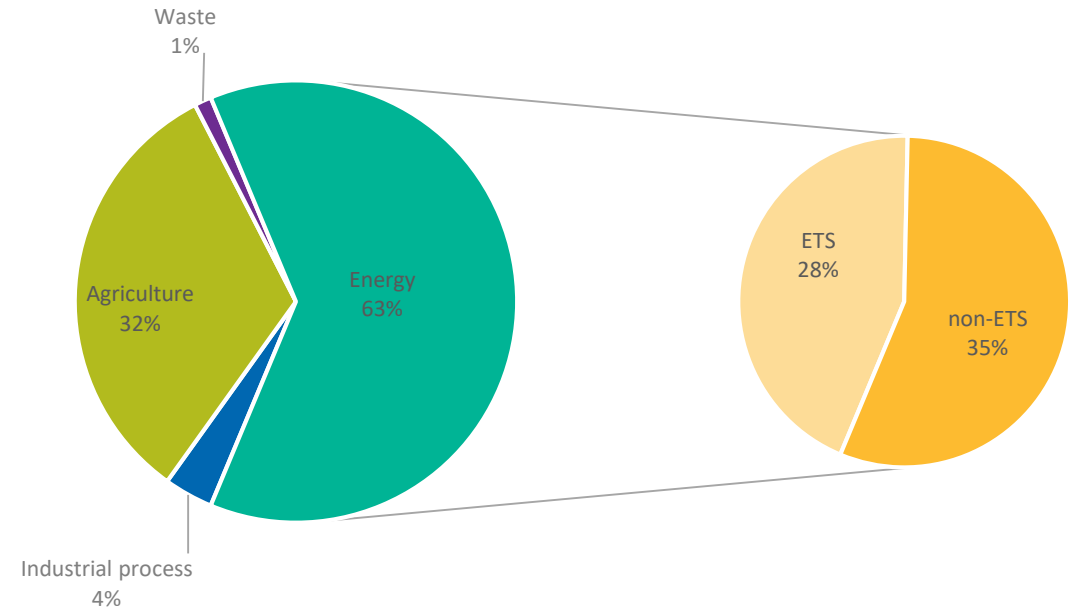
38 Of historic average energy demand 2001–2005 as per target calculation methodology (See DCCAE, 2017b).

Energy-related emissions

Of Ireland's total greenhouse gas emissions, approximately 63% are energy related (Figure 5). The remaining 37% are non-energy-related emissions from the agricultural and waste sectors. Projections for non-energy-related emissions combined with those from energy use in Ireland are reported by the EPA in their annual National Emissions Projections[39].

Of the total energy-related emissions, the majority (56%) are from the non-Emissions Trading System (ETS) sector (which covers transport, residential and low energy intensive commercial energy users), with the rest (44%) coming from the EU ETS sector mentioned earlier in the report (which includes electricity generation, energy-intensive industries and aviation).

Figure 5: Greenhouse gas emissions in Ireland 2016



Source: EPA

Separate approaches are used to promote emissions reductions at EU level for the ETS and non-ETS sectors. A Directive establishing a scheme for GHG trading within Europe (2003/87/EC)[40], also referred to as the Emissions Trading Directive, was established in 2005 to cap EU ETS emissions. It is based on the principle of a 'cap and trade' system. A cap is set on the total amount of certain greenhouse gases that can be emitted by installations covered by the system. The cap is reduced over time so that total emissions fall. Installations covered by the ETS (electricity-generating power stations, large-scale industrial plants and the aviation sector) can buy and sell emissions allowances as needed. ETS companies must collectively reduce their emissions to 21% below 2005 levels by 2020. For 2030, the level of reduction increases to 43% for the EU.

