SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Energy Forecasts for Ireland to 2020

2011 Report

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December 2011 (Version 1.3)

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The Sustainable Energy Authority of Ireland

The Sustainable Energy Authority of Ireland (SEAI) was established as Ireland's national energy authority under the Sustainable Energy Act 2002. SEAI's mission is to play a leading role in the transformation of Ireland into a society based on sustainable energy structures, technologies and practices. To fulfil this mission, SEAI aims to provide well-timed and informed advice to Government and deliver a range of programmes efficiently and effectively, while engaging and motivating a wide range of stakeholders and showing continuing flexibility and innovation in all activities. SEAI's actions will help advance Ireland to the vanguard of the global clean technology movement, so that Ireland is recognised as a pioneer in the move to decarbonised energy systems.

SEAI's key strategic objectives are:

- Energy efficiency first – implementing strong energy efficiency actions that radically reduce energy intensity and usage
- Low-carbon energy sources – accelerating the development and adoption of technologies to exploit renewable energy sources
- Innovation and integration – supporting evidence-based responses that engage all actors, supporting innovation and enterprise for our low-carbon future

The Sustainable Energy Authority of Ireland is part-financed by Ireland's EU Structural Funds Programme, co-funded by the Irish Government and the European Union.

Energy Modelling Group

There are growing opportunities for SEAI to support evidence-based policy formation in the area of energy efficiency and renewable energy. These include ex ante assessments of the impact of different policy measures against baseline energy forecasts. Such assessments involve modelling a range of short-term and medium-term scenarios for energy demand and supply growth.

SEAI's Energy Modelling Group (EMG), established in 2009 specifically to meet this need, is providing high-quality analysis and policy advice on a range of energy/climate issues at the national and European level. Along with SEAI's Energy Policy Statistical Support Unit (EPSSU), it operates within SEAI's Low Carbon Technologies Development Division.

Executive Summary

This report is part of the annual series of forecast statements from the Sustainable Energy Authority of Ireland's (SEAI's) Energy Modelling Group (EMG). The energy projections to 2020 described here, are based on the trends evident in historic fuel usage across the industrial, residential, services and transport sectors and their response to economic growth and fuel price changes. The Energy in Ireland publication from SEAI's Energy Policy Statistical Support Unit (EPSSU) reports these historic trends in detail. The impact of government policy initiatives on the future direction of these trends are modelled in the projections along with the influence of future economic growth and fuel and carbon price changes. The resulting forecasts are used as a basis to inform future policy formation and evaluation as well as for national reporting to the European Commission on Ireland's renewable energy obligations and for reporting by the Environmental Protection Agency (EPA) on future emissions trajectories to the United Nations Framework Convention on Climate Change (UNFCCC) and the European Commission.

As highlighted in last year's report, forecasting energy demand in the current economic climate is a challenging process – particularly in the short term. Projections for economic growth, which are the key drivers behind Ireland's energy demand, are continually being re-estimated as events unfold globally and within the EU. Further reductions in macro-economic trends over the short term, combined with projections of slower long term recovery and the expected impact of future energy-saving measures, leads to a reduction in projected energy demand for Ireland over the period to 2020, compared to last year's forecast.

These reductions in turn reduce the quantity of renewable energy required to meet our EU renewable energy obligations and national targets. As set out in the 2009 Renewable Energy Directive (28/EC/2009), Ireland must achieve a 16% share of renewable energy in overall consumption (Renewable Energy Share, RES 16%) and a 10% share of renewable energy in transport consumption (RES-T 10%). Progress on these targets to date is presented in detail in Energy in Ireland (2011 report). The current report presents the trajectories required to deliver on these targets by 2020. Where appropriate, the level of effort associated with these trajectories is presented.

The Renewable Energy Directive sets out how EU member states that overachieve on their targets can trade renewable energy compliance with those member states that fall short. This is designed to incentivise the required renewable energy development in the most cost effective locations in the EU. Decision 406/2009/EC of the European Commission includes a target for Ireland to reduce greenhouse gas (GHG) emissions in the Non - Emissions Trading Sector (non-ETS) by 20% below 2005 levels by 2020. The impacts of the scenarios modelled are compared in the context of the requirements of these directives.

The forecast for energy demand has been made with the latest national and EU targets in mind. The *Baseline* scenario provides a reference against which the impact of current government policy targets and measures, as modelled in the National Energy Efficiency Action Plan (NEEAP)/ National Renewable Energy Action Plan (NREAP) scenario, can be benchmarked. The *NEEAP/NREAP* scenario assumes that the 20% efficiency target and the 16% overall RES target, required by the EU Renewable Energy Directive (based on achievement of the 40% renewable electricity, 12% renewable heat and 10% renewable transport targets) are achieved.

Further *Exploratory scenarios* are used to illustrate possible deviations from the *NEEAP/NREAP* scenario. This includes modelling the impacts of extending deployment of renewable energy technologies to a very ambitious level (*Exploratory Potential* scenario), and conversely, taking a pessimistic view of future deployment of renewable energy technologies and assuming under-achievement of our energy efficiency targets (*Exploratory Risk* scenario).

Key messages

- Total final consumption in the *Baseline scenario* is 2.7% lower in 2020 than in last year's forecast. This decline is due to the expectation of reduced future economic activity but also to the impact of the already implemented efficiency measures delivering energy savings.
- Last year the *Baseline* final consumption was 9.4% higher than in the *NEEAP/NREAP* scenario. This year the difference is 7.6%. The narrowing of the gap is positive news as it shows how planned actions last year are now having an impact on the energy system.
- The *NEEAP/NREAP* scenario requires, by 2020, a full implementation of all the measures contained in the NEEAP, the construction of a total of 4,200 MW of renewable electricity, 200,000 electric vehicles on the road, around 400 million litres of biofuel sales, and the delivery of 313 ktoe of renewable heat. Some of the requirement for renewable heat will be delivered from 150 MWe of biomass CHP and a lesser amount from newly built homes installing renewable heating as required by the 2008 Building Regulations. Further policy measures designed to close the 155 ktoe gap to the heat target are currently being evaluated.
- Ireland's target under EU Decision 406/2009/EC[1] is to achieve a 20% reduction in non-Emissions Trading Sector (ETS) GHG emissions by 2020 relative to 2005 levels. A reduction of 21% is estimated in non-ETS energy-related CO_2 emissions through the achievement of *NEEAP/NREAP* scenario targets. This compares to 8% in the *Baseline* scenario. Last year's forecast estimated a reduction of 17% in the *NEEAP/NREAP* scenario.
- Two factors are influencing the non-ETS energy-related CO_2 reduction this year as compared to last: (1) the more pessimistic economic projections; and (2) the higher fossil fuel price assumptions shifts energy demand to electricity which is in the ETS sector.
- The *Exploratory Potential* and *Risk* scenarios present two extreme deviations from this result. In the optimistic case where significantly higher levels of renewable energy deployment are achieved (*Exploratory Potential* scenario) the total reduction in energy-related CO_2 emissions is 35%. The reduction in the non-ETS sector of 21% is the same as in the *NEEAP/NREAP* scenario because the expansion of renewable energy capacity in the *Exploratory Potential* impacts on the ETS sector only.
- The *Exploratory Risk* scenario which takes a pessimistic view of renewable energy technology deployment and energy efficiency improvements to 2020 sees a reduction of 11% in non-ETS energy-related CO_2 emissions.
- The *Exploratory Risk* scenario outcome indicates that Ireland could be required to purchase compliance in the order of 4% (500 ktoe/5.8 million MWh) of the RES 16% obligation from other member states.
- The *Exploratory Potential* would see 720 ktoe (8.3 million MWh) available for export. Significant costs are likely to be associated with putting the infrastructure in place to support the renewable energy assumptions in the *Exploratory Potential* scenario. A sufficiently high RES compliance price could make this financially viable.

1 Decision 406/2009/EC on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.

The Energy Modelling Group welcomes any comments on the contents of this report. Feedback can be sent to emg@seai.ie.

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Introduction

Under the Sustainable Energy Act 2002, SEAI has a national role in compiling and disseminating projections of energy production and use. This report by SEAI's Energy Modelling Group (EMG) presents a range of energy supply and demand forecasts for the Republic of Ireland for the period to 2020.

The main purpose of the report is to inform debate on future energy trends, particularly as they relate to national and EU policies on energy efficiency, renewable energy, climate change, air quality and security of energy supply. This includes providing information for use by Ireland's Environmental Protection Agency (EPA) in preparing energy-related projections of greenhouse and trans-boundary gas emissions.

The tables summarising the data and growth rates relating to the energy forecast are grouped in time periods relevant to policy discussions:

- the period between now and 2016, the date by which our energy savings target of 9% must be met under the EU Energy Services Directive
- the period to 2020 – which is the period covered by Ireland's White Paper on Energy, the National Energy Efficiency Action Plan (NEEAP), the National Renewable Energy Action Plan (NREAP) and EU Directive targets for renewable energy and greenhouse-gas emissions

Our methodology builds on a number of years' work undertaken in association with the Economic and Social Research Institute (ESRI). A common goal of the continuing work undertaken by SEAI is to improve the availability of disaggregated data to underpin its modelling and forecasting capability. This report can be read in conjunction with the Energy Policy Statistical Support Unit (EPSSU) publication *Energy in Ireland 1990–2010*, which provides the context of historical trends in energy supply and energy use.

1 Methodology and Assumptions

As highlighted in last year's report, forecasting future energy demand in the current economic climate is a challenging process. Projections for economic growth and fuel price changes, which are the key drivers behind our energy demand, are continually being re-estimated as economic events within the EU and globally unfold. Given the link between these energy forecasts and macro-economic trends, using the most up-to-date data sources remains a focus of this exercise. In addition to estimating these variables, much work is undertaken to estimate the impacts of current demand and supply side energy policy for incorporation into the projected trends.

To arrive at the set of assumptions for this year's forecast, described below under the categories of macro-economic, fuel price and carbon price assumptions, a consultation exercise was undertaken involving several key stakeholders. These included the Department of Communications, Energy and Natural Resources (DCENR), the Department of Environment, Community and Local Government, the Department of Finance, other government departments, the Economic and Social Research Institute (ESRI), the Environmental Protection Agency (EPA) and EirGrid, Ireland's transmission system operator. Consideration was given to a range of existing macro-economic and fuel-price projections from EU and international sources during the consultations period. Together with results of modelling undertaken by the ESRI, some level of consensus was achieved around the most applicable set of assumptions to be used.[2] These are typically agreed in September of each year to allow time for the modelling process to be completed on time for this report.

1.1 Macro-economic assumptions

A set of macroeconomic projections for Ireland was produced by the ESRI in September this year. These projections use the HERMES model to project domestic economic activity which in turn depends on international factors captured in the NiGEM[3] model – including international oil prices (discussed below). These macroeconomic projections represent one possible view of economic growth taken in September, 2011.[4] The requirement to freeze assumptions at this stage rules out subsequent changes to key assumptions that might come to light in the period immediately before publication of these forecasts.

Table 1 ***Key macro-economic assumptions***

	Average Annual % Growth 2011–2015	Average Annual % Growth 2016–2020
GDP	3.0%	3.3%
GNP	2.3%	3.6%
Personal consumption	0.2%	2.9%

	2010	2011	2015	2020
Housing completions, thousands	15	10	32	33
Stock of cars, thousands	1,917	1,819	1,891	2,032
Population, thousands	4,428	4,427	4,484	4,603

2 Specific endorsement of assumptions is not obtained from all stakeholders. SEAI together with the ESRI make a final determination on the basis of all arguments presented at the time the assumptions must be set in order to allow time for modelling to occur prior to publication of this report.

3 National Institute Global Econometric Model

4 A number of other estimations have since been produced, including by the Department of Finance (GDP 2011 – 2015; 2.2%, GNP 2011-2015; 1.5% , November 2011 and Reuters consensus (representing the expectations of private domestic forecasters): GDP 2011 – 2015; 2.3%, GNP 2011-2015; 1.7% , October 2011poll.

Short term uncertainty versus long term forecasting...

The prospects for growth in EU economies and Europe generally over the next 18 months are uncertain. These energy forecasts, therefore, focus on medium and longer-term issues, rather than trying to predict in detail events in the current year or next year. As a basis for these forecasts, the ESRI prepared a medium-term macro-economic scenario that captures known information about the world, the EU and the Irish economies as at the beginning of September 2011. It assumes that over the coming decade the EU returns to a more normal growth profile and that the Irish economy behaves in a broadly consistent manner. Any variation on the short-term forecasts should not significantly affect this medium-term scenario. With all such medium or long-term forecasts there is a margin of error, and this must be taken into account when interpreting the resulting numbers.

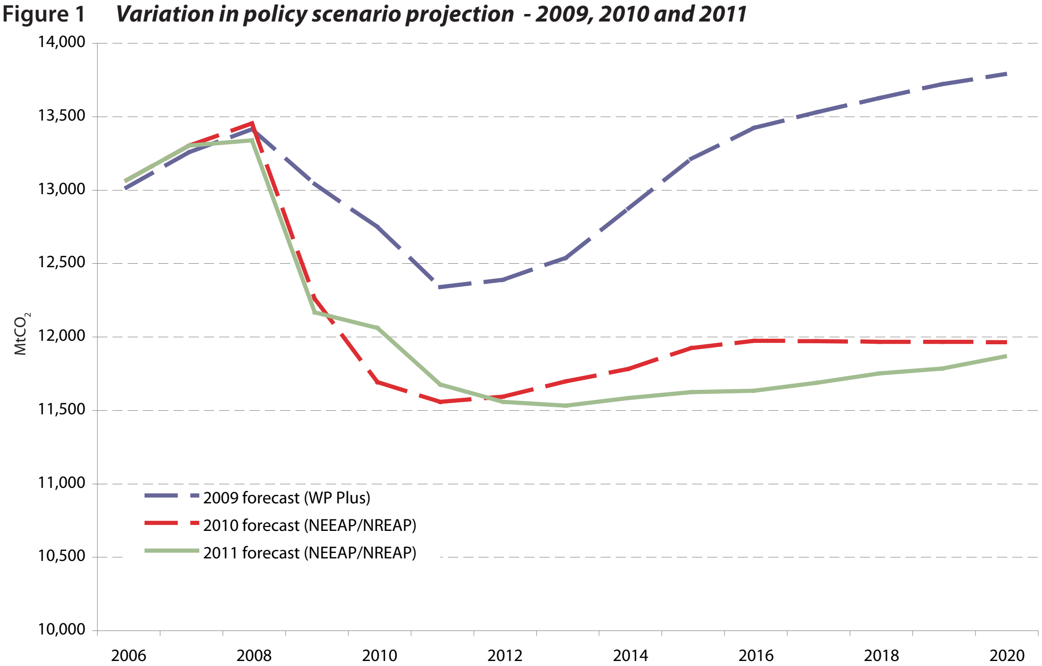
The impact of uncertainty in future economic growth over recent years is evident in revisions to key assumptions for each year's forecast as detailed in the table below.

Table 2 ***Revisions to key macroeconomic assumptions over recent years***

	Average Annual % Growth - GNP	
	2011–2015	2016–2020
2009	5.5%	3.3%
2010	3.0%	2.2%
2011	2.3%	3.6%

Projections of total final consumption (policy scenarios) for the last three years forecasts are compared in the figure below. The impact of changes to macro-economic, fuel and carbon price, and policy assumptions and their interaction, together with modelling refinements is evident in the changed demand projections for each forecasting process.

Figure 1 ***Variation in policy scenario projection - 2009, 2010 and 2011***



Source: ESRI. (Chart: SEAI)

1.2 Fuel price assumptions

The International Energy Agency (IEA) publishes fuel price projections in November each year as part of its World Energy Outlook (WEO). The most recent prices available for this process are from the 2010 WEO.[5] Its projections suggested a 2011 oil price of circa $85 per barrel of oil; this is substantially below the actual price of $110 in September 2011.[6]

The interaction of a lower price projection is outlined in Figure 2 below. Essentially, cheaper energy results in higher international economic growth, which in turn suggests higher domestic Irish growth on the basis that we are a small open economy that depends on exports for much of its income. This higher domestic growth, however, does not align with recent short-term economic outlooks. To reflect this, the WEO oil price projection (2010) was adjusted to account for current price levels, to produce an adjusted price projection, which then returns to the longer term WEO growth trajectory by 2020. The recent WEO published in November 2011 aligns closely with these assumptions as shown in Figure 2. Gas and coal prices remain consistent with WEO projections as these do not show a significant deviation from actual prices in 2011.

Figure 2 ***Oil price projections from WEO publications and 2010 assumption***

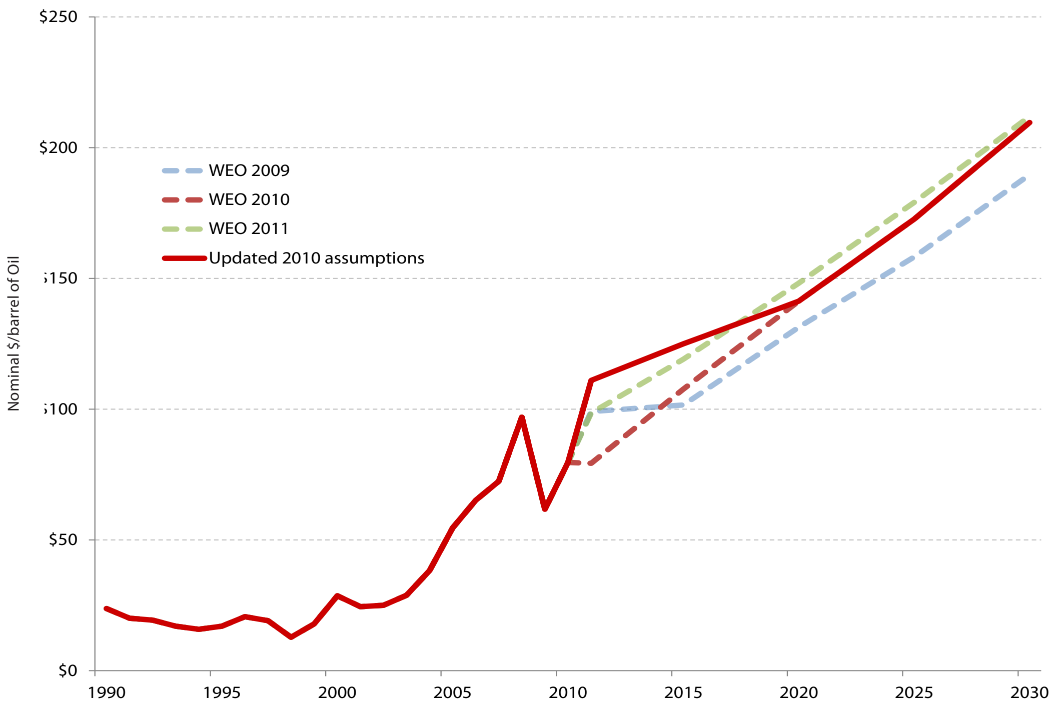


Table 3 ***Fuel price assumptions***

	2011	2015	2020
	Fuel Price $2009/Unit		
Coal (tonne)	97	98	106
Oil (barrel)	106	108	110
Gas (MBtu- GCV)	10	11	12
Peat (MWh)	15	15	15

5 World Energy Outlook 2010, http://www.worldenergyoutlook.org/
6 Bloomberg accessed on 28/09/2011

Impact of variations in oil price …

Since Ireland is a small open economy, output in the traded sector heavily depends on world demand for Irish exports and on Ireland's competitive position. Any shock to the global economy that has a positive impact on global growth will increase the demand for Irish exports and therefore domestic output. In order, to estimate the impact of oil price shocks on the domestic economy, it is necessary to first estimate the impacts on the international economy. The ESRI uses the NiGEM world model of the National Institute of Economic and Social Research to simulate the effects of the oil price scenarios on the international economy.

The results for the international environment are then incorporated into the ESRI HERMES macro-economic model to determine the impacts on the Irish economy. To consider the economic impacts of the lower oil-price scenario (shown as 'WEO 2010 in Figure 2) the effects of this oil price shock for the international economy are first estimated. The impact of a fall in oil prices on output and inflation varies across countries and depends on the response of monetary authorities. An oil price shock of the size modelled would have a substantial negative effect on inflation. Monetary authorities react by reducing interest rates to negate some of the downwards pressure on the price level. The lower level of interest rates would decrease the cost of capital in these countries and boost output in the international economy.

This type of shock would affect Ireland through several channels. For example, the fall in interest rates would encourage investment, and therefore output. In addition, stronger growth in the international economy would increase the demand for Irish exports. The effects of this type of positive shock on the Irish economy can be stronger than on the international economy. This arises not necessarily because the Irish economy is more exposed directly to oil prices, but rather because of its greater sensitivity to an upturn in international output.

When the lower (IEA 2010) oil price assumption is modelled, this leads to more optimistic macroeconomic forecasts for the international and the Irish economies over the next five years, estimated via the NiGEM model. ESRI estimates suggest that the impact of this lower oil price assumption would be to increase the growth rate of GDP in Ireland by around 0.5 percentage points over the period to 2020 with a related increase in energy demand.

Source: ESRI.

1.3 Carbon price assumptions

The EU Emissions Trading Scheme (ETS) carbon price is modelled as part of the work undertaken for the IEA's World Energy Outlook publication. These prices are used as inputs to this year's forecast.[7] The ETS carbon price applies to large energy-intensive installations such as electricity generators and large industry; it does not apply to smaller users such as SMEs and householders.

The 2009 Finance Bill[8] saw the introduction of a carbon tax of €15 per tonne of CO_2 which applies to energy users not covered by the ETS. This tax was signalled to increase further in the first national recovery plan. A subsequent revised plan published in July 2011 does not commit to further carbon tax increases. These policy developments have influenced the future carbon tax assumptions. Carbon tax is held at €15 per tonne until the (currently lower) ETS carbon price reaches €15 per tonne. After this point the carbon tax is assumed to follow movements in the ETS carbon price. The ETS CO_2 price and the carbon tax are also shown in *Table 4 below.*

Table 4 *CO_2 price assumptions*

	2011	2015	2020
	$€_{2009}/tCO_2$		
ETS	14.5	25	33
Carbon tax	15.83	25	33

1.4 Modelled scenarios and forecast process

Three scenarios are modelled as part of this year's forecasting process: the *Baseline,* the *NEEAP/NREAP* and the *Exploratory.*

The ***Baseline*** includes all policy measures legislated for up to the end of 2010 and represents a hypothetical future scenario in which no further policy actions or measures have been taken. This then provides a basis for comparison with the other scenarios in which the expected additional effects of government policy to 2020 are modelled.

The ***NEEAP/NREAP*** scenario accounts for both the National Renewable Energy Action Plan (NREAP)[9] – submitted to the EU Commission in July 2010, and the National Energy Efficiency Action Plan (NEEAP), first published in May 2009.[10] The NREAP details a pathway for Ireland to meet the binding commitments of 16% Renewable Energy Share (RES) of national energy consumption and a 10% RES of road and rail transport consumption (RES-T) by 2020. The NEEAP outlines how Ireland will achieve 20% energy efficiency savings, calculated on the basis of the average energy demand from 2001 to 2005. Central to these documents is a description of the policies and measures required to achieve these targets. Appendix 1a and 1b outline the measures identified by government to enable Ireland to achieve these targets, which form the basis for the *NEEAP/NREAP scenario.*

The ***Exploratory scenario*** looks at two alternative outcomes in 2020. The ***Exploratory Potential*** looks at the impact of developing the available renewable resource as outlined by current government policy; in particular, the effect of incorporating the White Paper targets for ocean energy and biomass electricity generation, as well as full implementation of the Gate 3 programme for wind.[11] The ***Exploratory Risk*** scenario looks at the risks to achieving the energy efficiency and renewable energy targets and takes a pessimistic view as to whether the challenges associated with policy implementation in these areas will be met.

Full details of the policy measures applied in each scenario are discussed in the relevant sections of the report, and detail is provided in Appendix 1b.

The forecasting process is summarised in the following steps:

1) The ESRI calibrates its HERMES energy sub-model based on the agreed input assumptions on fuel price, economic assumptions and renewable energy capacity. This model produces demand projections for fuel and electricity based on the underlying historical statistical relationships between economic activity and energy consumption in the Industrial, Services, Residential and Transport sectors. This year several improvements and updates have been included in the demand modelling process. The ESRI intend to publish the full detail of the model updates in the near future.

7 Previous forecasts used the CO_2 price assumptions based on outputs of the EU Commission's PRIMES model 2009.
8 Finance Bill 2010 http://www.kpmg.ie/financeact2010/deptdocs/docs/Finance%20Bill2010.pdf
9 See: http://www.dcenr.gov.ie/NR/rdonlyres/03DBA6CF-AD04-4ED3-B443-B9F63DF7FC07/0/IrelandNREAPv11Oct2010.pdf
10 Savings estimates have been updated to reflect revised forecasts impacting on potential impacts. The application of impacts assumed per policy/measure is detailed further in a subsequent section of this report and in the appendices.
11 See: http://www.eirgrid.com/media/CER_08_260.pdf and http://www.eirgrid.com/media/CER_%2009_191.pdf

2) SEAI adjusts the HERMES energy sub-model output to account for energy efficiency measures put in place before the end of 2010, but that are considered too recent to affect the historical statistical trend. This results in the *Baseline* scenario energy consumption as presented in this report.

