

Submission to An Coimisiún Pleanála

In respect of an application for the proposed development of

Ballincor Windfarm and Associated Infrastructure

Made to An Coimisiún Pleanála under

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Observation Submitted on behalf of

Trinity College Dublin, Rosse Observatory, Birr Castle

Demesne, Birr, County Offaly

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Acronym	Meaning
TCD	Trinity College Dublin
LOFAR	LOw Frequency ARray, in this document this refers to the pan-European array operated by the LOFAR ERIC
I-LOFAR	Irish LOw Frequency ARray, in this document this refers to the LOFAR station located at the Rosse Observatory in Birr, operated by TCD
ERIC	European Research Infrastructure Consortium
RFI	Radio Frequency Interference
DFHERIS	Department of Further and Higher Education, Research, Innovation and Science
DIAS	Dublin Institute of Advanced Studies
UG	University of Galway
UCD	University College Dublin
TUS	Technological University of the Shannon
UCC	University College Cork
AOP	Armagh Observatory and Planetarium
DCU	Dublin City University
EMC	Electro-Magnetic Compatibility

1.0 INTRODUCTION

This submission is made on behalf of Trinity College Dublin, who operate the Rosse Observatory, Birr Castle Demesne, Birr, County Offaly, in respect of the application for approval made by RWE Renewables Ireland Ltd. for a 10-year permission to develop the Ballincor Windfarm at Cloonaheen, Ballincor Demesne, and Curralanty, County Offaly, and Clonfree, Castletown and Cronekill, County Tipperary.

The application is a Strategic Infrastructure Development (SID) application under section 37E of the Planning and Development Act 2000, as amended.

It is noted that the proposed development comes within the scope of the provisions of the Renewable Energy Directive III (Directive 2023/2413).

1.1 Background and Context

This Observation is made on behalf of Trinity College Dublin (TCD). TCD's Rosse Observatory is based on the grounds of Birr Castle Demesne, County Offaly. TCD owns and operates the Irish Low Frequency Array station (I-LOFAR) on behalf of the Irish LOFAR consortium. I-LOFAR is the primary radio astronomy facility in Ireland and operates additionally as part of the pan-European LOFAR telescope. TCD also operates other radio telescopes at the site. The station is a nationally and internationally important element of strategic research and development infrastructure across a broad range of scientific, educational, research, commercial, technological and security sectors. It benefits from a high level of national and county level protection, including national and county level planning policy.

Radio telescopes such as I-LOFAR are extremely sensitive to the incredibly faint radio emission from a diversity of astronomical sources. Wind farms are significant sources of radio frequency interference (RFI) at frequencies ranging from tens of megahertz into the gigahertz region, as documented in the European Conference of Postal and Telecommunications Administrations (CEPT) ECC Report 321. Without mitigation, windmill operation can severely impact the operations of radio telescopes such as I-LOFAR, and the other radio telescopes on site.

A detailed review of the EIAR and application documents has been undertaken by competent experts with particular regard to the potential RFI impacts on the operation of the radio telescope. Appendix 15 of the EIAR (Volume 2) references the radio telescope but does not provide any technically competent impact assessment for the purpose of quantifying and potentially mitigating impacts.

The TCD and I-LOFAR teams have undertaken a detailed and evidence-based technical assessment of the potential RFI effects and conclude that the proposal does not align with internationally accepted LOFAR co-existence standards and that without appropriate mitigation, which may be possible (as described in Section 5 below), there is a high probability of a significant, adverse and permanent impact on the operation of the radio telescope.

1.1.1 Objectives of this Submission

TCD and I-LOFAR acknowledge the contribution of wind energy to Ireland's renewable energy transition away from imported fossil fuels and to meeting national climate targets, and the weighting of potential climate benefits in the assessment of applications as provided for under Section 15(1) of the Climate Action and Low Carbon Development Act 2015 (as amended).

The assessment of any application must also afford significant weight to the location and operational needs of established strategic infrastructure that is of national and international significance. The I-LOFAR

telescope is a State-funded element of Ireland's participation in the LOFAR European Research Infrastructure Consortium and a major contributor to the national and international scientific, educational, research, commercial, technological and security sectors.

As noted, I-LOFAR's evidence-based analysis concludes with a high probability of certainty that the Ballincor Wind Farm as currently proposed presents an unacceptable adverse risk to the performance of the I-LOFAR radio telescope, and that risk is so significant as to make the facility redundant as both a stand-alone scientific instrument for indigenous research and research-led training projects. Additionally, there is risk to Ireland's participation in the LOFAR ERIC, jeopardising significant investments to date by Research Ireland, DFHERIS, their predecessors, and several HEIs across the island of Ireland.

TCD, in collaboration with the wider I-LOFAR consortium and the LOFAR ERIC, have carried out a preliminary assessment in the time available. Having regard to the conclusions of this assessment, An Coimisiún is requested to:

1. Refuse permission by reason of the significant, adverse and permanent impact of the proposed windfarm on the ongoing operation of the I-LOFAR radio telescope, and the failure of the EIAR and application documents to adequately identify, quantify and assess, those impacts, and to propose potential mitigation, if possible.

Or, in the alternative:

2. Request Further Information from the Applicant to:
 - a) Submit an evidence-based assessment, prepared by relevant and competent experts, of the RFI risks of the wind farm in its entirety for both indigenous and scattering modalities, and to determine mitigations in both cases so as to ensure the RFI impact is within acceptable levels as defined by radio astronomy experts in the LOFAR ERIC, specifically that *the wind farm may only be permitted if the turbines and their associated equipment radiate at least 35 dB below the norm for EN 55011 class A equipment*. Additionally, a proper assessment of the impact of scattering from DAB and all other transmitters in the Midlands on the telescope operations, caused by the presence of wind farm infrastructure (turbines and their associated equipment), must be undertaken.