39 Available from www.epa.ie

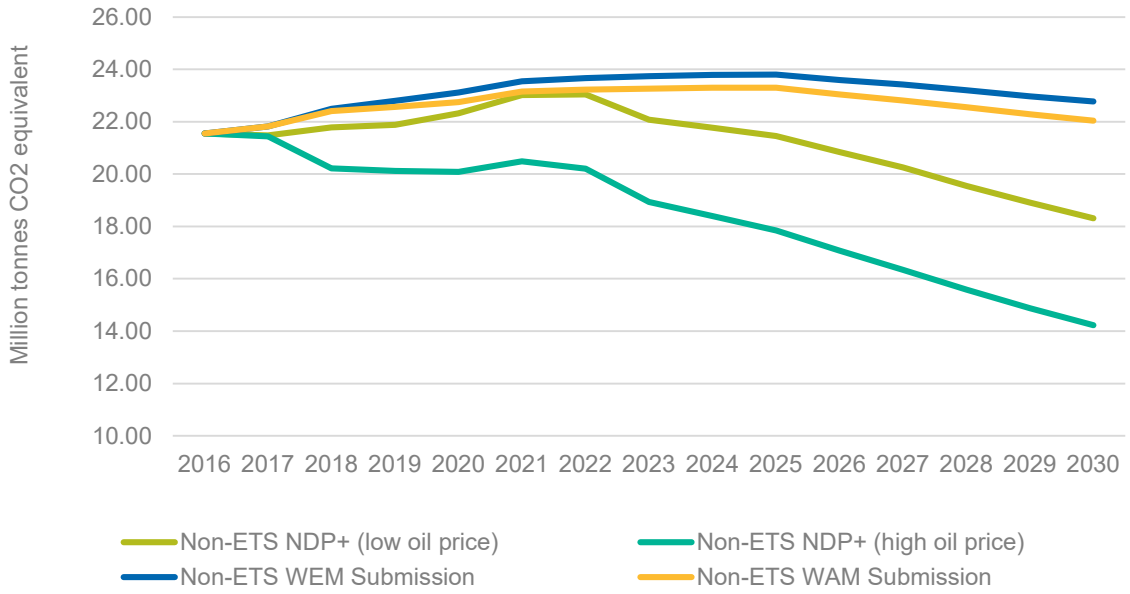
40 Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC. The ETS operates in 31 countries (all 28 EU countries plus Iceland, Liechtenstein and Norway). Available from: https://ec.europa.eu/clima/policies/ets_en

For sectors outside the EU ETS, the EU *Effort Sharing Decision*[41] establishes a binding greenhouse gas emissions target for all EU Member States relative to a 2005 baseline. The non-ETS sector covers energy-related emissions in the residential, transport, agriculture and waste sectors, as well as small businesses/industry. It also comprises non-energy-related agriculture and waste disposal emissions. The EU Member States' national targets are set to collectively deliver a reduction of around 10% in total EU emissions from the sectors covered by 2020 and of 30% by 2030, compared with 2005 levels.

Ireland's target for 2020 is for a 20% reduction in non-ETS emissions compared to 2005. There are binding annual emissions limits for the period 2013–2020 to ensure a gradual move towards the 2020 target. For 2030, this target has been set at 30% below 2005 levels of non-ETS emissions[42]. Current projections for the agricultural sector suggest there will not be a reduction in GHG emissions from that sector (EPA, 2018). This leads to very challenging trajectories for the non-ETS energy sectors.

Latest trends published by the EPA[34] indicate Ireland's non-ETS emissions are projected to be 0% and 1% below 2005 levels in 2020 under the *With Existing Measures* and *With Additional Measures* scenarios, respectively[43]. For 2030, non-ETS emissions are projected to be 1% above 2005 levels in the *WEM* scenario, and only marginally better at 0.5% below 2005 levels for the *WAM* scenario. An immediate acceleration of emissions reductions is required to put Ireland on the long-term trajectory of emissions reductions required.

Figure 6: Non-ETS energy-related emissions only



Source: EPA

Increased ambition and targets for set for sustainable energy deployment as outlined in the National Development Plan[44] have been modelled in the NDP+ scenarios. If these ambitions are archived, this could lead to non-ETS emissions of between 2% and 7% below 2005 levels being archived by 2020, and between 8% and 17% below 2005 for 2030; the range is linked to the low and high oil price sensitivity respectively. These trajectories will require significant and ongoing policy development and deployment if they are to be realised. The projected non-ETS emissions for all scenarios are included in Figure 6.

41 Decision No 406/2009/EC a.k.a. Effort Sharing Decision. Available from: http://ec.europa.eu/clima/policies/effort/index_en.htm

42 https://ec.europa.eu/clima/policies/effort_en

43 The EPA With Existing Measures (WEM) scenario is underpinned by the SEAI Baseline scenario and the With Additional Measures (WAM) scenario is underpinned by the SEAI Advanced scenario.

