



# Sustainable Energy Authority of Ireland

## National Energy Research, Development & Demonstration Funding Programme

### FINAL REPORT

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#### SECTION 1: PROJECT DETAILS

<b>Project Title</b>	IEA Wind Task 41: Enabling distributed wind to contribute to Ireland's energy future
<b>Lead Grantee (Organisation)</b>	Dundalk Institute of Technology
<b>Lead Grantee (Name)</b>	Paul MacArtain
<b>Final Report Prepared By</b>	Paul MacArtain
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	<b>Name</b>	<b>Organisation</b>
<b>Project Partner(s)</b>	Justin Gleeson	AIRO, Maynooth University
<b>Collaborators</b>		

#### Project Summary

This project supports Ireland's participation in the IEA Wind task 41 entitled "Enabling wind to contribute to a distributed energy future" and seeks to undertake research to contribute to the aims of this task and to enshrine outputs from the previous IEA Wind Task 27. This proposal aims to participate and contribute knowledge to the IEA Wind Task 41 and through that mechanism to other IEA tasks as well as to International Electrotechnical Committee (IEC) standards development, which are internationally strategically important. The Programme for government identifies that the participation in the European Green Deal will support areas which facilitate "structural shifts from decarbonisation" which this project aims to assist. In addition, it has the identified aim of supporting research to "ensure that Ireland is at the cutting edge of scientific and technological innovation in meeting our climate change targets" which this proposal again addresses through participation in International research exchange fora. Currently there are issues with grid-wide penetration of wind energy on an all island basis resulting in 12% of wind energy being "dispatched down" in 2020, according to Eirgrid. Distributed generation better matches the load to the resource locally and avoids constraint and curtailment issues, thereby assisting in achieving Ireland's 2030 EU Climate framework requirements. Furthermore, the National Energy and Climate plan 2021-2030 identifies that Ireland's participation in IEA activities in the 8 TCPs aligns with national strategic objectives related to renewable energy, and energy-related research.

<b>Keywords</b>	GIS, LiDAR, Distributed wind, Microgeneration, Micro-siting, Load profiling, island grids
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### 2.1 Executive Summary

IEA Wind Task 41: Enabling distributed wind to contribute to Ireland's energy future project has achieved an obstacle mapping model for the Republic of Ireland. The project would compare real world measurements and build a virtual 3D model of wind potential based on SEAI wind atlas and then specific site measurements.

This project addressed challenges in the Irish context and contributed to IEA Wind Task 41 by:

Developing a GIS wind turbine micro-siting tool modelling by codifying recommended practices from IEA Wind Task 27, that considers the physical features of a site for the optimum placement of small wind turbines

Assessing wind turbulence regimes, from LiDAR measurements, at multiple heights applicable to hub heights for small and medium-scale wind turbines for IEA Task 41's efforts in progressing wind turbine design standards. This consists of measurements at 5 rural sites and an Island location, combined with microscale wind resource modelling

Investigating wind control strategies to maximise penetration in off grid applications that employ distributed grids, using the island site of Lambay Island as an off-grid test case.

Creating case studies, data sets, academic journal papers and research inputs to IEA Wind Task 41.

The outputs of the project have been presented to SEAI and some outputs have been published as a peer reviewed publication.

### 2.2 Introduction to Project

The project aims were to increase the knowledge about low level wind resources and to concurrently implement the IEA Wind Task calculations on obstacle impacts on small wind turbine siting in a map based context. Ireland had conducted a small scale renewable energy field trial which had yielded very useful results which have been presented globally. This project aimed to build on that knowledge base and to conduct both a real and virtual mapping of small wind energy potential across Ireland.

### 2.3 Project Objectives

The main project objectives were:

This project aims to help address of these challenges in the Irish context and as a contribution to IEA Wind Task 41 by:

- 1) Developing a GIS wind turbine micro-siting tool modelling by codifying recommended practices from IEA Wind Task 27, that considers the physical features of a site for the optimum placement of small wind turbines
- 2) Assessing wind turbulence regimes, from LiDAR measurements, at multiple heights applicable to hub heights for small and medium-scale wind turbines for IEA Task 41's efforts in progressing wind turbine design standards. This consists of measurements at 5 rural sites and an Island location, combined with microscale wind resource modelling
- 3) Investigating wind control strategies to maximise penetration in off grid applications that employ distributed grids, using the island site of Lambay Island as an off-grid test case.
- 4) Creating case studies, data sets, academic journal papers and research inputs to IEA Wind Task 41.

