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Sustainable Energy Authority of Ireland

National Energy Research, Development & Demonstration Funding Programme

FINAL REPORT TEMPLATE

SECTION 1: PROJECT DETAILS – FOR PUBLICATION

Project Title	**Mapping Webtool to Support the Preparation of Local Authority Renewable Energy Plans**
Lead Grantee (Organisation)	School of Geography, University College Dublin
Lead Grantee (Name)	Dr. Ainhoa González
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	Name	**Organisation**
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Collaborators	Eoghan McCarthy	All Ireland Research Observatory, Maynooth University
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Project Summary (max 500 words)

The effective uptake and preparation of Local Authority Renewable Energy Strategies (LARES) is a keystone in providing a robust and clear planning framework for facilitating renewable energy deployment at local level, in order to meet national and European targets, and for moving towards a sustainable economy. This project has delivered an operational and user-friendly Webtool to explore sectoral constraints and facilitators as recommended in the LARES methodology. The Webtool centralises spatial datasets covering primary environmental and planning considerations for the various renewable energy technology types (wind, solar, geothermal, wave/tidal and biomass). It includes participative bespoke geoprocessing tools for the wind and solar subsectors to facilitate examination of specific land-use sensitivities and deliberations around viable renewable energy areas. It is anticipated that the Webtool will enhance the effectiveness and transparency of assessments that are central to the preparation of LARES and, in this way, promote their wider preparation and implementation. Moreover, the systematic application of the methodology is to provide transparent and accountable planning decisions that help secure social acceptance for a significant ramp-up in renewable energy, as well as to achieve full environmental best-practice in compliance with European law.

Keywords (min 3 and max 10)	Renewable Energy Strategies; Spatial analysis; Online mapping; Environmental constraints and facilitators.

SECTION 2: FINAL TECHNICAL REPORT – FOR PUBLICATION (max 10 pages)

2.1 Executive Summary

The effective uptake and preparation of Local Authority Renewable Energy Strategies (LARES) is a keystone in providing a robust and clear planning framework for facilitating renewable energy deployment at local level, in order to meet national and European targets, and for moving towards a sustainable economy. This project has delivered an operational and user-friendly Webtool to explore constraints and facilitators for the deployment of renewable energy projects, in line with the SEAI's LARES methodology. The Webtool centralises spatial datasets covering primary environmental and planning considerations for the various renewable energy technology types (i.e. solar, wind, geothermal, wave/tidal and biomass). It includes two participative bespoke geoprocessing tools (one for wind and one for solar) to facilitate examination of subsector-specific sensitivities and deliberations around viable renewable energy areas. It is anticipated that the Webtool will enhance the effectiveness and transparency of assessments that are central to the preparation of LARES an, in this way, promote their wider preparation and implementation. Moreover, the systematic application of the methodology is to provide transparent and accountable planning decisions that help secure social acceptance for a significant ramp-up in renewable energy, as well as to achieve full environmental best-practice in compliance with European law.

2.2 Introduction to Project

Renewable Energy Targets and Implementation

The provision of renewable energy sources is an important component of Irish energy policy. Directive 2009/28/EC (EC, 2009) on the promotion of the use of energy from renewable sources establishes a mandatory minimum target for Ireland to achieve a 16% share of all energy consumption from renewable sources by 2020.The National Renewable Energy Action Plan (NREAP) (Government of Ireland, 2010), prepared on foot of the Directive, establishes that by 2020, 40% of total electricity consumption in Ireland is to come from renewable sources. However, progress on the implementation of renewable energy projects has been slow, and 'Ireland's Energy Targets - Progress, Ambition and Impacts' (SEAI, 2016) reported that in 2014, 8.6% of overall energy demand was derived from renewable sources, mainly onshore wind. More recently, it has been estimated that, under the current trajectory of renewable energy deployment, Ireland could fall three percent short of its target (SEAI, 2017).

The proposed increase to 27% by 2030 in Europe under the revision of the Renewable Energy Directive, stresses the need for stepping up renewable energy development. Although there is a move away from national binding targets post 2020, Member States are required to contribute to this revised EU-wide target by implementing measures and developing the renewable energy sector that corresponds best to their national situation. In Ireland, the soon to be launched new Renewable Electricity Support Scheme (RESS) has been developed to incentivise the introduction of sufficient renewable electricity generation to meet national and EU-wide renewable energy and decarbonisation targets out to 2030.

The planning system has a critical role to play in facilitating the realisation of the RESS and the achievement of the government's ambition for renewable energy deployment. Given current technologies, wind power continues to offer the greatest potential for a significant increase in the generation capacity in the short- to medium-term. In fact, onshore wind power is expected to contribute to approximately 90% of the 2020 electricity targets (Government of

Ireland, 2010). Although solar and biomass technologies have seen an increase in recent years (SEAI, 2017), the lack of sub-sector subsidies is hampering large-scale developments in renewables other than wind. Similarly, the Offshore Renewable Energy Development Plan (OREDP - DCCAE, 2014) sets the framework for wind, wave and tidal projects, yet wind presents the most viable solution with a number of developments currently in the planning system (i.e. Dublin Array, Oriel and Codling offshore windfarms).