44 https://www.per.gov.ie/en/national-development-plan-2018-2027/

Table 3 illustrates the cumulative non-ETS emissions for the scenarios depicted in Figure 6 with the addition of agriculture emissions – thereby representing the total anticipated non-ETS emissions for Ireland. It is evident that even with the gains anticipated from *NDP* measures, annual emissions are not falling fast enough to be on the necessary trajectory for long-term targets (see Figure 8). For further information on the gap to the 2030 target, see Table 2.3 of the recent EPA publication *Ireland's Greenhouse Gas Emissions Projections 2017–2035* (EPA, 2018).

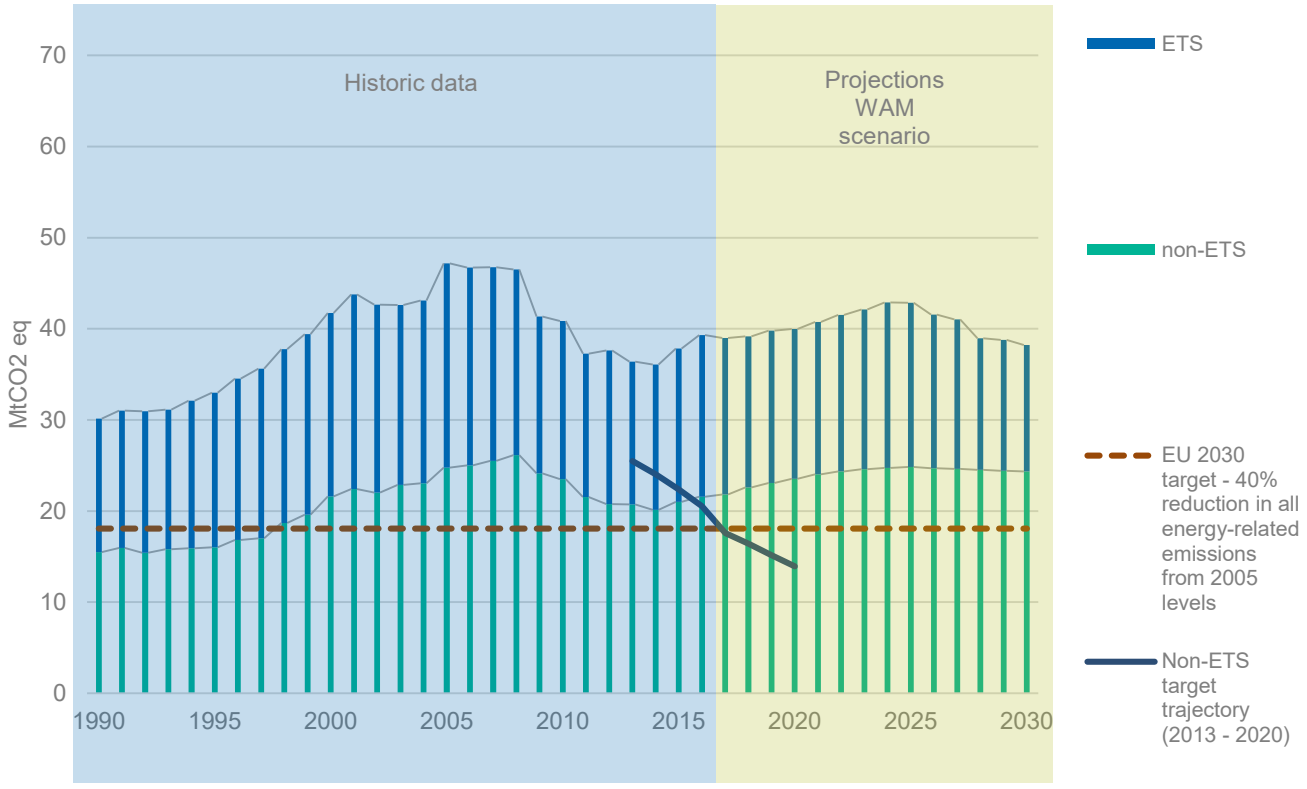
Table 3: Cumulative 2021–2030 non-ETS emissions

Non-ETS Scenarios	Cumulative emissions from 2021 including non-energy use emissions in Agriculture, wastes and industrial processes									
KtCO2e	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Non-ETS NDP Low Price	46,809	93,847	140,078	186,089	231,860	277,120	321,896	366,078	409,745	452,926
Non-ETS NDP High Price	44,269	88,468	131,564	174,198	216,371	257,871	298,741	338,962	378,592	417,695
Non-ETS WEM Submission	47,329	94,982	142,883	190,906	239,032	287,049	334,992	382,830	430,557	478,206
Non-ETS WAM Submission	46,932	94,149	141,572	189,107	236,731	284,196	331,534	378,722	425,760	472,675