## 2.4 Summary of Key Findings/Outcomes

### **WP1: GIS wind micro-siting tool developed.**

AIRO at Maynooth University developed a GIS based small wind turbine micro-siting modelling tool via codifying IEA Wind TCP Task 27 outputs. The aim was to be a public facing GIS, informing end users of the suitability of wind turbine locations via SEAI Wind atlas, post project. This work will support the implementation of wind microgeneration and contribute to SEAI's suite of GIS tools.

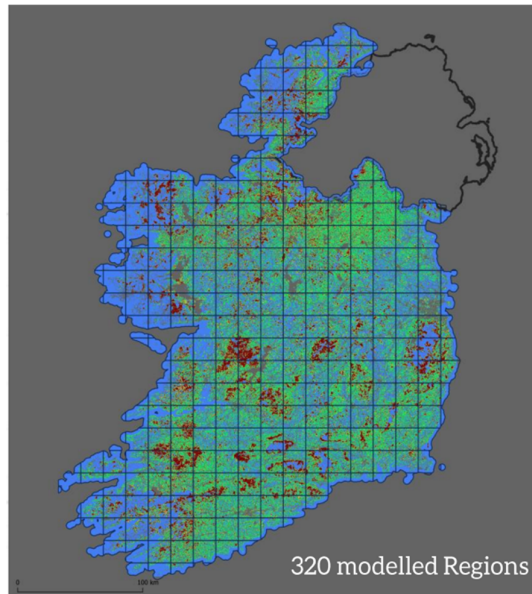


Figure 1: GIS mapped wind resource for ROI

The wind was modelled for 9 turbine types with varying heights and rotor diameters and potential obstacles were identified across the whole country for each turbine type. This has built a map of obstacles and areas where turbines should not be installed for the Republic of Ireland.

Comparison with real life measurements:

DKIT provided wind measurement data from a met mast and a wind LIDAR system for two sites adjacent to a distributed energy site under measurement. The topography around the sites and the potential obstacles were assessed by the GIS tool and for the different turbine types the obstacles were identified. A comparison of a small rotor (3m) on a 10 m tower vs a large rotor (25m) on a 40 tower are shown in figure 2. This is illustrative of the qualitative pictures which can be generated by the GIS tool, and how the size of the wind installation is influenced by obstacles across a wider area compared with a small turbine.

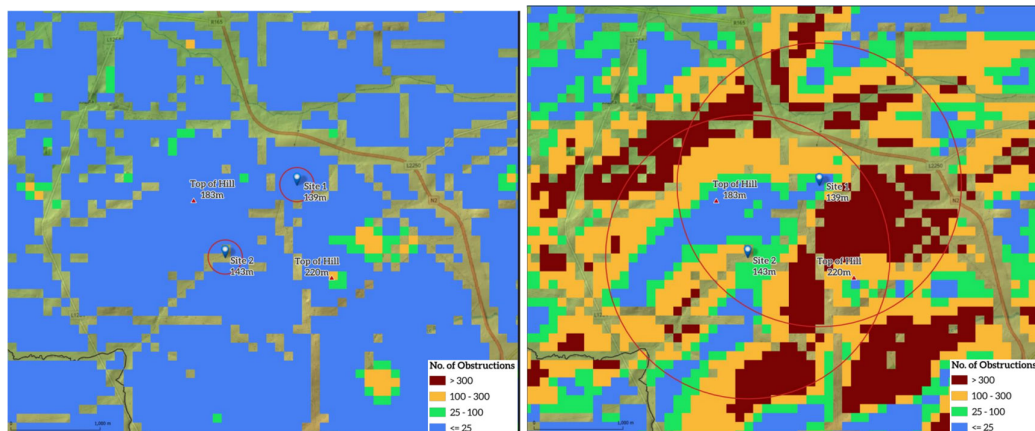


Figure 2: Obstruction visualisation compared with rotor diameter and tower height. 9 turbine comparators are available which can be placed in any location nationally.

The findings from this work were presented to SEAI in February 2025 with a view to incorporation into existing publicly available resources for energy analysis.