This assessment must identify and address:

- 1.1 All potentially harmful impacts, including, but not limited to, those identified in Table 5.12, above.
 - 1.2 All potential transmitters external to this development, including, but not limited to, DAB, with potential to be detected at the telescope modulated by the blade motion of the turbines.
 - 1.3 The applicant should supply emission spectra from 30MHz upwards for the system components and for a complete turbine system. The spectra should be taken in accordance with EN 55011/CISPR-11 Group A, with measurements taken at 10m or 30m from the systems, to allow independent third-party assessments. Spectra of both quasi-peak and broadband emission should be included.
- b) Submit a revised EIAR that identifies, quantifies and assesses those impacts, and proposes mitigation measures if available, the measures required to implement those mitigation measures, and a clear commitment by the applicant to the implementation of those measures to ensure such mitigations can and will be implemented.

This assessment is required prior to any decision on the application for the following reasons:

- (i) To enable an assessment by An Coimisiún of the potential impacts and the efficacy of proposed mitigation measures that are reasonable, feasible and that can be implemented.
- (ii) To clearly detail and articulate in the EIAR the proposed mitigation measures to which the Applicant is committing and will be obliged to implement at its own cost in the event that the project proceeds.
- (iii) To clearly detail RFI/EMC monitoring that will be undertaken by the Applicant for the duration of construction and operation phases, and further mitigation measures that may be necessary in the event that the mitigation measures are not effective.
- (iv) The information required to undertake the necessary assessments, to specify mitigation measures and to demonstrate the efficacy and practicality of those measures.

This submission provides the rationale for An Coimisiún to invite the applicant to submit the requested assessments and itemises the information that An Coimisiún is invited to request from the Applicant for the purpose of satisfying items (i) to (iv), above.

The revised EIAR and design details must demonstrate to the satisfaction of An Coimisiún that the mitigation measures are reasonable, feasible, will be effective, and will be the responsibility of the developer to implement.

In the event that the Applicant does not demonstrate to the satisfaction of An Coimisiún that effective mitigation measures can be implemented at its expense, TCD reluctantly requests An Coimisiún to refuse permission, having regard to the likely significant, adverse and permanent impact of the proposed windfarm on the ongoing operation of the I-LOFAR radio telescope, and the failure of the EIAR and application documents to adequately identify, quantify and assess, those impacts, and to propose potential mitigation, if possible.

1.2 Structure of this Submission

This submission is structured to provide An Coimisiún with the necessary information to fully understand the nature and magnitude of the impacts on the radio telescope, the failure of the EIAR to identify and quantify the impacts, and the consequent absence of mitigation measures proposed in the EIAR, and the necessary additional information required to undertake an informed assessment of potential mitigation to protect the ongoing operation of ILOFAR.

Section 2 provides an overview of I-LOFAR and the operation of the radio telescopes at TCD's Rosse Observatory.

Section 3 provides an overview of the relevant planning policy context.

Section 4 provides a summary of the information provided in the EIAR and application documents in respect of the I-LOFAR facility.

Section 5 provides a summary of the likely significant, adverse and permanent impacts, and potential mitigation measures.

TCD respectfully requests An Coimisiún to invite the Applicant to submit as Further Information including a revised EIAR, and revised plans and assessments, and further detail and assessment in respect of the Mitigation Measures proposed in the EIAR as supplemented in this submission, to demonstrate to the

satisfaction of An Coimisiún and TCD the efficacy and practicality of those measures based on robust survey data, monitoring, assessment, and evidence of successful comparators.

1.3 Contributors to this Submission

This Submission has been prepared by Declan Brassil & Co, Chartered Planning Consultants, in conjunction with TCD, the I-LOFAR Consortium, and the LOFAR ERIC, comprising the following competent experts:

- Evan Keane, Director of TCD's Rosse Observatory, Head of the I-LOFAR Telescope
- Joe McCauley, Senior Experimental Officer at TCD, Station Manager for I-LOFAR
- Peter Gallagher, Chair of the LOFAR ERIC Council
- Aaron Golden, Head of the I-LOFAR Consortium
- Mark Daly, Technological University of the Shannon, Athlone
- Michiel Brentjens, Senior Scientist, The Netherlands Institute for Radio Astronomy (ASTRON)
- Emma van der Wateren, Instrument Scientist, ASTRON
- Michiel van Haarlem, Director of the LOFAR ERIC

2.0 I-LOFAR

The I-LOFAR radio telescope was constructed, and is operated, by Trinity College Dublin, on behalf of a consortium of higher-level institutions on the island of Ireland including:

- Trinity College, Dublin (TCD).
- Dublin Institute for Advanced Studies (DIAS).
- University of Galway (UG).
- University College Dublin (UCD).
- Technological University of the Shannon (TUS), Athlone.
- University College Cork (UCC).
- Armagh Observatory and Planetarium (AOP).
- Dublin City University (DCU).

The facility has been funded by Research Ireland (and its predecessor Science Foundation Ireland), the Department of Further and Higher Education, Research, Innovation and Science, Offaly Co. Council, as well as the institutes comprising the I-LOFAR consortium.