Strategic Planning for the Renewable Energy Sector

Robust, coordinated and sustainable strategies are required at regional and local level to achieve national and European obligations. Large-scale renewable energy development requires long-lead times in respect of land assembly, resource monitoring, securing investment, grid access, environmental impact assessment, community consultation and the planning process. Strategic planning is therefore a critical enabling factor for the development of renewable energy. The opportunity to strategically plan for harnessing offshore renewables was embraced by the Government in the preparation of the OREDP. However, onshore, development in the sector remains largely ad-hoc and fragmented. On foot of the Wind Energy Guidelines (DEHLG, 2006), twenty-two local authorities have developed policies on wind energy, but only fifteen have produced standalone wind energy strategies either as separate policy documents or as an appendix to their statutory development plan (SEAI, 2013b). Moreover, the quality and detail of these policies vary enormously. Partially as a result of this, the planning process remains a very significant bottleneck and lacks regulatory consistency and certainty. To add to this planning uncertainty, the escalation in public and political opposition and concern over the potential impacts on residential amenity, has led the government to a review the Wind Energy Guidelines (DECLG, 2006), which are currently undergoing Strategic Environmental Assessment (SEA).

On the wider context of sectoral planning that takes account of the various renewable energy technologies, the Methodology for Local Authority Renewable Energy Strategies (LARES) (SEAI, 2013b), provides a best-practice guide to assist local authorities in developing renewable energy strategies and policies to support and move forward strategic planning in the sector. While building upon and updating the methodological approach included in the Wind Energy Guidelines (DEHLG, 2006), it expands it to make it applicable to the range of renewable energy types. The central analytical step of the methodology entails a review of infrastructural and environmental constraints and facilitators. The systematic application of the methodology is to provide transparent and accountable planning decisions that help secure social acceptance for a significant ramp-up in renewable energy and associated grid infrastructure, as well as to achieve full environmental best-practice in compliance with European law. This constraints and facilitators mapping approach was also adopted in the preparation of the OREDP (DCCAE, 2014). The methodology builds upon widely applied spatial multi-criteria analysis techniques for environmental sensitivity analysis. The often conflicting policies of promoting renewable energy to tackle climate change and conserving nature in order to halt biodiversity loss, for example, require a priori analysis and understanding of the intrinsic sensitivity of the receiving environment to identify strategically suitable locations and, in this way, avoid and/or mitigate adverse effects at project level.

This is addressed by Directive 2001/42/EC for SEA which requires that the effects of development plans and programmes are assessed in order to identify and mitigate any significant adverse effects on population and human health, biodiversity, flora, fauna, water, air, climate, soils, geology, landscape, cultural heritage and material assets (EC, 2001). Under the Directive's requirements, plans and programmes that set a framework for future development consent of projects must be subject to SEA. LARES are not a statutory requirement and, in principle, a SEA is not automatically required. However, in light of their identification of viable renewable energy areas that may guide development consent,

undertaking SEA of LARES is recommended best-practice. In SEA, environmental sensitivity analysis present a framework for systematically characterising potential impacts and anticipating potential land-use conflicts arising from proposing developments in environmentally sensitive locations. It can serve as an empirical and objective critical foundation to promote evidence-based environmental assessment and planning. In the context of the LARES methodology, environmental sensitivity analysis provides a robust foundation for environmental constraints mapping.

Online Planning Tools

Spatial considerations are central to renewable energy planning. Geographically-explicit examination of areas susceptible to change and of suitable development areas is an essential part of any informed planning process and decision. Moreover, the requirement for plans, programmes and projects to undergo an environmental assessment (i.e. SEA or EIA) in order to mitigate potentially significant impacts brings further attention to the need to consider the spatial implications of planning decisions. More so, land use and marine planning decisions require deliberation of multiple socio-economic and environmental criteria, such as those relating to demographics, protected areas, or natural resource availability and quality aspects. This calls for a multi-criteria approach to planning and decision making. The above considerations have contributed to multi-criteria analysis through Geographic Information Systems (GIS) becoming a prominent technique in planning.

Technological advancements have significantly expanded online GIS capabilities leading to an increased deployment of interactive planning Webtools (e.g. Smith, 2016). However, the large majority of these Webtools provide basic multiple data visualisation and querying functionality and have limited analytical capability (Roth, 2013, Smith, 2016). That is, they allow presentational (i.e. problem-exploration) rather than analytical (i.e. problem-solving) applications (Babelon et al., 2017; Smith, 2016). The former focuses on information dissemination and typically entails one-way data communication, for which a plethora of thematic mapping sites has emerged in the last decade (e.g. SEAI's Wind Atlas and Geothermal and Bioenergy Mapping Systems). The later commonly involves more complex user interaction, supports two-way communication and facilitates data processing and examination (Roth, 2013).

In Ireland, an Environmental Sensitivity Mapping (ESM) Webtool has been recently developed to support SEA and planning processes (EPA, 2017). The ESM Webtool centralises over 90 publicly available SEA-relevant spatial datasets, and includes novel analytical functionality in the form of a Widget which enables instant generation of context-specific environmental sensitivity maps. The ESM Widget is based on a multi-criteria spatial analysis approach using GIS. It applies geoprocessing techniques to measure the intrinsic sensitivity of the receiving environment. It also facilitates public engagement, a mandatory requirement under the SEA Directive, by enabling user-defined selection of environmental criteria as well as weights that reflect the relative importance of the criteria brought into the assessment. The mapped outputs aim to highlight the relative environmental sensitivity of different areas, providing a critical evidence-basis for sectoral planning discussions. Such maps add value to SEA and planning processes by supporting the development of alternatives that avoid or minimise potentially incompatible or unsustainable zonings. Guiding development and sectoral activities towards least sensitive areas helps promote protection of environmentally sensitive and valuable areas. The ESM Webtool is applicable across planning hierarchies and sectors as long as relevant data are available. Currently, the Webtool supports land use planning, but the research team behind this proposal considers that it can provide a robust decision support tool for the preparation of LARES. It could complement and advance SEAI's current mapping systems.

