# Ireland's Offshore Wind Potential

From Net Zero to Net Export

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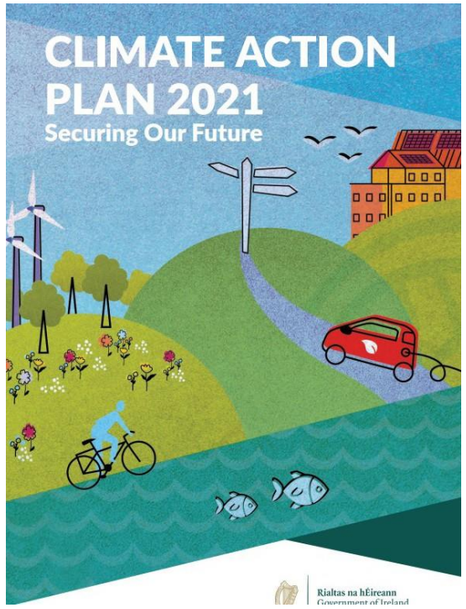
# Background to this Study

**This report presents findings on the capacity of offshore wind required in Ireland to meet domestic emission reduction targets from 2021 to 2050 known in this report as 'Net Zero' and also look at the additional available potential for offshore wind for 'Net Export' to other countries.**

We base our findings on simulations of Ireland's future energy requirements to meet growing societal needs, economic demands, and climate targets. The results presented are not 'what will happen' but rather 'what is required' if Ireland is to resolve these future needs and meet climate targets.

The key national policy drivers for this analysis are the 2020 Programme for Government and the Climate Act 2021 where Ireland committed to halving greenhouse gas emissions by 2030 and reaching net zero by 2050 at the latest. The Plan for Government stated an ambition to realise the "immense potential of Ireland's offshore renewables and to produce a longer-term plan setting out how, as a country, we will take advantage of the massive potential of offshore energy on the Atlantic Coast". As part of this vision a plan is required to set out how Ireland can become a major contributor to a pan-European renewable energy generation and transmission system, taking advantage of a potential of at least 30 GW of offshore floating wind power in the Atlantic.

At a European level, the regulation on guidelines for trans-European energy infrastructure requires Member States to conclude non-binding agreements to cooperate on goals for offshore renewable generation to be deployed within a number of defined sea basins by 2050. This study does not look at specific sea basins and instead looks at the national requirements for offshore wind for Net Zero and subsequently Net Export without being location specific.







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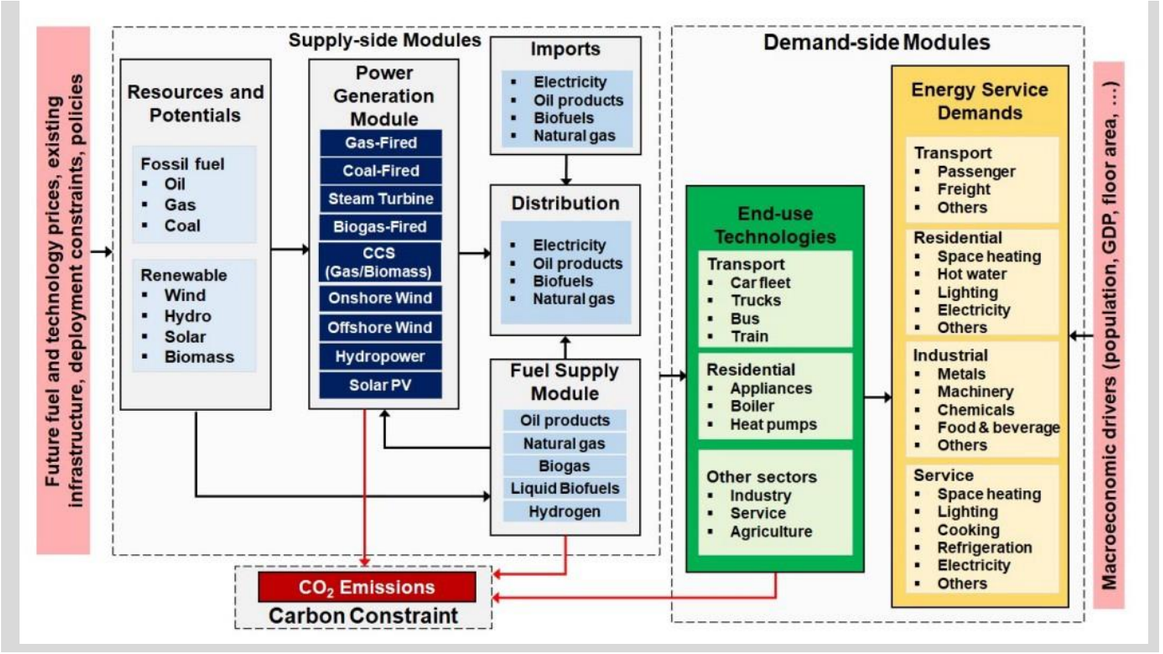
# Looking to the Future