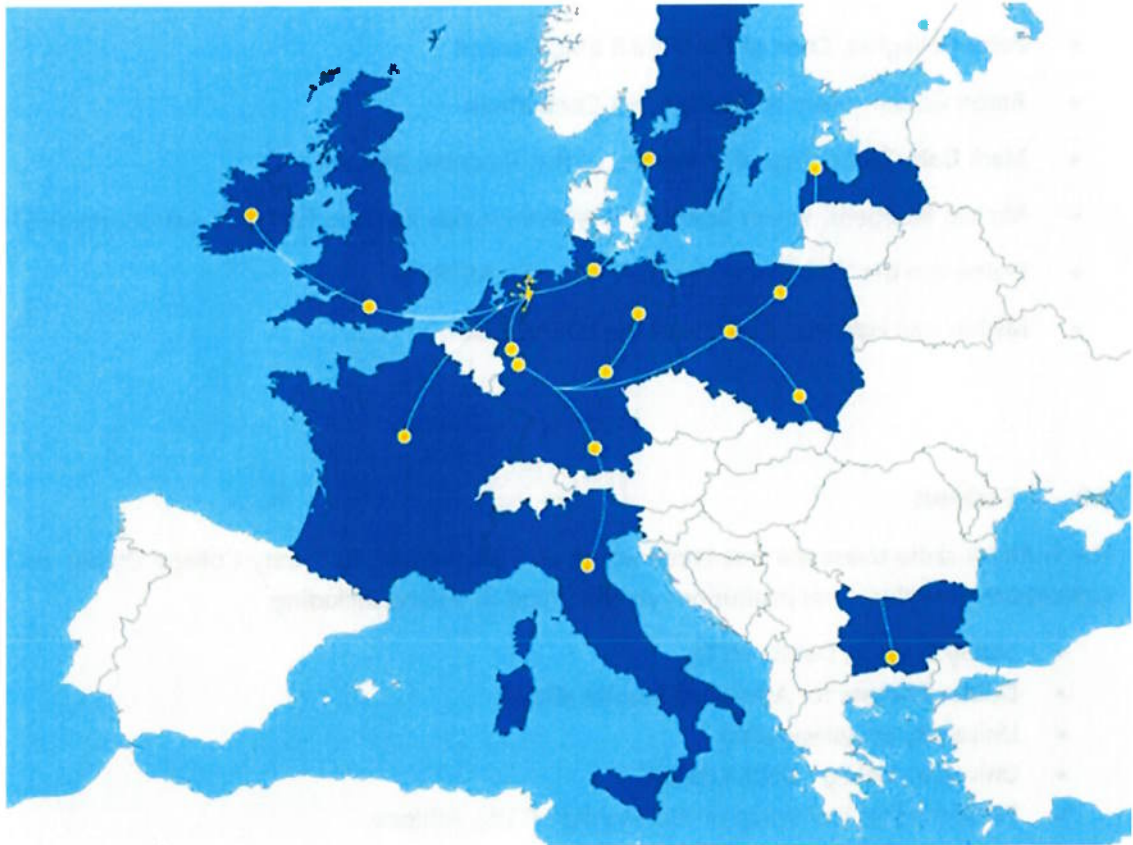
The Irish LOFAR station forms the westernmost element of the pan-European network of such telescopes extending from Birr, Co. Offaly in the west to Latvia in the east. New stations are being built in Bulgaria, Italy and the Czech Republic over the next 2 years.

The I-LOFAR station operates in two modes:

1. International mode. The effectiveness of any telescope depends on the signal collecting area (larger means more sensitivity) and the diameter of the telescope (where larger means higher resolution). When used in international mode, the station acts as the westernmost station of a network which, when operating together, effectively operates like a single dish telescope with a

diameter of over 1900 km (when the Bulgarian station comes online in late 2026, the effective diameter rises to over 2700 km). This means that I-LOFAR plays a disproportionately important role as it is part of the longest continental baselines, directly contributing to the spatial resolution of the entire European array; without I-LOFAR the sharpest images taken by the network become blurry.

Figure 2.1, below, illustrates the location and context of the I-LOFAR facility within the pan-European LOFAR telescope, a facility of national and international significance. The Irish station in Birr is the Western-most station, thus contributing to the highest resolution capabilities of the European-wide array.



2. Local mode (also known as stand-alone mode). I-LOFAR is heavily used in local only mode by researchers from the I-LOFAR consortium institutions. In this mode of operation, I-LOFAR is mostly used on its own by Irish researchers for space weather monitoring, pulsar timing for gravitational wave studies, detailing of the pulsar emission mechanisms, planetary science, as well as having performed the largest SETI surveys ever performed by any radio astronomy instrument to date.

Figure 2.2, below, is an aerial view of TCD's Rosse Observatory, where the I-LOFAR antennas, both the high-band (above FM band), and low-band (below FM band) arrays, are obvious. Operating stand-alone, I-LOFAR is effectively two telescopes each of approximately 60 metres in diameter.



Over the last decade, a large body of scientific research has been performed using I-LOFAR, in both modes. In addition, having such a world class research facility available in Ireland provides a training ground for the next generation of Irish radio astronomers. As well as maintaining strong collaborative links to the international scientific community a high-talent pipeline has been created. Radio astronomers of international renown are now being developed in Ireland. Some of these astronomers stay (and continue to use I-LOFAR), and many have been recruited by the top radio astronomy facilities in the world. As radio astronomy represents the leading edge of high-performance computing work this system not only produces radio astronomers but is also contributing significantly to the training of data scientists, engineers, and many other technical fields, thus ensuring the impact extends even wider across the broader high skills Irish economy.

I-LOFAR also forms the essential component of Ireland's participation in the LOFAR ERIC (European Research Infrastructure Consortium). An ERIC is a full juridical person and corporation under EU law; the goal of such pan-European entities is the establishment and operation of vital pan-national research infrastructure. There are only 31 ERICs in total and LOFAR is one of only two ERICs that Ireland is involved in. LOFAR ERIC is thus a project of national importance for which Ireland, and Ireland has an international obligation to maintain the operations of LOFAR. Additionally, in the Irish context, I-LOFAR is a unique and key facility enabling North-South research collaboration due to the participation of Armagh Observatory and Planetarium in the I-LOFAR Consortium.

In terms of the international development and based on the success of LOFAR from the Irish perspective, Ireland is also considering membership of the Square Kilometre Array Observatory (SKAO) project; SKAO in the Southern Hemisphere and LOFAR in the Northern Hemisphere will, for the 2030s and beyond, be the

leading radio astronomy facilities in the world. This increased standing of Irish scientists in this highly technical, highly rewarding field, would not be possible, nor continue, without I-LOFAR.

3.0 OVERVIEW OF RELEVANT PLANNING POLICY

This section provides an overview of national, regional and county level policy that supports the ongoing and effective operation of I-LOFAR.