References

Babelon, I, Alexander Ståhle, A and Balfors, B (2017). Toward Cyborg PPGIS: exploring socio-technical requirements for the use of web-based PPGIS in two municipal planning cases, Stockholm region, Sweden. Journal of Environmental Planning and Management, 60(8):1366-1390.

DCCAE (2014). Offshore Renewable Energy Development Plan - A Framework for the Sustainable Development of Ireland's Offshore Renewable Energy Resource. Department of Communications, Climate Action and Energy, Government of Ireland.

DCENR (2012). Strategy for Renewable Energy 2012-2020. Department of Communications, Energy and Natural Resources, Government of Ireland.

DEHLG (2006). Wind Energy Guidelines for Planning Authorities. Department of the Environment, Heritage and Local Government, Government of Ireland.

EC (2001). Directive 2001/42/EC, of 27th June, on the assessment of the effects of certain plans and programmes on the environment. European Commission. Official Journal of the European Union, L 197/30, 21.7.2001.

EC (2009). Directive 2009/28/EC of the European Parliament and of the Council, of 23 April, on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. Official Journal of the European Union, L 140/16, 5.6.2009.

EPA (2017). Environmental Sensitivity Mapping Webtool to Support Strategic Environmental Assessment in the Republic of Ireland. Prepared by the All-Island Research Observatory (AIRO) for the Environmental Protection Agency.

Government of Ireland (2010). National Renewable Energy Action Plan, Submitted under Article 4 of Directive 2009/28/EC. Government of Ireland.

Roth, RE (2013). Interactive maps: What we know and what we need to know. Journal of Spatial Information Science, 0(6):59-115.

SEAI (2013a). Wind Energy Planning Strategies on the Island of Ireland: Towards a Shared Policy Framework. Prepared by National Institute for Regional and Spatial Analysis (NIRSA) for the Sustainable Energy Authority of Ireland.

SEAI (2013b). Methodology for Local Authority Renewable Energy Strategies. Sustainable Energy Authority of Ireland.

SEAI (2016). Ireland's Energy Targets Progress, Ambition and Impacts. Sustainable Energy Authority of Ireland.

SEAI (2017). Ireland's Energy Projections - Progress to Targets, Challenges and Impacts. Sustainable Energy Authority of Ireland.

Smith, DA (2016). Online interactive thematic mapping: Applications and techniques for socio-economic research. Computers, Environment and Urban Systems, 57:106-117.

2.3 Project Objectives

Ensuring a sustainable energy future and achieving renewable energy targets requires a consistent and committed approach to forward renewable energy planning through the preparation and implementation of LARES, and through enhanced co-ordination and collaboration between local authorities across regions. The primary objectives of this project have the overall goal of facilitating the preparation of LARES by providing an effective, consistent and transparent evidence-base, and by enabling systematic consideration of environmental criteria when identifying viable renewable development areas.

The project objectives will be achieved through the following tasks:

Objective 1: Review of current implementation, practice issues and opportunities in the preparation of LARES

- Identifying and gathering all renewable energy strategies prepared to date by local authorities using SEAI's LARES methodology as the basis. The following LARES have been preliminarily identified: Clare, Mayo, Meath, Tipperary and Waterford.
- Setting up review criteria from the recommendations of the LARES methodology (SEAI, 2013b) to systematically review the available strategies.
- Identifying the correlations and differences between the available strategies, particularly in relation to spatial datasets applied in examining technical and environmental constraints and facilitators, and to cross-county and cross-border areas and designations.

- Undertaking one-to-one consultation with local authority representatives involved in the preparation of the available strategies to gather feedback on current methodological issues and opportunities for improvement.
- Reporting on findings relating to the state-of-the-art of current practice, and putting together a preliminary list of environmental criteria (i.e. spatial datasets) to support the preparation of LARES. This preliminary list is to be presented at the first consultation workshop for discussion, expansion and agreement.

Objective 2: Development of a LARES-specific environmental sensitivity analysis method and related criteria and sensitivity scores

- Undertaking two consultation workshops with local authority energy and planning officers, regulators, energy authorities, developers and academics to gather key stakeholder views on the development of an online support tool for the preparation of LARES. The first workshop will focus on assessment criteria, while the second workshop will pilot the draft Webtool. Specific stakeholder feedback will be sought at both workshops on environmental sensitivity, spatial datasets and Webtool functionality and applicability.
- Agreeing on a set of environmental criteria for constraints and facilitators mapping for each of the renewable energy types (i.e. onshore and offshore wind, solar, biomass, geothermal, wave and tidal).
- Adjusting the environmental sensitivity methodology to the requirements of the renewable energy sector. This will entail participatory definition of scientific scores that define the intrinsic sensitivity of the agreed environmental criteria.
- Gathering all publicly available spatial datasets relating to the agreed set of criteria for each of the renewable energy types and preparing a data inventory.

Objective 3: Development of a LARES decision support Webtool

- Processing all gathered spatial datasets (including, where relevant, datasets from SEAI's mapping systems) for inclusion into vector geodatabases specific to each renewable energy type.
- Converting all spatial datasets to raster for inclusion in the environmental sensitivity Widget/s.
- Developing a suite of Widgets one per renewable energy technology type (e.g. a Widget for wind, a Widget for solar, etc.). The possibility to devise a single Widget that will present technology-specific criteria on demand will be explored.
- Developing a Webtool to visualise and query all relevant spatial datasets and to host the Widget/s for assessing environmental sensitivity to support renewable energy constraints and facilitators mapping. This will initially be hosted on the AIRO mapping infrastructure (ESRI ArcGIS technology) for the duration of the research project. Towards completion, the research team will collaborate with the SEAI GIS team to work towards the integration of the Webtool and accompanying Widget/s into the existing SEAI mapping portal.
- Piloting the applicability of the Webtool through a stakeholder workshop using one of the available renewable energy strategies as a case study.