Source: EPA

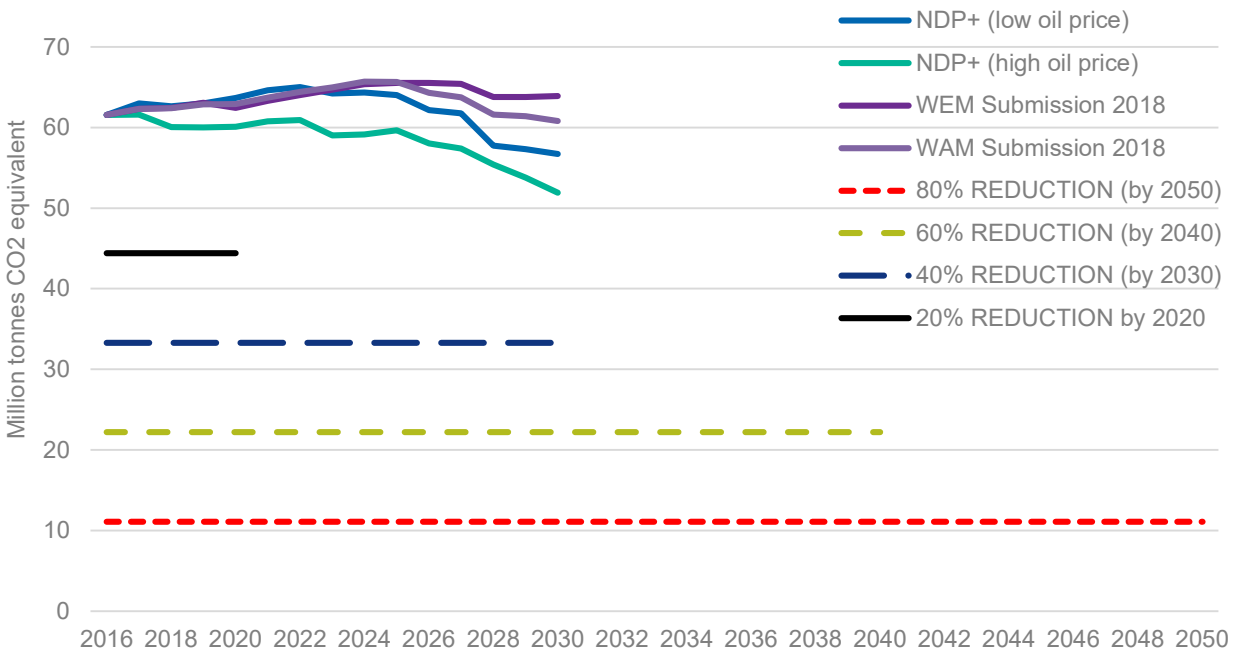
Ireland's national policy position, established in 2014, provides a high-level policy direction for the adoption and implementation by Government of plans to enable the State to move to a low carbon economy by 2050. Statutory authority for the plans are set out in the Climate Action and Low Carbon Development Act 2015 (Irish Government, 2015) and mandates an aggregate reduction of at least 80% CO_2 emissions (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors; and 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 7: Energy-related *Advanced* (*With Additional Measures*) Scenario



Since adoption of the National Policy Position the EU and Irish Government have become signatories to the legally binding Paris Agreement. The Paris Agreement does not make a distinction between ETS and non-ETS emissions. A key part of the agreement is the commitment to have emissions peak as soon as possible and the EU has committed to a 40% reduction on 1990 GHG emissions levels by 2030. Figure 7 illustrates the emission trajectory anticipated for the *With Additional Measures* scenario for energy-related emissions only. Note the targets illustrated in Figure 7 are calculated proportional to 1990 energy-related emissions only. All GHG emissions for all scenarios modelled are included in Figure 8, highlighting the scale of the challenge in meeting emissions targets.

Figure 8 : Total greenhouse gas emissions and EU and National targets



Source: EPA

Comparison to previous projections

In last year's projections (2017) renewable heat (RES-H) was anticipated to meet 9% by 2020. Based on the later than anticipated introduction date of the Support Scheme for Renewable Heat, this is reduced to approximately 7.5% by 2020.