## How do We Understand our Choices?

We cannot predict the future, but we can prepare for it by understanding what shapes it. In this study we use computer simulations of the future power and energy system of Ireland to test ideas of what might happen. This economy wide energy system model called TIM (short for TIMES-Ireland Model) uses equations to describe the relationship between energy use, the economy and future growth in demand. The package was developed by Professor Hannah Daly and her team in MaREI to take into account Ireland's unique energy system context, including a very high potential for offshore wind energy and the challenge of integrating this on a relatively isolated grid, a very ambitious decarbonisation target in the period to 2030, the policy need to inform 5-year carbon budgets to meet policy targets, and the challenge of decarbonising heat in the context of low building stock thermal efficiency and high reliance on fossil fuels. It then finds the lowest-cost pathway to re-architect and restructure Ireland's entire energy system, for electricity, transport, industry, residential and commercial, and novel fuels like hydrogen and bioenergy, to reduce emissions to meet the target. It accounts for all the linkages in the system; rather than transform it one piece at a time, it transforms the entire system, accounting for all the sector couplings and trade-offs, even between distant parts of the system.

Rather than offering a single prescriptive plan, the model helps structure our discussions of the trade-offs and uncertainties; and helps us develop meaningful, consistent narratives of energy transformation, while considering a huge range of possible futures. A full description of the model and inputs can be found here




**This is a schematic of the data flow of inputs and outputs in the TIM energy model.A link to the model and explanation is in the appendix**

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# How Much Offshore Wind Will Ireland Need?

## The Difference between Net Zero and Net Exporter

Ireland's need for offshore wind to meet domestic Net Zero targets is strongly influenced by future electricity demand which is a function of economic growth, population projections and uptake of technologies and fuels. The primary driver is the overall demand for electricity across the economy from families, companies, businesses but also from data centres and electricity demand for hydrogen production. Electricity demand will also grow in response to the decarbonisation of the economy as electricity reaches deeper into sectors such as transport and heating which today are dependant on fossil fuels and have low levels of electricity. A secondary driver is the amount of onshore wind and other renewables that can be deployed. As onshore wind has a lower cost than offshore wind, it is beneficial to maximise its potential. In this study we examine the upper and lower bounds of these future scenarios but assume that each scenario meets Ireland domestic climate targets including net zero by 2050.

Depending on what views are taken on these uncertain outcomes two diverging storylines emerge, one which is more optimistic but both equally plausible



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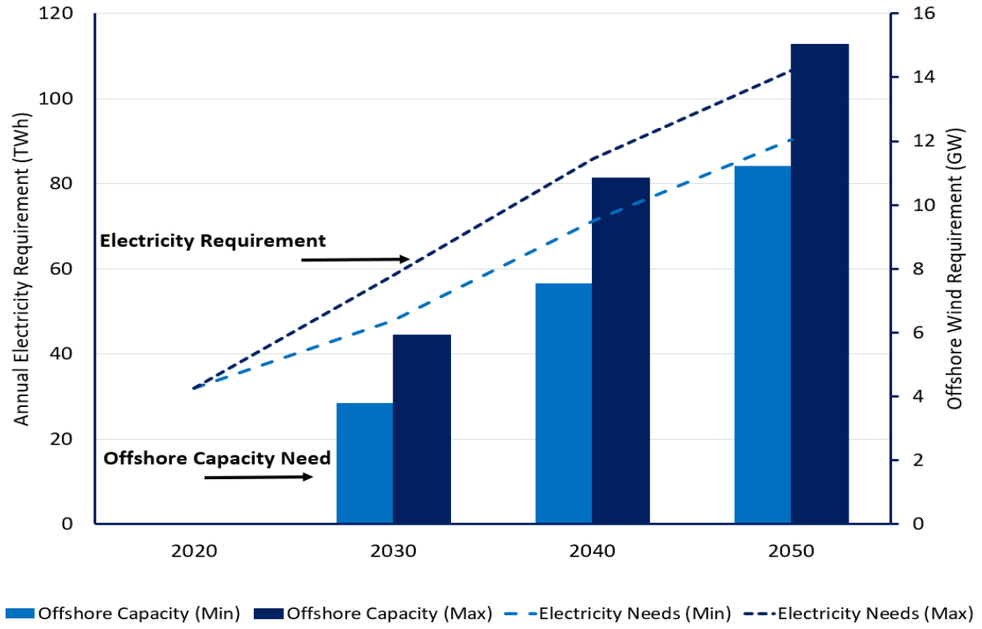
# How Much Offshore Wind Capacity is needed for Net Zero Domestically