3) Both the *NEEAP/NREAP* and the *Exploratory Potential* scenarios take into account the impact of all energy efficiency measures outlined in the NEEAP; equivalent to a 20% reduction in average energy demand over the period 2001–05. The *Exploratory Risk* scenario takes the view that only 50% of the remaining future energy savings required to meet the target will be achieved.

4) SEAI then generates the *NEEAP/NREAP* and the *Exploratory* scenarios supply projections, taking into account the methodology that underpinned the production of the NREAP. The NREAP outlines how Ireland will meet the two binding targets specified in the EU Renewable Directive 28/EC/2009:

    1) 16% of total energy consumption from renewable sources by 2020 (RES-16%)

    2) 10% of consumption in the transport sector from renewable sources by 2020 (RES-10%)[12]

5) ESRI runs an electricity dispatch model (IDEM) for all three scenarios, taking into account the SEAI adjusted demand and the input assumptions for the electricity sector.[13]

6) SEAI incorporates these results into the final forecast.

12 The specific calculation methodology for the transport target is outlined in Article 3(4) of the EU Renewable Energy Directive (28/EC/2009) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:en:PDF

13 Detail on the IDEM model is available at http://www.esri.ie/research/research_areas/energy/idem/

2 Baseline Forecast to 2020

The *Baseline scenario* represents a hypothetical future scenario in which no further policy actions or measures are initiated after 2010. Policies and measures legislated for and commenced up to the end of 2010 are modelled in the *Baseline*. Hence, this scenario does not represent a realistic outcome, but rather acts as a reference case for the other scenarios. This allows it to be used as a benchmark to measure the expected impact of forthcoming policy measures to 2020.

The *Baseline* scenario also indicates how previously implemented policies and measures are affecting the energy system year on year. When differences in year on year economic forecasts are accounted for, the movement of the *Baseline* scenario towards the trajectory of the *NEEAP/NREAP* scenario represents the implementation of policies that support the various energy targets. The difference between the *Baseline* and *NEEAP/NREAP* scenarios has reduced from 9.4% in the 2010 forecast to 7.6% in the current forecast , thus illustrating the progress made.

2.1 Policy achievements to date (Baseline)

Existing demand-side energy efficiency policies and measures considered implicit in the *Baseline* scenario are summarised below. These represent actions that have been in place for some time and of which the impact is likely to be represented in the historic trends; thus no adjustments are made to the HERMES macro-economic model outputs for these policies[14]:

- SEAI Public Sector Building Demonstration Projects
- Non-Residential Building Regulations 2005
- ReHeat (Renewable heat incentives in the services sector)
- SEAI Large Industry programmes
- Residential Building Regulations 2002
- SEAI Warmer Homes Scheme
- SEAI Greener Homes Scheme (efficiency gains)

A more recent set of demand-side efficiency policies that are considered too recent to be picked up in the historical trends is summarised below. The estimated impacts of these are accounted for differently in the model.[15] In general, a proportion of the savings impact is assumed implicit, and an adjustment made to the HERMES outputs for the remainder of savings expected over the lifetime of the policy.

- Green Public Procurement (via the Accelerated Capital Allowance Scheme (ACA))
- Supports for Exemplar Energy Efficiency Projects (SEEEP) and Energy Efficiency Retrofit Fund (EERF) public and commercial sector grants
- SEAI Small Business (SME) Supports
- Accelerated Capital Allowance Scheme (services sector)
- Residential Building Regulations 2008
- Efficient Boiler Standards
- Domestic lighting efficiency gains (Eco-Design Directive)
- SEAI Home Energy Saving scheme
- VRT/motor tax changes
- Improved economy of private-car fleet (by EU regulation)
- Aviation efficiency

Assumptions on the supply side relating to electricity, transport and heat renewable energy production represent achievements to date and actions committed to previously, of which the impact is assumed to be already implicit in the Baseline forecasted trends. These achivements are:

14 Where installations of renewable energy technologies result in net efficiency gains, these savings are eligible contributors to national energy efficiency targets as per the EU Energy Services Directive.

15 Specific detail on adjustments made is provided in Appendix 1a.

- Renewable electricity generation capacity is based on those units that have secured a grid-connection agreement and can avail of the Renewable Energy Feed-In Tariff (REFIT). This amounts to a total renewable electricity capacity of 2,840 MW by 2020 as compared to around 1,500 MW capacity at the end of 2010.
- The Biofuels Obligation Act 2010 sets renewable energy usage in the transport sector at 3% (4% by volume) of all energy consumption in the sector.
- The 2008 Building Regulations specify that at least 10 kWh/m^2 per annum of the heat requirements of a residential dwelling must come from renewable sources.

It should be noted that the *Baseline scenario* does not include the impact of further delivery of renewable electricity as expected through the Gate 3 process. This is incorporated and further discussed in subsequent scenarios.

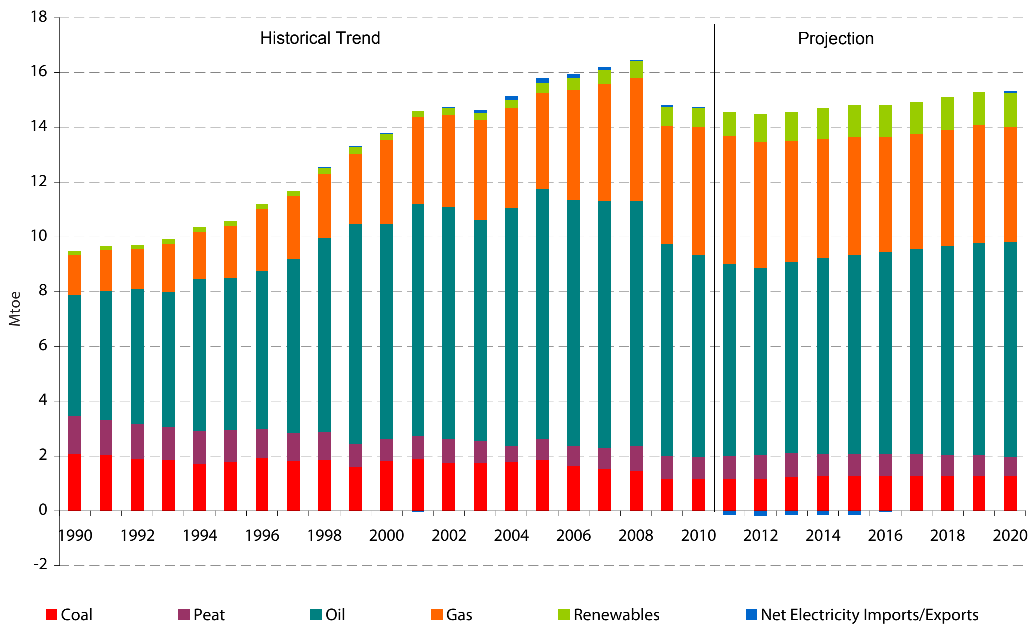
Details of the savings associated with the efficiency measures and the expansion of the electricity capacity are shown in Appendix 1a and 1b.

2.2 Primary Energy Requirement (Baseline)

Context:

- Primary energy requirement *(Baseline)* represents the hypothetical level of required energy inputs (including for the generation of electricity) across all energy using sectors of the economy before the application of future policy efforts required to meet targets.[16]

Figure 3 ***Total Primary Energy Requirement (TPER) 1990–2020 (Baseline)***



Forecast trend:

- Projected total primary energy requirement is lower this year compared with last year's forecast (5.6%) as a result of revised macro-economic, fuel and CO_2 price assumptions, and also due to the effect of policy achievements to date (as outlined above).
- Primary energy demand for oil remains dominant in future, with increasing levels of gas demand contributing to total primary requirement.

Table 5 ***Total Primary Energy Requirement (TPER) 1990–2020 (Baseline)***

Fuel	Total Primary Energy Supply (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Coal	1,167	1,270	1,297	11.1	1.1	1.4	0.5	8	9	8
Oil	7,373	7,368	7,859	6.6	0.6	0.0	1.6	50	50	51
Gas	4,704	4,224	4,201	-10.7	-1.1	-1.8	-0.1	32	29	27
Peat	791	805	667	-15.6	-1.7	0.3	-4.6	5	5	4
Renewables	679	1,168	1,221	79.9	6.0	9.5	1.1	5	8	8
Electricity Imports (Net)	40	-53	80	98.1	7.1	-	-	0	0	1
Total	**14,754**	**14,781**	**15,324**	**3.9**	**0.4**	**0.0**	**0.9**			

16 As modelled in the NEEAP/NREAP scenario.

2.3 Total Final Energy Demand (Baseline)

Context:

- Total final demand *(Baseline)* represents the hypothetical level of final energy demand across all energy using sectors of the economy before the application of the expected impact of future policy efforts required to meet targets.

Figure 4 ***Total Final Demand by Sector 1990–2020 (Baseline)***

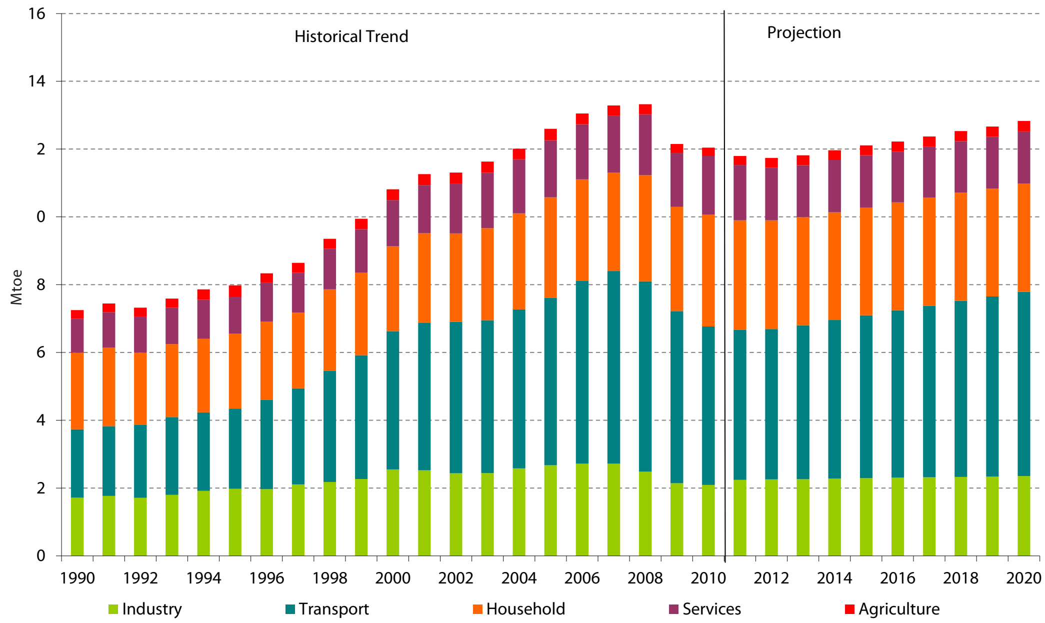
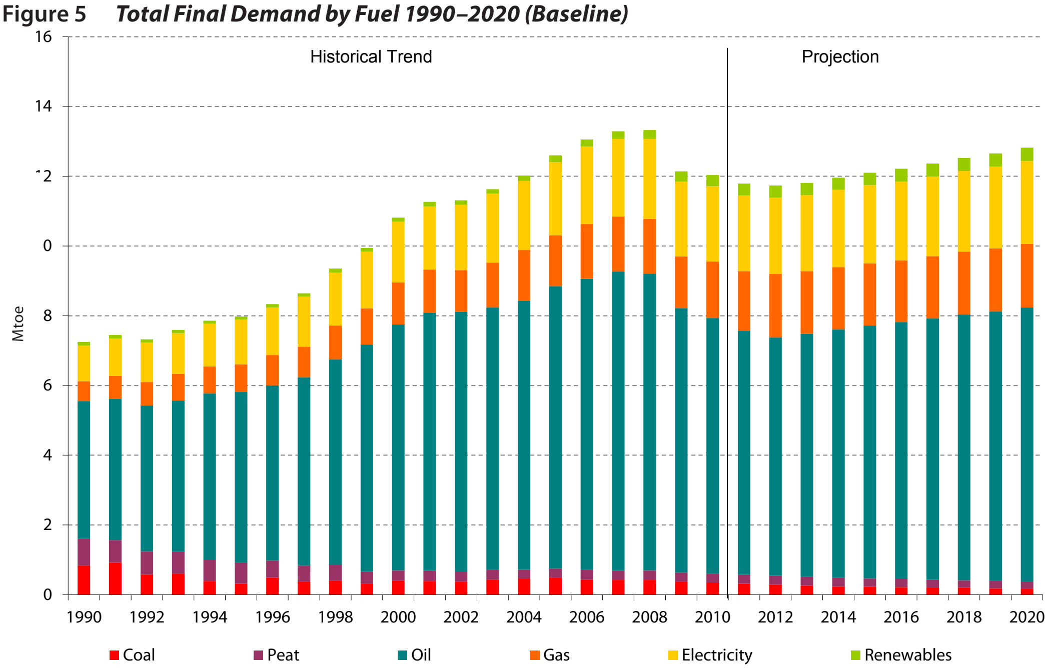


Figure 5 ***Total Final Demand by Fuel 1990–2020 (Baseline)***



Forecast trend:

- Projected total final demand is lower this year (2.7%) compared with last year's forecast as a result of revised macro-economic, fuel and CO_2 price assumptions, and also due to the effect of policy achievements to date (as outlined above).

Table 6 ***Final Energy Demand by Sector 2010-2020 (Baseline)***

Sector	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Sectoral Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Household	3,294	3,183	3,189	-3.2	-0.3	-0.6	0.0	27	26	25
Industry	2,093	2,309	2,353	12.4	1.2	1.6	0.5	17	19	18
Services	1,737	1,497	1,545	-11.1	-1.2	-2.5	0.8	14	12	12
Agriculture	247	297	306	23.8	2.2	3.1	0.8	2	2	2
Transport	4,674	4,936	5,437	16.3	1.5	0.9	2.4	39	40	42
Total	**12,046**	**12,222**	**12,830**	**6.5**	**0.6**	**0.2**	**1.2**			

Table 7 ***Final Energy Demand by Fuel 2010-2020 (Baseline)***

Fuel	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Coal	351	215	177	-49.6	-6.6	-7.8	-4.8	3	2	1
Oil	7,330	7,368	7,859	7.2	0.7	0.1	1.6	61	60	61
Gas	1,618	1,770	1,817	12.3	1.2	1.5	0.7	13	14	14
Peat	254	234	205	-19.2	-2.1	-1.3	-3.3	2	2	2
Non-Renewable Waste	9	9	9	-1.2	-0.1	-0.2	0.0	0	0	0
Renewables	321	364	385	19.9	1.8	2.1	1.4	3	3	3
Electricity	2,164	2,262	2,378	9.9	1.0	0.7	1.3	18	19	19
Renewable Elec	320	647	633	97.6	7.0	12.4	-0.5			
Fossil Elec	1,843	1,615	1,745	-5.3	-0.5	-2.2	2.0			
Total	**12,046**	**12,222**	**12,830**	**6.5**	**0.6**	**0.2**	**1.2**			

2.4 Renewable Energy (Baseline)

This section deals with the impact of existing policy on future renewable energy use in Ireland. As only those policies implemented prior to the end of 2010 are considered in the *Baseline*, this scenario is not an expected outcome, but rather a look at how far the intensive policy activity of recent years has carried us towards our goals and obligations.

The Renewable Energy Directive of June 2009 (28/EC/2009) outlines the binding obligations on renewable energy use to 2020 for each EU member. The purpose of this legislation is to drive the EU towards a 20% penetration of renewable energy by 2020. This target is divided among the member states based on their access to renewable resources and their ability to exploit these resources. Ireland's two binding targets are:

- Renewable Energy Share (RES) of 16% of total energy consumption in 2020 (RES 16%)
- 10% of road and rail transport consumption from renewable sources in 2020 (RES-T 10%)

This EU legislation complements the Government's stated ambitions as outlined in the Energy White Paper in 2007:

- 40% of electricity consumption from renewable energy by 2020 (RES-E 40%)
- 10% of transport consumption from renewable energy by 2020 (RES-T 10%)
- 12% of thermal consumption from renewable energy by 2020 (RES-H 12%)

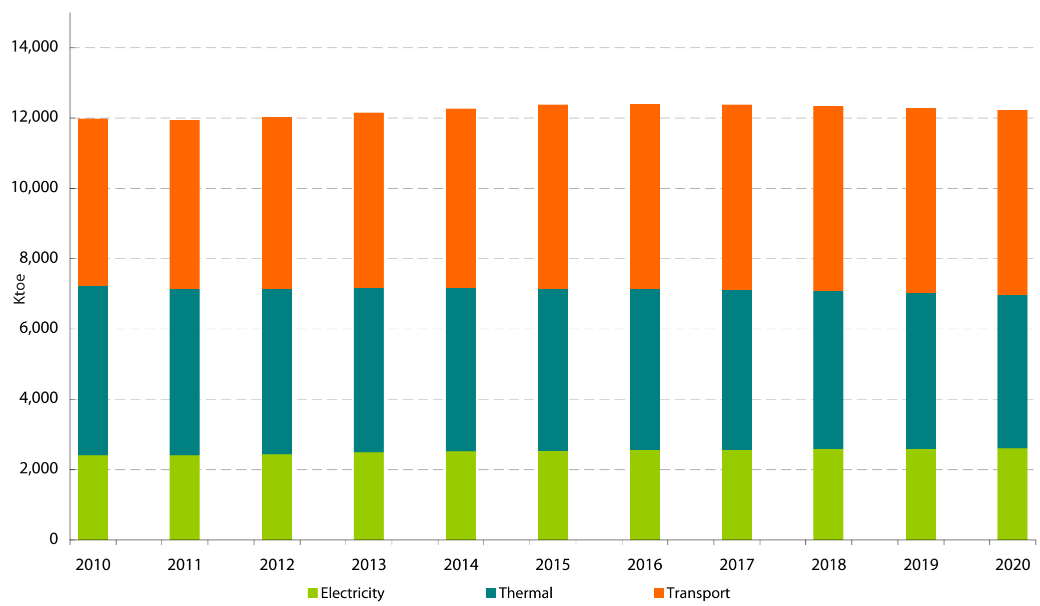
This section presents the final energy consumption in each of the energy end-use services (*modes*) of heat, transport and electricity and shows how current policy is driving us towards our targets in each of the three sectors.

2.4.1 RES-Renewable Energy Contribution to Overall Energy Demand (Baseline)

Context:

- *Figure 6* shows the Gross Final Consumption (GFC) of energy in the Republic of Ireland separated by mode of use. GFC is calculated as outlined in the Renewable Energy Directive (28/EC/2009)[17] and takes account of energy lost in transmission networks and used in energy conversion installations such as electricity generators.
- The *Baseline* demand accounts for energy savings arising from measures introduced prior to the end of 2010. The details of these are discussed in section 2.1 and apply to GFC in the same way.
- The GFC in the electricity sector has historically made up the smallest proportion of total GFC while energy used for heat and transport typically account for up to 80% of the total.
- The share of each end use sector in GFC has important implications for the relative level of effort required in each end use sector to achieve the renewable energy targets i.e. 1% of REH-H or RES-T is currently equivalent to 2% of RES-E.
- Renewable energy shares (RES) in each end use sector are shown in *Figure 7*. The RES in each sector is affected by both the growth in renewable energy use and the growth in energy demand.
- RES has seen a large increase in recent years though the impact of renewable policies such as the Mineral Oil Tax Relief Scheme and the Biofuel Obligation Scheme, the Renewable Electricity Feed in Tariff (REFIT) for renewable electricity and the Greener Homes Scheme and the ReHeat scheme in heat.

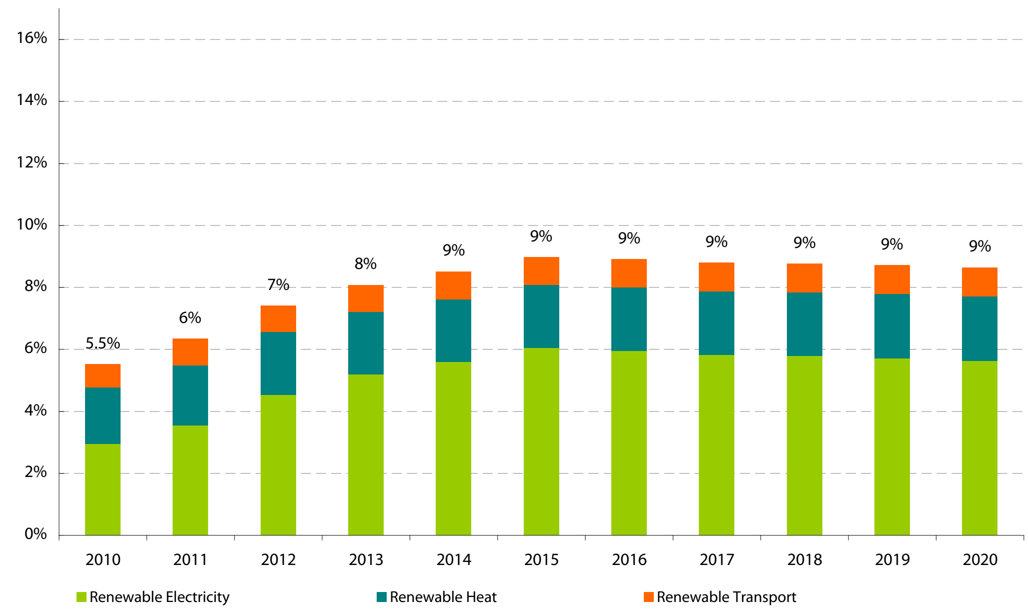
Figure 6 ***Gross Final Consumption by Mode of Consumption 2010-2020 (Baseline)***



17 GFC calculation also includes an adjustment for countries with a large proportion of aviation in their GFC. See article (3) and article (5) of the EU Renewable Energy Directive (28/EC/2009) for calculation methodology.

2 Baseline Forecast

Figure 7 ***Renewable Energy Contribution to Gross Final Consumption (Baseline)***



Scenario trend:

- In 2020, electricity use accounts for 21% of overall demand while transport and thermal use account for over 39% each.
- The proportional share of heat consumption drops over the forecast horizon as the usage of energy for heating is reduced through existing efficiency measures.
- Overall RES levels out at 9% by 2014 as the last of the currently scheduled wind farm[18] projects are connected to the grid. The *Baseline* projects the hypothetical future where no further wind projects are connected.
- The transport share remains at 1% of overall RES over the horizon supported by the biofuels obligation, while renewable heat maintains a 2% share of overall RES over the horizon.
- Increasing GFC over the period reduces the RES figure from 2015 onwards.

Table 8 ***Energy Consumption by Mode of Application 2010–2020 (Baseline)***

Application Mode	Gross Final Consumption RES Dir (Ktoe)			Growth %	Average Annual Growth Rate %			Energy Share by Mode %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Electricity	2,490	2,563	2,695	9.4	0.9	0.7	1.3	20	21	21
Thermal	5,208	5,027	5,019	-3.7	-0.4	-0.6	0.0	42	41	39
Transport	4,798	4,724	5,033	4.9	0.5	-0.3	1.6	38	38	39
(Transport for RES-T)	3,883	3,802	4,072	4.9	0.5	-0.4	1.7			
Total	**12,496**	**12,315**	**12,746**	**2.2**	**0.2**	**-0.2**	**0.9**			

18 Calculated from data published by EirGrid accessed on 30th September 2011http://www.eirgrid.com/media/Contracted%20Wind%20Farms%20-%20 30%20Sep%202011.pdf

Table 9 ***Renewable Energy % of Gross Final Consumption (Baseline)***

Renewable Energy	Renewable Energy Fuels (ktoe)			Growth %	Contribution to Modal RES %			Contribution to Overall RES %		
	2010	**2016**	**2020**	**10 -'20**	**2010**	**2016**	**2020**	**2010**	**2016**	**2020**
Renewable Electricity	341	706	717	110.7	14.8	29	27	3	6	6
Renewable Heat	228	252	266	16.3	4.4	5	5	2	2	2
Renewable Transport	92	111	119	29.0				1	1	1
(For RES-T)	93	114	122	30.6	3.0	3	3			
RES								**5**	**9**	**9**

Scenario outcome: level of effort

- REFIT will support a further 1,000MW of wind expected to connect to the electricity grid by 2014. This implies a build rate of close to 200 MW per year to 2014.
- The biofuels obligation in transport maintains the 3% (4% by volume) share of biofuels in transport consumption.
- Policy action is limited in the heat sector and the small increase in renewable usage is due to the implementation of Part L of the 2008 Building Regulations.[19] This requires all newly constructed houses to have at least 10 $Kw/h/m^2$ coming from renewable energy. The 16% increase is equivalent to an average of 16,000 homes a year installing a renewable heating source.

