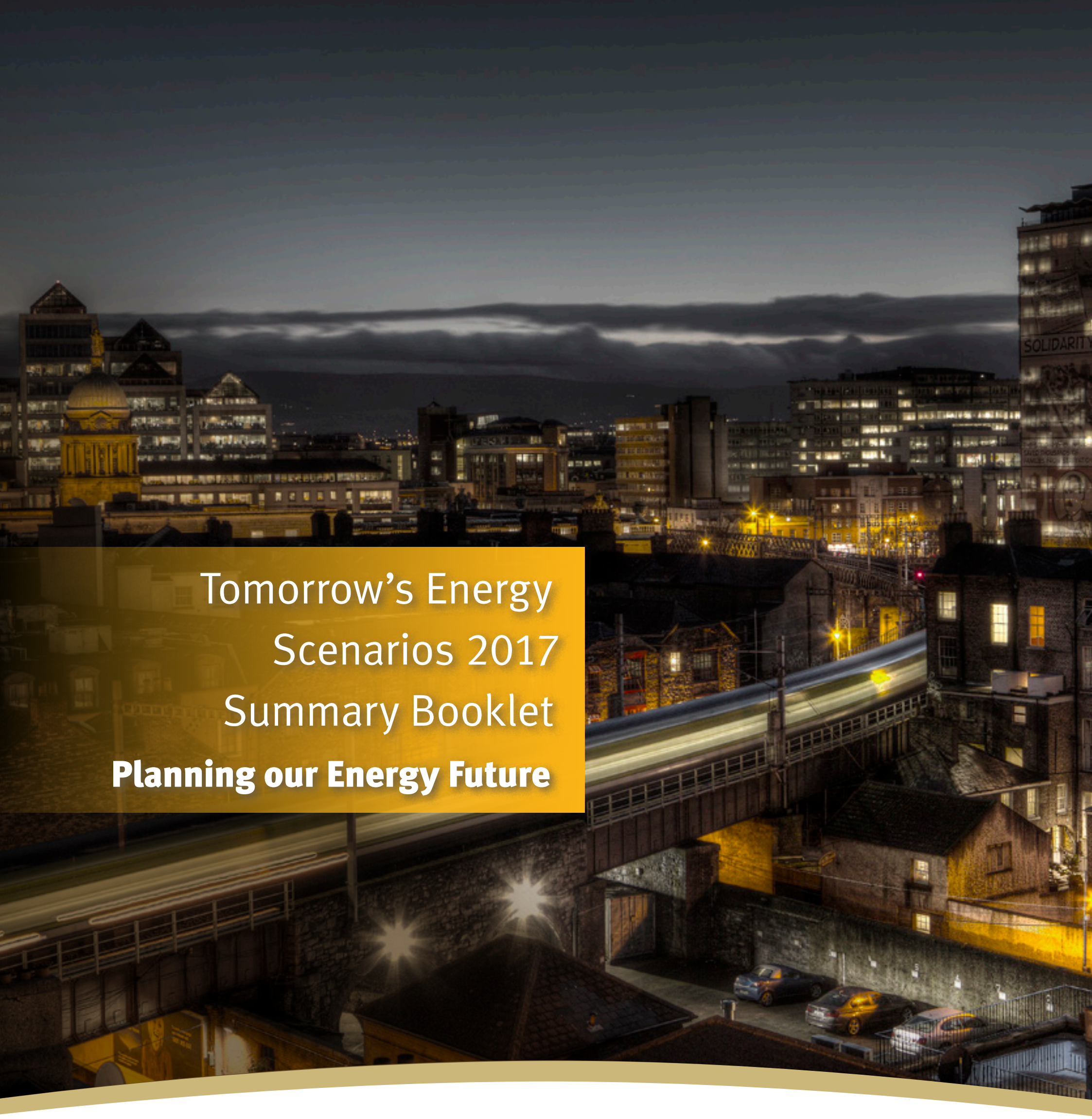


Tomorrow's Energy Scenarios 2017 Summary Booklet

Planning our Energy Future

EIRGRID

The current. The future.

Introducing scenario planning

At EirGrid, one of our roles is to plan the development of the electricity transmission grid to meet the future needs of society. A key part of this process is considering a range of possible ways that energy usage may change in the future. We call this scenario planning.

We are introducing scenario planning to encourage a flexible and robust approach to grid development. It will allow us to manage uncertainties and be prepared for the changes of the future. It also allows us to better engage with our stakeholders by gathering their input at the earliest possible opportunity in our grid development process.