2.4 Summary of Key Findings/Outcomes

The project has delivered an operational and user-friendly web-tool to map environmental, technical and planning considerations to assist in the determination of areas that may be suitable for the development of renewable energy technologies. The approach is based on the

assessment of sectoral facilitators and constraints as recommended in the SEAI's LARES methodology.

The LARES Web-tool is composed of two parts: 1) A Viewer that centralises spatial datasets covering primary environmental, technical and planning considerations for five renewable energy technology types (i.e. wind, solar, geothermal, biomass, wave and tidal); and 2) a participative bespoke geoprocessing Widget to facilitate the examination of the suitability of areas for renewable energy development for two of the main technology types (i.e. wind and solar).

2.5 Project Impact

It is anticipated that the Webtool (available at https://gis.seai.ie/LARES/Viewer_V1/) will enhance the effectiveness and transparency of assessments that are central to the preparation of LARES an, in this way, promote their wider preparation and implementation by local authorities. Moreover, the systematic application of the methodology is to provide transparent and accountable planning decisions that help secure social acceptance for a significant ramp-up in renewable energy, as well as to achieve full environmental best-practice in compliance with European law.

2.6 Recommendations

The LARES Webtool has the potential to significantly contribute to systematic, transparent and evidence-led renewable energy planning in Ireland. However, it has not been possible to incorporate the bespoke solar and wind land suitability assessment widgets developed as part of the project before project completion, due to IT constraints associated with the SEAI's GIS infrastructure. As a result, the current Webtool only enables visualisation and querying of environmental, technological and planning constraints and facilitators. Land suitability assessment and characterisation (i.e. acceptable in principle, open for consideration, not normally permissible) is currently not possible due to the lack of access to the relevant widgets. There is a high demand for the Webtool and the functionality of its widgets, as evidenced by correspondence from renewable energy planning consultants and local authorities, so it is unfortunate that the Webtool's full functionality remains unavailable to the general public. It is therefore strongly recommended that measures are put in place for the incorporation of the widgets to ensure full functionality and application potential of the tool.

Similarly, training should be rolled out to build the capacity of users (e.g. local authority plan-makers, environmental and planning consultants) for the effective use and implementation of the Webtool. This has been brought up to the attention of the SEAI. However, the delivery of such training is not possible until the LARES Webtool if fully set up in the organisation's GIS infrastructure.

The ongoing maintenance of the Webtool (with regards to spatial data updates and potential IT adjustments) will require dedicated budget and personnel. The effectiveness of decision support tools and the validity of their outputs are as good as the data inputs available within them. It is therefore essential that periodic data updates are undertaken to maintain the environmental, technical and planning datasets relevant and current.

2.7 Conclusions and Next Steps

As noted above, the LARES Webtool has the potential to advance evidence-led renewable energy planning in Ireland. However, the limitations outlined above need to be addressed to

ensure users can benefit from its full potential, and the Webtool has the intended impact on renewable energy planning practice and technological deployment.

SECTION 3: COMMUNICATION & DISSEMINATION (max 3 pages)

3.1 Communication, Dissemination and Exploitation

Dissemination Summary Tables

Refer to in Table 3.1 on the next page for details of the scientific publications.

Refer to in Table 3.2 on the next page for details of the dissemination activities.

3.2 Intellectual Property Management & Exploitation

N/A

Table 3.1 – List of Scientific Publications

Title	Main Author	Journal Title	Number, Date or Frequency	Publisher	Year of Publication	Is/Will open access be provided? If you marked "will", provide an estimate of the date	Peer-reviewed (Y/N)?
Developing a renewable energy planning decision-support tool: Stakeholder input guiding strategic decisions	A. González	*Applied Energy*	312: 118782. DOI: 10.1016/j.apenergy.2022.118782	Elsevier	2022	No	Y

Table 3.2 – List of Dissemination Activities

Type of Activity	Main Leader	Title	Date/Period	Location	Type of Audience*	Size of Audience
Stakeholder workshop	González, A	N/A	20th November 2019	Dublin	Industry, consultancies, planners, policy makers	44
Stakeholder workshop	González, A	N/A	17th September 2020	Dublin (online)	Industry, consultancies, planners, policy makers	21

SECTION 4: PROJECT STATUS & WORK PLAN

4.1 Work Plan

Table 4.1 – List of Work Packages

No.	Title	Status Update and Completion Status (%)
WP-1	State-of-the-art in the preparation of LARES	Completed
WP-2	Stakeholder consultation on spatial data and associated sensitivity	Completed
WP-3	Data collection, collation and preparation	Completed
WP-4	Development of LARES decision support Webtool	Completed
WP-5	Project management	Completed