**WP2: Wind resource measurement and modelling**

To complement the virtual and calculated wind resource available, DKIT undertook a number of wind measurements at a series of sites using its ZX vertical profiling wind LIDAR. This unit could measure to 300m and at 10 set heights to build a picture of obstacle influence on wind resources. These wind measurement campaigns were located at a potato farm, a local authority compound with a small wind turbine installed, and on a remote island with an off grid system installed.

**Case study 1:**

The wind measurement at the potato farm was with a view to comparing the best renewable energy solution for that site’s energy needs, comparing solar and wind. The wind analysis was conducted based on a LIDAR deployment but also using wind data from a nearby met mast and estimating regional winds using WAsP, an industry tool. The 60m measurement of wind was refined down to 15m a.g.l. at the farm location. This also allows a variation in height similar to the obstacle tool, to determine the location of the turbine.

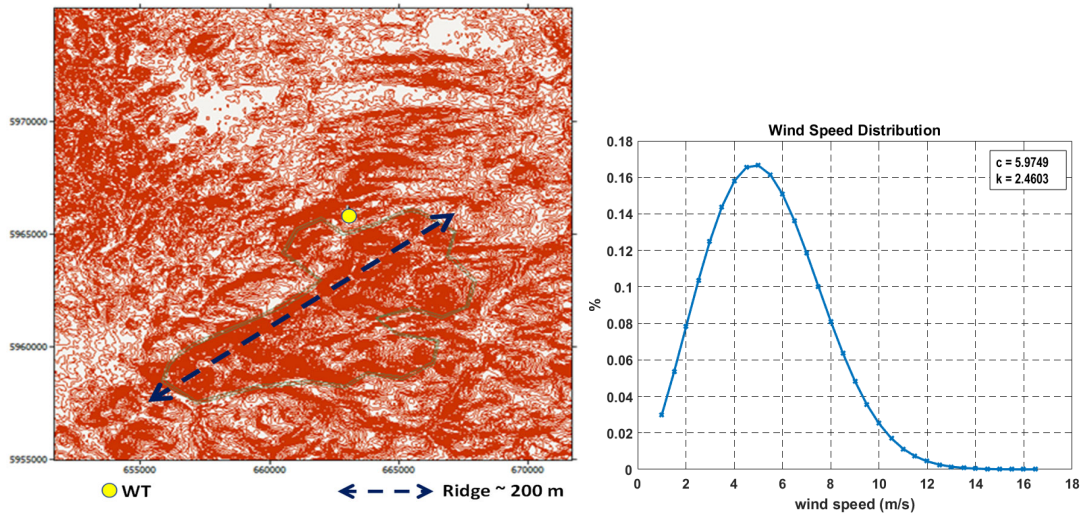


Figure 3: WAsP output and wind speed distributions at 15m with potential turbine site identified in yellow.

From this work and in conjunction with long term energy measurements made at the site, formed the basis of a study which was published on the best distributed energy solution for this farm site given current costs for wind and solar. We compared the energy output of a 15kW wind turbine and 40kW<sub>p</sub> of solar PV and the load profile of the site and presented a potential optimal energy scenario for the system.

Annual energy benefit comparison						
Technology	Energy Generation (kWh)	Energy Import (kWh)	Energy Savings (kWh)	% Energy Savings	Energy Export (kWh)	% Generation Exported
15 kW WT	31,261	36,212	18,658	34%	12,603	40%
40 kW <sub>p</sub> PV	33,434	46,122	8,748	16%	24,686	73%

Table 1: comparison of renewable generation types at this site.

Further analysis on the lowest cost of energy, LCOE, with a further influence of TAMS departmental grants, with and without an export payment, showed that wind energy was comparable to solar energy in a site with significant winter energy needs.

Table

**Table 6: LCOuE Comparison with and without TAMS support**

Technology	CC (€)	$C_{O\&M}$ (€)	$t$ (yrs)	$r$ (%)	CRF	AEO Useful (kWh)	LCOuE (€/kWh)	LCOuE (€/kWh) TAMS
15 kW WT	100,000	525	20	7	0.094	18,658	0.53	0.23
40 kWp PV	48,000	400	20	7	0.094	8,748	1.15	0.25

Table 2: LCOE with and without grant assistance showing wind lower than solar

The data making up this study and the analysis within were published in a peer reviewed journal, Cleaner Energy Systems, in June 2025.