We have investigated key influences on the future usage of the grid in order to develop our scenarios. Using these influences, we have developed four scenarios using our own experience and significant input received from government departments and agencies, energy research groups, industry representatives and bodies, and the public.

Each scenario describes a different possible future for the generation and consumption of electricity out to 2040.

We first published draft scenarios in February 2017 as part of a nine week consultation on our energy future. We had a great response to the consultation and received many highly detailed submissions. We have used this information to improve our scenarios and provide more information.

This summary booklet gives an overview of our scenarios. For more detailed information on the scenarios please read our main report which can be found on our website.

The scenarios will be reviewed every two years to take into account changes in the industry and energy environment.

Tomorrow's Energy Scenarios

Steady Evolution

Renewable electricity generation maintains a steady pace of growth. This is due to steady improvements in the economy, and in the technologies which generate electricity. New household technologies help to make electricity consumers more energy aware. This increases energy efficiency in homes and businesses. Over time, electricity consumers gradually begin to make greater use of electric vehicles and heat pumps. This means that, over time, electricity powers a larger proportion of transportation and heating.

Onshore wind generation increases to approximately 5,200 MW by 2030

Ireland's 2030 emissions targets are met

New 700 MW interconnector to Europe is in place by 2025

Slow Change

The economy experiences very slow growth. Investment in new renewable generation is only in established, low risk technologies. Due to poor economic growth, new technologies that could increase the use of renewable generation at household and large scale levels are not adopted. Overall there is little change in the way electricity is generated when compared to today. Domestic consumers and commercial users are also avoiding risk and uncertainty. The only source of demand growth is the connection of new data centres but the level of investment slows down significantly after 2025.

Fossil fuel generation capacity remains over 5,000 MW by 2030

The total demand for electricity increases by 22% by 2030 compared to today

Ireland's 2030 emissions targets are missed

Low Carbon Living

The economy enjoys high economic growth. This encourages the creation and rollout of new technologies for low carbon electricity generation. There is strong public demand to reduce greenhouse gas emissions. In addition to high carbon prices and incentives for renewables, this creates a high level of renewable generation on the grid. This clean energy then combines with improvements to broadband and transport to drive growth in large data centres.

Coal generation is repowered to Gas and Peat generation is repowered to Biomass by 2025

The total demand for electricity increases by 53% by 2030 compared to today

Data Centre connections reach 1950 MVA in 2030 - most of these are based in Dublin

Consumer Action

A strong economy leads to high levels of consumer spending ability. The public want to reduce greenhouse gas emissions. Electricity consumers enthusiastically limit their energy use and generate their own energy. This results in a large number of community led energy projects and a rapid adoption of electric vehicles and heat pumps in the home.

There are almost 560,000 electric vehicles on the road by 2030

17% of residential houses are heated through heat pumps by 2030

Household batteries and Solar PV help to increase self-consumption of electricity

Electricity demand

Electricity demand growth has many contributing factors. Population growth, economic growth, and of course the effects of weather are examples. Energy efficiency measures also help to reduce electricity demand.

Our scenarios consider these factors along with other variables. We consider the electrification of heating and transport with heat pumps and electric vehicles. We also consider the possibility of consumers moving their electricity usage at certain times of the day in order to reduce their energy bills. The biggest contributor to our future demand growth is large industrial customers such as data centres.

Data centres account for over 75% of new demand growth in most of our scenarios.

Data centres are large buildings which house computer servers used to store data from smartphones, tablets and computers. The largest data centre electricity demand is in our Low Carbon Living scenario. In this scenario, data centres are attracted by Ireland's improved infrastructure, as a result of strong economic growth, and high levels of renewable generation.

Our scenarios see the total electricity demand increasing between 22% and 53% by 2030 compared to today.

Our scenarios predict a relatively slow uptake of pure electric vehicles until 2025-2030. It is likely that hybrid vehicles will act as a transition between petrol and diesel vehicles to electric vehicles.

From 2025 onwards, improvements in battery technology and decreasing capital costs of electric vehicles are expected to significantly increase the level of electric vehicle uptake.

The largest adoption of electric vehicles and heat pumps occurs in our Consumer Action scenario. This is a result of consumers trying to lower their carbon footprint.

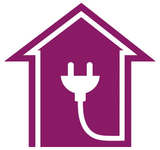
Our Consumer Action scenario contains approximately 560,000 electric vehicles on the road in 2030.