Table 4.2 – Summary of Work Packages

WP No. & Title	**WP1: State-of-the-Art in the Preparation of LARES**		
Start Month No.	1	**Finish Month No.**	6
WP Lead	Ainhoa González, University College Dublin (UCD)		
WP Contributors	Post-doctoral researcher, UCD		
Objective(s)	***WP1-O1***: To review implementation of LARES.		Completion Update: Completed
	WP1-O2: To identify current practice issues and opportunities in the preparation of LARES.		Completion Update: Completed
Description (max 200 words)	This Work Package will identify and review LARES prepared to date (including Clare, Mayo, Meath, Tipperary and Waterford county strategies) to identify the correlations and differences between them, particularly in relation to spatial datasets applied in examining technical and environmental constraints and facilitators, and to cross-county and cross-border areas and designations. This will be done by setting up specific review criteria (extracted from the recommendations of the Methodology for LARES) and systematically reviewing the available strategies. It will also include one-to-one consultation with key experts and stakeholders (see further detail in WP2) to identify current methodological issues and opportunities for improving the preparation of LARES.		
Milestones	***WP1-M1***: Knowledge and understanding on the current state-of-the-art in the implementation of LARES and priority areas for improvement. ***WP1-M2***: Preliminary identification of spatial datasets to support WPs 2, 3 and 4.		Completion Status (%): 100% Completion Status (%): 100%
Deliverables	***WP1-D1***: Report on 'State-of-the-art on LARES' describing progress and limitations affecting implementation (provided in month 6).		Completion Status (%):100%
Deviations from planned WP (if applicable)	N/A		
Key Outcomes	Detailed review and understanding of LARES methodology implementation, datasets used and data access constraints identified by local authorities up to November 2019. Associated report submitted to the SEAI.		

WP No. & Title	**WP2: Stakeholder Consultation on Spatial Data and Associated Sensitivity**		
Start Month No.	2	**Finish Month No.**	24
WP Lead	Ainhoa González, University College Dublin (UCD)		
WP Contributors	Post-doctoral researcher, UCD		

	Justin Gleeson, All-Island Research Observatory (AIRO), Maynooth University Eoghan McCarthy, AIRO, Maynooth University	
Objective(s)	***WP2-O1***: To gather stakeholders' views on current practice issues affecting the preparation of LARES, and on key environmental criteria	Completion Update: Completed
	WP2-O2: To engage stakeholders in the design and development of the Webtool.	Completion Update: Completed
Description (max 200 words)	Stakeholder consultation will be central to the identification of criteria and their associated scientific scores (i.e. relative degree of intrinsic sensitivity) to support the assessment of environmental constraints, and to develop a Webtool that satisfies the requirements of the renewable energy sector. This Work Package will focus on putting in place effective consultation mechanisms. This will include a stakeholder mapping exercise, online and one-to-one communication with relevant representatives throughout the project timeframe, and two stakeholder workshops, one for agreeing criteria and relative sensitivity scores, and the second one for piloting the Webtool.	
Milestones	***WP2-M1***: Two-way stakeholder engagement (consultation and dissemination). ***WP2-M2***: Consensus of spatial datasets to be incorporated in the Webtool, supporting WPs 3 and 4. ***WP2-M3***: Understanding of stakeholder preferences on Web interface usability and functionality.	Completion Status (%): 100% Completion Status (%): 100% Completion Status (%): 100%
Deliverables	***WP2-D1***: Material to support the delivery of the workshops (e.g. 2-page issues paper, presentations, and Webtool pilot testing case study) (workshops are planned for months 10 and 18). ***WP2-D2***: Report on 'Stakeholder consultation on LARES', describing the consultation mechanisms applied, listing the consulted stakeholders and reporting on the findings of consultation, including a final list of agreed spatial datasets, scientific scores and weights, and any interface functionality recommendations (provided in month 24).	Completion Status (%):100% Completion Status (%):100%
Deviations from planned WP (if applicable)	N/A	
Key Outcomes	Extensive stakeholder consultation and resulting identification and prioritisation of key spatial datasets to support renewable energy planning, as well as review of the draft LARES webtool and subsequent adjustments to incorporate stakeholder feedback. Associated report submitted to the SEAI.	

WP No. & Title	**WP3: Data Collection, Collation and Preparation**		
Start Month No.	4	**Finish Month No.**	24
WP Lead	Justin Gleeson, All-Island Research Observatory (AIRO), Maynooth University		
WP Contributors	Ainhoa González, University College Dublin (UCD) Post-doctoral researcher, UCD Eoghan McCarthy, AIRO, Maynooth University		
Objective(s)	***WP3-O1***: To gather all publicly available spatial datasets relating to the agreed set of criteria for each of the renewable energy technology types.		Completion Update: Completed
	WP3-O2: To harmonise the gathered datasets.		Completion Update: Completed
Description (max 200 words)	Data gathering and harmonisation will span across the project timeline. The project team will start gathering datasets early in the project in order to identify available information and gaps. Once agreement has been reached on the set of criteria for each renewable energy type (within the framework of the first stakeholder workshop), data gathering efforts will intensify. Collated data will be checked for consistency, accuracy and currency. The findings of this review will be collated in associated metadata for publication in the Webtool. Datasets will be		

	subsequently manipulated to ensure, in so far as possible, completeness, as well as to standardise their spatial reference system. Datasets will be compiled in technology-specific and SEA-theme specific geodatabases, and ultimately converted to raster and harmonised on the basis of stakeholder-defined sensitivity for their inclusion into the Widget/s. Any data updates will be duly incorporated into the Webtool; the most current set of data will be provided at project completion.	
Milestones	***WP3-M1***: Spatial datasets associated to the agreed LARES criteria compiled. ***WP3-M2***: Spatial datasets ready for inclusion in the Webtool and Widget/s.	Completion Status (%): 100% Completion Status (%): 100%
Deliverables	***WP3-D1***: Data inventory; this will be a spreadsheet with all the datasets incorporated into the Webtool, organised by SEA theme for each of the renewable energy types (a draft provided in month 12 and the final inventory in month 24). ***WP3-D2***: A suite of geodatabases, one per renewable energy type, with all the gathered publicly available spatial datasets (in month 24).	Completion Status (%):100% Completion Status (%):100%
Deviations from planned WP (if applicable)	N/A	
Key Outcomes	Inventory of spatial datasets and associated geodatabases to support renewable energy planning. These have been provided to the SEAI GIS team.	