**Case study 2:**

Potential for microgeneration to contribute to EV charging

A second LIDAR deployment site was at a compound with a small wind turbine already installed. This site was chosen as while it is rural the impact of wind would be on the transport sector as it is beside a motorway.



Figure 4: LIDAR deployment at motorway site close to two motorway service stations.

The impact of this was also to assess local obstacles such as trees, buildings and a road bridge nearby. The site was relatively close to the Irish Sea to the east and the onshore wind can also be seen in the wind rose.

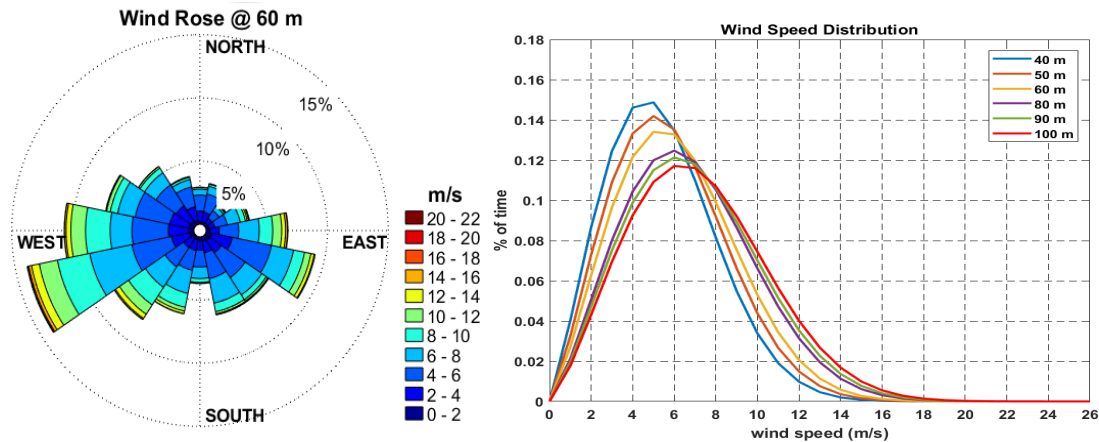


Figure 5: Wind rose and wind speed distributions from LIDAR measurements at motorway site.

In this situation a small wind turbine would not be useful so a comparison was made with a number of medium scale turbines, suitable for autoproduction cases.

% Annual number of EV car that could be met by each wind turbine				
Turbine	AEP (kWh)	DC (kWh) @ 70% AC-DC Efficiency	Average km @ 0.19 kWh/km	Average number of cars @15,000 km/yr
NP100	199,860	139,902	736,326	49
V47	928,570	649,999	3,421,047	228
V52	1,763,800	1,234,660	6,498,211	433
E82	5,817,800	4,072,460	21,434,000	1,429
E82	6,098,300	4,268,810	22,467,421	1,498
E82	6,452,000	4,516,400	23,770,526	1,585
V90	6,846,500	4,792,550	25,223,947	1,682
E101	9,817,600	6,872,320	36,170,105	2,411
S107	9,992,200	6,994,540	36,813,368	2,454

Table 3: Theoretical output from turbines at the sites identified.

## 2.5 Project Impact

The project could have international impact from the implementation or making public of the GIS modelling tool. The US National Renewable Energy Laboratory conducted a project in this theme but without the resolution and impact that this tool could have on decision making in small and medium wind energy. Furthermore the tool can be scaled with larger turbines and could be integrated with wind measurements to give better information to prospective wind installers. The work was well received at the IEA Wind TCP Task 41 international meeting in February 2024 and it was seen as a significant contribution to the group with requests for the tool to be made public, with support.

The case study work with the LIDAR has been published in a peer reviewed journal (<https://doi.org/10.1016/j.cles.2025.100186>) and highlights the potential for small wind energy in Ireland, especially with the availability of export tariffs for renewable energy.

## **2.6 Recommendations**

Further developments in integrating the mapping tool into the public domain should be made. The possibility for academic research to be undertaken using the tool is also present.

## **2.7 Conclusions and Next Steps**

The project team continue to work in their respective disciplines and will be assessing future opportunities.