Our scenarios look at a number of technologies for the electrification of heating in the future. Storage heaters, district heating and community-owned combined heat and power plants are all examined.

We consider heat pumps to be the primary method by which heating electrifies in the future. Heat pumps are used for space heating and cooling, as well as water heating.

We assume that the majority of heat pumps are installed in new buildings and housing developments. Heat pumps are more electrically intensive than electric vehicles.

Our Consumer Action scenario contains over 330,000 installed heat pumps by 2030.

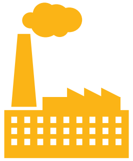


Electricity supply

Fossil fuel generation

The trend towards decarbonisation and reducing carbon output in the future will lead to reduced operating hours of large fossil fuel generators. Our scenarios examine possibilities for the future of coal, peat, gas and other fossil fuels.

The fossil fuel generators on the power system change dramatically over time throughout the four scenarios. Some generation fuel types are closed down, while other new generation begins producing power.



Our Low Carbon Living scenario assumes that coal generation has stopped by 2025. The other three scenarios assume it has stopped by 2030.

There are a number of possibilities for the future repowering of Moneypoint, Ireland's only coal generator. Gas, biomass, and other technologies are being considered. Our scenarios consider Moneypoint power station converting to gas. The installed capacity of the gas generation and the timing of the conversion vary in our scenarios.

Peat generation has stopped in all our scenarios by 2025, except in Slow Change in which it stops by 2030. In some scenarios it is replaced by biomass generation.

In all scenarios, many of Ireland's older gas generators will retire by 2025 due to EU Emissions Directives. Our scenarios assume new gas generators will be on the system between 2017 and 2040.

Renewable generation

Our scenarios consider a variety of renewable generation on the power system. The difference in renewable generation capacity between our scenarios grows substantially over time. This represents the many uncertainties surrounding the build-out of renewable generation in the future.

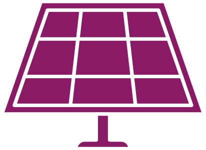
Installed renewable generation capacity varies between 5,600 MW in Slow Change and 12,100 MW in Low Carbon Living by 2030.

Onshore wind generation capacity continues to grow across all scenarios over time. The largest challenge for the connection of further onshore wind is the social acceptance of this technology. The largest capacity of onshore wind farm is in Low Carbon Living. This reaches a capacity of 5,500 MW by 2030.

Ireland has enormous potential for offshore energy developments. Offshore wind is more costly to develop than onshore wind in Ireland. It is very likely Ireland will require additional offshore wind generation to meet future decarbonisation targets. We have reflected this in our scenarios.

In our Low Carbon Living scenario, we have assumed 3,000 MW of offshore wind generation capacity is developed by 2030.

Solar photovoltaic (PV) generation has become more economical in recent years. It is likely that we will see large scale solar PV connecting to the system at an increasing rate from the mid-2020s. Our scenarios consider a range of installed solar PV capacities between 200 MW and 2,500 MW in 2030.



Domestic solar PV reduces system demand significantly in the Consumer Action scenario during the summer.

All of our scenarios show biomass generation increasing in capacity over the next 25 years. This includes some new generators, combined with an uptake in community led biomass schemes. There is also a conversion of Ireland's peat generation stations to biomass in some scenarios.

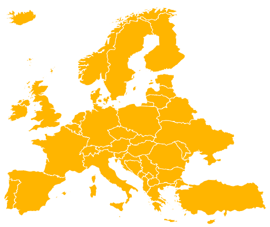
Electricity storage and interconnection

Electricity storage at large scale levels has traditionally been pumped hydro energy storage, such as Ireland's Turlough Hill generating station. Battery energy storage has become more economically viable due to decreasing capital costs. Battery energy storage currently has the greatest potential for electricity storage in the future due to its relatively small footprint compared to other storage methods.

Large scale grid connected battery energy storage will likely connect along with renewables such as solar and wind farms. Household battery energy storage will likely connect with domestic solar PV to provide consumers with energy at night.

Total energy storage capacity reaches 2,350 MW in our Low Carbon Living scenario by 2030. This includes new battery energy storage and new pumped hydro storage.

Transmission grids are often interconnected so that energy can flow from one country to another. Ireland is currently interconnected to Great Britain through the East-West Interconnector which has a capacity of 500 MW.



Our scenarios have considered further interconnection to both France and Great Britain.