Although the recent increase to the Biofuels Obligation Scheme has had a notable increase in the renewable transport (RES-T) share to 4.1% in 2017, anticipated continuing energy demand growth in the transport sector suggests a RES-T of 3.9% in the *Baseline* scenario and 4.8% in the *Advanced* scenario – which includes an additional increment to the Biofuels Obligation relative to the *Baseline*.

Renewable electricity (RES-E) is broadly similar in terms of installed capacity assumptions but there was a 1 percentage point fall in the 5-year average capacity factor (used in the wind normalisation calculation) due to a lot of the 2017 capacity additions not generating until the latter part of 2017.

These differences, together with a lower oil price input assumption, which results in greater demand, account for the fall in the overall renewable energy share compared to the 2017 energy projections.

Impact of a higher oil price

Following a prolonged period of low oil prices (Jan 2015 to October 2017, average Europe Brent spot price ~50 US dollars per barrel), a significant increase to around 75 US dollars per barrel (as at August 2018) has been observed. Oil prices have increased since October 2017, and if sustained in the medium term a higher oil price could lead to lower demand than anticipated in both the 2017 projections and the more recent 2018 low oil price scenarios. The oil price effect is explored in the *NDP+* scenarios presented in this report. As a small and open economy, Ireland is strongly susceptible to both the changes to the macroeconomic environment and the energy demand changes that accompany high oil prices. In particular, transport and industry energy demand can notably fluctuate depending on the oil price assumption. Some consumer purchasing and technology choices are also influenced by the oil price input assumptions.

When examining the sensitivity to the oil price on renewable energy target achievement is it interesting to consider the relative shares of electricity, heat and transport in gross final consumption, rather than the absolute values that can vary significantly with different oil price assumptions.

The relative shares of electricity, heat and transport in gross final consumption have historically been largely stable, in spite of considerable oil price volatility. In the short term (to 2020) it is reasonable to assume that the relative shares will not vary greatly from their historical values. A calculation of the overall renewable energy share in 2020 based on those relative shares (rather than the absolute consumption) was also estimated to ameliorate oil price projection variance to 2020.

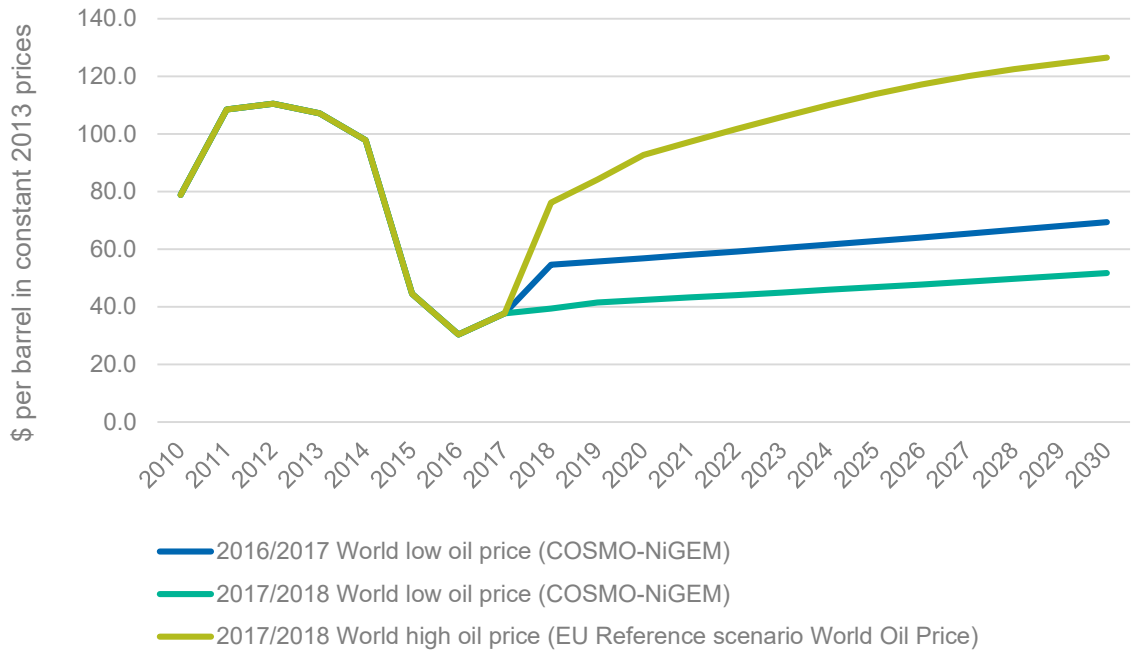
There has been a slow but steady increase in the share of electricity demand in gross final consumption in recent years. That trend is anticipated to continue in light of longer-term energy policy aims to increase electrification of heat and transport. Energy-efficiency measures in Ireland's *National Energy Efficiency Action Plan* (*NEEAP*) predominately impact the heat sector, and so heat share in gross final consumption is likely to continue the observed trend of a receding share of gross final consumption.