19 Part L requirements can also be met through onsite micro generation of electricity. For most homes the heating solution is the most economical and this calculation assumes that the majority of new houses choose to meet the requirement with heating technologies.

3 NEEAP/NREAP Scenario to 2020

This scenario is based on the details published in both the National Energy Efficiency Action Plan[20] (NEEAP) and the National Renewable Energy Action Plan[21] (NREAP). These have been submitted to the EU Commission and represent Ireland's strategy to meet energy efficiency and renewable energy obligations at national and EU level.

Fundamental to this scenario is the interaction between efficiency measures that reduce energy demand and the level of effort required to achieve renewable energy obligations. The benefits of 'energy efficiency first' have been well established. A recent 'Economic analysis of residential and small-business energy efficiency improvements'[22], and SEAI's 2009 publication 'Ireland's Low Carbon Opportunity'[23]show that for a wide range of efficiency measures, the cost to society of implementing these is negative. This has the added benefit of reducing the amount of effort required on the supply side to achieve renewable energy obligations.

Energy Efficiency

In addition to the energy efficiency measures applied in the *Baseline*, the following measures are incorporated in the *NEEAP/NREAP* and *Exploratory scenarios* to model the expected impact of achieving Ireland's national 20% energy savings target for 2020. These measures are applied in the modelling ahead of application of the supply-side measures:

- SEAI Public Sector Programme
- Public transport efficiency
- Better Energy Workplaces (services sector)
- Residential Building Regulations 2011
- Nearly zero energy dwellings (a further revision to the Residential Building Regulations in 2016)
- Building Regulations 2012 – Buildings other than dwellings
- Smart meter roll-out
- Better Energy Homes
- Electric vehicle deployment
- More efficient road traffic movements

Renewable Energy

The *NEEAP/NREAP scenario* applies the methodology used in the production of Ireland's NREAP. The NREAP outlines the minimum response required from the various policy measures in order to achieve the Renewable Energy Directive (28/EC/2009) obligations of:

- 16% of total energy consumption from renewable sources by 2020 (RES-16%)
- 10% of consumption in the transport sector from renewable sources by 2020 (RES-10%[24])

The White Paper of 2007 and subsequent government announcements outline renewable targets for 2020 for each energy use mode – a 40% share of renewable energy in electricity (RES-E),[25] a 10% share of renewable energy in transport (RES-T) and a 12% share of renewable energy in heat (RES-H). These modal targets are used as a starting point for modelling the RES 16% in the *NEEAP/NREAP* scenario on the following basis:

1. If the combination of White Paper targets results in a shortfall below RES 16%, RES-E is increased. This reflects the potential available for renewable electricity generation.
2. If the combination of the White Paper targets results in the RES 16% being surpassed, RES-H is reduced. This recognises the documented challenges of stimulating renewable heat use.[26]

20 http://www.dcenr.gov.ie/NR/rdonlyres/FC3D76AF-7FF1-483F-81CD-52DCB0C73097/0/NEEAP_full_launch_report.pdf
21 http://www.dcenr.gov.ie/NR/rdonlyres/FC3D76AF-7FF1-483F-81CD-52DCB0C73097/0/NEEAP_full_launch_report.pdf
22 http://www.seai.ie/Publications/Statistics_Publications/Energy_Modelling_Group/Econ_Analysis_of_Energy_Efficiency_Improvements/Economic_Analysis_of_Residential_and_Small-Business_Energy_Efficiency_Improvements.html
23 http://www.seai.ie/Publications/Low_Carbon_Opportunity_Study/Irelands_Low-Carbon_Opportunity.pdf
24 The RES-T target accounts for road and rail transport only; EVs and second-generation biofuels receive a favourable weighting in the calculations.
25 A target of 33% RES-E was originally specified in the 2007 White Paper. This was revised upwards to 40% following the results of the All-Ireland Grid Study
26 http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/policy/renewable_heat/incentive/rhi_proposals/rhi_proposals.aspx

The NREAP points to a range of policy actions required to achieve the outlined obligations. These are used as the basis for modelling the *NEEAP/NREAP scenario.*

RES-E

The Renewable Energy Feed-In Tariff (REFIT) is the main policy instrument used to support the expansion of renewable electricity capacity. These tariffs, in conjunction with other supports relating to infrastructure, RD&D, etc. are designed to deliver:

- An expansion of biomass electricity-generating capacity to 270 MW through the implementation of co-firing plans in Edenderry power station *(35 MW)*, the construction of two waste-to-energy units *(44 MW)*, and the continued development of landfill-gas electricity generation *(44 MW)* and biomass CHP *(150 MW)*.
- Construction of at least 75 MW of wave energy
- An expansion of both onshore and offshore wind capacity, supported by the Gate 3 process, and the rollout of the transmission network upgrade plans

RES-T

The Biofuels Obligation Act 2010[27] and the rollout of the Electric Vehicles (EVs) support measures,[28] to help achieve the target of 10% of road vehicles being electric by 2020, and drive the renewable energy usage in transport. The biofuel obligation is designed so it can be adjusted upwards as required to meet the target.

RES-H

The recently approved REFIT tariffs for biomass CHP drive the use of renewable heat in industrial and commercial applications. Part L of the 2008 Building Regulations requires new residential buildings to install renewable heating technology.

Appendix 1b outlines details of the policy measures modelled in the scenario.

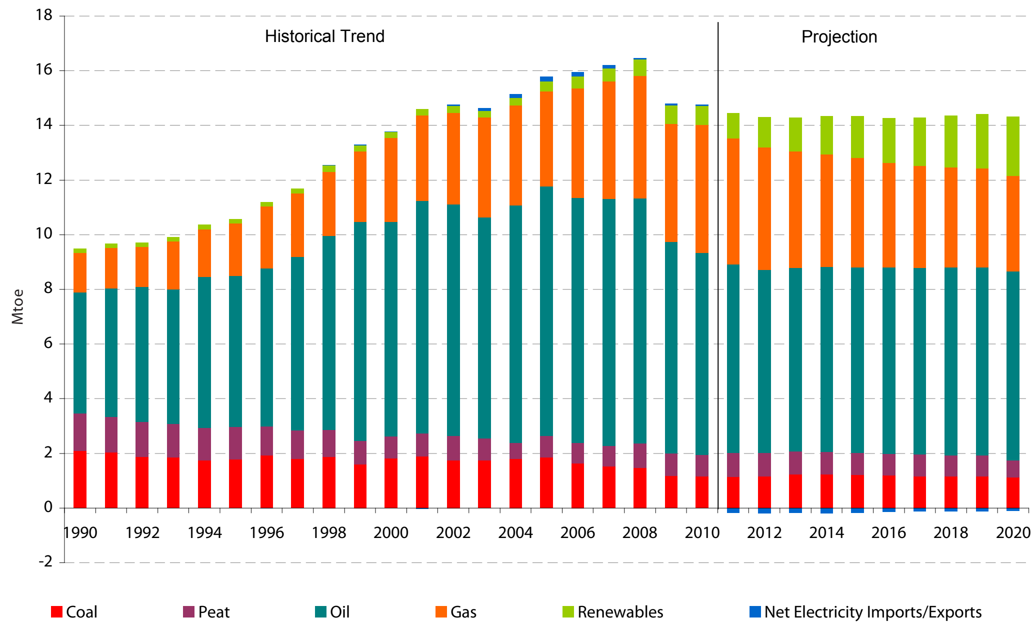
3.1 Primary Energy Requirement (NEEAP/NREAP)

Context:

- Primary energy supply represents the required energy inputs (including for the generation of electricity) across all energy using sectors of the economy.
- Oil has dominated the historic trend (50% of total primary energy requirement in 2010), while gas inputs increase significantly over the period to 2010 (10.5% per annum since 1990).
- Renewable energy share of primary energy has increased to 679 ktoe in 2010, or 5% of primary energy requirement.

27 http://www.irishstatutebook.ie/pdf/2010/en.act.2010.0011.PDF
28 http://www.seai.ie/Renewables/EV_support_programme_launched/

Figure 8 ***Total Primary Energy Requirement 1990–2020 (NEEAP/NREAP)***



Forecast trend:

- Primary energy demand is 7.2% lower in the *NEEAP/NREAP* scenario compared to the *Baseline* due to the impact of the energy efficiency and renewable energy targets.
- Renewable energy contribution is projected to increase at an average of 12.3% per annum to 2020, raising its share of primary energy requirement to 15% in 2020.
- Primary energy requirement of fossil fuels is projected to decrease over the period 2010 to 2020 at a rate of around 1.3% per annum.

Table 10 ***Total Primary Energy Requirement by Fuel 2010-2020 (NEEAP/NREAP)***

Fuel	Total Primary Energy Supply (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Coal	1,167	1,192	1,132	-3.0	-0.3	0.4	-1.3	8	8	8
Oil	7,373	6,818	6,907	-6.3	-0.6	-1.3	0.3	50	48	49
Gas	4,704	3,818	3,504	-25.5	-2.9	-3.4	-2.1	32	27	25
Peat	791	794	612	-22.6	-2.5	0.1	-6.3	5	6	4
Renewables	679	1,647	2,166	219.2	12.3	15.9	7.1	5	12	15
Electricity Imports (Net)	40	-139	-104	-357.5				0	-1	-1
Total	**14,754**	**14,130**	**14,217**	**-3.6**	**-0.4**	**-0.7**	**0.2**			

3.2 Total Final Energy Demand (NEEAP/NREAP)

Context:

- Total final demand peaked in 2008 at 13,324 ktoe following an extended period of strong economic growth since 1996/1997. In 2010, the main contributor was transport (39%) followed by residential (27%), industry (17%), services (14%) and agriculture (2%).
- Transport has been the main driver of total energy demand (132%, 1990 to 2010), contributing greatly to the use of oil (62% of total oil in 2010). Oil remains the dominant source of final energy at 61% (in 2010).
- Since 2008 energy demand has reduced as a consequence of the recession and lower economic growth. It follows that the main reduction has been in oil (14%, 2008 to 2010), linked primarily to reduced activity in freight transport.
- Electricity demand has increased steadily from 1990 to 2010 (5.6% per annum) to account for 18% of total final demand in 2010.

Figure 9 ***Total Final Demand by Sector 1990–2020 (NEEAP/NREAP)***

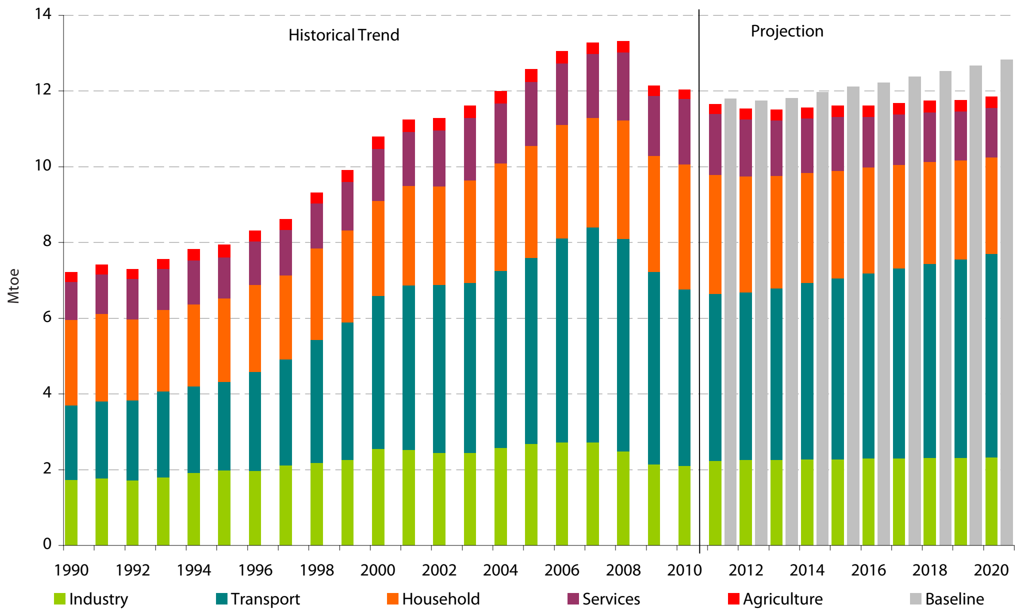
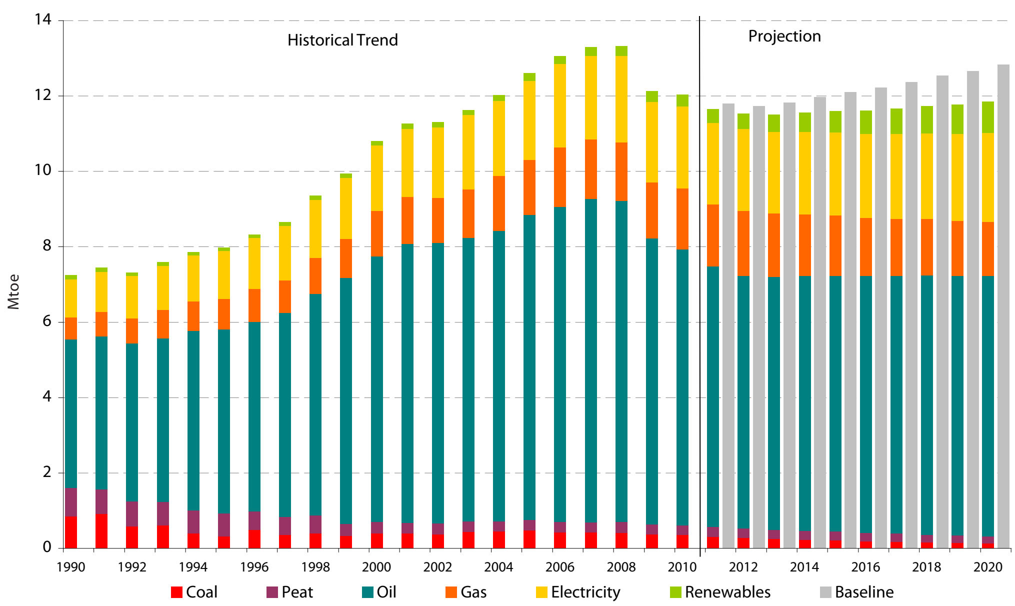


Figure 10 ***Total Final Demand by Fuel 1990–2020 (NEEAP/NREAP)***



Forecast trend:

- Total final demand is projected to decrease marginally over the period to 2020, in line with modest economic growth forecasts, and in response to the input assumptions on fuel prices and demand reduction through efficiency measures over the period.
- Projected demand in 2020 is less than 1% lower compared with last year's forecast.
- Oil demand is expected to remain the dominant fuel over the period, its share of total final demand reducing only marginally to 58% of the total by 2020.
- Electricity demand is expected to continue to increase its share of total final demand (0.8% growth per annum to 2020).

Table 11 *Final Energy Demand by Sector 2010-2020 (NEEAP/NREAP)*

Sector	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Sectoral Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Household	3,294	2,791	2,552	-22.5	-2.5	-2.7	-2.2	27	24	22
Industry	2,093	2,291	2,325	11.1	1.1	1.5	0.4	17	20	20
Services	1,737	1,347	1,295	-25.5	-2.9	-4.2	-1.0	14	12	11
Agriculture	247	297	306	23.7	2.2	3.1	0.8	2	3	3
Transport	4,674	4,895	5,375	15.0	1.4	0.8	2.4	39	42	45
Total	**12,046**	**11,621**	**11,853**	**-1.6**	**-0.2**	**-0.6**	**0.5**			

Table 12 *Final Energy Demand by Fuel 2010-2020 (NEEAP-NREAP)*

Fuel	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Coal	351	186	129	-63.1	-9.5	-10.0	-8.7	3	2	1
Oil	7,330	6,818	6,907	-5.8	-0.6	-1.2	0.3	61	59	58
Gas	1,618	1,541	1,442	-10.9	-1.1	-0.8	-1.6	13	13	12
Peat	254	226	191	-24.6	-2.8	-1.9	-4.1	2	2	2
Non-Renewable Waste	9	9	9	-1.2	-0.1	-0.2	0.0	0	0	0
Renewables	321	617	822	156.0	9.9	11.5	7.4	3	5	7
Electricity	2,164	2,224	2,352	8.7	0.8	0.5	1.4	18	19	20
Renewable Elec	320	741	943	194.2	11.4	15.0	6.2			
Fossil Elec	1,843	1,483	1,409	-23.6	-2.7	-3.6	-1.3			
Total	**12,046**	**11,621**	**11,853**	**-1.6**	**-0.2**	**-0.6**	**0.5**			

Policies and measures: level of effort

- In addition to the impact of the projected fuel prices and macro-economic growth forecasts, energy savings expected from a range of policies and measures across the economy will reduce future energy demand. Commentary on the impact of these measures, together with an indication of the level of effort required to realise the *NEEAP/NREAP* trajectories presented in this section, is provided in the sectoral breakdown (below). The measures incorporated in the modelling are based on those outlined in detail in the NEEAP[29], and the extent to which they are incorporated is detailed further in Appendix 1a.

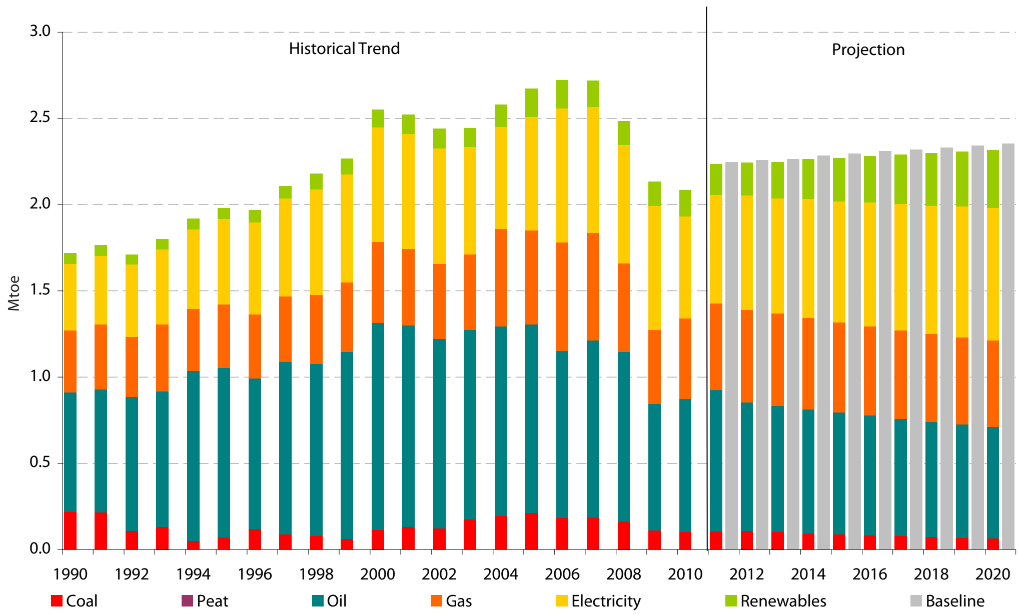
29 Savings estimates have been updated to account for changes in macro-economic forecast variables and other assumptions.

3.3 Industry Final Energy Demand (NEEAP/NREAP)

Context:

- The industry sector accounted for 17.4% of total final consumption (TFC) in 2010.
- Demand in the sector peaked in 2006 and reduced in line with the economic recession up to 2010.
- The use of renewable energy for heat and transport accounted for 7% of demand in the sector in 2010.

Figure 11 ***Industry Final Energy Demand by Fuel 1990–2020 (NEEAP/NREAP)***



Forecast trend:

- The projected share of industrial demand of total final energy demand in 2020 is 20% (see table 9, with an overall demand increase of 11.1% between 2010 and 2020.

Table 13 ***Industry Final Energy Demand by Fuel 2010-2020 (NEEAP/NREAP)***

Industry	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Coal	103	84	64	-38.0	-4.7	-3.3	-6.7	5	4	3
Oil	769	693	647	-15.9	-1.7	-1.7	-1.7	37	30	28
Gas	468	517	500	6.9	0.7	1.7	-0.8	22	23	22
Non-Renewable Waste	9	9	9	-1.2	-0.1	-0.2	0.0	0	0	0
Renewables	153	268	333	118.1	8.1	9.8	5.6	7	12	14
Electricity	591	721	772	30.5	2.7	3.4	1.7			
Total	**2,093**	**2,291**	**2,325**	**11.1**	**1.1**	**1.5**	**0.4**			

Policies and measures: level of effort

- The forecasted trend assumes ongoing energy savings of 400GWh[30] per annum from the Large Industry Energy Network (LIEN) and Energy Agreements Programme members[31] to 2020.
- Awareness and use of the Accelerated Capital Allowance Scheme (providing a tax incentive for the purchase of energy efficiency technologies on the Triple E register) is assumed to increase by 2% per annum to 2020.
- Total energy savings required in the industrial sector by 2020 are equivalent to around 16% of 2010 total industrial demand.

30 An attribution factor of 28.5% is currently applied to this figure to account for savings attributable to the programme intervention.

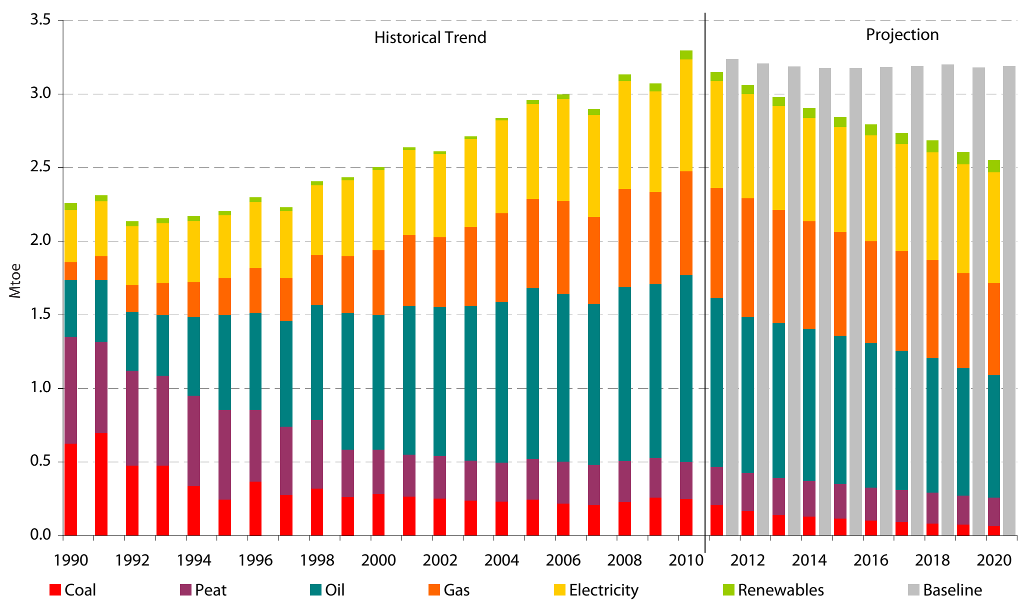
31 Around 150 of Ireland's largest industrial energy users (accounting for over 70% of 2010 industrial energy demand) are currently members of the programme.

3.4 Residential Final Energy Demand (NEEAP/NREAP)

Context:

- The residential sector accounted for 27% of total final demand in 2010.
- The housing stock increased from 1,026,000[32] dwellings in 1990 to an estimated 2,012,000[33] in 2010.
- Historically, the share of oil and gas, primarily for space and water heating, has grown in line with the increasing number of dwellings.
- Electricity demand has increased due to both the increased number of dwellings and increased use of electronic devices (including televisions, personal computers, white-goods and other electrical appliances and gadgets) within each dwelling.
- The use of renewable energy – for example for water and space heating – made a modest contribution to overall demand in 2010 (1.8%).

Figure 12 ***Residential Final Energy Demand by Fuel 1990–2020 (NEEAP/NREAP)***



Forecast trend:

- The projected share of total final demand in 2020 is 27% for the residential sector.
- An overall decrease in demand to 2020 is forecast (22.5%), with all energy sources, other than renewable energy, decreasing in use up to 2020

Table 14 ***Residential Final Energy Demand by Fuel 2010-2020 (NEEAP/NREAP)***

Residential	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Coal	248	102	65	-73.6	-12.5	-13.7	-10.5	8	4	3
Oil	1,267	981	836	-34.0	-4.1	-4.2	-3.9	38	35	33
Gas	710	693	628	-11.6	-1.2	-0.4	-2.4	22	25	25
Peat	254	226	191	-24.7	-2.8	-1.9	-4.1	8	8	7
Renewables	58	71	85	45.6	3.8	3.4	4.4	2	3	3
Electricity	758	719	748	-1.3	-0.1	-0.9	1.0	23	26	29
Total	**3,294**	**2,791**	**2,552**	**-22.5**	**-2.5**	**-2.7**	**-2.2**			

32 Excluding vacant.
33 Includes impact of a methodological change in data collection; this figure includes vacant dwellings.