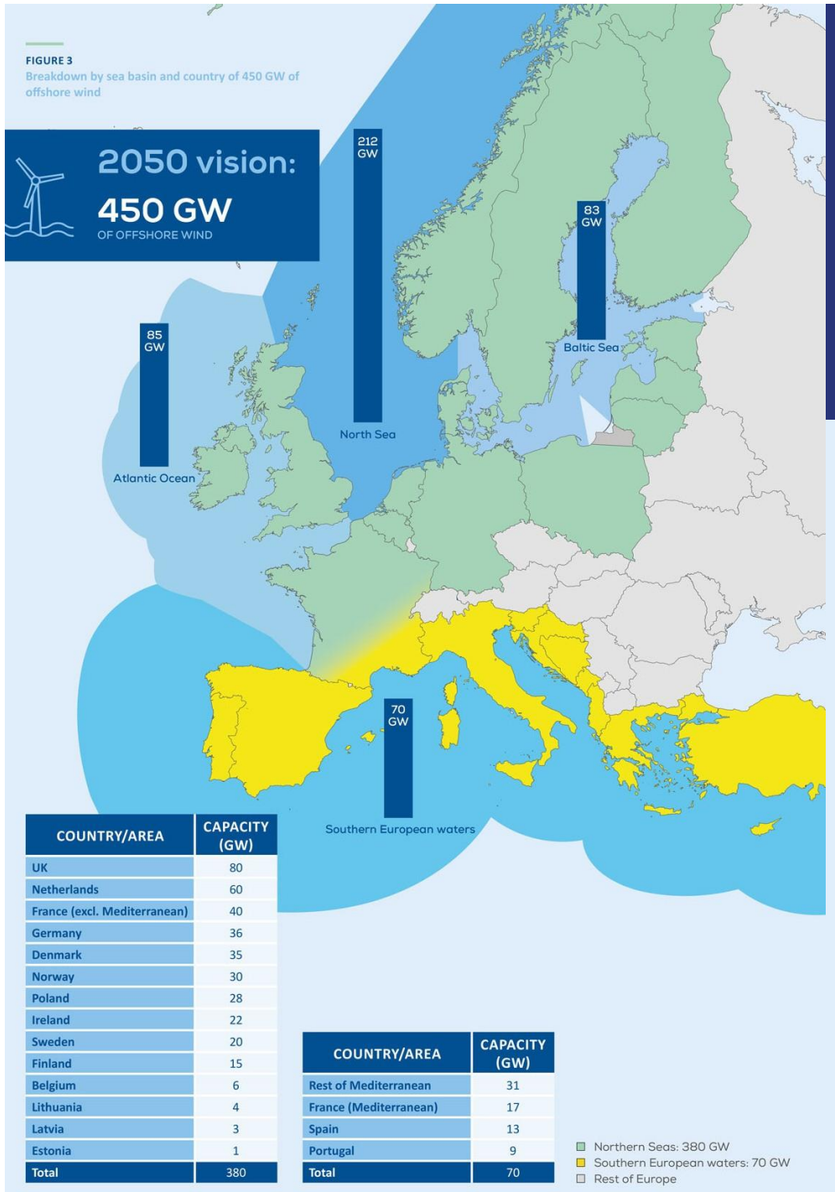
### Electricity Needs and Offshore Wind Required

Meeting Irelands domestic climate targets will likely result in an overall annual electricity requirement of between 90-110 TWh by 2050. This a significant increase in todays electricity demand which is 32 TWh. The offshore wind resource required to meet this future need varies between 11 and 15 GW for the same given potential of onshore wind of 11.5 GW in 2050. We assume an offshore wind capacity factor of 50% and onshore wind capacity factor of 30%. Variations of these capacity factors will naturally change the installed capacity required but not the overall energy needed. The difference between the lower and upper bound of offshore wind capacity is influenced by the level of electrification across the economy especially in sectors like transport and heating. The impact of data centre deployment and hydrogen also play a role with lower levels of each requiring lower amounts of offshore wind.