Transport has been responsible for the largest share in gross final consumption since 2015. Transport energy demand is strongly linked to the overall performance of the economy and, to a lesser extent, oil prices – given the almost exclusive reliance on oil in the sector. Therefore, the absolute transport energy demand is particularly sensitive to the oil price input assumptions.

As part of the modelling already undertaken by the ESRI, SEAI were provided with a price sensitivity exploring the impact of higher prices (based on EU reference scenario prices, rather than the UK BEIS price set used for the *Advanced* scenario projections). The *NDP+ Price Sensitivity* scenario uses the EU Reference Price scenario fuel prices (Figure 9) to illustrate the potential effect of higher prices in future. The EU Commission is encouraging all Member States to use the EU reference prices (at least as a sensitivity) to facilitate at least some level of harmonisation across EU Member State modelling exercises.

Price assumptions for the sensitivity start at $76 in 2018 (close to current prices) and grow to over $125 by 2030.

Figure 9: Oil price input assumptions



Source: NiGEM[45] and EU Reference scenario models[46]

45 NiGEM model (National Institute Global Econometric Model, https://nimodel.niesr.ac.uk/) maintained by the National Institute of Economic and Social Research (http://www.niesr.ac.uk/). Price assumptions for other fuels (i.e. excluding oil and not included in Figure 9) are the 'low' price scenarios from the UK's Department for Business, Energy & Industrial Strategy (BEIS) published on 30 November 2017 (https://www.gov.uk/government/publications/fossil-fuel-price-assumptions-2017)

46 European Commission, 2016, EU Reference Scenario 2016. Available from: https://ec.europa.eu/energy/en/news/reference-scenario-energy

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Annex A: Summary tables of scenario input assumptions and results