3.1 Policy Support for I-LOFAR

The **National Space Strategy for Enterprise 2019-2025** outlines the Government's vision for the space-active enterprise sector is for Ireland to develop *'an economically sustainable and expanding space-active industry, delivering quality jobs for the economy of tomorrow'*. The national strategy focuses on harnessing new opportunities within the evolving international space sector, supporting the development of a highly skilled and adaptable workforce, encouraging awareness of space among the public and private sector, developing and maintaining a strategic business.

The Strategy explicitly recognises I-LOFAR as a pillar of Ireland's international research capability and an important space related education programme. The strategy acknowledges that investment in membership of the International LOFAR allows Irish researchers and students to be involved in world class research projects in modern astronomy. Such investment is key in driving awareness of Ireland's activities in space and, importantly, in developing the required skills in Ireland's graduates and future workforce.

More generally, the Strategy seeks to enable and accelerate the ongoing development and expansion of sustainable space-active enterprise and research capacity across Ireland and building international linkages and awareness of Ireland's space capabilities.

Impact 2030: Ireland's Research and Innovation Strategy provides a whole-of-government strategy which seeks to leverage national performance to date, and the establishment of the new Department of Further and Higher Education, Research, Innovation and Science, in order to advance Ireland's Research and Innovation (R&I) system's strategic development. Through this Strategy, Ireland will intensify its commitment to building a knowledge-based economy, building on existing competitive strengths and engaging intensively with the adoption of new and emerging technologies which will be central to long-term economic, environmental and social sustainability at national and regional level.

Flagship initiatives included in the Strategy relevant to the protection and support of I-LOFAR include

15. Our network of research and development centres and facilities will be developed to ensure that Ireland is at the forefront of technological advances, including in advanced manufacturing 5.0, life-sciences and bioprocessing, ICT, food and agri-tech, space and energy sectors, and to embrace and respond to the twin challenges of climate and digital transition.

28. Maximise Irish engagement in the European Research Area and develop other global connections in our pursuit of international collaborations that are underpinned by excellent research and that deliver clear impact.

The **Regional Spatial and Economic Strategy for the Eastern & Midland Area** (RSES) economic strategy seeks to achieve a strong economic base across the Region that is supported by enterprise, innovation and skills. The aim is for a vibrant and diversified enterprise base with strong and healthy clusters bringing

disruptive technology innovations to national and global markets, with a responsive and efficient labour market. To achieve this, the RSES that investing in Science, Technology and Innovation will accelerate the economic and societal return on investment.

The RSES identifies that the Region is home to a wide range of organisations engaged in innovation, such as education institutions and research centres, and recognises this as is a key strength that can be capitalised upon. In this respect, RPO 6.9 of the RSES specifically provides that the Regional Assembly will supports the Regional Enterprise Plans to focus on *'leverage opportunities in big data and data analytics from iLOFAR'*

Table 5.2 of the **Offaly County Development Plan 2021-2027** identifies the *'opportunities to capitalise on I-LOFAR in Birr, for example, in big data and data analytics, recognising Birr as a technology hub based on high quality employment parks and attractiveness of place'* as a key initiative in the overall economic development strategy for the County. In this regard, the significance of I-LOFAR at a Regional level is recognised in the Midlands Regional Enterprise Plan.

Section 5.5.3 of the Development Plan recognises that *'there are leveraging opportunities in big data and data analytics from Irish Low Frequency Array (I-LOFAR), which is the Birr-based Irish station in a European wide network of radio telescopes used to observe the universe at low frequencies, and in this regard the Council recognises Birr as a technology hub'*.

The following Policy and Objective is included in the Development Plan:

ENTP-16 *It is Council policy to support leveraging opportunities in big data and data analytics from Irish Low Frequency Array (I-LOFAR), which is the Birr-based Irish station in a European wide network of state-of-the-art radio telescopes used to observe the universe at low frequencies, and in this regard recognise Birr as a technology hub.*

ENTO-08 *It is an objective of the Council to support leveraging opportunities in big data and data analytics from Irish Low Frequency Array (I-LOFAR), which is the Birr-based Irish station in a European wide network of state-of-the-art radio telescopes used to observe the universe at low frequencies, and in this regard facilitate the development of Birr as a technology hub.*

3.2 Overview of Planning Policy Relating to Appropriate Location of Wind Energy Infrastructure

The **National Planning Framework First Revision** (Revised NPF) acknowledges that increases in population, economic growth, higher levels of food demand, transitioning to a more sustainable energy market and conservation goals will ultimately result in increased competition for suitable land to facilitate these accumulating pressures. However, the Revised NPF recognises that *'some parts of Ireland are more suitable than others for facilitating particular national sectoral aims by reason of physical factors, environmental sensitivities, land capacity and existing settlement patterns'*.

In this respect, National Policy Objective 70 seeks to *'promote renewable energy use and generation at appropriate locations within the built and natural environment to meet national objectives towards achieving a climate neutral economy by 2050'*.

The **RSES** the Strategy supports an increase in the amount of new renewable energy sources in the Region. However, the RSES also establish a need to identify areas suitable for such renewable energy development and have regard to potential impacts on biodiversity, landscape and heritage. Furthermore, it identifies a need *'to engage with, and be responsive to the needs of communities asked to host renewable energy*

infrastructure' and considers the 'need for early stakeholder engagement in relation to renewable energy generation projects is critical'.

Section 3.2.6 of the **Offaly County Development Plan 2021-2027** (Offaly Development Plan) provides that site suitability is an important factor in determining the suitability of wind farms having regard to possible adverse impacts on a range of environmental factors. In this respect, the Offaly Development provides that *'the Council is therefore required to achieve a reasonable balance between responding to overall positive Government policy on renewable energy and enabling the wind energy resources of the Planning Authority's area to be harnessed in a manner that is consistent with proper planning and sustainable development'.*

In this respect policy CAEP-25 provides that *'it is Council policy to encourage and facilitate the production of energy from renewable sources, such as from bioenergy, waste material, solar, hydro, geothermal and wind energy, subject to proper planning and environmental considerations'.* Objective CAEO-03 similarly provides that *'it is an objective of the Council to achieve a reasonable balance between responding to government policy on renewable energy and in enabling the wind energy resources of the county to be harnessed in an environmentally sustainable manner'.*

CAEO-05 provides that 'wind energy developments shall not normally be permitted' in areas outside of 'Areas Deemed Open for Consideration for Wind Energy Development'.