WP No. & Title	**WP4: Development of LARES Decision Support Webtool**		
Start Month No.	6	**Finish Month No.**	24
WP Lead	Justin Gleeson, All-Island Research Observatory (AIRO), Maynooth University		
WP Contributors	Eoghan McCarthy, AIRO, Maynooth University Ainhoa González, University College Dublin (UCD) Post-doctoral researcher, UCD		
Objective(s)	***WP4-O1***: To develop a Webtool tailored to the requirements of LARES.		Completion Update: Completed
	WP4-O2: To develop a Widget or suite of Widgets that supports environmental constraints and facilitators mapping.		Completion Update: Completed
Description (max 200 words)	This Work Package will develop the online mapping tool interface and functionality for visualising, querying and printing spatial datasets relevant to the renewable energy sector. It will amalgamate renewable energy datasets from SEAI's mapping systems. It will include a bespoke geoprocessing tool to undertake environmental sensitivity analysis. The output maps will support examination of environmental constraints to inform the identification of viable renewable energy areas. The maps will be the result of a user-defined selection of relevant criteria and their relative importance weights. This participatory approach will enable tailoring the assessment to technology-specific and region-specific concerns and considerations.		
Milestones	***WP4-M1***: Development of a user-friendly geoprocessing tool/s (Widget/s) to assess environmental sensitivity to each renewable energy technology type. ***WP4-M2***: Development of a Webtool to visualise and query the spatial datasets relevant to LARES and to host the environmental sensitivity Widget/s.		Completion Status (%): 100% Completion Status (%): 100%
Deliverables	***WP4-D1***: Webtool with LARES-relevant spatial datasets and Widget/s (a draft will be provided in month 10 and the final version in month 24). ***WP4-D2***: Widget/s for examining environmental sensitivity (i.e. constraints mapping) for the various renewable energy		Completion Status (%):100% Completion Status (%):100% Completion Status (%):100%

	technologies (draft in month 10; final in month 24). ***WP4-D3***: User manual with step-by-step guidance to effectively and coherently apply both the Webtool and the Widget/s (draft in month 10; final in month 24).	
Deviations from planned WP (if applicable)	N/A	
Key Outcomes	Online GIS-based interactive tool with environmental and planning data to support exploration of opportunities/constraints for renewable energy development (biomass, solar, geothermal, wind, wave/tidal), including bespoke widgets for site suitability analysis of large scale solar and wind farm developments, and supporting user manual. The webtool has been integrated into the SEAI's GIS infrastructure but IT barriers have prevented integration of solar/wind widgets. The User Manual has been provided to the SEAI.	

WP No. & Title	**WP5: Project Management**		
Start Month No.	1	**Finish Month No.**	24
WP Lead	Ainhoa González, University College Dublin (UCD)		
WP Contributors	Justin Gleeson, All-Island Research Observatory (AIRO), Maynooth University		
Objective(s)	***WP5-O1***: To effectively coordinate the project.		Completion Update: Completed
	WP5-O2: To fulfil SEAI's reporting requirements.		Completion Update: Completed
Description (max 200 words)	This Work Package will coordinate the different project tasks, as well as maintain communication with, and fulfil reporting requirements to the SEAI. An inception meeting will be held with the SEAI to agree the project plan and the steering committee, establish communication and information exchange arrangements, and a meeting schedule. Project management will also maintain the project's financial records and prepare the final report (which will bring all project deliverables together as appropriate).		
Milestones	***WP5-M1***: Achievement of all project objectives and effective and timely provision of all project deliverables.		Completion Status (%): 100%
Deliverables	***WP5-D1***: Detailed project plan and programme at project inception (provided in month 1). ***WP5-D2***: Final Report including executive summary. Clear and detailed account of the research approach applied during the project, key findings and recommendations. This will contain a maximum of 30 pages (in month 24). ***WP5-D3***: Final accounts form (in month 24).		Completion Status (%):100% Completion Status (%):100% Completion Status (%):100%
Deviations from planned WP (if applicable)	N/A		
Key Outcomes	Final report with a detailed account of the research methodology, key findings and recommendations. Report submitted to the SEAI.		