Table 3: 2020 scenario input assumptions and target progress

	Baseline (WEM)	*Advanced (WAM)*	*Adv. (WAM + shares adjusted)*	*NDP+ low oil price*	*NDP+ high oil price*
	2020	**2020**	**2020**	**2020**	**2020**
Energy Efficiency %	14.0	15.9	15.9	15.9	15.9
RES-E %	37.2	37.7		38.4	38.5
RES-H %	7.5	7.4		8.4	10.9
RES-T % *(regulation)*	3.5 (7.3)	4.3 *(9.2)*		4.8 (9.2)	4.8 (9.2)
Overall RES %	11.5	**11.9**	**12.6**	**12.7**	**13.9**
Total GHG Emissions Mtonnes CO_2eq	62,447 incl. agriculture, industrial process and wastes	62,916 incl. agriculture, industrial process and wastes	-	63,654 incl. agriculture, industrial process and wastes	60,087 incl. agriculture, industrial process and wastes
Prices	BEIS 2017 fossil fuel prices.	BEIS 2017 fossil fuel prices.	BEIS 2017 fossil fuel prices.	BEIS 2017 fossil fuel price.	EU *Energy Reference Scenario* (2016) Prices.
Policies and measures (PAMs)	Includes policies in place prior to the end of 2016.	Includes anticipated impact of all pre-*NDP* announced and active PAMs.	Includes anticipated impact of all pre-*NDP* announced and active PAMs.	Includes anticipated impact of *NDP* measures and additional measures (drives a marginal increase in activity by 2020).	Includes anticipated impact of *NDP* measures and additional measures (drives a marginal increase in activity by 2020).
Biofuel blend assumptions	E5 and B4.8 blends (=8.696% biofuels by volume by 2020) with 95% of biodiesel eligible for double counting for standalone RES-T target.	E5 and B6.3 blends (11.11% biofuels by volume by 2020) with 95% of biodiesel eligible for double counting for standalone RES-T target.	E5 and B6.3 blends (11.11% biofuels by volume by 2020) with 95% of biodiesel eligible for double counting for standalone RES-T target.	E5 and B6.3 blends (11.11% biofuels by volume by 2020). Continued increase in blending rates post-2020 until levels of E10 and B12 are reached by 2030 (maintained thereafter). 95% of biodiesel eligible for double counting for standalone RES-T target.	E5 and B6.3 blends (11.11% biofuels by volume by 2020) Continued increase in blending rates post-2020 until levels of E10 and B12 are reached by 2030 (maintained thereafter). 95% of biodiesel eligible for double counting for standalone RES-T target.
Low carbon heating assumptions	2 full years of Support Scheme for Renewable Heat (SSRH) prior to 2020, <€300m spend.	2 full years of SSRH prior to 2020, <€300m spend.	2 full years of SSRH prior to 2020, <€300m spend.	2 full years of SSRH prior to 2020; accelerated heat pump uptake in homes/new buildings.	2 full years of SSRH prior to 2020, accelerated uptake based on price signal; accelerated heat pump uptake in homes/new buildings.
Electricity generation	Lough Ree and West Offaly stations close once the PSO expires at the end of 2019.	Lough Ree and West Offaly cofire peat and biomass post-2020. Additional interconnection, offshore wind and ocean energy.	Lough Ree and West Offaly cofire peat and biomass post-2020. Additional interconnection, offshore wind and ocean energy.	Lough Ree and West Offaly cofire peat and biomass post-2020. Additional interconnection, offshore wind and ocean energy.	Lough Ree and West Offaly cofire peat and biomass post-2020. Additional interconnection, offshore wind and ocean energy.
EVs	8k vehicles by 2020.	10k vehicles by 2020 based on the grant scheme for home chargers and zero BIK.	10k vehicles by 2020 based on the grant scheme for home chargers and zero BIK.	10k vehicles by 2020 based on the grant scheme for home chargers and zero BIK.	10k vehicles by 2020 based on the grant scheme for home chargers and zero BIK
Energy Efficiency	Impact based on 2017 budget allocation.	Additional impact based on 2018 budget allocation (expanded programmes).	Additional impact based on 2018 budget allocation (expanded programmes).	Additional impact based on 2018 budget allocation (expanded programmes).	Additional impact based on 2018 budget allocation (expanded programmes).

Table 4: 2030 scenario input assumptions and target progress

	Advanced (WAM)	*NDP+ low oil price*	*NDP+ high oil price*
	2030	**2030**	**2030**
Energy Efficiency %	22.1	24.7	24.7
RES-E %	43.2	~55	~ 55
RES-H %	8.8	19.4	24.9
RES-T % *(regulation)*	4.3 (15.4)	10.0 (23.5)	10.3 (24.7)
Overall RES %	**14.3**	**24.0**	**26.0**
Total GHG Emissions Mtonnes CO_2eq	60,808 incl. agriculture, industrial process and wastes.	56,712 incl. agriculture, industrial process and wastes.	51,894 incl. agriculture, industrial process and wastes.
Prices	BEIS 2017 fossil fuel price assumptions.	BEIS 2017 fossil fuel price assumptions.	EU *Energy Reference Scenario* (2016) Prices.
Biofuel blend assumptions	E5 and B6.3 blends.	E10 and B12 blends.	E10 and B12 blends.
Policies and measures (PAMs)	Includes anticipated impact of all pre-*NDP* announced and active PAMs (end 2016).	Includes anticipated impact of enhanced suite of PAMs as stated in the *NDP*.	Includes anticipated impact of enhanced suite of PAMs as stated in the *NDP*.
Low carbon heating assumptions	2 full years of SSRH prior to 2020, <€300m spend. No SSRH post-2020.	SSRH continues running to 2030; accelerated heat pump uptake in homes/ new buildings.	SSRH continues running until 2022, price effects drive uptake after that; Accelerated heat pump uptake in homes/new buildings.
Electricity generation	Lough Ree and West Offaly cofire peat and biomass post-2020. Additional interconnection, offshore wind and ocean energy.	Lough Ree and West Offaly cofire peat and biomass post-2020. Additional interconnection, offshore wind and ocean energy, with 55% RES-E achieved by 2030.	Lough Ree and West Offaly cofire peat and biomass post-2020. Additional interconnection, offshore wind and ocean energy, with 55% RES-E achieved by 2030
EVs	~500,000 EVs by 2030.	~500,000 EVs by 2030.	~500,000 EVs by 2030.
Energy Efficiency	Additional impact based on 2018 budget allocation (expanded programmes).	Additional impact based on 2018 budget allocation (expanded programmes). Plus greater ambitions for the built environment and modal shift in transport.	Additional impact based on 2018 budget allocation (expanded programmes). Plus greater ambitions for the built environment and modal shift in transport.