DMS-109 Wind Farms of the Offaly Development Plan outlines relevant development management considerations relating to planning applications for wind energy developments and, in addition to the Wind Energy Statement Designations Map (see below), identifies a range of local considerations to be taken into account in the assessment of any application including the *'impact of the development on radio observatories and broadcast communications in the area'.*

The **Offaly Wind Energy Strategy** (Offaly Wind Strategy) forms part of the Offaly Development Plan. The objectives of the Offaly Wind Strategy generally support wind energy as a renewable energy source which can play a vital role in achieving national targets in relation to reductions in fossil fuel dependency and greenhouse gas emissions. In order to achieve this, the Offaly Wind Strategy identifies key areas within the county that are 'Open for Consideration for Wind Energy Developments' or 'Unsuitable for Wind Energy Developments' based on wind speed, access to the electricity grid and substations, and avoidance of adverse impacts on the landscape and designated site.

The site of the proposed development is located within an Area Not Deemed Suitable for Wind Energy Development. From review of

Section 8 of the Offaly Wind Strategy considers such areas as *'generally unsuitable for wind farm development due to significant environmental, heritage and landscape constraints and housing density'.* While small scale turbines or extensions to existing wind farms may be considered on a case-by-case basis, there is a generally presumption against large scale wind farm development within such areas.

The **Tipperary County Development Plan 2022-2028** (Tipperary Development Plan) also promotes and facilitates renewable energy development, in accordance with the policies and objectives of the Tipperary Renewable Energy Strategy 2016 (forming Volume 3 of the Development Plan). Policy 10 - 1 seeks to:

'Support and facilitate new development that will produce energy from local renewable sources such as hydro, bioenergy, wind, solar, geothermal and landfill gas, including renewable and non-renewable enabling plant, subject to compliance with normal planning and environmental criteria, in co-operation with statutory and other energy providers. The provisions of the Tipperary Renewable Energy Strategy (and any review thereof) as set out in Volume 3, will apply to new development.' [Emphasis added]

The strategic aim of the **Tipperary Renewable Energy Strategy** is to facilitate a low-carbon future in Tipperary by supporting the sustainable development of the renewable energy sector in Tipperary. Having regard to Wind Energy development Policy TWIND 1: provides:

'It is the policy of the Council to support, in principle and in appropriate locations, the development of wind energy resources in county Tipperary. The Council recognises that there is a need to promote the development of 'green electricity' resources and to reduce fossil fuel dependency and greenhouse gas emissions in order to address the global issue of climate change, and to comply with European and International policies with regards to renewable and sustainable energy resources.' [Emphasis added]

Appendix 1 of the Tipperary Renewable Energy Strategy includes a Wind Energy Strategy (Tipperary Wind Strategy) incorporating Map 11 identifying 'Areas Open for Consideration for New Wind Energy Development' or 'Areas Unsuitable for New Wind Energy Development'. The

The proposed development is located within in area designated as 'Areas Unsuitable for new wind energy development'. Policy TWIND 4 defines such areas as *'new wind energy development in these areas is not permitted. These areas have a special or unique landscape character where the main objective is conservation. Where there are existing wind energy developments in these areas, their repowering may be considered appropriate. Any impact on the environment must be low and subject to proper planning and sustainable development, and the guidelines set out in this strategy'*. Policy TWIND 4.13 further provides that *'new wind energy projects will not normally be considered in these areas'*.

3.3 Summary of Policy Context

While the planning policy context is generally supportive of increasing energy output from renewable sources, it is notable that the relevant strategies and policies are unambiguous that some locations are more suitable than others in terms for their capacity to absorb such development. A reasonable balance must be achieved in terms of meeting energy renewable targets in a manner which is consistent with proper planning and sustainable development and adequately protecting established strategic assets of national and international significance in an area.

The proposed development is located within an area designated as not suitable for new wind energy development under both the Offaly Development Plan and the Tipperary Development Plan. Both Offaly's and Tipperary's Wind Energy Strategies, following considered and systematic analysis of a range of environmental and operational criteria and comprehensive public and stakeholder consultation, have deemed the location of the proposed development as not suitable for wind farm development and is therefore a material contravention of both Development Plans.

The planning application seeks to justify the proposed Material Contravention of both Development Plans on the basis of statutory obligations under the Climate and Low Carbon Development Act 2021 (as amended). The Supreme Court Judgement in *Coolglass v An Coimisiún Pleanála* interpreted that section 15(1) of the Act creates a legal test, namely that any decision of a relevant body must fall within the "spectrum" of outcomes that can be regarded as "consistent" with section 15(1) of the Act. This applies 'in so far as practicable'. Paragraph 112: states:

*'It follows that a planning authority is entitled to approach its task on a presumption that **any strategy or development plan adopted is consistent with climate objectives, and that any decision consistent with such a plan and strategy will itself be consistent with those objectives, and***

therefore in compliance with s. 15(1). That is so particularly having regard to the range of outcomes implied by the concepts of consistency, and practicability.'

Paragraph 114 goes on to state:

'More generally, in most cases it will be the case that a project will be entitled to permission, or to be refused, or to have permission granted with conditions, because of the correct application of considerations of proper planning and sustainable development, which themselves have been shaped by the State's plans and strategies for the achievement of the climate objectives, but s. 15 may reinforce that process, and in some cases be decisive.

...It follows that in the planning context, s. 15 need not be addressed by a planning authority of its own motion. However, if the section is relied on in support of an application, an authority should be able to explain why the decision to which it has come is consistent as far as practicable with the climate objectives.'