Ireland's energy and emissions targets

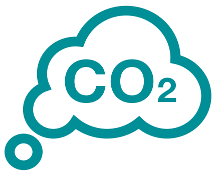
Decarbonisation of the energy system is a trend which will continue into the future.

While this document is not intended to be a decarbonisation roadmap, each scenario can show what level of carbon dioxide would be outputted from the power generation sector if that scenario were to occur.

They can also show what level of renewable generation meets electricity demand in the future.

Over 40% of the total electricity demand is met by renewable generation in Steady Evolution and Low Carbon Living in 2020. This meets our 2020 renewable electricity target.

All of our scenarios show a decrease in carbon emissions out to 2030. Slow Change has the highest carbon production as it has the lowest level of low carbon electricity supply.



By 2030, Low Carbon Living produces 27% of today's annual carbon dioxide production from the power generation sector.

The output of our scenarios can be used as guidance to the possible futures of electricity generation and supply. All of these scenarios would require change in order to become a reality. In particular, significant changes to electricity generation, demand, interconnection, and storage would be needed in order to achieve the high renewable generation seen in Low Carbon Living.

By 2030 renewable electricity generation varies between 47% and 75% of total electricity demand depending on the scenario.

Key statistics in 2030 – Electricity demand

The following tables summarises the key demand components in our 2030 scenarios[1].

Demand Component Information	Steady Evolution	Low Carbon Living	Slow Change	Consumer Action
Total Data Centre Capacity (MVA)	1,100	1,950	850	1,675
Total number of Electric Vehicles	247,000	426,000	90,000	560,000
Total % of Vehicles which are Electric	11%	19%	4%	25%
Total number of Heat Pumps	199,000	279,000	100,000	339,000
Total % of Households with Heat Pumps	10%	14%	5%	17%
Total Demand (TWh)	36.3	43.8	35.1	42.6

[1] Data centre capacities are rounded to the nearest 10 MVA. Electric vehicles and heat pump numbers are rounded to the nearest 1,000.

Key statistics in 2030 – Electricity supply

The following table summarises the installed generation capacities in our 2030 scenarios[2].

Fuel Type	Steady Evolution	Low Carbon Living	Slow Change	Consumer Action
Coal	0	0	0	0
Gas	4,660	4,210	4,660	4,660
Peat	0	0	0	0
Distillate Oil	220	100	320	100
Heavy Fuel Oil	0	0	0	0
Waste (assume 50% renewable)	100	100	80	100
Fossil Fuel Generation Total	4,930	4,360	5,020	4,810
Wind (Onshore)	5,140	5,500	4,640	5,380
Wind (Offshore)	700	3,000	250	1,000
Wind Generation Total	5,840	8,500	4,890	6,380
Hydro	240	240	240	240
Biomass/Landfill Gas(including Biomass CHP)	390	750	270	430
Solar PV	500	2,500	200	1,500
Ocean (Wave/Tidal)	50	100	20	70
Renewable Generation Total	7,070	12,140	5,660	8,670
Pumped Storage	290	650	290	290
Small Scale Battery Storage	200	500	50	800
Large Scale Battery Storage	250	1,200	50	400
Demand Side Management	500	750	400	1,000
DC Interconnection	1,200	1,950	500	1,200
Conventional Combined Heat and Power	160	180	150	190
Total Capacity	14,600	21,730	12,120	17,360

[2] Generation capacities are rounded to the nearest 10 MW in each table.

Continuing the conversation

Tomorrow's Energy Scenarios 2017 is the beginning of our interactions with stakeholders and the public on planning our energy future. We plan to continue gathering insights from the energy industry and public over the coming months and years to help us improve our scenarios for our 2019 version of this document.

In autumn 2017, we will be publishing **'Tomorrow's Energy Scenarios 2017 Locational Information Paper'** to provide more information on our locational assumptions for future electricity demand and supply.

Following that, we will analyse how the existing transmission grid performs under each of the four scenarios over a range of timeframes. The analysis will show if the existing transmission grid can support each scenario or if potential issues or risks to the safe and secure operation of the grid arise and need to be solved. The results of this analysis will be published in **'Tomorrow's Energy Scenarios 2017 Transmission System Needs Assessment'** report in winter 2017/18.

Please visit our **website** for further information on our scenarios. Alternatively, please email us your views on Tomorrow's Energy Scenarios to **scenarios@eirgrid.com** and one of our team will be in touch.

We look forward to receiving your feedback and using it to improve Tomorrow's Energy Scenarios in the future.

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