Policies and measures: level of effort

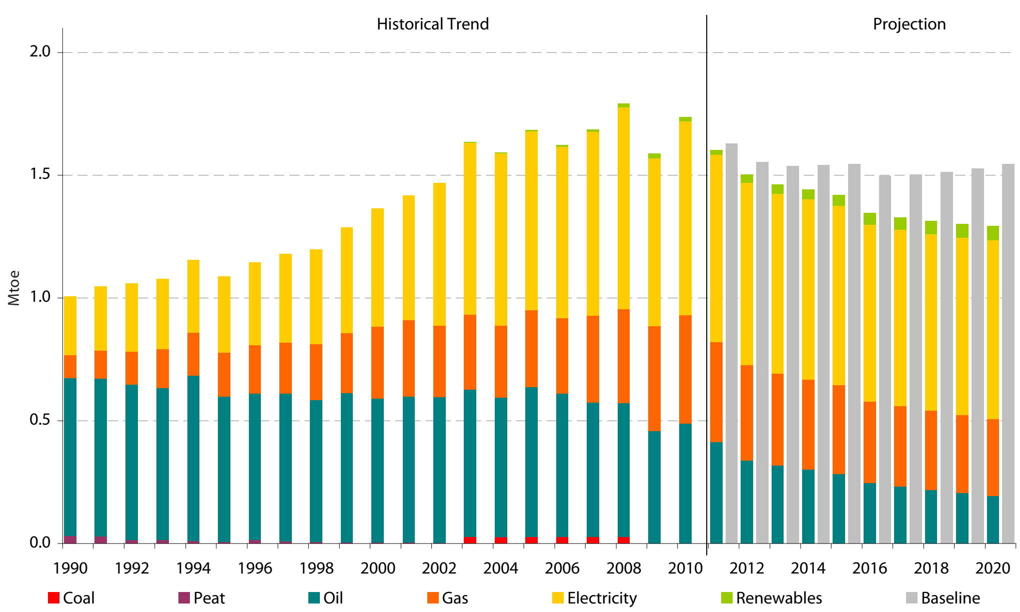
- The most significant policy effort underway is the National Retrofit Scheme under the banner of Better Energy Homes. As many as 100,000 dwellings will need to be retrofitted for improved energy efficiency each year up to 2020; this could reduce to as few as 50,000 if a deeper level of retrofit is achieved.[34] This will incorporate retrofit of renewable energy technologies in existing dwellings at historic levels.
- Continuing roll out of low energy lighting, in response to the gradual withdrawal of incandescent light bulbs from the European market, will provide significant savings in the sector. As many as 8 million bulbs will be replaced up to 2020 as a result of this phase out.
- Current building regulations require very high energy performance by new dwellings. While the projected level of new builds is low (25,000 to 30,000 each year up to 2020), continual improvement in the regulations will ensure minimal net-increases in energy demand for new dwellings.
- Renewable energy will continue to be a required component of any new build dwelling as per the Building Regulations – this applies to the assumption of average annual new build dwellings per annum to 2020. Currently, 10kWh/m2 must be supplied from a renewable energy source - e.g. solar thermal, heat pump or biomass boilers.

3.5 Services Final Energy Demand (NEEAP/NREAP)

Context:

- The services sector accounted for 14% of total final demand in 2010.
- Historically, the share of electricity in the sector has been increasing (for end-uses such as lighting and office equipment, water treatment and public lighting etc.)
- An increasing trend is observed for gas use and a reducing trend for oil, both used for space and water heating within the sector.
- The use of renewable energy for heating has been low historically.

Figure 13 ***Services Final Energy Demand by Fuel 1990–2020 (NEEAP/NREAP)***



Forecast trend:

- The projected share of total final demand in 2020 reduced to 11%.
- Electricity is projected to increase its dominance of fuel shares in the sector up to 2020 (increasing to 56%).
- Renewable energy contribution is projected to increase to 5% in 2020 from 1% in 2010.

34 Retrofit under the current programme is achieving an estimated 20% reduction in energy demand for around €3,000 investment per dwelling. Higher levels of expenditure ('deeper retrofit') will enable higher levels of savings per dwelling.

Table 15 ***Services Final Energy Demand by Fuel 2010-2020 (NEEAP/NREAP)***

Services	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Coal	0	0	0	-	-	-	-	0	0	0
Oil	491	247	193	-60.8	-8.9	-10.8	-6.0	28	18	15
Gas	440	331	314	-28.5	-3.3	-4.6	-1.3	25	25	24
Renewables	17	47	59	236.8	12.9	18.0	5.6	1	4	5
Electricity	789	721	729	-7.6	-0.8	-1.5	0.3	45	54	56
Total	**1,737**	**1,346**	**1,295**	**-25.5**	**-2.9**	**-4.2**	**-1.0**			

Policies and measures: level of effort

- Direct expenditure on retrofit upgrades in the public and commercial sectors via government programmes[35] has amounted to around €87 million for 2009 - 2011.
- Total expenditure will need to increase across the public and commercial sector, to an estimated €35 to €45 million per annum (total) in order to meet targets for Better Energy Workplaces by 2020.[36]
- SEAI's Small and Medium Enterprise Programme is assumed to support 450 new businesses per annum, each savings 10% of total energy demand in the first year of programme participation.[37]
- Awareness and use of the Accelerated Capital Allowance Scheme is assumed to increase by 2% per annum to 2020, increasing the level of deployment of energy efficient technologies in both the private (commercial) sector and within Government by utilisation of the Triple E register for green public procurement.
- Membership of SEAIs Public Sector Partnership Programme which is aimed at embedding strategic sustainable energy management practices in the public sector, is assumed to increase to over 50 Departments and agencies before 2015 (accounting for an estimated 80% of public sector energy use) from a base of 30 partners in 2011.
- While the overall economy wide target for energy efficiency is a 20% improvement by 2020, the target for the public sector is to achieve a 33% improvement.

3.6 Transport Final Energy Demand (NEEAP/NREAP)

Context:

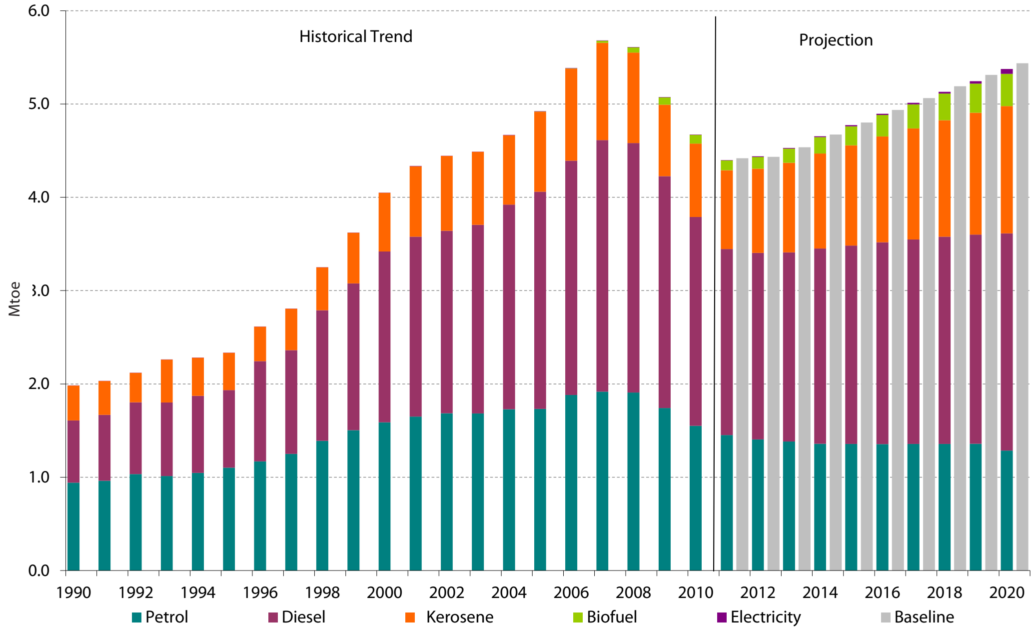
- The transport sector accounted for 39% of total final demand in 2010.
- Demand in the sector has historically tracked economic growth; this results in growth of around 130% on 1990 levels by 2010.
- Demand has fallen in the sector since 2007 due to the recession and lower economic growth, as road freight activities and private car usage contracted.
- The use of renewable energy in transport in the form of biofuels, predominantly blended as either bio-diesel or ethanol (petrol), has a small impact on overall demand in the sector up to 2010, accounting for 2% of total final demand.

35 Including SEEEP (2009), EERF (2010) and Better Energy Workplaces 2011.

36 Based on required savings valued at €55,000 per GWh, and payback periods of 4 to 5 years. Weighted average payback for Government grant schemes in the sector 2009 to 2011 is approximately 4 years.

37 Level of savings consistent with programme experience to date.

Figure 14 ***Transport Final Energy Demand by Fuel 1990–2020 (NEEAP/NREAP)***



Forecast trend:

- The projected share of transport demand of total final energy demand in 2020 is 45%, with an overall demand increase of 1.6% between 2010 and 2020.
- Increasing demand for kerosene up to 2020 (over 70% growth to 2020) reflects a projected return to high levels of tourism and related kerosene use in aviation.
- Renewable energy contribution is projected to continue to increase on the basis of increasing use of biofuel, which is to raise its share of transport final demand to 6% in 2020.

Table 16 ***Transport Final Energy Demand by Fuel (NEEAP/NREAP)***

Transport	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Oil	4,578	4,652	4,977	8.7	0.8	0.3	1.7	98	95	93
Kerosene	787	1,133	1,364	73.3	5.7	6.3	4.7	17	23	25
Petrol	1,551	1,355	1,287	-17.1	-1.9	-2.2	-1.3	33	28	24
Diesel	2,238	2,164	2,327	4.0	0.4	-0.6	1.8	48	44	43
Biofuels	92	231	345	273	14	16	10.6	2	5	6
Electricity	4	12	52	1232.6	29.6	21.0	43.6	0	0	1
Total	**4,673**	**4,895**	**5,375**	**15.0**	**1.4**	**0.8**	**2.4**			

Policies and measures: level of effort

- Energy savings in the transport sector required in 2020 amount to almost 10% of 2010 transport demand, equivalent to the energy used by almost 450,000 cars (24% of 2010 private car fleet), or over 550 million litres of fuel.
- Improved fuel economy of the vehicle fleet is expected to be achieved via EU regulation reducing the maximum levels of allowable (on-road) CO_2 per kilometre for new vehicles sold in the EU to 120gCO_2/km in 2015 and 95gCO_2/km by 2020.
- The shift to CO_2 ratings for motor tax has already altered purchasing patterns in Ireland towards the low CO_2 bands, bringing forward in time the shift to lower carbon vehicles supported by the EU regulation[38].
- Achievement of the electric vehicle target will require 200,000 electric vehicles to be in operation on Irish roads by 2020.

38 Further detail on this policy impact available in 'Energy in Ireland, 2010 Report', SEAI, 2010.

3.7 Electricity Generation - Fuel inputs and outputs (NEEAP/NREAP)

Context:

- ESRI's IDEM model is used to produce the electricity sector projections. IDEM is a least-cost economic dispatch model that optimises the electricity system on a half-hourly basis to meet demand in that half hour. This economic dispatch is based on the various generation unit characteristics. A more in-depth discussion of this model is contained in section 6 of this report. The fuel and carbon prices used in the model correspond with the prices shown in *Table 3* in *Section 2*.
- The electricity-generation portfolio modelled as part of the national energy forecasts is shown in *Table 17*. The timing and location for connection, or closure, of conventional generation units is based on the published connection schedule in EirGrid's 2010 Generation Capacity Statement.[39] The quantities of renewable capacity connected are based on the methodology used in the NREAP. Biomass co-firing, land fill gas and waste to energy as well as ocean capacities reflect the published numbers in the NREAP. An additional, 150MW of biomass CHP (the amount contained in the recently approved REFIT for biomass CHP) are also modelled. The quantity of wind-energy capacity connected is determined through an iterative process so that the electricity produced by wind energy results in an overall RES of 16%.
- The wind-capacity connection plans outlined in the Incremental Capacity Transfer (ICT)[40] programme provide the basis for when and where wind capacity is connected after 2014. Up to 2014 the published list of scheduled connection dates for wind farms is used[41]. The ICT programme is based on EirGrid's Grid25[42] study and represents a development plan for the transmission network to support the connection of renewable energy. As with last year's forecast, the renewable electricity required to meet RES 16% matches the White Paper target of 40% RES-E – the share of renewable electricity in gross electricity consumption.

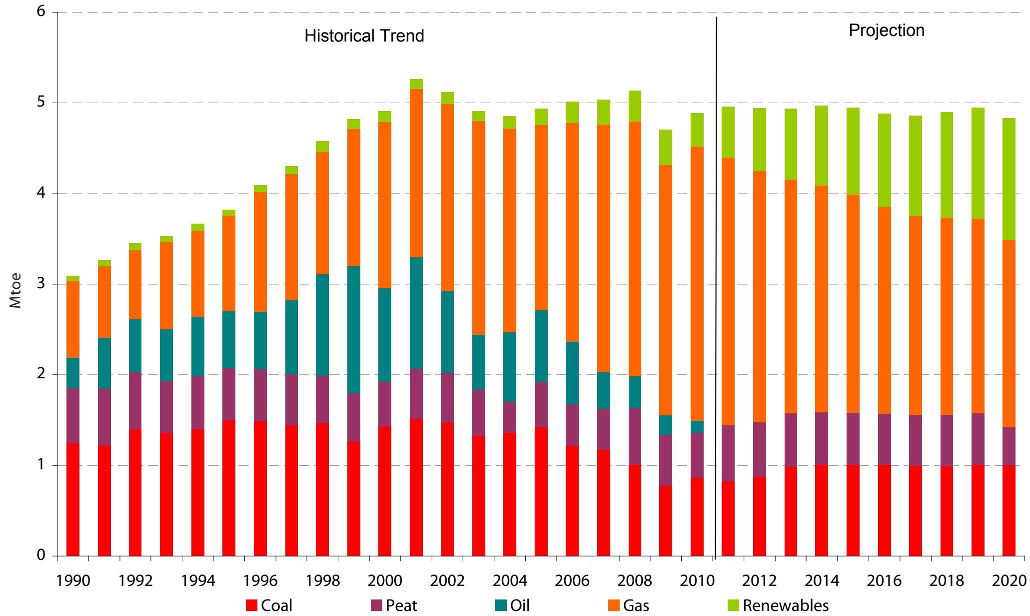
Table 17 ***Grid Connected Electricity Capacity Assumptions in NEEAP/NREAP Scenario***

	Grid Connected Generation Capacity MW										
Generation Type	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Coal	848	848	848	848	848	848	848	848	848	848	848
Oil	806	806	806	0	0	0	0	0	0	0	0
Gas	3,708	3,708	3,708	3,708	3,708	3,708	3,708	3,708	3,708	3,708	3,708
(Peaking Plant)	510	510	706	804	804	804	804	804	804	804	804
Peat	346	346	346	346	346	346	346	346	346	346	346
Non-Renewable Embedded Generation	123	123	123	123	123	123	123	123	123	123	123
Renewables	1,702	2,011	2,502	2,592	2,867	3,135	3,242	3,447	3,574	3,731	4,202
of which:											
Wind	*1,421*	*1,700*	*2,170*	*2,239*	*2,492*	*2,703*	*2,795*	*2,966*	*3,058*	*3,182*	*3,619*
Wave	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*19*	*38*	*56*	*75*
Hydro	*234*	*234*	*234*	*234*	*234*	*234*	*234*	*234*	*234*	*234*	*234*
Biomass	*47*	*77*	*98*	*119*	*141*	*198*	*213*	*228*	*244*	*259*	*274*
Interconnection	400	400	400	900	900	900	900	900	900	900	900

- In addition to the capacity inputs outlined, extra constraints are imposed on the model that may not necessarily align with the economic dispatch but are required for overriding reasons, such as ensuring security of supply.
- Figure 15 below shows input fuel mix for electricity generation constant with the capacity assumptions above when optimised to meet electricity demand, including exports.

39 http://www.eirgrid.com/media/GCS%202011-2020%20as%20published%2022%20Dec.pdf
40 http://www.eirgrid.com/media/Gate%203%20ITC%20Results%202010-2023.pdf
41 http://www.eirgrid.com/customers/connectedandcontractedgenerators/
42 http://www.eirgrid.com/media/Grid%2025.pdf

Figure 15 ***Input Fuel Mix for Electricity Generation 1990–2020 (NEEAP/NREAP)***



Forecast trend

- The total amount of fuel inputs to electricity generation remains static over the period to 2020 despite an increase in demand and exports. This is due to an increase in the efficiency of generation. Less fuel is required to meet electricity demand.
- Coal and peat generation are lower on the merit order than gas and oil. As coal and peat are cheaper than gas based on the projected fuel and carbon prices shown in section 2, gas tends to be displaced by renewable electricity generation.[43]
- The share of gas is projected to drop from 62% in 2010 to 43% in 2020. The share of renewable fuels in overall fuel consumption for generation grows from 8% in 2010 to 28% in 2020.

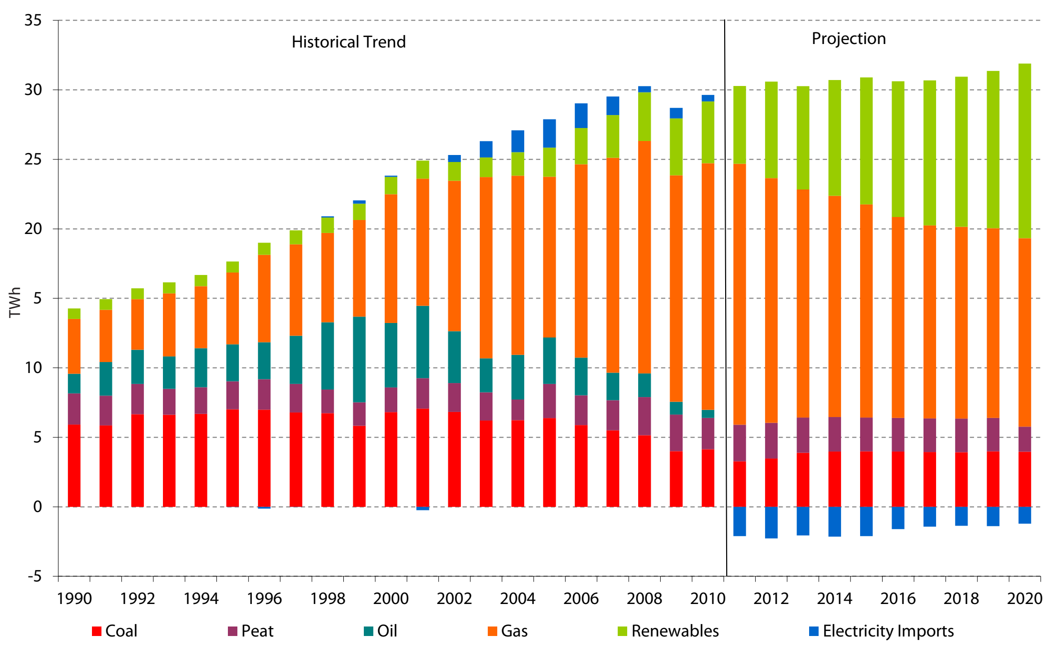
43 Renewable electricity generation is defined as priority dispatch in the market. Wind and hydro have no fuel costs so are the cheapest units in the dispatch market.

Table 18 ***Electricity Generation Primary Fuel Inputs 2010–2020 (NEEAP/NREAP)***

Fuel	Elec Gen Fuel Inputs (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10–20	10–20	10–16	16–20	2010	2016	2020
Coal	868	1,005	1,002	15.6	1.5	2.5	-0.1	18	21	21
Oil	137	0	0	-100.0	-100.0	-100.0	0	3	0	0
Gas	3,024	2,277	2,062	-31.8	-3.8	-4.6	-2.5	62	47	43
Peat	490	568	421	-14.2	-1.5	2.5	-7.2	10	12	9
Renewables	367	1,030	1,345	266.7	13.9	18.8	6.9	8	21	28
Total	**4,885**	**4,881**	**4,830**	**-1.1**	**-0.1**	**0.0**	**-0.3**			

- The amount of electricity generated increases by 15% over the period driven by an increase in domestic demand and in exports.
- Exports from the Republic of Ireland occur because the cost of generation is less than elsewhere for more time during each year.
- The share of renewable electricity generation in final generation grows from 16% of generation to 38% of generation. The RES-E 40% target refers to electricity consumption – electricity generation is higher due to exports.
- *Figure 16* shows the amount of electricity generated to meet demand from the fuel inputs by type of fuel.

Figure 16 ***Electricity Generation Output by Fuel Source 1990–2020 (NEEAP/NREAP)***



Policies and measures: level of effort

- The increasing proportion of renewable energy drives improved generation efficiency. Wind power and hydro power, in terms of thermal efficiency, are 100% efficient.[44] As these fuels displace electricity generation from combustion, the system becomes more efficient.
- This reduces Ireland's import dependency as less imported fossil fuel is required. The Baseline scenario, at 54% efficiency, requires up to 7% more fossil fuel in 2020 than the *NEEAP/NREAP* at 58% efficiency.
- The level of exports is influenced by the price of electricity generation in Northern Ireland, the capacity available on the interconnectors and the price of electricity in the British electricity market.

44 The efficiency of the power system is measured in terms of thermal efficiency. Hydro and wind installations, like all turbines, are not 100% mechanically efficient, but are 100% thermally efficient.

Table 19 ***Electricity Generation Output by Fuel Source 2010–2020 (NEEAP/NREAP)***

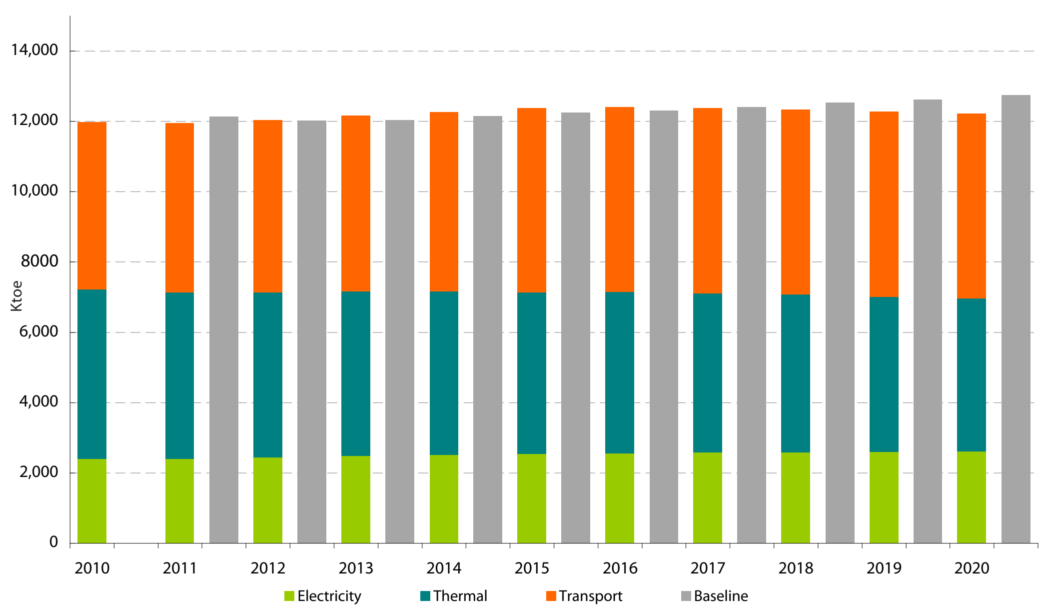
Fuel	Gross Electricity Generation (GWh)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10–20	10–20	10–16	16–20	2010	2016	2020
Coal	4,143	3,975	3,963	-4.3	-0.4	-0.7	-0.1	14	12	12
Oil	568	0	0	-100.0	-100.0	-100.0	0	2	0	0
Gas	17,744	14,455	13,561	-23.6	-2.7	-3.4	-1.6	62	45	41
Peat	2,259	2,427	1,806	-20.0	-2.2	1.2	-7.1	8	8	5
Renewables	4,451	9,759	12,563	182.3	10.9	14.0	6.5	16	30	38
Of Which										
Electricity Exports (Net)	-470	1,612	1,211	357.5				2	5	4
Total Generation	**28,694**	**32,227**	**33,105**	**15.4**	**1.4**	**2.0**	**0.7**			

3.8 Renewable Energy (NEEAP/NREAP)

Context:

- Figure 17 shows the Gross Final Consumption (GFC) trend across the energy end use applications of Heat, Transport and Electricity for the *NEEAP/NREAP* scenario. As described in the Baseline scenario, GFC includes all energy used in each of the economic sectors as well as energy lost in the transmission networks and energy used in the transformation of fuel into heat and electricity.
- Heat and transport have historically made up most of GFC, while electricity has had the smallest share.
- Total transport energy consumption is calculated differently for the denominator in the overall (16%) RES target compared with the (10%) RES-T target in accordance with the EU Directive.[45] When calculating the overall RES target, total GFC includes aviation as well as domestic road & rail and inland marine. When calculating the RES-T target, only road & rail consumption are included in the denominator, with electricity and second generation biofuels receiving a weighting in the calculation.