The proposed development is a material contravention of the wind strategies of two County Development Plans, and the provisions of the Offaly County Development Plan that protect the operation of I-LOFAR. The High Court in Coolglass treated section 15 as a 'comply with' obligation. The Supreme Court held that the obligation is 'insofar as is practicable' that is a lower standard than 'comply with' and 'insofar as possible'. As such, the Coimisiún must afford significant weight to the fact that the development materially contravenes the strategies in two Development Plans and policies and objectives contained in one of those plans to protect the operation of I-LOFAR.

In addition, it is noted that the strategic importance of I-LOFAR and associated research at Birr Castle in terms of Ireland's international research capability and an important space related education programme is acknowledged at a national level and further supported by both the RSES and the Offaly Development Plan. Both policy ENTP-16 and objective ENTO-08 seek to '*support leveraging opportunities in big data and data analytics from Irish Low Frequency Array (I-LOFAR), which is the Birr-based Irish station in a European wide network of state-of-the-art radio telescopes used to observe the universe at low frequencies, and in this regard recognise Birr as a technology hub*'.

The submitted application documents make no reference to the status afforded to I-LOFAR at a national, regional and local level. Significantly, the submitted documents fail to acknowledge the protection of I-LOFAR as provided for under policy ENTP-16 and objective ENTO of the Offaly County Development Plan. Given the high potential for significant adverse impacts on the continued operation of the I-LOFAR facility, the proposed development is also a Material Contravention of policy ENTP-16 and objective ENTO-08 of the Offaly County Development Plan.

4.0 ASSESSMENT OF EFFECTS – EIAR AND APPLICATION DOCUMENTS

Section 15.3.1 of the EIAR (Volume 1) addresses telecommunications links and identifies I-LOFAR as part of the wider LOFAR network. The EIAR acknowledges that I-LOFAR operates in a radio-quiet zone and has requested restrictions on developments that could generate EMF interference. It references a 5 km 'exclusion zone' around I-LOFAR requested by I-LOFAR and goes on to rely on that 5 km reference to determine impact rather than undertaking an evidence-based assessment of impact. It states:

'T1 is at the edge of this buffer (circa 4.96 km from I-LOFAR to closest turbine distance) while the substation and all other turbines are >5 km. Consultation was undertaken with the observatory to inform the assessment of potential impacts. At the time of writing, in relation to Ballincor Wind Farm, no response had been received.'

The EIAR states that wind farm infrastructure 'could, in some cases' produce RFI either by reflection or emissions, however the application focuses entirely on the hypothetical impact of T1 and provides no evidence-based assessment of the cumulative impact of the combined RFI output of all proposed turbines and associated infrastructure within a referenced 10 km 'consultation radius'.

No evidence, modeling, empirical or quantitative assessment is included in the EIAR or the Technical Appendices. In the absence of any evidence presented in the EIAR, it concludes at page 15-14:

'As such, the proposed project has the potential to contribute, albeit marginally, to cumulative RFI levels in the region, depending on the final design and technologies used. No significant residual effect is anticipated'

The assessments undertaken by I-LOFAR have concluded that the potential effects are significant, adverse and permanent, as detailed below.

Prior engagement between I-LOFAR and RWE prior to submission of Ballincor plan

The EIAR makes several references to 'early consultation' undertaken with the observatory to inform the assessments of potential impacts, with no response to date, noting (on page 15-20) that:

'should the project progress to planning approval, further engagement will be pursued to ensure that any technical concerns are addressed.'

I-LOFAR advises that this is factually incorrect. Representatives from RWE Renewables Ireland Ltd. and I-LOFAR have had numerous interactions via e-mail and Zoom/Teams calls prior to and since the Offaly County Development Plan came into effect in October 2021 to discuss proposed wind farm developments. RWE Renewables Ireland Ltd. were made fully aware of: (i) the impact the wind farm as proposed would have on the operations of the I-LOFAR telescope facility; and (ii) the mitigations necessary to manage these, as communicated to I-LOFAR by colleagues within the wider European LOFAR community.

I-LOFAR further note that the applicants would have been fully aware of the submissions made by the I-LOFAR consortium to the Offaly County Development Plan, and the amendments to DMS-109 of Chapter 13 Development Management Standards of the County Development Plan 2021-2027 requiring the applicants to have performed a risk assessment to the radio observatory with measures implemented to ensure no interference to the telescope's operational integrity.

5.0 LIKELY SIGNIFICANT ADVERSE PERMANENT EFFECTS AND POTENTIAL MITIGATION

This section provides a summary of the likely significant, adverse and permanent impacts, and potential mitigation measures.

5.1 Likely Significant Impacts

There are two primary ways in which a wind farm can cause harm to a sensitive radio telescope, addressed in sections 5.1.1 and 5.1.2, below.

5.1.1 Direct Emissions from the Wind Farm

The first way in which wind farm can harm a radio telescope is by direct emissions from the windfarm of harmful interference. This increases with turbine numbers and with increased numbers of developments.

Preliminary assessments carried out by the I-LOFAR consortium, in collaboration with colleagues at ASTRON who operate the ERIC LOFAR telescope across the European network, indicate that this proposed development poses a threat to I-LOFAR by way of direct harmful interference, that is interference originating from the wind turbines and their sub-systems. These preliminary results are shown in **Appendix A** of this submission, along with results modelled for the same development with mitigation applied to 35dB below EN 55011 standards

There are many potential causes of direct harmful interference into a radio telescope from a windfarm. All can be mitigated by increased distance, lower nacelle height with respect to the telescope, and blocking terrain features between the telescope and the development. The preliminary assessment indicates no significant terrain blocking features between this development and the I-LOFAR site.