We also examined an exploratory low energy demand scenario assuming major structural changes in drivers of demand such as transport modal shifting, substituting emission intensive materials like cement, and reducing building heat demand through behaviour change and efficiency. In that scenario offshore wind capacity is significantly lower and reaches 4 GW in 2050 reflecting a much lower level of electricity demand growth across society. A full table of these figures is presented in the appendix while a detailed explanation of this specific low demand scenario is presented here

# How Much Offshore Wind Capacity Will Ireland Have for Net Export




| COUNTRY/AREA | CAPACITY (GW) |
|---|---|
| UK | 80 |
| Netherlands | 60 |
| France (excl. Mediterranean) | 40 |
| Germany | 36 |
| Denmark | 35 |
| Norway | 30 |
| Poland | 28 |
| Ireland | 22 |
| Sweden | 20 |
| Finland | 15 |
| Belgium | 6 |
| Lithuania | 4 |
| Latvia | 3 |
| Estonia | 1 |
| Total | 380 |

| COUNTRY/AREA | CAPACITY (GW) |
|---|---|
| Rest of Mediterranean | 31 |
| France (Mediterranean) | 17 |
| Spain | 13 |
| Portugal | 9 |
| Total | 70 |

Ireland has an ambition to be a net exporter of electricity and does not yet have a plan to deliver this. A figure of 30 GW offshore wind capacity is referenced in the Plan for Government meaning that once domestic net zero targets are met (previous page) approximately 15-19 GW of offshore capacity remains for export, however figures presented by WEI highlight an appetite and pipeline of projects in excess of this.

Analysis by the European Commission to understand the needs for the EU as a whole to meet its climate obligation in the 'Clean Planet for All' communication, referenced an offshore wind capacity requirement of between 360 to 450 GW in 2050. Details were not presented on a Member State basis but a 2019 WindEurope report 'Our energy, our future' examines where 450 GW of offshore wind could be deployed most cost-effectively around Europe, to deliver climate neutrality by 2050. The report concludes that 212 GW should be deployed in the North Sea, 85 GW in the Atlantic (including the Irish Sea), 83 GW in the Baltic, and 70 GW in the Mediterranean and other Southern European waters with Ireland deploying a capacity of 22 GW in total by 2050. This points to a gap between the government ambition to deliver 30 GW of offshore wind and the wider resource required to decarbonise Europe. This gap between ambition and delivery can be filled with analysis to determine how Ireland can maximise the economic and environmental potential of this offshore resource.

**Appendix of Results-Electricity Requirement and associated Offshore Capacity needed. All scenario assume 11.5 GW of onshore wind by 2050.**

Note figures are ROI only.

| Scenario | 2020 | 2030 | 2040 | 2050 | Unit |
|---|---|---|---|---|---|
| Electricity Needs (Max) | 32 | 58 | 86 | 107 | TWh |
| Electricity Needs (Min) | 32 | 48 | 71 | 90 | TWh |
| Electricity Needs (Low Demand) | 32 | 40 | 48 | 53 | TWh |
| Offshore Capacity (Max) | 0 | 6 | 11 | 15 | GW |
| Offshore Capacity (Min) | 0 | 4 | 8 | 11 | GW |
| Offshore Capacity (Low Demand) | 0 | 2 | 3 | 4 | GW |

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# How to use this analysis and FAQ's

- **What are the weaknesses in this analysis:** This report does not provide forecasts or predictions. It provides information to help us make informed decisions about the future based on analysis. The analysis is strong on technology and economic aspects and weak on representing human behaviour. Equally Ireland's industry sector is limited due to lack of detailed data
- **What are the strengths of this analysis:** This analysis looks at energy across the full economy and allows us to see interactions across all modes of energy into the future.
- **What would change results most:** The achievement of climate targets as set out in government legislation (Climate Action and Low Carbon Development Act 2015 (as amended)) is the main driver of results. If these emissions targets were not achieved, then lower volumes of renewable electricity would be required. The assumption of a 100% non synchronous electricity system post 2030 is also a significant assumption that would change results if it were not attained
- **Where did the assumptions come from?:** Please see the following freely accessible publication https://gmd.copernicus.org/preprints/gmd-2021-359/gmd-2021-359.pdf
- **Who funded this report and why?** This study was funded by Wind Energy Ireland to understand how much offshore wind is required to meet Ireland's domestic climate targets.
- **Who contributed to this report?** This report was written and coordinated by Paul Deane. Modelling Development and numerical modelling was undertaken by Hannah Daly, Vahid Aryanpur, Olexandr Balyk, Alessandro Chiodi, Ankita Gaur, James Glynn, Jason McGuire, Xiufeng Yue. This report was prepared in MaREI, the SFI Research Centre for Energy, Climate and Marine.

HOST INSTITUTION

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

**Corrections to this report:** This report was originally issued on 10 May 2023 but an error in the final values was spotted, and the report was corrected and reissued. The error related to an incorrect capacity factor for offshore wind which resulted in an overestimation of the offshore wind capacity required to meet Irelands domestic Net Zero Targets

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