Figure 17 ***Energy Consumption by Mode of Application 2010–2020 (NEEAP/NREAP)***[46]



45 See article (3) of the directive 2009/28/EC
46 Calculated based on the methodology outlined in the Renewable Directive (28/EC/2009).

3 NEEAP / NREAP Scenario

Forecast trend:

- The GFC in 2020 is 8% lower in the *NEEAP/NREAP* scenario than in the *Baseline*. The energy efficiency savings outlined in the NEEAP impact on the trend particularly in the use of heat.
- The EU calculation methodology allows member states with a large share of aviation fuel usage in their GFC to make an adjustment for this sector. The strong recovery in aviation fuel use in this year's projections increases its share significantly. The adjustment acts to reduce GFC over the forecast horizon.
- The share of heat in GFC drops to 35% by 2020 a fall of over 20%. This makes the RES-H target of 12% more attainable as less effort is required.
- RES-E grows by 7% over the period to 2020, reaching a share of 23% of GFC by 2020. A higher share of electricity in GFC means that the progress in RES-E will it more strongly affect the overall RES figure.

Table 20 ***Energy Consumption by Mode of Application (NEEAP/NREAP)***

Fuel	Final Consumption (ktoe)			Growth %	Average Annual Growth Rate %			Modal Shares %		
	2010	2016	2020	10–20	10–20	10–16	16–20	2010	2016	2020
Electricity	2,490	2,520	2,665	7.0	0.7	0.2	1.4	20	22	23
Thermal	5,209	4,501	4,126	-20.8	-2.3	-2.4	-2.2	42	39	35
Transport	4,812	4,646	4,910	2.0	0.2	-0.6	1.4	38	40	42
Transport For RES-T	3,883	3,758	4,006	3.2	0.3	-0.5	1.6			
Total	**12,511**	**11,668**	**11,701**	**-6.5**	**-0.7**	**-1.2**	**0.1**			

Polices and measures: level of effort

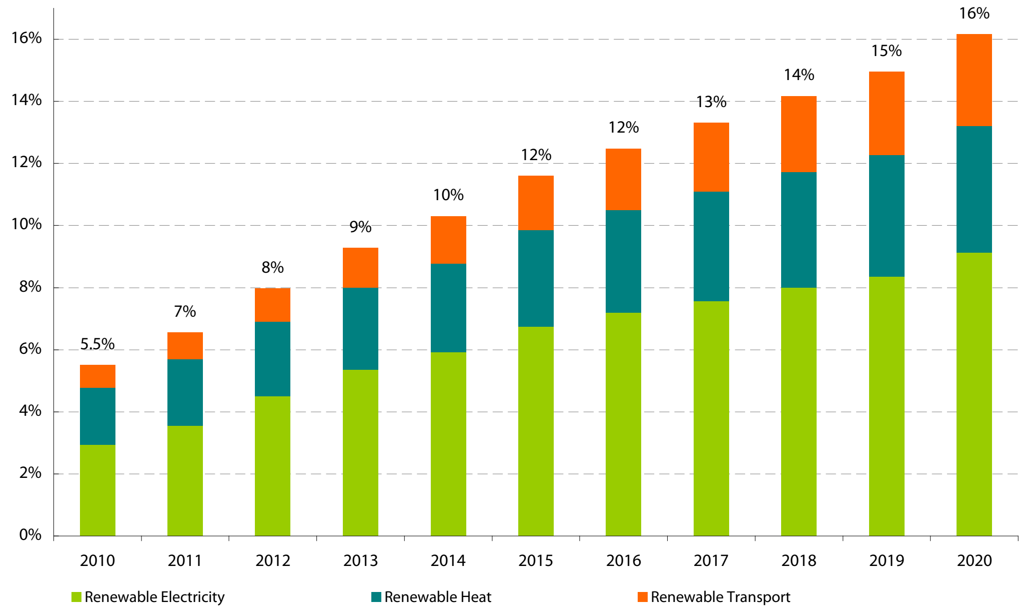
- Energy efficiency has a large role to play in the achievement of RES targets. Renewable energy targets are based on a percentage of GFC for each mode. Reducing this demand reduces the quantity of renewable energy required.
- The 2020 difference in effort between the Baseline and the *NEEAP/NREAP* in terms of meeting a RES target of 16% is equivalent to over 3,500MW more of onshore wind turbines.

3.8.1 RES Renewable Contribution to Overall Energy Demand (NEEAP/NREAP)

Context:

- *Figure 18* shows the combined renewable energy contributions from each end use sector to overall energy demand. This trend represents the minimum effort required for Ireland to comply with the EU obligations for the projected demand. Should economic growth prove to be much different than projected, a different level of effort will be required to meet the RES 16% and RES-T 10% obligations.
- The NREAP sets out how Ireland will approach the achievement of the binding obligations based on demand projections from 2009 which relied on far more optimistic economic growth projections. The change in demand projections has lowered the amount of renewable energy that needs to be generated.
- The drop in demand, as in last year's forecast, results in the White Paper targets of RES-E 40%, RES-T 10%, RES-H 12% adding up to an overall RES of 16%.

Figure 18 ***Renewable Energy Contribution to Final Consumption (NEEAP/NREAP)***



Scenario trends:

- Renewable energy output must grow by an average of 11% per annum to 2020 to achieve the RES16%.
- Renewable electricity makes the largest contribution to the RES target – 9% in 2020.
- A growth rate of 15% per annum in renewable energy in the transport sector is required to meet the RET-T 10% target in 2020.

Table 21 ***Renewable Energy as % of Final Consumption (NEEAP/NREAP)***

Renewable Energy	Total Final Demand (ktoe)			Growth %	Contribution to Modal RES %			Contribution to Overall RES %		
	2010	2016	2020	10–20	2010	2016	2020	2010	2016	2020
Renewable Electricity	341	839	1,080	217.3	14.8	33	40	2.95	7	9
Renewable Heat	228	386	477	108.7	4.4	9	12	1.8	3	4
Renewable Transport	92	231	345	273.1				0.7	2	3
For RES-T	*93*	*239*	*392*	*319.8*	*3.0*	*6*	*10*			
Total Renewable Energy	**661**	**1,456**	**1,902**	**204.0**						
RES								**5.5**	**12**	**16**

Scenario outcome: level of effort:

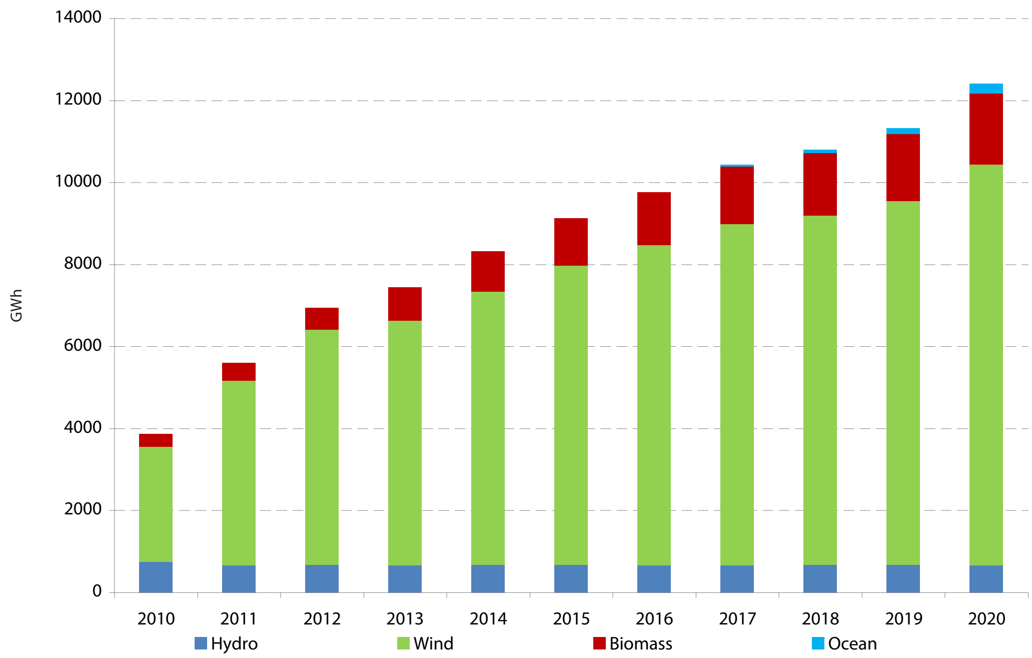
- The REFIT scheme for electricity generation supports the increase in renewable electricity. Renewable energy in transport is driven by the biofuels obligation and to a lesser degree the electric vehicles (EVs) target. Building regulations and the Better Energy schemes are supporting a proportion of renewable heat but it is hoped that most growth in this sector will come from biomass CHP supported through the REFIT.
- All sectors require considerable effort to achieve the three fold increase in renewable energy that is required to meet the RES 16%. The following sections outline the individual end use modes in detail focusing on the level of effort required.

3.8.2 RES-E Renewable Contribution to Electricity (NEEAP/NREAP)

Context:

- The Gate process[47] administered by the Commission for Energy Regulation (CER) supports the REFIT scheme by granting offers to wind projects. EirGrid manages the connections of renewable electricity to the transmission network and its Grid 25[48] grid upgrade plan is optimised for future planned renewable electricity development
- Renewable electricity was targeted in the Energy White Paper of 2007 to reach 15% of electricity consumption by 2010. Last year, renewable electricity accounted for 14.8% of gross final electricity consumption which made this sector the largest contributor to total RES, with 3% of total GFC.
- Renewable electricity is now the largest contributor to renewable energy consumption, having increased by over 500% in output since 1990.
- The opportunities to develop large scale hydro power were largely exhausted before 1990. The growth in renewable electricity has been due to an increase in wind power generation and to a lesser degree biomass electricity generation.
- As detailed in earlier sections, the current government target for RES-E is 40% by 2020.

Figure 19 ***Renewable Contribution to Electricity (NEEAP/NREAP)***



Scenario trend:

- Achieving the RES-E target of 40% requires growth of 12.5% per annum in renewable electricity output.
- The largest contribution is from wind (32% of the 40% RES-E by 2020) with biomass generation contributing 5%.
- The growth in wind output follows published data[49] on what is scheduled for connection up to 2014. The profile is based on the published plans for wind connection up to 2020, scaled each year according to what is required to reach RES-E of 40% in 2020.
- Last year's forecast projected wind to contribute more to RES-E and biomass to contribute less. The change this year is due to the inclusion in the modelling of 150MW of biomass CHP. This capacity is the amount contained in the recently approved REFIT for biomass CHP. [50]
- Ocean is projected to make a marginal contribution from 75MW of installed capacity by 2020.

47 http://www.cer.ie/en/electricity-transmission-network-current--consultations.aspx?article=fb726a75-7365-4dfb-9e16-ff5c5d2d363a
48 http://www.cer.ie/en/electricity-transmission-network-current--consultations.aspx?article=fb726a75-7365-4dfb-9e16-ff5c5d2d363a
49 See EirGrid http://www.eirgrid.com/customers/connectedandcontractedgenerators/
50 http://www.dcenr.gov.ie/Energy/Sustainable+and+Renewable+Energy+Division/REFIT.htm

Table 22 ***Renewable Electricity Generation Fuels Contribution to RES-E (NEEAP/NREAP)***

Sector	Total Final Demand (GWh)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10–20	10–20	10–16	16 - '20	2010	2016	2020
Biomass	309	1,285	1,735	460.6	18.8	26.8	7.8	1	4	5
Hydro	745	673	664	-10.8	-1.1	-1.7	-0.3	3	2	2
Ocean	0	0	244	n/a	0.0	0.0	n/a	0	0	1
Wind	2,818	7,802	9,922	252.1	13.4	18.5	6.2	10	27	32
Total Generation	**3,872**	**9,761**	**12,566**	**224.5**	**12.5**	**16.7**	**6.5**			
Gross Consumption	*28,958*	*29,312*	*30,991*	*7.0*						
RES-E								**13**	**33**	**40**

Scenario outcome: level of effort

- Wind generation will provide the bulk of Ireland's renewable energy in 2020. To meet the RES-E target approximately 3,550MW of wind needs to be connected. Currently there is around 1,500MW of installed capacity.
- The current annual build rate of around 170MW per year would see a further 1,530MW of wind installed between 2011 and 2020; 170MW is equivalent to about 10 average size onshore wind farms. The average annual capacity added must increase to over 200MW so that the required 3,619MW is attained by 2020. The Incremental Capacity Transfer (ITC) programme links the process Gate 3 process and Grid 25 investment and plans to deliver this increase in annual construction.
- Meeting the biomass generation requirement with domestic resources could need up to 30,000 ha of land for energy crops. This represents a significant increase from the current area dedicated to energy corps of around 3,000 ha. Associated supply chain development will also be required for energy crops and other biomass feedstock.
- Ocean energy devices are being developed and tested in Ireland at present through the Ocean Energy Prototype Research and Development Programme. [51] Commercially viable devices must be available before 2020 in order to reach 75 MW in that year.

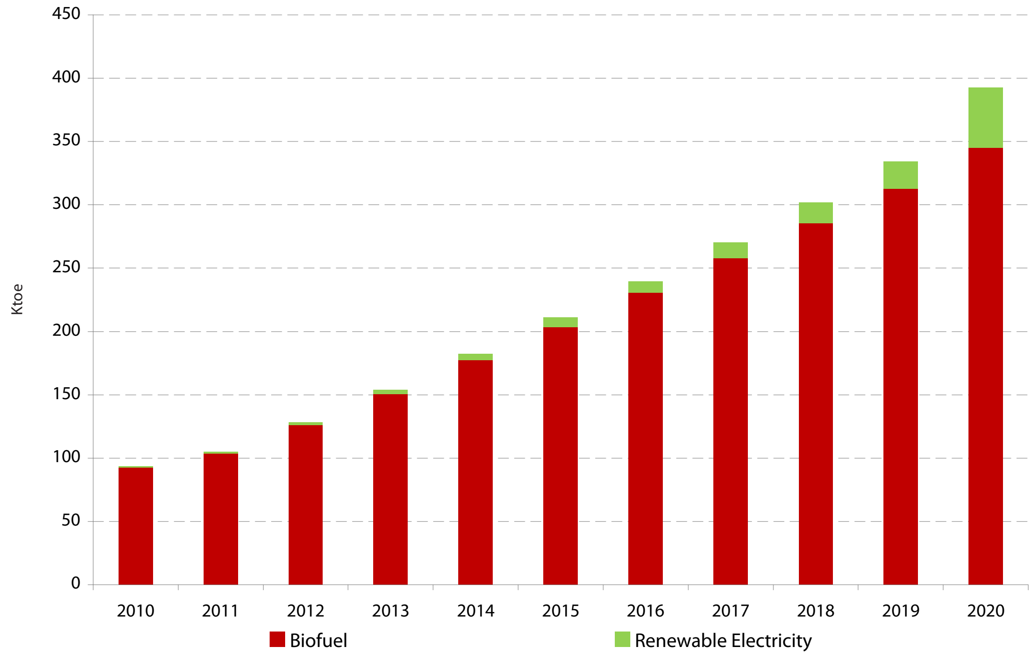
3.8.3 RES-T Renewable Contribution to Transport (NEEAP/NREAP)

Context:

- The RES-T target of 10% by 2020 is set out as a binding target in the Renewable Energy Directive (28/EC/2009). A separate calculation methodology is specified to calculate this target in the directive. The projections below use this calculation methodology.[52]
- The same directive outlined detailed criteria for determining the sustainability of biofuels. These specify that the production of biofuels should not interfere with the food supply or induce damaging change in land use.
- Electric vehicles (EVs) and plug-in hybrid vehicles (PHEVs) are currently available for purchase from many of the major car manufacturers. Ireland's EV target would see over 200,000 such vehicles on the road by 2020.

51 The ocean energy development programme is led by the Ocean Energy Development Unit in SEAI.
52 See articles (3) and (5) of the Renewable Energy Directive (28/EC/2009)

Figure 20 ***Renewable Energy Contribution to REST-T (NEEAP/NREAP)***



Scenario trend:

- The large increase in renewable electricity for transport consumption is driven by two factors – (1) the increase in EVs on the road and (2) the increase in RES-E towards 40% in 2020. EVs account for only 1% of the RES-T target by 2020 when the directives weighting methodology is accounted for in the calculation.
- Biofuels are required to grow by 14% per annum to meet the remainder of the RES-T target.

Table 23 ***Renewable Energy Contribution to RET-T (NEEAP/NREAP)***

Fuel	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10–20	10–20	10–16	16–20	2010	2016	2020
Renewable Elec-tricity	1	9	47	4548.8	46.8	42.7	53.2	0.02	0	1
Biofuels	92	231	345	273.1	14.1	16.5	10.6	2.4	6	9
Total Renewables	**93**	**239**	**392**	**319.8**	**15.4**	**17.0**	**13.2**			
Total Consumption	*3,883*	*3,758*	*4,006*							
RES-T								**2.4**	**6**	**10**

Scenario outcome: level of effort

- The biofuels obligation requires transport fuel suppliers to provide a specified amount of their sales in the form of biofuels. The obligation currently stands at 4% by volume which is equivalent to 3% in energy terms.
- The biofuel obligation must increase over the horizon to 2020 to meet the RES-T of 10% in 2020. This increase is shown here as gradual but it is likely it will take the form of several step changes as the technical aspects of using increasing blends are incorporated into the supply chain[53].
- The 345 ktoe of biofuel required in 2020 is equivalent to around 400 million litres. This equates to the average passenger car in Ireland covering 2,300 km powered by biofuels in 2020.
- The EV target is supported by an upfront grant and VRT relief for consumers. Plans are in place to roll out a network of charging points across the country. This infrastructure development, combined with smart grid technology, is required to support the target attainment.

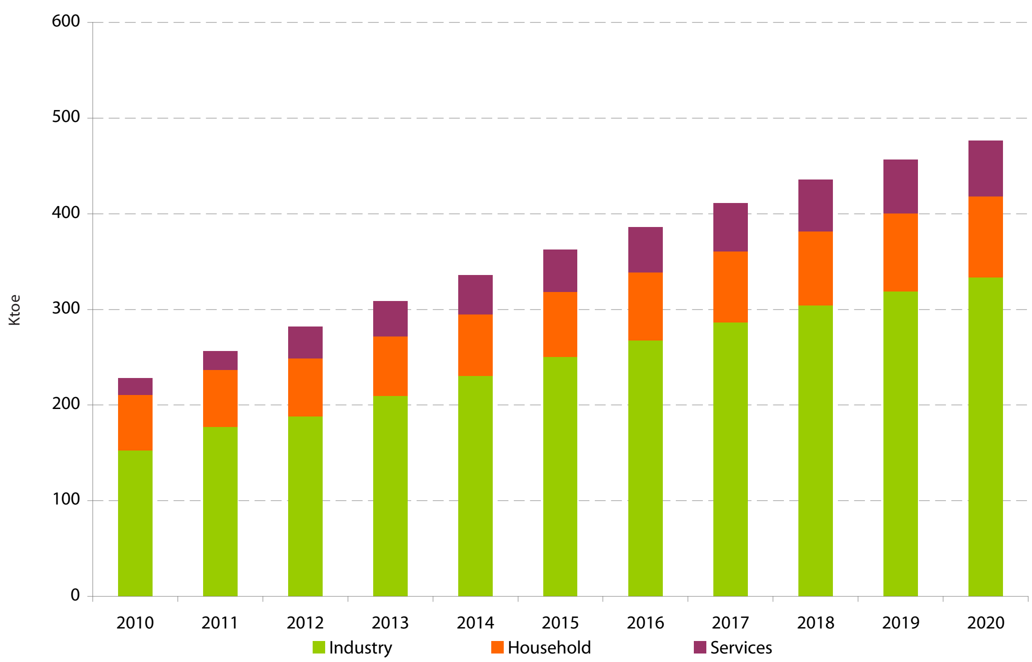
53 Suppliers in USA are required to accommodate up to 15% blend in roads transport fuels.

3.8.4 RES-H Renewable Contribution to Heat (NEEAP/NREAP)

Context:

- Historically renewable energy for heat has made the largest contribution to RES making use of woody biomass from a wide range of sources across all the economic sectors.
- Renewable heat from biomass can come from sawmill residues, thinnings from forest maintenance, waste wood from construction, biogenic waste and energy crops etc. In general, the woody biomass produces energy through combustion while other wastes and grass are converted to biogas through anaerobic digestion (AD) prior to combustion.
- Due to the cost of transport, heat is generally consumed at the point of generation to maximise efficiency. Transportation costs have typically limited the use of biomass resources for heat.
- RES-H remained largely static from 1990 to the mid 2000's. Policy action has changed this somewhat in recent years, with growth in biomass usage, solar thermal and heat pump technology.
- Policy instruments in the past have focused on grants for renewable energy installations through schemes such as the Greener Homes scheme for households and the ReHeat scheme for businesses[54]. These were designed to build market capacity for various renewable heating technologies.
- The recently approved biomass REFIT for electricity generation can allow for up to150MWe of biomass CHP to be constructed. This will affect RES-H through stimulating the production of renewable heat by improving the financial viability of many more potential sites.

Figure 21 ***Thermal Energy Contribution to RES-H (NEEAP/NREAP)***



Scenario trends:

- The use of renewable heat must grow by over 7% per annum to reach a RES-H of 12% by 2020.
- Renewable heat use in the industrial sector predominates over the period to 2020 – accounting for 8% of RES-H by 2020.
- The residential sector sees growth projected at 4% per year driven by newly built homes complying with the renewable energy requirement in Part L of the 2008 Building Regulations.

54 Both of these schemes were closed to new applicants at the end of 2010.

Table 24 ***Thermal Renewable Energy Contribution by Sector (NEEAP/NREAP)***

Fuel	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Sectoral Shares %		
	2010	2016	2020	10–20	10–20	10–16	16 –20	2010	2016	2020
Industry	153	268	333	118.1	8.1	9.8	5.6	3	6	8
Household	58	71	85	45.6	3.8	3.4	4.4	1	2	2
Services	17	47	59	236.8	12.9	18.0	5.6	0	1	1
Total Renewable Energy	**228**	**386**	**477**	**108.7**	**7.6**	**9.1**	**5.4**			
Total Consumption	*5,209*	*4,501*	*4,126*	*-20.8*	*-2.3*	*-2.4*	*-2.2*			
RES-H								**4**	**9**	**12**

Scenario outcomes: level of effort:

- The biomass CHP REFIT provides for 150MW_e of electricity generation capacity. Applying the average heat to power ratio of the current CHP[55] stock, this will provide approximately 240MW_{th} heat capacity.
- 240MW_{th} of heat capacity is projected to deliver 127 ktoe in 2020 or 27% of the required 477 ktoe in the industrial and services sectors.
- The ongoing impact of Part L of the 2008 Building Regulations is projected to provide a further 30 ktoe in the residential sector.
- For example, a further 200MW_{th} of CHP (155 ktoe) is required to ensure the shortfall to the RES-H target is met. Contributions can also be made from other technologies and efficiency measures

3.9 Energy related CO_2 emissions (NEEAP/NREAP)

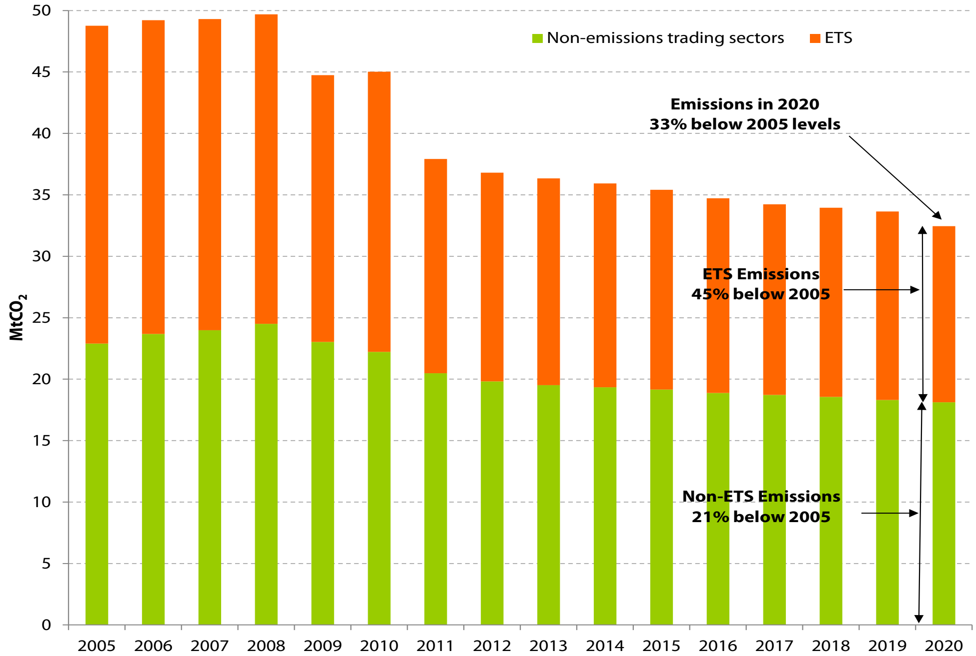
Context:

- EU member states have signed up to a set of binding GHG emissions reduction targets for 2020. These apply separately to the EU Emissions Trading Scheme (ETS), including large industrial emitters (cement production, metal process power generation etc) and non-ETS sectors (transport, residential, services, agriculture and waste).
- The ETS target is designed to reduce EU wide emissions from ETS participants by 21% compared to 2005 levels. Target achievement is essentially guaranteed by the cap-and-trade system, with emissions levels capped for each member state in the EU at the level required to achieve the overall target.
- The second target relates to non-ETS emissions. Beyond 2010, in the absence of a further international agreement on climate change, Member States have agreed to reduce their GHG emissions to meet the Community's overall GHG emission reduction commitments (20% by 2020 in the non-ETS sector compared to 2005 levels), on the basis of an 'effort-sharing' decision.[56] Ireland has been set the maximum possible target of a 20% reduction under the decision; a target that was set in 2005 on the basis of a country's relative GDP per capita i.e. at a time when Ireland's economy was experiencing strong growth.
- The energy efficiency and renewable energy measures outlined in the *NEEAP/NREAP* scenario save energy and move generation away from carbon producing sources. This acts to reduce CO_2 emissions.
- Historically agriculture activities – the raising of livestock, dairy and tillage – accounted for most of the emissions in the non-ETS sector, around 45% in 2010. These emissions arise from non-energy related activities.
- This report deals with CO_2 emissions from energy related activities only.