Remaining mitigation can be achieved by careful design of the windfarm systems to ensure Electro-Magnetic Compatibility (EMC) between the wind farm and the telescope. It should be noted that, although wind farm components must conform to certain industrial standards designed to ensure that they don't cause harmful interference to similar systems, a radio telescope is orders of magnitude more sensitive to unwanted signals compared to industrial systems. **EMC between a wind farm and a radio telescope has been successfully achieved at the LOFAR core at Dwingeloo in the Netherlands where, through careful design of all aspects of the turbines used, coexistence has been possible.** A non-exhaustive list of potential sources of harmful interference from a windfarm include:

Table 5.1 Potential Sources of Harmful Interference

Threat source	Possible mitigation
The inverters	These are a significant threat to I-LOFAR due to high rates of change in both currents and voltages with high associated RFI generation potential values and the possibility of RFI radiating from the long cable lengths from the generator nacelle. • All cables should be appropriately filtered and shielded. • The inverter should be fully shielded and at the base of the tower – nacelle just has the generator placing inverters as far away from the station and as low as possible.
All electronics in the nacelle	EMC tight cabinets for everything.
RFI radiating from cables	Many different types of cables are involved, but generally: • Very careful filtering on all long cables • Shielded twisted cables where appropriate. • No pig tails should be used on cable shielding (360-degree connection). • Cable shielding to be grounded at both ends. • All cables to be in EMC cable trays. • Digital communications should be at least via shielded CAT7 cable. • RFI mitigation applied to the power cabling between nacelle and base of the tower.
Aviation lights	Custom aviation light (SMPS replaced with linear PSU, no PWM used). No strobe, use the Nordex LOFAR approved LED type with linear power supply (no PWM).
Monitoring systems (weather etc.)	As these are normally mounted at hub height or greater, it is important that communications from these systems should not radiate RFI. Careful EMC design should apply to all such systems and their associated cabling (both power and communications). No switch mode power supplies to be used.
Inadequate grounding & EMC bonding	Normally grounding is done for safety/lightning protection.

	• To enhance RFI protection, multiple ground paths should be employed to lower the inductance in the ground path. • Sections of the tower should be fully EMC bonded, ideally the tower is a Faraday cage. Tower sections should be equi-potentially bonded to the ground conductors. • All bonding to be made between similar metals, where dissimilar metals must be bonded, materials should be selected for galvanic compatibility and protected from moisture. • Bonds should be installed in accessible locations to facilitate testing and maintenance.
Yaw motors	Soft start for yaw motors with shielding for motor housing & cables if PWM controlled.
Switching transients from contactors.	Snubber circuits for all contactors to reduce switching transients.
Lighting.	No fluorescent lighting in the nacelle, LED lighting, if used on the site, should be powered by means of a linear regulator rather than an inverter (no PWM control).
Intra-turbine communication.	Any communications to/from/between turbines should be via optical fibre ethernet.
RFI leakage from turbines	Gaps to be minimised and dimensionally unsuited to act as 'slot antennas' in the LOFAR frequency range as well as at any other protected astronomy band . While the LOFAR arrays are the largest telescopes currently in operation, the LOFAR band is not the only part of the spectrum used for scientific research at the Observatory. Any mechanical discontinuities (doors etc.) should be made RF tight when closed by suitable gasketing.

There are technical solutions to all the above issues which should be applied to ensure Electro-Magnetic Compatibility. These must be applied before development commences. In the Netherlands, at a development whose closest turbine is c. 4.3 km from the telescope, these issues were largely solved by use of a turbine system especially developed to address the problems.

To ensure strict coordination and collaboration between the parties going forward, a legally enforceable covenant was also signed to ensure no problems through the life of that project.

An additional impact of that development was the ongoing need for monitoring of the development to ensure the agreed limits are being met. This had ongoing cost implications in terms of telescope time and people. It is to be expected that the same would be required at I-LOFAR.

Direct harmful interference poses a particular problem for calibration of the I-LOFAR telescope which degrades observations with the full LOFAR system on a continent-wide basis. Additionally, direct harmful interference severely degrades the many observations taken with the ILOFAR station only.

5.1.2 Scattering and Diffraction of Terrestrial Transmissions

The second way in which wind farms can result in harm to radio telescopes relates to the scattering and diffraction of terrestrial transmissions (DAB broadcasts etc.) from the turbine structures. This allows signals to reach the telescope which would otherwise not be seen. Experience in the Netherlands has shown this to be a significant issue. Additionally, sources of natural radio emission in the sky rising or setting or near the wind farm, and any terrestrial broadcasts *behind* the wind farm as seen by the telescope, will also appear at the telescope modulated by the motion of the turbine blades. The only mitigations in this scenario are distance and lower maximum height of blade tips with respect to the telescope. Blocking terrain features, largely absent in this development, also help.

It is important that the applicant provides the assessments and information set out below and engages positively with I-LOFAR prior to the Coimisiún determining this application, and to state and commit to implementing appropriate mitigation measures at the design and operational stages should the applicant demonstrate to the satisfaction of the Coimisiún be satisfied that mitigation is possible. Post-development engagement only would not be acceptable.

5.2 Detail of Further Information Required

On the basis of the information presented in this submission, it is evident that significant additional information is required in order to identify, describe and assess all likely significant direct and indirect impacts on the operation of I-LOFAR as identified in this submission, that presents an evidence-based assessment of the magnitude of those impacts having regard to the baseline context, and includes proposals to mitigate those impacts to acceptable levels substantiated by appropriate data and analysis, and evidence of their successful use in comparable contexts.

Accordingly, it is imperative that the Applicant is requested to provide significant further information for the following reasons:

- To enable an assessment by An Coimisiún of the efficacy of proposed mitigation measures that are reasonable, feasible and can be implemented.
- To clearly detail and articulate in the EIAR the proposed mitigation measures to which the Applicant is committing and will be obliged to implement at its own cost in the event that the project proceeds.
- To clearly detail monitoring that will be undertaken by the Applicant for the duration of construction and operation, and further mitigation measures that may be necessary in the event that the mitigation measures are not effective.