ANNEX 1 – CASE STUDY TEMPLATE

Project Title	
Mapping Webtool to Support the Preparation of Local Authority Renewable Energy Plans	
Project Summary – Please provide a brief and high-level summary of your project. (Max 3 sentences)	
The project has delivered an online interactive decision support tool (available at https://gis.seai.ie/LARES/Viewer_V1/) for the preparation of Local Authority Renewable Energy Strategies (LARES). The Webtool centralises spatial datasets covering primary environmental and planning considerations for the various renewable energy technology types. It includes participative bespoke geoprocessing tools to facilitate examination of sector-specific land-use sensitivities and deliberations around viable renewable energy areas for large scale solar and wind farm developments.	
What challenges did you face? Challenges can be technical (e.g. sensor failure), managerial (e.g. delay in the hiring process), financial (e.g. unexpected costs), etc.	
It has not been possible to integrate the bespoke solar and wind widgets, developed as part of this project, into the SEAI Geographic Information Systems (GIS) infrastructure due to IT barriers.	
Three key statistics – If applicable, please provide three key statistics related to your RD&D Project: e.g. X kW generation capacity; X Papers Published; X Communities/Users involved; X potential energy/cost savings	
1.	N/A
2.	N/A
3.	N/A
What would you regard as the three most significant achievements or impacts enabled by this SEAI funding?	
1.	Compilation of comprehensive geodatabases of environmental, technical and planning spatial data layers to inform renewable energy planning and deployment.
2.	Stakeholder input into the determination of priority datasets for each renewable energy technology (wind, solar, geothermal, wave/tidal and biomass)
3.	Development of a user-friendly online tool to support the preparation of Local Area Renwable Energy Strategies.
How has this or will this research project be of benefit to Ireland?	
It is anticipated that the Webtool will enhance the effectiveness and transparency of assessments that are central to the preparation of LARES an, in this way, promote their wider preparation and implementation. Moreover, the systematic application of the methodology is to provide transparent and accountable planning decisions that help secure social acceptance for a significant ramp-up in renewable energy, as well as to achieve full environmental best-practice in compliance with European law.	
What was the biggest learning outcome throughout the project?	
The importance of bringing organisational GIS teams from the onset and the need to think ahead of project completion deadlines with regards to the transferability and ongoing maintenance of IT-based research outputs.	
What has this SEAI funding enabled for you/your organisation? (e.g. building capacity, developing a product, opening new markets, growth in revenue). Please be specific and quantify your responses where possible.	
Developing a decision support tool that will serve a public good.	
What advice would you give to other researchers?	
To think ahead of project completion deadlines with regards to the transferability and ongoing maintenance of IT-based or technological research outputs.	
If you wish, please describe your overall experience working on this project (e.g. are you happy with its success, what was the highlight for you, and/or what do you have planned next)	

I am very happy with the successful delivery of what we set out to do. The LARES Webtool is the first of its kind worldwide and given that it is closely aligned with the SEAI's LARES methodology, it can present a significant step forward in transparent and evidence-based renewable energy planning and deployment in Ireland, setting also the basis for good practice in other jurisdictions. However, the difficulties encountered with regards to its full transferability to the SEAI's GIS infrastructure and the consequent impact on the publication and practical application of the Webtool were unexpected, and the lack of opportunities to address these have resulted in an unsatisfactory outcome. There is a high demand for the tool, as evidenced by correspondence from renewable energy planning consultants and local authorities, so it is unfortunate that the Webtool's full functionality remains unavailable to the general public. It is therefore recommended that measures are put in place so that the research outcomes are made fully and effectively accessible to all.

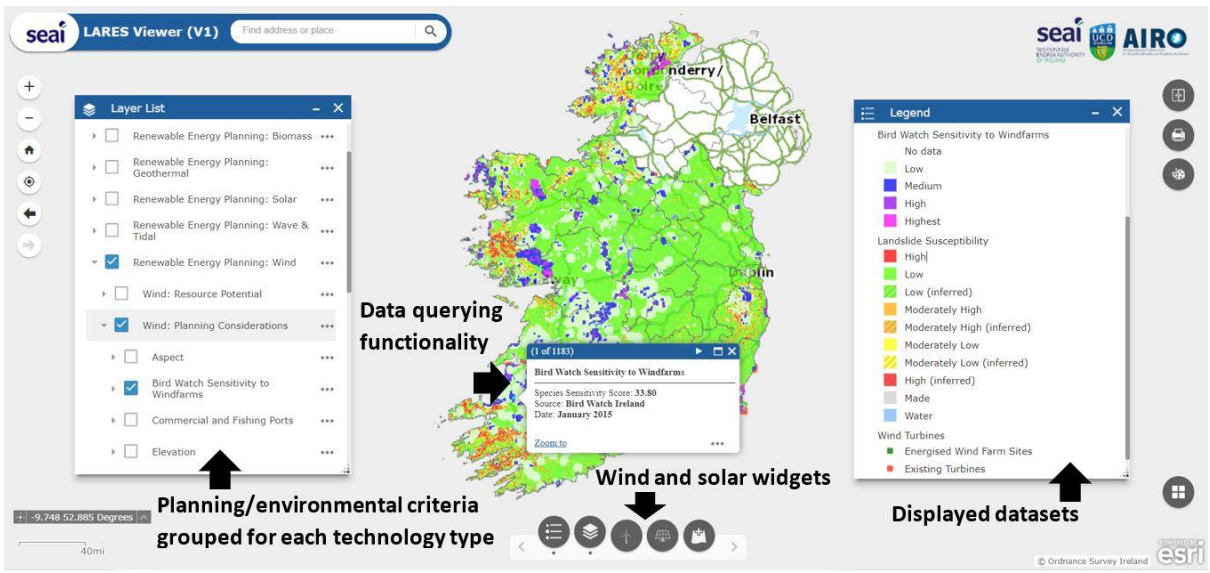

Figure 1. Screenshot of the LARES Webtool (https://gis.seai.ie/LARES/Viewer_V1/) illustrating the tiered thematic approach to grouping relevant datasets/criteria and their interrogation.