55 Current CHP heat to power ratio is 1.6:1. SEAI, Combined Heat and Power in Ireland 2010 update, http://www.seai.ie/Publications/Statistics_Publications/EPSSU_Publications/CHP%20in%20Ireland%202010%20Report.pdf

56 EU Decision 406/2009/EC.

Figure 22 ***Energy Related CO_2 Emissions (NEEAP/NREAP)***



Scenario trend:

- The fall in economic growth expectations along with policy action on renewable energy deployment and energy efficiency improvements acts to reduce total emissions from energy by 33% as compared to 2005 levels by 2020.
- Much of this reduction is concentrated in the ETS sector due to the increase in renewable electricity generation displacing imported fossil fuels - resulting in a 45% reduction.
- The non-ETS sector sees a reduction of 21% as compared to 2005 in this year's forecast. The *Baseline* suggests a reduction of close to 8%. The difference between the two is as a result of the extra energy efficiency and renewable energy measures in the *NEEAP/NREAP* scenario.

4 Exploratory Scenarios – Potential and Risk

Two *Exploratory scenarios* have been developed to illustrate the effects of changing some of the key assumptions in the forecasts.

The potential for renewable electricity generation in Ireland has been well established and a number of policies and plans are in place to exploit these resources. Equally, the difficulties in overcoming market barriers and failures in the areas of renewable energy and energy efficiency are well documented.

The *Exploratory Potential* scenario acknowledges the renewable energy resource potential and highlights the effort required to exploit it. A higher growth of renewable electricity compared to the *NEEAP/NREAP* scenario is modelled building on these plans as follows:

- Wind – the full extent of Gate 3 wind planned for connection by 2020 is incorporated. This means that in this scenario, close to 5,700 MW of wind is connected by 2020.
- Wave – the 500 MW White Paper target is assumed to be achieved.
- Biomass – around 350 MW of biomass producing capacity is connected by 2020, including 150 MW of biomass CHP, 104 MW of biomass co-firing in the peat plants, 44 MW of waste-to -energy and 54 MW of landfill gas.
- Interconnection – a second 500 MW interconnector is constructed, linking Ireland to the UK, in 2016. The total interconnection between the island of Ireland and the UK is 1,400 MW in 2020.

The *Exploratory Risk* scenario makes cautious (pessimistic) assumptions on the development of our resources, and on the implementation of the energy efficiency measures. The purpose of this scenario is to examine what a slacking of effort on energy efficiency and renewable energy might mean for stated targets and EU obligations. This scenario models a lower growth of renewable energy across the end use modes of heat, transport and electricity, and fewer savings from energy efficiency policies, as follows:

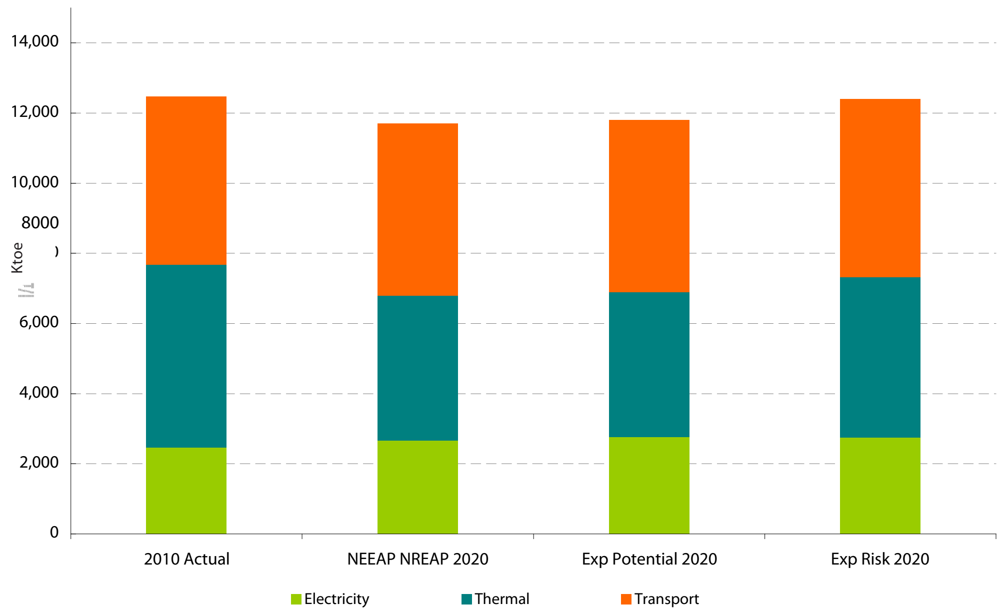
- Energy efficiency:
  - Future savings expected from policies and measures occurring after 2010 are halved.
  - This includes savings expected from the national retrofit scheme (Better Energy Homes and Workplaces), future building regulations, Accelerated Capital Allowances (public and private sector), the Public Sector Programme, and all transport related measures.
- Electricity:
  - Wind –a lower annual build rate is assumed than in the *NEEAP/NREAP* scenario with the total capacity reaching 3,300 MW by 2020
  - Wave – it is assumed that commercial devices are not in operation by 2020.
  - Biomass – a capacity of 130 MW of biomass electricity generation is connected by 2020. The reduction occurs due to the assumption that only 50 MW of biomass CHP is constructed and that no incineration of biogenic waste occurs. Also, only one peat station achieves co-firing of 35MW, while 44 MW landfill gas is installed.
- Transport:
  - Electric vehicles – half of the 10% EV target is achieved by 2020.
  - Biofuels –only 5% of transport consumption results from biofuels on the basis of the hypothetical assumption that use of this resource in Ireland is limited by international competition for biofuels deemed acceptable under the EU sustainability criteria.
- Heat
  - Only 50 MW_e of the 150MW_e allowance in the electricity REFIT scheme for solid biomass and anaerobic digestion (AD) CHP is assumed to be built. Most of this capacity is projected to be built in the industrial sector, and the remainder in the services sector.
  - Some development of renewable energy happens in the residential and services sectors from Better Energy Homes supporting solar thermal, Better Energy Business supporting a range of technologies and Part L of the 2008 Building Regulations requiring the installation of renewable heating in new buildings.

4.1 Gross Final Consumption (GFC) (Scenario Comparison)

Context:

- The *Exploratory Potential* scenario contains the full saving outlined in the NEEAP and has a gross final consumption equivalent to the *NEEAP/NREAP* scenario.
- The *Exploratory Risk* scenario assumes that some of the measures outlined in the NEEAP do not achieve the targeted savings. This acknowledges the significant challenges involved in achieving the targeted savings in some areas.

Figure 23 ***GFC by Mode of Application (Scenario Comparison)***[57]



Scenario Trends:

- When compared to 2010, the share of heat, transport and electricity changes in each of the scenarios. The share sof electricity and transport increase more strongly in the *NEEAP/NREAP* and the *Exploratory Potential* scenarios than in the *Exploratory Risk* scenario.
- This is largely due to the impact of the NEEAP savings in each scenario – most NEEAP savings occur in the use of heat which reduces its share relative to the other sectors. The *Exploratory Risk* scenario sees less savings resulting in heat retaining a higher proportion of total consumption.

57 Calculated based on the methodology outlined in the Renewable Directive (28/EC/2009).

Table 25 ***Energy Consumption by Mode of Application (Scenario Comparison)***

	2020 GFC by Scenario (ktoe)				Energy Application Share by Scenario %			
	2010 Actual	NEEAP/ NREAP	Exp Potential	Exp Risk	2010 Actual	NEEAP/ NREAP	Exp Potential	Exp Risk
Electricity	2,464	2,665	2,757	2,739	20	23	23	22
Thermal	5,212	4,126	4,126	4,589	42	35	35	37
Transport	4,796	4,910	4,915	5,084	38	42	42	41
Total	**12,472**	**11,701**	**11,799**	**12,411**				

Scenario outcome: level of effort:

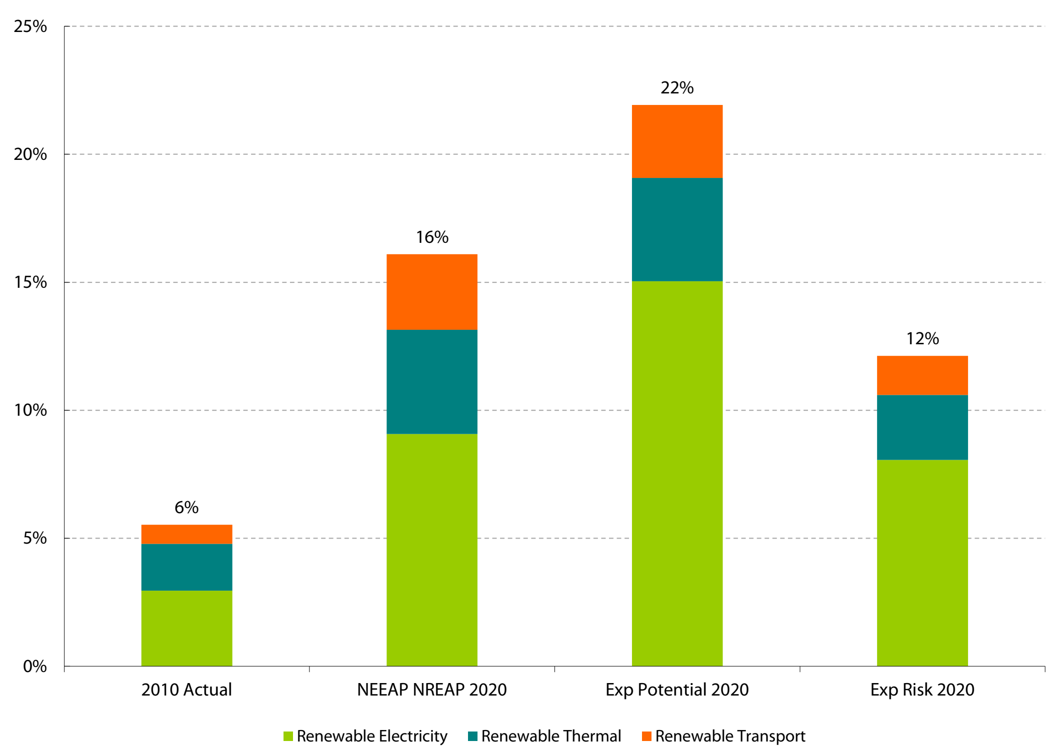
- To achieve the savings targeted in the residential sector through retrofit a total of 100,000 homes a year could require upgrade between now and 2020; this could reduce to as few as 50,000 if a deeper level of retrofit is achieved. The *NEEAP/NREAP* and the *Exploratory Potential* scenarios assume that this level of effort is achieved; the *Exploratory Risk* assumes that future policy effort falls short by 50%.
- This increases the level of effort required to achieve renewable energy targets in the *Exploratory Risk* scenario. As the majority of NEEAP measures are concentrated in the heat sector this will increase the effort required on the supply side to achieve the RES-H target of 12%.

4.2 Renewable Contribution (RES) to Overall Energy Demand (Scenario Comparison)

Context:

- A substantial level of effort is required – both in terms of energy efficiency and renewable energy development – to meet the RES 16% as described in section 3.
- The *Exploratory Potential* scenario examines the possible impact and implications of achieving the more ambitious potential renewable energy expansion.
- The *Exploratory Risk* highlights the impact of a shortfall in the level of effort in both energy efficiency and renewable energy.

Figure 24 ***Renewable Energy Contribution to GFC (Scenario Comparison)***



Scenario Trends:

- As outlined in section 3.2 the *NEEAP/NREAP* scenario achieves RES 16% through hitting the White Paper modal targets of RES-E 40%, RES-T 10% and RES-H 12%.
- The *Exploratory Potential* reaches RES 22%, driven by a projected increase in RES-E to 65%; implying growth of over 400% over the period. Previous studies in the area have established that the upper limit of RES-E, without a large increase in interconnection or storage, is in the region of 50%. This is summarised more fully in the RES-E section below.
- The *Exploratory Risk* scenario signals a shortfall to the RES targets across all three modal applications. The RES-H is projected to increase by just 58% with RES-T and RES-E projected to increase by over 100%.

Table 26 ***Renewable Energy Share (RES) of GFC (Scenario Comparison)***

	Renewable Energy by Scenario (ktoe)				Growth % 10–20			RES Contribution %			
	2010 Actual	NEEAP/ NREAP	Exp Potential	Exp Risk	NEEAP/ NREAP	Exp Potential	Exp Risk	2010 Actual	NEEAP/ NREAP	Exp Potential	Exp Risk
RE Elec	315	1,078	1,621	869	242	414	176	3	9	15	8
RE Heat	228	477	477	360	109	109	58	2	4	4	3
RE Trans	93	393	395	219	320	322	134	1	3	3	2
Total	**637**	**1,948**	**2,492**	**1,447**	**76**	**125**	**36**				
RES								**6**	**16**	**22**	**12**

Scenario outcome: level of effort:

- Energy systems – due to the longevity of energy generation infrastructure – tend to evolve over decades rather than years. The *Exploratory Potential* scenario would require very significant levels of annual infrastructure and systems development over the period to 2020.
- The future existence of a strong EU export market for renewable energy generated in Ireland is required to fund such large scale investment. Ireland will be able to sell RES compliance to other member states in the EU[58] if we overachieve on our targets and investors in electricity generation here may be able to sell electricity into the physically interconnected market in the near future.[59]
- This potential over and above what is required to meet the 2020 overall RES targets amount to around 700 ktoe (9 million MWhs) that could possibly be sold to other member states.
- Conversely, should Ireland fall short on our targets we will have to purchase compliance from other EU member states. The *Exploratory Risk* scenario would see Ireland purchasing 4% of our target (6 million MWhs) from our EU neighbours.

4.2.1 RES-E Renewable Contribution to Electricity (Scenario Comparison)

Context:

- Ireland ranks as one of the best places in Europe in quality of renewable energy resource for electricity generation. Even with this potential, significant barriers and challenges must be overcome to tap into this resource in an economically and environmentally sustainable way.
- The development of significant amounts of wind energy requires at a minimum, improvements in the way the grid operates, an expansion of the transmission grid itself, efficient administration for the processing of generator applications and major changes to how electricity markets operate. Going beyond the RES-E 40% target may also require extra interconnection and/or more storage capacity on the system.
- Ocean energy is in the development and demonstration phase. Ocean energy devices require full scale testing in actual operating environments to develop full scale commercially viable devices.
- Biomass electricity generation depends on having biomass feedstock available. This requires development of feedstock supply chains and the growing of energy crops to meet demand.

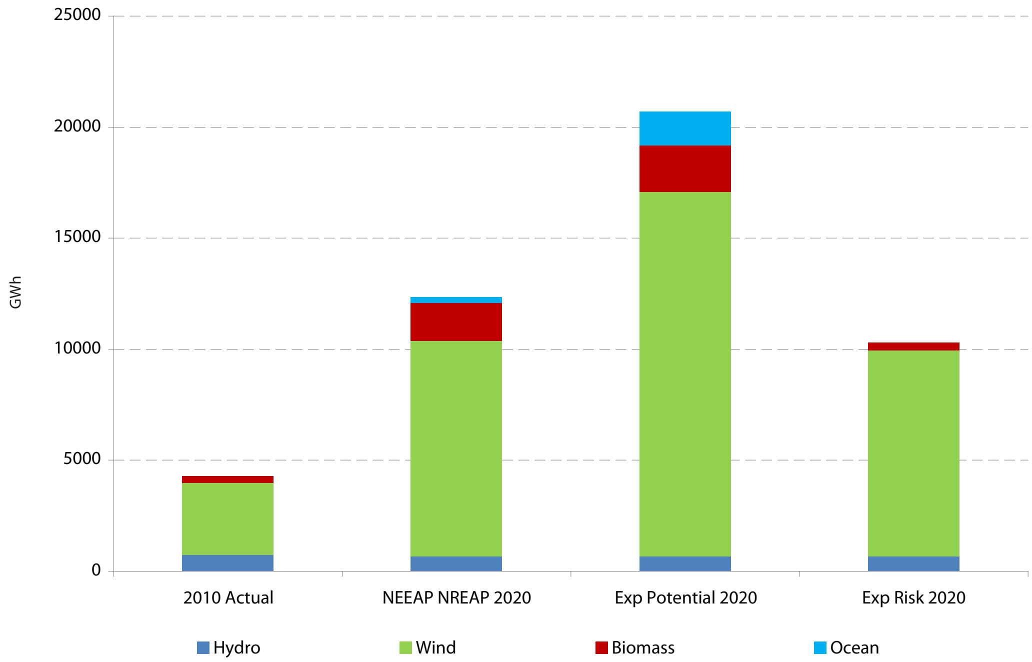
58 See article 6 of the Renewable Energy Directive 28/EC/2009

59 EU legislation has been enacted that will see EU electricity markets achieve improved integration by 2014. In addition, several projects are investigating the possibility of offshore electricity grids such as the ISLES project are currently operating.

Table 27 ***Grid Connected Renewable Electricity Capacity (Scenario Comparison)***

	Capacity Assumptions By Scenario MW			
Generation Type	**2010 Actual**	**2020 NEEAP/ NREAP**	**2020 Exp Potential**	**2020 Exp Risk**
Renewables	**1,751**	**4,202**	**6,795**	**3,668**
of which:				
Wind	1,421	3,619	5,720	3,325
Wave	0	75	500	0
Hydro	234	234	234	234
Co-Firing	5	35	103	35
Landfill Gas	34	44	44	44
CHP	9	150	150	50
Waste to Energy	0	44	44	0
Interconnection	400	900	1,400	900

Figure 25 ***Renewable Contribution to Electricity (Exploratory)***



Scenario trends:

- The *Exploratory Potential* scenario assumes that all the wind projects in Gate 3 are delivered as planned. This drives a growth of 114% in wind generation from 2010. The *Exploratory Risk* sees a more modest growth in wind generation of 35% - 10% less than the *NEEAP/NREAP* scenario –over the period 2010 to 2020.
- Biomass electricity generation increases in all scenarios. The White Paper targets modelled in the *Exploratory Potential* sees a projected biomass generation increase of 156%. Reductions in the co-firing, CHP and waste to energy capacity modelled in the *Exploratory Risk* reduce this growth to just 10%.

Table 28 ***Contribution of Renewable Electricity Generation to RES-E by Fuel Source (Scenario Comparison)***

	Renewable Energy by Scenario (ktoe)				Growth % 10–20			Contribution to RES-E %			
	2010 Actual	NEEAP/ NREAP	Potential	Risk	NEEAP/ NREAP	Potential	Exp Risk	2010 Actual	NEEAP/ NREAP	Potential	Risk
Hydro	745	664	664	673	-	-	-	3	2	2	2
Wind	3,234	9,707	16,429	9,286	200	408	187	11	31	51	29
Biomass	309	1,735	2,084	353	460	573	14	1	6	6	1
Ocean	0	244	1,533	0	n/a	n/a	n/a	0	1	5	0
Total	**4,288**	**12,350**	**20,636**	**10,312**							
Gross Con	28,658	30,991	32,070	31,851							
RES-E								**15**	**40**	**65**	**32**

Scenario outcome: level of effort:

- The *Exploratory Potential* assumes that all the wind in Gate 3 is connected by 2020 – adding to the already connected capacity from previous schemes. The current average annual build rate of around150 MW would have to more than double to achieve this. A similar rate of increase would be required in the roll out of the Grid 25 transmission grid upgrade plan.
- The *Exploratory Potential* makes the assumption that large wave energy technology will have moved beyond the development and demonstration phase by 2020 and that the supply chain will be capable of constructing 500MW by 2020 to contribute 5% of RES-E in that year. The *Exploratory Risk* is more pessimistic and looks at the possibility that no commercial device will be in operation by 2020.
- Accounting for the White Paper targets on biomass electricity generation, as well as the wind and ocean assumptions, the *Exploratory Potential* is projected to have a RES-E of 65%. Analysis conducted in the all-island grid study[60], EirGrid's 2009 study on interconnection[61], EirGrid's 2010 study on the facilitation of renewable project[62] and Pöyry's 2010 study on low-carbon generation options for Ireland[63] all consider renewable penetration close to RES-E 50%. These studies explored the limits of renewable electricity on the Irish grid. A RES-E of 65% is well beyond the limits established in these studies.
- The *Exploratory Risk* examines the scenario where current impediments to the development of wind projects intensify. This has the impact of reducing the annual build rate to just over 100MW per year and reduces the contribution of wind to RES-E to 29%.

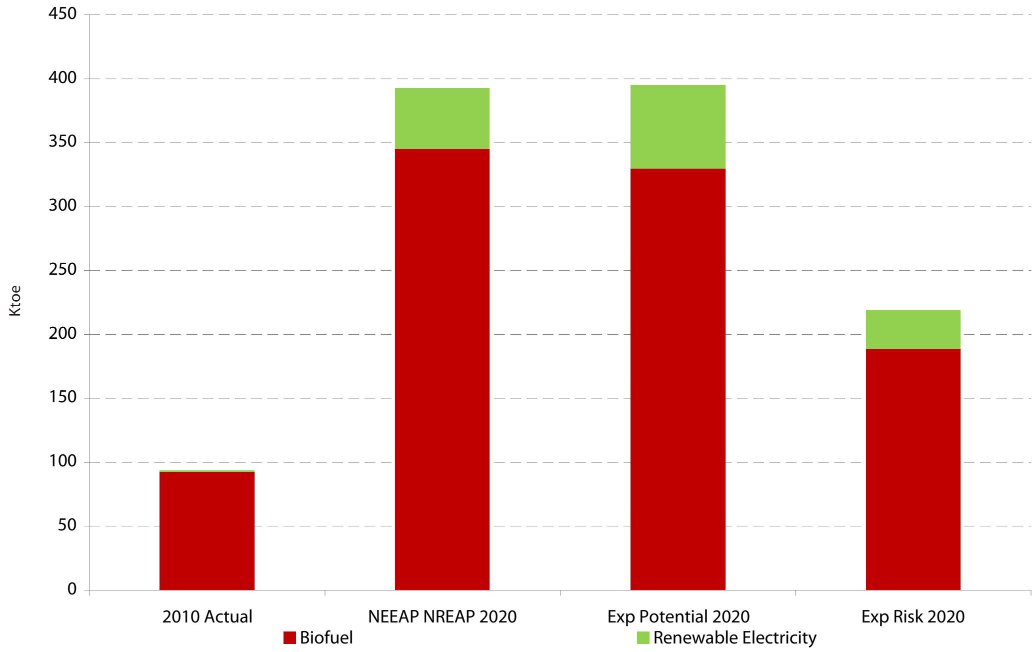
4.2.2 RES-T Renewable Contribution to Transport (Scenario Comparison)

Context:

- The Renewable Energy Directive (28/EC/2009) obliges each member state to achieve a RES-T of 10% which is calculated according to a prescribed methodology. This is summarised in section 3.4.
- The *Exploratory Risk* scenario models a situation where (1) the market for electric vehicles does not mature in time to reach the 2020 target and (2) the unavailability of sufficient quantities of sustainable biofuels does not allow Ireland to meet the stated obligations.
- The *Exploratory Potential* scenario deals with the transport sector in a similar way to the *NEEAP/NREAP* scenario, described in *section 3.8*. The only difference is an increase in the amount of electricity consumption that can be counted towards the target. This is due to the higher proportion of RES-E in the *Exploratory Potential* scenario allowing more of the electricity demand from EVs to be counted towards the target.