Table 5: Summary of *National Development Plan* (*NDP*) measures

Contribution to 2021–2030 Non-ETS targets	Contribution to long-term decarbonisation
Investment in energy efficiency, with upgrades to homes increasing from 30,000 to 45,000 per annum from 2021 to achieve a minimum BER Rating 'B'.	New Renewable Electricity Support Scheme to support up to 4,500 megawatts of additional renewable electricity by 2030.
Investments in energy efficiency of existing commercial and public building stock with a target of all public buildings and at least one-third of total commercial premises upgraded to BER Rating 'B'.	Energy research funding to accelerate diversification away from fossil fuels to green energy, including wind, wave, solar, biomass, biofuels, biogas and hydrogen.
Supports for changing out oil-fired boilers to heat pumps, along with the provision of roof solar, in at least 170,000 homes.	Ongoing reinforcement of existing power grid and Enhanced electricity interconnection, including the Celtic Interconnector to France and further interconnection to the UK.
Full roll-out of the new Support Scheme for Renewable Heat.	Conversion of Moneypoint to end the burning of coal by 2025 and conversion of peat power plants to more sustainable low carbon technologies by 2030.
At least 500,000 electric vehicles on the road by 2030 with additional charging infrastructure to cater for planned growth.	Roll-out of the National Smart Energy Metering programme to commence in 2019.
Expand the refuelling network for alternately fuelled vehicles to address freight emissions.	Development of gas infrastructure projects to support regional and rural development and the low carbon transition.
Major investments in public transport, including replacement of public transport bus fleet, Cycling and Walking Network	Piloting of 'climate-smart countryside' projects to establish the feasibility of the home and farm becoming net exporters of electricity
Town-scale pilots of food and agricultural waste to gas in agricultural catchments for local gas networks supply and biogas production	

Annex B Methodological description

SEAI's National Energy Modelling Framework (NEMF) is a suite of modelling tools used for modelling the Irish energy system, both supply and demand side, to inform Irish Government energy policy and project Ireland's energy use based on these policies.

The NEMF outputs scenario projections of possible future energy supply and demand given a certain set of Government policies, thus quantifying current progress towards European and national renewable energy, energy efficiency and emissions targets. The scenario outputs aid in the analysis of long-term European and national targets and identifying compliance gaps. The NEMF will also be used for developing the set of scenarios for the upcoming first *National Energy and Climate Plan*.

The modelling process involves:

1. Creation of a baseline energy projection using a macro-economic model.
2. Assessing the impacts of policies and measures using bottom-up sectoral models.
3. Analysing the combined impact of a suite of policy measures on the baseline projection.
4. Producing a range of energy demand for possible future policy influence.

The macro-economic model currently in use is called COSMO (Core Structural Model of the Irish Economy), which creates a baseline forecast of energy consumption by sector (ESRI, 2017c). A range of sectoral models are used to analyse both supply and demand side energy. Electricity supply is modelled using a commercial power system software called PLEXOS[47]. A BioHeat model is used for techno-economic modelling of bioenergy supply chains in Ireland for the electricity generation, transport and heat sectors[48]. There is also a separate transport energy simulation model, which considers biofuels blending and the growth of low emissions vehicles in the vehicle stock, including electric vehicles. In addition, separate modelling by an energy-efficiency policy analysis tool (Unlocking model) informed the energy efficiency estimates included in the NEMF[49].

47 PLEXOS is an integrated electric power, gas and water simulation software package from Energy Exemplar. In the context of the National Energy Projection, it is the tool used for electric power model. For more information on the Irish context see: https://www.ucc.ie/en/energypolicy/models/plexos/

48 See publication by Clancy et al., 2018 for further information on the BioHeat model.

49 See SEAI 2015 publication for further information on the unlocking energy efficiency tool.

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