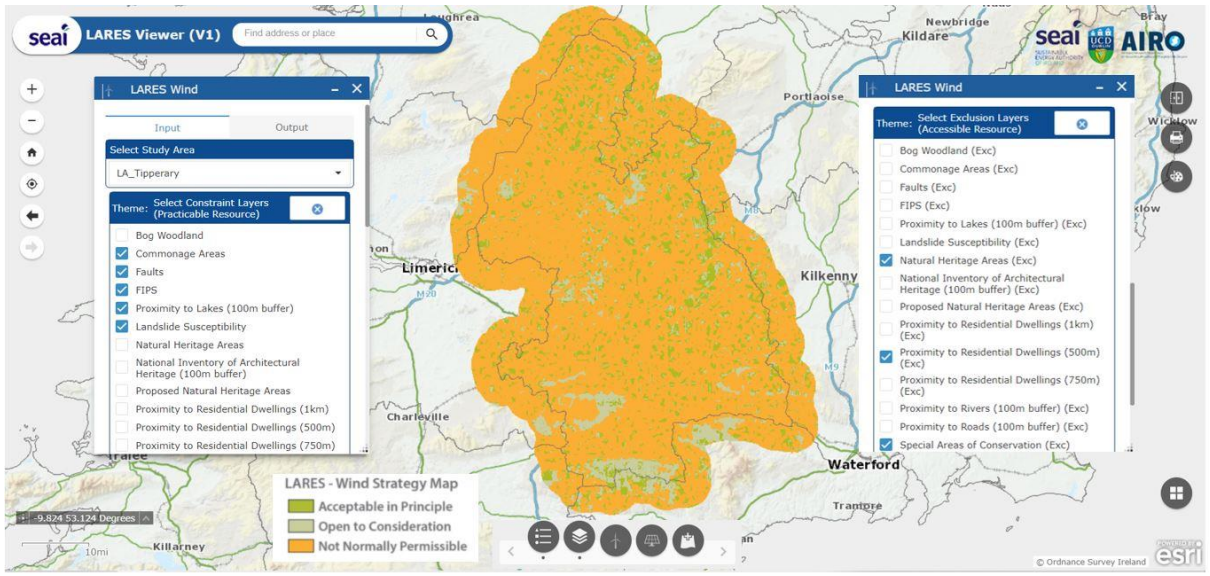

Figure 2. Example of a LARES wind widget site suitability assessment output. While the widget only displays once in the web-tool's interface, it has been replicated here to illustrate the selection of criteria as constraints (left) or as exclusions (right).

ANNEX 2 – PROJECT COMPLETION SURVEY

Workforce Statistics *Please indicate in the table below the number of people who worked on this project within the Lead/Partner Organisation Types listed*		
Project Staff (By Lead/Partner Organisation Type)	**Number of Women**	**Number of Men**
Industry and SMEs (if applicable)		
Academia or publicly funded research institutes (if applicable)	1	1
Of which, number of PhD Students		
Other Public Sector or Semi-state Organisations (if applicable)		2
How many of the above staff were recruited specifically for this project?		1

Engagement – Civil Society and Policy Makers	
Did your project involve working with students and/or school pupils (e.g. open days, participation in science)?	
Yes – Please specify	
No	X
Did your project engage with societal actors beyond the research or industrial community?	
Yes – Please specify	Environmental and planning consultants, local authority plan-makers, renewable energy associations and governmental representatives
No	
If yes, did you engage with citizens or organised societal groups (select from the below options)?	
No	X
Yes – in determining the research to perform	
Yes – while implementing the research	
Yes – in communication/dissemination of research results	
Did you engage with government / public bodies or policy makers (including international organisations)?	
No	
Yes – in framing the research	X
Yes – while implementing the research	
Yes – in communication/dissemination of research results	X
If you marked yes above and engaged with international organisations, please specify which organisation and which country here:	N/A
Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?	
Yes – as a primary objective	X
Yes – as a secondary objective	
No	
If you marked yes above, please add details here	The main research output is a publicly available decision support system for renewable energy planning and decision-making in Ireland.
If yes, at which level?	
Local / Regional Level	X
National Level	X

European Level	X (as a good practice decision support tool)
International Level	X (as a good practice decision support tool)

Dissemination and Market Readiness	
How many articles were published/accepted for publication in peer-reviewed journals?	1
How many articles were presented and published in conference proceedings?	N/A
How many new patent applications have been made?	N/A
How many spin-off companies were created/ are planned as a direct result of this project?. If you marked “are planned”, please give an estimation of the date of creation.	N/A
Did the project result in a market ready solution (e.g. a product, a service)? (Yes/No)	Yes (publicly accessible online RE decision support tool)

Communication Statistics	
Which of the following have been used to communicate information about your project? (tick as appropriate)	
□ Press Release □ Communication via social media (Twitter, Linkedin, Applicant website, etc.) □ Media Briefing □ TV coverage / report □ Radio coverage / report □ Brochures / posters / flyers □ DVD / Film / Multimedia □ Other (please specify):	□ Coverage in specialist press □ Coverage in general press □ Coverage in national press □ Coverage in international press □ Website for the general public X Event targeting general public (Festival, conference, exhibition) □ Scientific conferences X Other (please specify): Scientific publication

SEAI National Energy RD&D Funding Programme - Feedback
If you have any feedback or suggestions in relation to the SEAI National Energy RD&D Funding Programme, please provide below:
The RD&D Development Programme should consider what happens to research outcomes that require maintenance after project end-dates and that do not have a commercial value but rather represent a public good. Opportunities for the maintenance of this research’s outputs (i.e. the LARES Webtool) were explored with the SEAI advisory members, but no funding was deemed available for its maintenance, affecting its applicability in the long-term (e.g. as datasets become obsolete). Similarly, the implication of research projects that have a strong GIS component should be examined prior to project approval, so that mechanisms are put in place to ensure any relevant outputs (be it a spatial dataset or a webtool) are appropriately and effectively integrated into SEAIs’ GIS infrastructure at project completion.