60 http://www.dcenr.gov.ie/NR/rdonlyres/1B7ED484-456E-4718-A728-97B82D15A92F/0/AllIslandGridStudyStudyOverviewJan08.pdf
61 http://www.eirgrid.com/media/47693_EG_Interconnect09.pdf
62 http://www.eirgrid.com/media/FacilitationRenewablesFinalStudyReport.pdf
63 http://www.eirgrid.com/media/Low%20Carbon%20Generation%20Options%20for%20the%20All%20Island%20Market%20(2).pdf

Figure 26 ***Renewable Energy Contribution to RES-T (Scenario Comparison)***



Scenario trend:

- Renewable usage in the transport sector grows by over 220% in the scenarios reaching RES-T 10%. Biofuels contribute the most towards RES-T.
- The *Exploratory Potential* models the same number of EVs as the *NEEAP/NREAP* scenario but sees 26% more renewable electricity in transport as a result of the high level of RES-E in the electricity sector.
- The *Exploratory Risk* scenario has a far lower contribution from renewable electricity because of a smaller number of EVs but also because of a lower RES-E in electricity consumption.

Table 29 ***Renewable Energy Contribution to Transport (Scenario Comparison)***

	Renewable Energy by Scenario (ktoe)				Growth % 10–20			Contribution to RES-T %			
	2010 Actual	**NEEAP/ NREAP**	**Potential**	**Risk**	**NEEAP/ NREAP**	**Potential**	**Exp Risk**	**2010 Actual**	**NEEAP/ NREAP**	**Potential**	**Risk**
Renewable Electricity	3	48	65	30	1,628	2,245	979	0	1		1
Biofuel	119	345	330	189	189	177	58	3	9		5
Total	**122**	**393**	**395**	**219**	**222**	**223**	**79**				
Gross Con	*4072*	*4006*	*4,023*	*4,144*							
RES-T								**3**	**10**	**10**	**5**

Scenario outcome: level of effort

- The biofuels obligation allows the Government to set the proportion of biofuels that transport fuel suppliers are obliged to sell. Currently this is set at 3% of sales in energy terms (4% by volume).
- To count towards the target biofuels must comply with sustainability criteria. EU member states must set up a detailed and robust administrative structure that certifies eligible biofuel sources from both domestic sources and imports. Around 400 million litres of biofuel are required to meet the RES-T target.

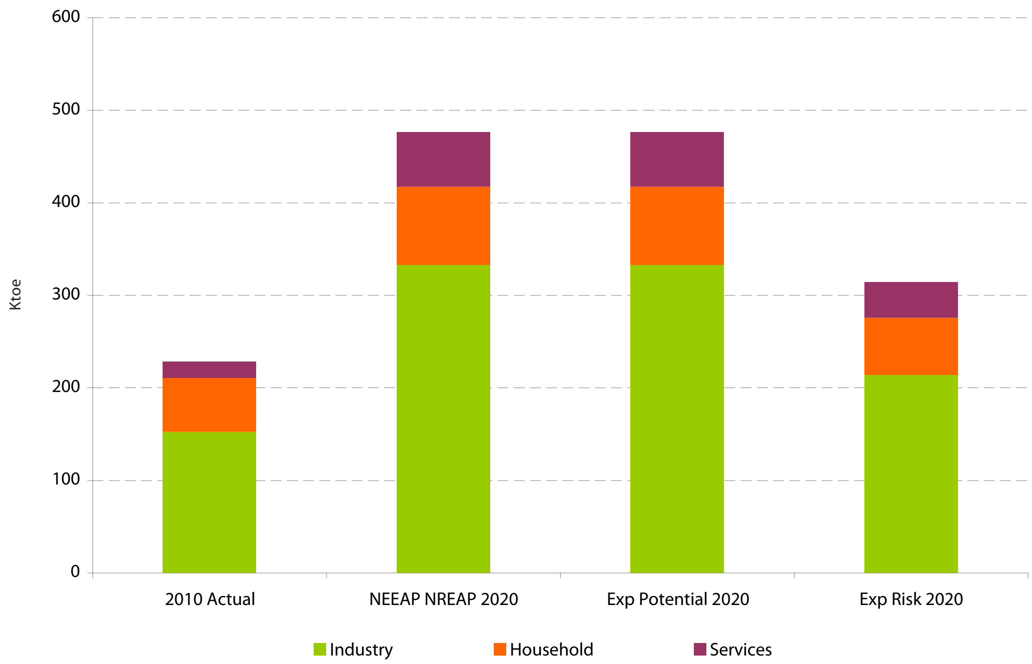
- Relief from the Vehicle Registration Tax (VRT) and an upfront grant are aimed at stimulating the EV market in Ireland. To achieve the 10% target over 20,000 EVs must be sold on average in each year to 2020. The *Exploratory Risk* scenario assumes only half of this level of sales is achieved.
- The assumption of a reduction in EV sales amounts to just 18 ktoe in 2020. The impact is small compared to the impact of the pessimistic assumption on biofuel – equivalent to a 156 ktoe reduction.

4.3 REH-H Renewable Contribution to Heat (Scenario Comparison)

Context:

- The *Exploratory* scenarios deals with a similar context and background as described in *section 3.8*
- The *Exploratory Potential* scenario assumes that the RES-H targets are met as in the *NEEAP/NREAP* scenario.
- The *Exploratory Risk* models polices that are currently in place for renewable heating. More renewable heat is required from these polices in this scenario to meet RES-H targets as the GFC is higher – arising from the underachievement of the NEEAP targets.

Figure 27 ***RES-H Consumption by Sector (Scenario Comparison)***



Scenario trend:

- Renewable heat is required to grow by over 200% in the period from 2010 to 2020 to achieve the REH-H target of 12% in the *NEEAP/NREAP* and the *Exploratory Potential* scenarios..
- The scenarios project that most of this increase will happen in the industrial sector. The economies of scale available to biomass installations in the industrial sector make this sector the most economically viable for the use of biomass.
- The *Exploratory Risk* scenario projects the impact of a reduced CHP capacity. This has the impact of increasing the renewable heat usage by just 40% – the RES-H target implies an increase of 110%.

Table 30 ***Thermal Renewable Energy Consumption by Sector (Scenario Comparison)***

	Renewable Energy by Scenario (ktoe)				Growth % 10–20			Contribution to RES-H %			
	2010 Actual	NEEAP/ NREAP	Potential	Risk	NEEAP/ NREAP	Potential	Exp Risk	2010 Actual	NEEAP/ NREAP	Potential	Risk
Industry	153	333	333	215	118	118	40	3	8		5
Household	58	85	85	62	46	46	46	1	2		2
Services	17	59	59	38	237	237	117	0.3	1		1
Total	**228**	**477**	**477**	**314**	**109**	**109**	**38**				
Gross Con	5,212	4,126	4,126	4,589							
RES-H								**4**	**12**	**12**	**7**

Scenario outcome: level of effort:

- The main driver for renewable heat is the biomass CHP REFIT. Some growth is also delivered through solar thermal, biomass boilers and heat pumps installed in newly constructed homes complying with Part L of the 2008 Building Regulations.
- The *Exploratory Potential* has the same requirement for policy effort as the *NEEAP/NREAP* scenario. The 150MW_e in the REFIT scheme will provide 240MWth capacity at current average heat to power ratios of existing CHP units. To meet the RES-H target approximately 440MWth are required.
- The *Exploratory Risk* scenario assumes that only 50MW_e of CHP is constructed by 2020 at a heat to electricity ratio of 1.6:1. This is projected to deliver 42 ktoe of renewable heat in 2020 or just 1% of the RES-H target.

5 Discussion

The following discussion provides some further consideration of the main outcomes of the forecasting process. The following themes are expanded below:

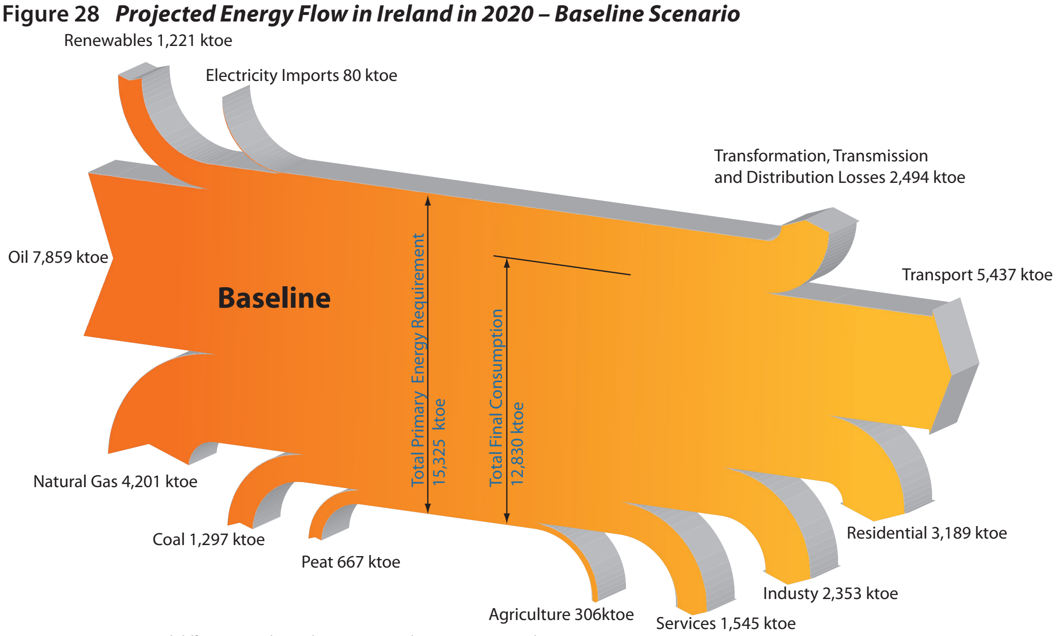
- the impact of economic projections and energy efficiency measures on projected energy consumption
- the remaining level of effort needed to achieve the headline *NEEAP/NREAP* scenario and how this varies for the *Exploratory* scenarios
- the impact on energy related CO_2 of all scenarios and the implications for compliance trading of each scenario
- the implications for renewable energy compliance trading of each scenario

Projected energy demand

The projected total final consumption for 2020 in the *Baseline scenario* (12,830 ktoe) is 2.7% lower than the corresponding figure in last year's forecast. This occurs for two reasons; first, revised economic forecasts from the ESRI reflecting the lower expectations for economic growth in the short term, and a slower return to economic growth in the long term (assumptions presented in the method section) lead to a reduction in projected demand. Secondly, further reductions in demand from existing policies and measures become implicit in the trend as they are picked up in the macro-economic modelling.

Figures 28 and 29 below show the projected energy flows for the *Baseline* and *NEEAP/NREAP* scenarios. Compared to the *Baseline*, the *NEEAP/NREAP* scenario shows a 6.6% reduction in the total primary energy requirement. Total final consumption reduces from 12,830 ktoe in the *Baseline* to 11,853 ktoe in the *NEEAP/NREAP* scenario (a 7.6% reduction), indicating the additional impact of energy efficiency measures.

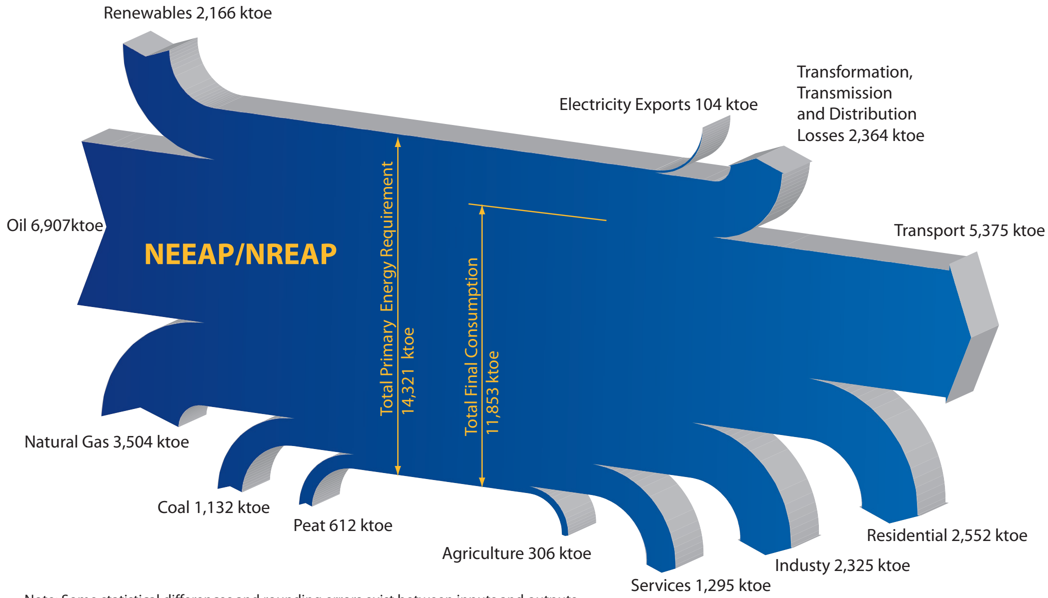
Figure 28 ***Projected Energy Flow in Ireland in 2020 – Baseline Scenario***



Note: Some statistical differences and rounding errors exist between inputs and outputs

The *NEEAP/NREAP* scenario models compliance with Ireland's renewable energy obligations in 2020. It indicates how achievement of the RES-E 40%, RES-T 10% and RES-H 12% targets is sufficient to deliver RES-16% in 2020. This scenario should be viewed as the minimum requirement for renewable energy by 2020 in order to meet RES 16%, particularly given the continuing uncertainty surrounding economic forecasting in Ireland.

Figure 29 ***Projected Energy Flow in Ireland in 2020 – NEEAP/NREAP Scenario***

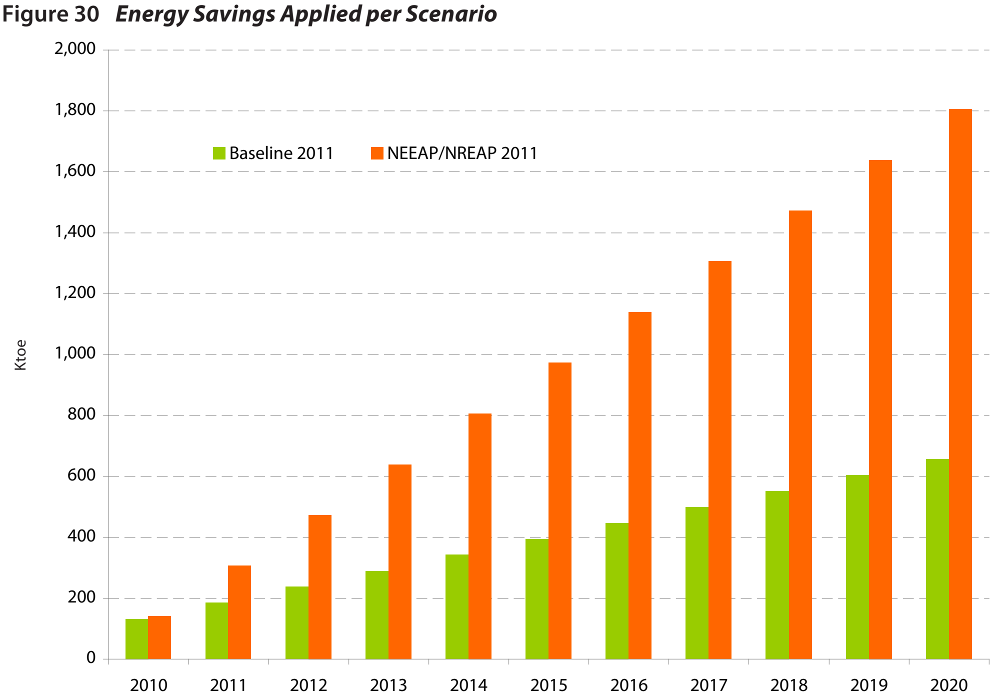


Note: Some statistical differences and rounding errors exist between inputs and outputs

The difference between the *Baseline* and *NEEAP/NREAP* scenarios is lower this year (991 ktoe) compared with last year (1,241 ktoe). Both scenarios in each year are based on identical macro-economic and fuel price assumptions the difference can be interpreted as the increasing impact of energy efficiency measures over time. As measures become further incorporated in the *Baseline*, its trend will converge with the *NEEAP/NREAP* scenario, illustrating delivery of demand reduction through efficiency improvements.

Much has been achieved in energy savings to date, as illustrated by the shift of the *Baseline* towards the *NEEAP/NREAP* scenario described above. An increasing level of effort in terms of both energy savings and renewable energy deployment is modelled as outlined in the assumptions section. The chart below illustrates the energy savings applied to both the *Baseline* and *NEEAP/NREAP* scenario.[64]

Figure 30 ***Energy Savings Applied per Scenario***



64 Appendix 1a contains detailed analysis of the efficiency measures underlying these adjustments.

Required level of effort

The *NEEAP/NREAP* scenario looks at the impacts assuming all the targets are achieved. The effort required to achieve the targets is significant for both renewable energy and energy efficiency. Some measures, such as the LEIN scheme for energy saving in large industry or the REFIT scheme supporting renewable energy, are well established and have been delivering progress towards targets and possibly beyond. The impact of more recent policy measures is less established and thus it is more difficult to project their impact.

When the required effort in each end use mode is examined across the scenarios, the relative challenges associated with each become clearer. The achievement of the RES-E target in the *NEEAP/NREAP* scenario requires around 4,200 MW of renewable electricity by 2020. This suggests that current build rates for wind need to be accelerated, as planned, in the coming years as well as the construction of all announced biomass generation capacity. The assumption of a reduced annual build rate of wind, along with reduced biomass build, in the *Exploratory Risk* scenario delivers 3,670 MW of renewable electricity generation which falls short of the target.

The RES-E of 65% reflected in the *Exploratory Potential* scenario cannot be achieved in the current electricity system as there are technical limits to the amount of non-synchronous generation possible on the existing system. The *Exploratory Potential* scenario will at a minimum require significant interconnection and/or storage capacity to allow the electricity system to function in addition to changes to electricity market rules of operation.

The impact of achieving the 10% electric vehicle (EV) target on the 10% RES-T target is small in comparison to the energy required from biofuels. The Biofuel Obligation that is currently in place has the flexibility to allow for upward adjustment to attain the 10% RES-T target by 2020 by requiring higher proportions of biofuels in petrol and diesel. While technical adjustments are required through the transport supply chain to accommodate higher biofuel usage, the biggest challenge to the achievement of the target will be access to biofuels that comply with the sustainability criteria specified in the Renewable Energy Directive. The *NEEAP/NREAP* and the *Exploratory Potential* scenarios assume that the 400 million litres of compliant biofuels required to meet the target in 2020 will be available.

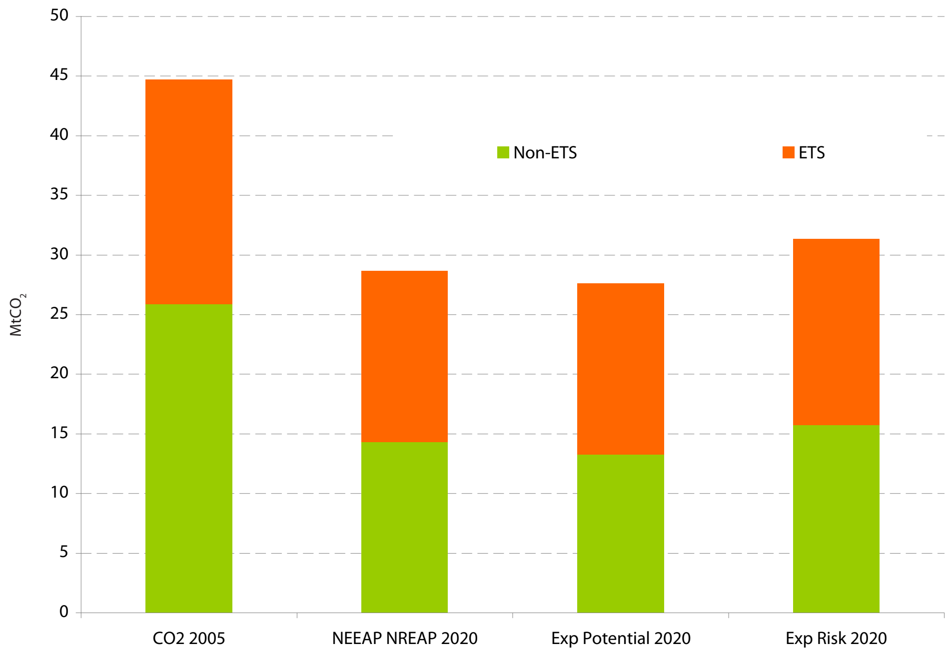
Much of the policy effort outlined in the NEEAP is focused on reducing the quantity of energy required for heating. The *NEEAP/NREAP* scenario assumes all the NEEAP targets are met and that all of the available biomass CHP in the REFIT scheme will be built. The 2008 Building Regulations includes a renewable obligation for newly built houses which is also assumed to have its full effect. When the projected impact of these measures is accounted for there is still a gap to the RES-H 12% target of around 150 ktoe (4%). The Government is currently evaluating a range of policies in this area to deliver the remainder of the target. The *Exploratory Risk* scenario assumes that only 50 MW of biomass CHP is constructed as a result of the REFIT, which would require up to 7% of the REH-H target to be delivered from new policies.

Energy related CO_2

Total CO_2 emissions vary for each scenario on the basis of different supply side assumptions and demand trajectories. Figure 31 below summarises 2020 CO_2 emissions associated with each scenario, and presents results for both ETS and non-ETS emissions. This enables an assessment to be made of progress on emission reduction targets for 2020 based on the projections. The *Exploratory Risk* scenario sees the lowest reduction, 17%, in energy related CO_2 in the non-ETS sector. This is the only scenario to show a shortfall on the 20% target.[65] The NEEAP/NREAP shows a reduction of 24% in energy related CO_2 in the non-ETS sector. While this is positive, the inclusion of agricultural emissions would significantly change the picture. It is likely that more effort will be required on energy related non-ETS CO2 to achieve the overall 20% target reduction for the non-ETS sector.

65 The actual target is for 20% reduction in overall non-ETS GHG emissions and the contribution to this target by the energy sector may result in a requirement of more than 20% or less than 20% reduction in non-ETS energy-related CO_2.

Figure 31 ***Energy-Related CO_2 Emissions 2005 & 2020 by scenario***



Compliance trading

The Renewable Energy Directive (28/EC/2009) allows EU member states that overachieve on their renewable energy obligations to sell to states that require extra renewable energy to meet their obligations. The *NEEAP/NREAP* scenario outcome would not require Ireland to partake in compliance trading as the RES 16% obligation is met from domestic sources. The *Exploratory Potential* scenario outcome could see up to 750 ktoe (8.7 million MWh) available for export. Justification of the large scale infrastructure investment required in this scenario would depend on a sufficiently high market price for compliance, as well as a market for the exported physical energy. The *Exploratory Risk* scenario would see Ireland buying 500 ktoe (5.8 million MWh) of compliance from other member states. This is financially justified where the cost of purchasing compliance is less than the cost of developing domestic resources.

At present the compliance market is at an early stage of development with a market price not yet established. As the 2020 end point approaches a market in compliance is likely to emerge.

6 Comparing Electricity Modelling for Energy Forecast; PLEXOS and IDEM

6.1 Overview

This section investigates the modelling of the power system using two distinct unit commitment and dispatch power system models. Results from the ESRI's Irish Dispatch of Electricity Model (IDEM) model and Energy Exemplars *PLEXOS[66] for Power Systems* – using the SEAI PLEXOS_Ireland data set – are compared for a one year model simulation of the 2020 Irish power system. Both models share a common set of inputs in the form of seasonal fuel prices, electricity demand profiles and all island generation portfolios for 2020, but the level of technical representation of power plant characteristics is different in each model. The IDEM model assumes a simplified representation of individual power plant and models individual power plant capacity, and average efficiency. A heuristic is applied in IDEM to base-load plant to limit excessive cycling.

The PLEXOS model has the capacity to model a more detailed representation of each power plant including multiple heat rates, minimum stable generation levels, ramp up and down rates, minimum up and down times and start costs and times. This has the effect of limiting the flexibility of certain power plant and also changes the way in which plants are committed and dispatched. SEAI's PLEXOS_Ireland model used in this exercise also has the added benefit of having a greater representation of individual power plant and the bidding behaviour of individual power plant in Great Britain. This enables the detailed modelling of flows across the interconnector.

The inclusion of these technical and modelling constraints in modelling the power systems and their effects on results are presented in greater detail below.

6.2 IDEM Model

The Irish Dispatch of Electricity Model (IDEM) is a simple model to determine the wholesale price of electricity. Generators bid their short-run marginal costs (fuel and carbon) and the model stacks these generators according to their bid price in each half hour, forming a merit order curve. IDEM then determines the cheapest way to meet demand in each half hour by letting the most expensive plant needed to meet demand set the system marginal price. Any plant that is generating in a given half hour is paid the system marginal price for that period.

Inputs for the model include plant capacities, efficiencies and availabilities as well as fuel and carbon costs. Outputs include the amount of electricity generated by each plant and the system marginal price in half-hourly period and the annual demand weighted shadow price of electricity. A simplified model of the GB market is used whereby plants are aggregated according to fuel types. This allows us to incorporate interconnection into the model.

To avoid excessive plant cycling, IDEM is run in three stages. The first stage is characterised by a reduced wind capacity. A plant is given base-load status if on average it is running above its minimum stable capacity for that month. In the second stage only these base-load plants are available at their minimum stable capacity and demand for each month is set to the minimum for that period. In the third stage the demand that has not been met by the base-load plants is used and the capacity is the residual of the base-load capacity along with all other remaining plants and wind.

6 PLEXOS and IDEAM

66 Energy Exemplar, PLEXOS for Power Systems, www.energyexemplar.com

6.3 PLEXOS Model

PLEXOS for Power Systems is an electricity system market modelling tool that can operate over various planning and scheduling horizons, using different algorithms, objective functions and operational methods in each case. It can be used for schedule generation, capacity expansion, transmission planning, portfolio optimisation and market analysis.

As an electrical system model, the core input data comprises primarily the technical details of the generators, transmission lines and loads as well as fuel costs, operations costs and emission production rates and costs. The nature of PLEXOS means that it can simultaneously optimise and take into account all technical limitations and constraints of the modelled power system. The optimisation problem is dynamically constructed at run-time based on the inputs provided. The objective function is to minimise the overall production costs, including incremental costs, no load costs, start costs and variable operating & maintenance costs, subject to specified system and plant specific technical constraints. Results are in the form of unit commitments and dispatches that meet demand at each given period at the lowest system cost. Shadow prices are also automatically determined as part of the solution to the optimisation problem. The price reported by PLEXOS represents the shadow price of the constraint that matches supply and demand. This can be considered as the change in the objective function for an incremental change in demand.

SEAI's PLEXOS_Ireland model is used here to predict future half hourly dispatch of electricity generating units (fossil-fuel and renewable), with a focus on the year 2020.

6.3.1 SEAI PLEXOS_Ireland Model

The SEAI PLEXOS_Ireland model is based on the validated model published by the Commission for Energy Regulation (CER) in April 2010. The CER model is designed to model electricity prices in the Single Electricity Market (SEM) over a horizon of 1-2 years. It contains all the technical operating characteristics of the existing electricity production (generating) units including maximum export capacity, minimum stable generation, heat rates, ramp rates, minimum and maximum up and down times, start costs and emissions profiles. Some amendments and adjustments have been made to this model to make it fit for longer-term forecasting to 2020.

These include:

- Extension of the modelling horizon to 2020
- A full model of Great Britain's power market including specific price mark-ups on generator price
- A change to the manner in which interconnector flows are modelled incorporating a characterisation of the interaction between the single electricity market and the UK market
- Power-system constraints have been applied in the model to reflect the operational rules commonly used in the Irish system.

The representation of the Great Britain (GB) market is based on proprietary data[67]. The units in GB are represented at a lower resolution than in the SEM to facilitate a more efficient model run. Properties such as minimum load and minimum up/down times are not represented. To capture the operational characteristic of the GB market – generator bid prices rarely equal their short-run marginal cost – a mark-up was added to each generator's bid price. New-plant build projections are based on analysis conducted by Redpoint Energy. Wind capacity build is based on the UK government's announced targets, with offshore wind reaching 10 GW by 2020. The PLEXOS software optimises the generator dispatch, including interconnector flows, for each half-hour in the day to produce the least-cost commitment and dispatch of plant to meet demand over the year. This optimisation is subject to constraints such as plant availability, system operating rules and wind profiles.

67 This data was obtained from Redpoint Energy which holds and maintains a full data set of GB generators.

6.4 Methodology

Both IDEM and PLEXOS models assume the same seasonal fuel and carbon price. The 2020 generation portfolio is taken from EirGrid's latest All Island Generation Capacity Statement and is common to both. IDEM has a simplified representation of the GB generation portfolio while the SEAI PLEXOS_Ireland model has a more detailed portfolio with individual power plant representation as described above. Both models share a common half hourly demand portfolio for the All Island System and GB. The models are run for concurrent periods at half hourly intervals for the year 2020. Annual demand and annual fuel price assumptions are shown below. Seasonal coal and gas prices are also shown. Note that in this exercise ancillary services and the transmission network are not considered.

Table 31 ***Electricity Demand Assumptions All-island of Ireland and GB 2020***

2020	All Island Demand (TWh)	All Island Peak (MW)	GB Demand (TWh)	GB Peak (MW)
IDEM	37.6	6,563	303.8	52,911
PLEXOS	37.6	6,563	303.8	52,911

Table 32 ***Fuel Price Assumptions 2020 (based on Table 2 assumptions)***

2020	Oil Price	Distillate Price	Peat Price		Carbon Price
IDEM	€60.43	€79.29	€12.00	€/MWh	€33.26
PLEXOS	€16.79	€22.02	€3.33	€/Gj	€33.26

Table 33 ***Quarterly Seasonal Fuel Prices 2020***

All Island	Coal Price	Gas Price	
Q1	3.17	11.36	€/GJ
Q2	2.92	9.50	€/GJ
Q3	3.37	9.37	€/GJ
Q4	4.83	9.92	€/GJ

For comparison purposes the PLEXOS model was also run with limited technical representation, known as *PLEXOS_Simplified*. This was to determine and isolate the effect on results of the inclusion of this level of technical detail on results. This simplified version of the model run excluded minimum stable generation, ramp rates, start costs, minimum up and down times and generator bid mark-ups in the GB system.

6.5 Results

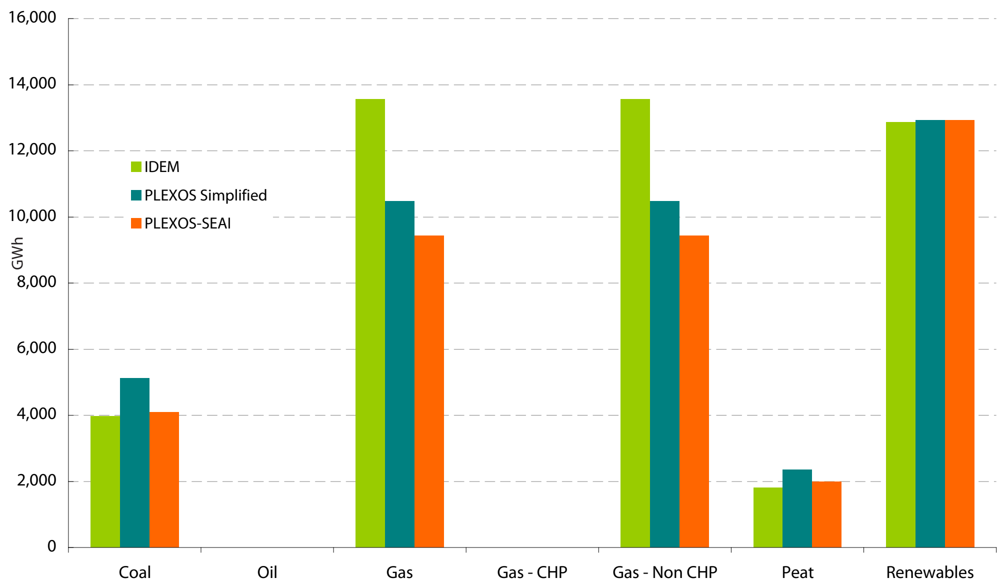
Both models produce adequate generation to meet demand in all periods with no un-served energy present. The table and figure below shows the generation in RoI by fuel type for each model for the target year of 2020.

Table 34 ***2020 Outputs for Each Model***

	IDEM(GWh)	PLEXOS Simplified (GWh)	PLEXOS-SEAI (GWh)
Electricity generated by type of fuel			
Coal	3963	5129	4081
Oil	0	0	0
Gas	13561	10476	9434
Gas - CHP	2	0	0
Gas - Non CHP	13559	10476	9434
Peat	1806	2341	1985
Renewables	12866	12918	12918
of which: Hydro	664	702	702
Biomass	1734	1819	1814
Wind	10019	10151	10155
Renewables share of generated			42%
Actual electricity generated	32196	31657	29335
Electricity exported from domestic plants	2992	3007	2503
Electricity imports	1781	1314	1254

Overall both models show RoI to be a net export of electricity but the detailed SEAI PLEXOS _Ireland model shows RoI plant to generating less electricity than results from the IDEM model. This is because the SEAI PLEXOS_Ireland model imports electricity into RoI from surplus gas and coal generation in Northern Ireland. There is also some difference caused in the modelling by specific differences in efficiencies for generation plant in NI. The SEAI PLEXOS_ Ireland model assumes slightly higher efficiencies (in the form of heat rates) than the IDEM model. For example, IDEM assumed an efficiency of 46% for Ballylumford CCGT unit while PLEXOS, using latest heat rates from the SEM, uses an average efficiency of 50% for the unit.

Figure 32 ***Annual Generation by Fuel 2020***



In the SEAI PLEXOS model peat is lowest on the thermal merit order. While the CO_2 price adds to the price of peat, in the model it is still a relatively cheap fuel with plant that is more efficient than coal. Coal units are also relatively low on the merit order but are almost put out of merit by a combination of high wind generation and a higher seasonal coal price in the last quarter of the year. The gas price in the first quarter of the year is higher than in the last quarter, so gas is seen to increase its relative portion of generation as the year progresses. On many occasions during the year the generation from coal plant is scaled back or turned off to allow gas units to come online above its minimum stable generation level. PLEXOS adds a constraint to the mathematical programme to enforce this minimum level when the unit is committed; this can have the effect of reducing generation from plant lower on the merit order and increasing generation from plant higher on the merit order. This can be seen in the simplified PLEXOS simulation when, in the absence of this constraint, generation from coal and peat is higher.

Another important technical constraint is the start-up cost of units. This constraint is enforced in the PLEXOS model and has the effect of reducing the cycling on and off of plant to meet varying demand. It can also have the effect of reducing output from mid merit plant as the model might find it more economical to leave base-load units to run for longer periods and thus displace generation from units higher up the merit order. To a lesser degree ramp rates and minimum up/ down times are also important as they limit the flexibility of units to respond to changes in demand and wind variability. Flexible units in the models are generally hydro generation, pumped storage and interconnection to GB. Interconnector (IC) is an important source of flexibility and within both models IC flows are scheduled intra-day. Both models show the RoI and the All Island system to be a net exporter of electricity in 2020. In the simplified PLEXOS model, the net interchange is much higher as cheaper peat and coal is allowed to come online and stay online longer as gas plant can come on below its minimum stable level. This has the effect of reducing the price of electricity in the region and makes it suitable for export.

In conclusion, while both the IDEM and the SEAI-PLEXOS_Ireland models show similar annual generation figures for base-load and renewable plant, there is a significant difference in the amount of gas generation between the models, with IDEM showing higher generation. The reason for this difference is the richer technical detail and more realistic characterisation of unit dispatch in the PLEXOS_Ireland model. This has an influence on the specification of efficiencies of units within the models and also the level of technical constraints which can affect the unit commitment and dispatch of plant. This scenario outcome could change substantially by varying the various input assumptions. Work is ongoing between the ESRI and UCC in comparing the two models using varied assumptions.

Acknowledgements

SEAI gratefully acknowledges contributions from the following organisations to the development of this report:

Economic and Social Research Institute (ESRI)

Department of Communications, Energy and Natural Resources (DCENR)

Environmental Protection Agency (EPA)

EirGrid

Department for Environment, Heritage and Local Government (DoEHLG)

Department of Transport (DoT)

Department of Finance (DoF)

Department of Agriculture, Fisheries and Food (DAFF)

University College Cork (UCC)

Appendix 1a: Energy Savings Adjustments

The following table summarises the assumptions made for incorporating energy savings for policies and measures as described originally in the National Energy Efficiency Action Plan (DCENR, May 2009)[68] in the *Baseline* and *NEEAP/NREAP* scenarios. In general, actions assumed implicit in the *Baseline* were in place before 2008; hence their impact is assumed to be already incorporated in the forecasted trends. Actions and measures implemented during the period 2008 to 2010 have also been incorporated in the *Baseline* on the basis outlined below i.e. a proportion is assumed already implicit and an adjustment made for the remainder of the expected future impact of the measure. Adjustments made for future (committed) measures are incorporated in the *NEEAP/NREAP*.

Measure	Estimated energy savings in 2020		Baseline assumptions	NEEAP/NREAP & Exploratory Potential scenarios	Exploratory risk scenario assumptions
	GWh (PEE)	ktoe			
Public Sector					
Public Sector Programme	1,261	108	-	Estimated impact from measure applied to both scenarios	50% of impact achieved
Green Public Procurement (via ACA)	287	25	10% implicit, 90% adjustment	As per baseline	50% of impact achieved
SEEEP and EERF (public sector)	88	8	10% implicit, 90% adjustment	As per baseline	
Public Sector Building Demonstration Programme	140	12	Assumed implicit in baseline.	-	
CHP (public sector)	183	16	75% implicit, 25% adjustment	As per baseline	
ReHeat (public sector)	123	11	Assumed implicit in baseline.	-	
Public transport efficiency	158	14	-	Estimated impact from measure applied to both scenarios	50% of impact achieved
Better Energy (public sector)	1,000	86	-	Estimated impact from measure applied to both scenarios	50% of impact achieved
Business					

68 Note: Savings estimates per policy have been updated to account for changed macroeconomic and other assumptions. Some new policies have also been incorporated.

SEAI Large Industry Programmes	2,728	235	Assumed implicit in baseline.	-	
SEAI SME Programme	506	43	25% implicit, 75% adjustment	As per baseline	
ACA (private sector)	688	59	10% implicit, 90% adjustment	As per baseline	50% of impact achieved
SEEEP and EERF (private sector)	177	15	10% implicit, 90% adjustment	As per baseline	
CHP (private sector)	428	37	75% implicit, 25% adjustment	As per baseline	
ReHeat (private sector)	288	25	Assumed implicit in baseline.	-	
Better Energy (Commercial sector)	1,000	86	-	Estimated impact from measure applied to both scenarios	50% of impact achieved
Buildings					
2002 Building Regulations -Dwellings	1,279	110	Assumed implicit in baseline.	-	
2008 Building Regulations -Dwellings	2,110	181	10% implicit, 90% adjustment	As per baseline	
2011 Building Regulations -Dwellings	833	72	-	Estimated impact from measure applied to both scenarios	50% of impact achieved
Building Regulations - Nearly Zero Energy Dwellings	225	19	-	Estimated impact from measure applied to both scenarios	50% of impact achieved
2005 Building Regulations - Buildings other than dwellings	300	26	Assumed implicit in baseline.	-	
2012 Building Regulations - Buildings other than dwellings	863	74	-		50% of impact achieved
Energy efficient boiler regulation	1,200	103	25% implicit, 75% adjustment	As per baseline	
Domestic Lighting (Eco-Design Directive)	1,200	103	25% implicit, 75% adjustment	As per baseline	
Greener Homes Scheme (GHS)	119	10	Assumed implicit in baseline.	-	
Warmer Homes Scheme (WHS)	130	11	Assumed implicit in baseline.	-	
Home Energy Saving (HES) scheme	365	31	10% implicit, 90% adjustment	As per baseline	
Smart Meter roll-out	624	54	-	Estimated impact from measure applied to both scenarios	50% of impact achieved

Better Energy Homes (residential retrofit)	6,000	516	-	Estimated impact from measure applied to both scenarios	50% of impact achieved
Mobility-Transport					
Electric vehicle deployment	688	59	-	Estimated impact from measure applied to both scenarios	50% of impact achieved
Vehicle registration tax (VRT) and annual motor tax (AMT) rebalancing	657	57	50% implicit, 50% adjustment	As per baseline	50% of impact achieved
Improved fuel economy of private car fleet (EU Regulation)	3,014	259	50% implicit, 50% adjustment	As per baseline	50% of impact achieved
More efficient road traffic movements	713	61	-	Estimated impact from measure applied to both scenarios	50% of impact achieved
Aviation efficiency	253	22	50% implicit, 50% adjustment	As per baseline	50% of impact achieved

Appendix 1b: Supply-side measures applied by scenario - 2020 assumptions

Measure	Baseline assumptions	NEEAP/NREAP scenario assumptions	Exploratory Potential assumptions	Exploratory Risk assumptions
Electricity				
VALOREN & THERMIE (Wind)	23 MW	23 MW	23 MW	23 MW
Alternative Energy Requirement (AER) (Wind)	844 MW	Wind: 844 MW	Wind: 844 MW	Wind: 844 MW
Gate 1 Wind	334 MW	334 MW	334 MW	334 MW
Gate 2 Wind	1090 MW	1267 MW	1267 MW	1267 MW
Gate 3 Wind (by 2020)	165 MW	To balance greater energy requirement, of overall RES 16% or 40% RES-E	3508 MW	0
Ocean	0 MW	75 MW	White Paper target of 500MW	0
Biomass – Co-firing, LFG, Waste to Energy, Biomass AD CHP	153 MW	273MW	White Paper & Bio energy Strategy 400 MW	130 MW
Hydro	234 MW	234 MW	234 MW	234 MW
Heat				
Building Regulations Part L 2008	New build requirements of 10 KWh/m^2/yr from renewable sources	New build requirements of 10 kWh/m^2/yr from renewable sources	New build requirements of 10 kWh/m^2/yr from renewable sources	New build requirements of 10 kWh/m2/yr from renewable sources
Greener Homes Scheme	Support for domestic renewable generating technologies	-	-	-
ReHeat Grant Scheme	Support for commercial renewable generating technologies	-	-	-
RetroFit Scheme	-	Support for renewable technologies	Support for renewable Technologies	-
NREAP CHP build (REFIT III)	20 MW_{th}	380 MW_{th}	380 MW_{th}	80 MW_{th}
Transport Sector				
Mineral Oil tax Relief	2%	-	-	-
Biofuels Obligation Scheme	3%	To balance 10% after EVs accounted for	To balance 10% after EVs accounted for	-
Electric Vehicles 10% target	0%	10% of vehicles in 2020	10% of vehicles in 2020	5% of vehicles in 2020

Appendix

Appendix 2: Baseline forecast data tables

Total Primary Energy Requirement by Fuel 2008 – 2020 (Baseline)

Fuel	Total Primary Energy Supply (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Coal	1,167	1,270	1,297	11.1	1.1	1.4	0.5	8	9	8
Oil	7,373	7,368	7,859	6.6	0.6	0.0	1.6	50	50	51
Gas	4,704	4,224	4,201	-10.7	-1.1	-1.8	-0.1	32	29	27
Peat	791	805	667	-15.6	-1.7	0.3	-4.6	5	5	4
Non-Renewable Waste	679	1,168	1,221	79.9	6.0	9.5	1.1	5	8	8
Electricity Imports (Net)	40	-53	80	98.1	7.1	-	-	0	0	1
Total	**14,754**	**14,781**	**15,324**	**3.9**	**0.4**	**0.0**	**0.9**			

Total Final Demand by Sector 1990 – 2020 (Baseline)

Sector	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Sectoral Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Household	3,294	3,183	3,189	-3.2	-0.3	-0.6	0.0	27	26	25
Industry	2,093	2,309	2,353	12.4	1.2	1.6	0.5	17	19	18
Services	1,737	1,497	1,545	-11.1	-1.2	-2.5	0.8	14	12	12
Agriculture	247	297	306	23.8	2.2	3.1	0.8	2	2	2
Transport	4,674	4,936	5,437	16.3	1.5	0.9	2.4	39	40	42
Total	**12,046**	**12,222**	**12,830**	**6.5**	**0.6**	**0.2**	**1.2**			

Total Final Demand by Fuel 1990 – 2020 (Baseline)

Fuel	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Coal	351	215	177	-49.6	-6.6	-7.8	-4.8	3	2	1
Oil	7,330	7,368	7,859	7.2	0.7	0.1	1.6	61	60	61
Gas	1,618	1,770	1,817	12.3	1.2	1.5	0.7	13	14	14
Peat	254	234	205	-19.2	-2.1	-1.3	-3.3	2	2	2
Non-Renew-able Waste	9	9	9	-1.2	-0.1	-0.2	0.0	0	0	0
Renewables	321	364	385	19.9	1.8	2.1	1.4	3	3	3
Electricity	2,164	2,262	2,378	9.9	1.0	0.7	1.3	18	19	19
Total	**12,046**	**12,222**	**12,830**	**6.5**	**0.6**	**0.2**	**1.2**			

Industry Final Energy Demand by Fuel 1990 – 2020 (Baseline)

Industry	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Coal	103	105	98	-5.2	-0.5	0.3	-1.8	17	15	13
Oil	769	781	791	2.9	0.3	0.3	0.3	130	108	102
Gas	468	526	515	10.1	1.0	2.0	-0.5	79	73	66
Non-Renewable Waste	9	9	9	-1.2	-0.1	-0.2	0.0	2	1	1%
Renewables	153	164	164	7.3	0.7	1.2	0.0	26	23	21
Electricity	591	724	776	31.2	2.8	3.4	1.7			
Total	**2,093**	**2,309**	**2,353**	**12.4**	**1.2**	**1.6**	**0.5**			

Residential Final Energy Demand by Fuel 1990 – 2020 (Baseline)

Residential	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Coal	248	110	79	-68.1	-10.8	-12.6	-8.0	8	3	2
Oil	1,267	1,181	1,161	-8.3	-0.9	-1.2	-0.4	38	37	36
Gas	710	848	880	24.0	2.2	3.0	0.9	22	27	28
Peat	254	234	204	-19.4	-2.1	-1.3	-3.3	8	7	6
Biofuels	58	71	85	45.6	3.8	3.4	4.4	2	2	3
Electricity	758	738	780	2.8	0.3	-0.4	1.4	23	23	24
Total	**3,294**	**3,183**	**3,189**	**-3.2**	**-0.3**	**-0.6**	**0.0**			

Services Final Energy Demand by Fuel 1990 – 2020 (Baseline)

Services	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Coal	0	0	0	-	-	-	-	0	0	0
Oil	491	339	338	-31.1	-3.7	-6.0	0.0	28	23	22
Gas	440	396	422	-4.1	-0.4	-1.7	1.6	25	26	27
Renewables	17	17	17	-2.1	-0.2	-0.2	-0.2	1	1	1
Electricity	789	745	768	-2.7	-0.3	-1.0	0.8	45	50	50
Total	**1,737**	**1,496**	**1,545**	**-11.1**	**-1.2**	**-2.5**	**0.8**			

Transport Final Energy Demand by Fuel 1990 – 2020 (Baseline)

Transport	Total Final Demand (ktoe)			Growth %	Average Annual Growth Rate %			Fuel Shares %		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Oil	4,578	4,821	5,314	16.1	1.5	0.9	2.5	98	98	98
Kerosene	787	1,133	1,364	73.3	5.7	6.3	4.7	17	23	25
Petrol	1,551	1,425	1,504	-3.0	-0.3	-1.4	1.4	33	29	28
Diesel	2,238	2,263	2,445	9.3	0.9	0.2	2.0	48	46	45
Biofuels	92	111	119	29	3	3	1.8	2	2	2
Electricity	4	4	4	2.1	0.2	0.3	0.0	0	0	0
Total	**4,673**	**4,936**	**5,437**	**16.3**	**1.5**	**0.9**	**2.4**			

Primary Fuel Mix (inputs) for Electricity Generation 1990 – 2020 (Baseline)

Fuel	Elec Gen Fuel Inputs (ktoe)			Growth	Average Annual Growth Rate			Fuel Shares		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Coal	868	1,054	1,120	29.1	2.6	3.3	1.5	18	22%	23%
Oil	137	0	0	-100.0	-100.0	-100.0	-	3	0	0
Gas	3,024	2,454	2,384	-21.2	-2.4	-3.4	-0.7	62	50	50
Peat	490	571	463	-5.6	-0.6	2.6	-5.1	10	12	10
Renewables	367	805	836	127.9	8.6	14.0	1.0	8	16	17
Total	**4,885**	**4,884**	**4,802**	**-1.7**	**-0.2**	**0.0**	**-0.4**			

Electricity Generation (output) by Fuel 1990 – 2020 (Baseline)

Fuel	Electricity Generation (MWh)			Growth	Average Annual Growth Rate			Fuel Shares		
	2010	2016	2020	10 - '20	10 - '20	10 - '16	16 - '20	2010	2016	2020
Coal	4,143	4,167	4,427	6.8	0.7	0.1	1.5	14%	13%	15%
Oil	568	0	0	-100.0	-100.0	-	-	2%	0%	0%
Gas	17,744	15,600	15,651	-11.8	-1.2	-2.1	0.1	62%	50%	53%
Peat	2,259	2,441	1,984	-12.2	-1.3	1.3	-5.0	8%	8%	7%
Renewables	4,451	8,212	8,341	87.4	6.5	10.7	0.4	16%	26%	28%
Electricity Imports (Net)	470	-619	932	98.1	-	-	-	2%	-2%	3%
Total	**28,694**	**31,039**	**29,471**	**2.7**	**0.3**	**1.3**	**-1.3**			

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Ireland's EU Structural Funds Programmes 2007 - 2013
Co-funded by the Irish Government and the European Union

EUROPEAN REGIONAL DEVELOPMENT FUND

The Sustainable Energy Authority of Ireland is partly financed by Ireland's EU Structural Funds Programme co-funded by the Irish Government and the European Union