Accordingly, An Coimisiún is respectfully requested to issue a Request for Further Information that requires the applicant to submit the following:

1. Submit an evidence-based assessment, prepared by relevant and competent experts, of the RFI risks of the wind farm in its entirety for both indigenous and scattering modalities, and to determine mitigations in both cases so as to ensure the RFI impact is within acceptable levels as defined by radio science experts in the LOFAR ERIC, specifically that *the wind farm may only be permitted if the turbines and their associated equipment radiate at least 35 dB below the norm for EN 55011 class A equipment*. Additionally, a proper assessment of the impact of scattering from DAB and all other transmitters in the Midlands on the telescope operations, caused by the presence of wind farm infrastructure (turbines and their associated equipment), must be undertaken.

This assessment must identify and address:

- 1.1 All potentially harmful impacts, including, but not limited to, those identified in Table 5.12, above.
 - 1.2 All potential transmitters external to this development, including, but not limited to, DAB, with potential to be detected at the telescope modulated by the blade motion of the turbines.
 - 1.3 The applicant should supply emission spectra from 30MHz upwards for the system components and for a complete turbine system. The spectra should be taken in accordance with EN 55011/CISPR-11 Group A, with measurements taken at 10m or 30m from the systems, to allow independent third-party assessments. Spectra of both quasi-peak and broadband emission should be included.
2. Submit a revised EIAR that identifies, quantifies and assesses those impacts, and proposes mitigation measures if available, the measures required to implement those mitigation measures, and a clear commitment by the applicant to the implementation of those measures to ensure such mitigations can and will be implemented.

This assessment is required prior to any decision on the application for the following reasons:

- c) To enable an assessment by An Coimisiún of the potential impacts and the efficacy of proposed mitigation measures that are reasonable, feasible and that can be implemented.
- d) To clearly detail and articulate in the EIAR the proposed mitigation measures to which the Applicant is committing and will be obliged to implement at its own cost in the event that the project proceeds.
- e) To clearly detail monitoring that will be undertaken by the Applicant for the duration of construction and operation phases, and further mitigation measures that may be necessary in the event that the mitigation measures are not effective.

The information required to undertake the necessary assessments, to specify mitigation measures and to demonstrate the efficacy and practicality of those measures.

6.0 CONCLUSION

I-LOFAR is the primary radio astronomy facility in Ireland and operates as part of the pan-European LOFAR telescope. The station is a nationally and internationally important element of strategic research and development infrastructure across a broad range of scientific, educational, research, commercial, technological and security sectors. It benefits from a high level of national and county level protection, including national and county level planning policy.

I-LOFAR is an established and state-funded infrastructure asset of national and international importance and is the only one research grade radio telescope in the country. It has very specific locational requirements and cannot be relocated. Both relevant County Development Plans designate the area in which the proposed windfarm is located as unsuitable for wind energy development and the Offaly Plan protects the operation of the facility. There are many potentially suitable sites for windfarm development that will not affect the operation of I-LOFAR, a fixed and immobile strategic asset, and that do not materially contravene statutory land use plans. As such, I-LOFAR must be afforded a high level of protection from 'footloose' development that has the potential to adversely affect its operation, and the precautionary principle must apply.

I-LOFAR is extremely sensitive to the incredibly faint radio emission from a diversity of astronomical sources. A detailed evidence-based analysis by competent experts of the EIAR and application documents concludes with a high probability of certainty that the Ballincor Wind Farm as currently proposed presents an unacceptable adverse risk to the performance of the I-LOFAR radio telescope, and that risk is so significant as to make the facility redundant as both a stand-alone scientific instrument for indigenous research and research-led training projects. There is also a risk to Ireland's participation in the LOFAR ERIC, jeopardising significant investments to date by Research Ireland, DFHERIS, their predecessors, and several HEIs across the island of Ireland.

Section 5.2 and Table 5.1 above identify the information necessary to allow the applicant, the Coimisiún and the I-LOFAR Consortium to properly assess impact and to identify mitigation measures that are reasonable, feasible, will be effective, and will be the responsibility of the developer to implement.

In the event that the Applicant does not demonstrate to the satisfaction of An Coimisiún that effective mitigation measures can be implemented at its expense, I-LOFAR reluctantly requests An Coimisiún to refuse permission, having regard to the likely significant, adverse and permanent impact of the proposed windfarm on the ongoing operation of the I-LOFAR radio telescope, and the failure of the EIAR and application documents to adequately identify, quantify and assess, those impacts, and to propose potential mitigation, if possible.

We trust that An Coimisiún will afford due regard to the matters raised in this submission and we look forward to a favourable outcome.

APPENDIX A

PRELIMINARY IMPACT MODELLING

We have performed preliminary modelling of the impact of direct emissions from the proposed wind farm, which is located to the South of the Observatory, as shown in Fig A.1.

Figure A.1: Location of the proposed Ballincor wind farm and I-LOFAR.



An analysis of the effects of RFI emission **from the proposed development only** on the I-LOFAR station is given. An analysis, made under the same conditions of the same development, but with all turbines mitigated to emit at 35dB below EN 55011 standards or better, is also shown.

It is important to note that this analysis does not deal with diffraction/reflection from the installation structures of other potential interfering radio emission (terrestrial or otherwise). The analysis was made using code developed by ASTRON who operate the LOFAR ERIC. The code uses an implementation of ITU P.452-18 (<https://www.itu.int/rec/R-REC-P.452-18-202310-I/en>) which is a procedure for the evaluation of interference between stations on the surface of the Earth at frequencies

above about 100 MHz. The maps shown for frequencies below 100 MHz are therefore indicative only, although experience in the Netherlands indicate that they are correct to within only a few percent.

The contour maps shown in **Figures A.2 and A.3** below are top-down synoptic views, which place I-LOFAR at the centre. The Ballincor development is marked in the 7 o'clock position (south-southwest). These maps are made with the assumption that the telescope at the centre detects a particular maximum threshold level of interference¹ from the development.

Using the assumption that the windfarm emits at the maximum limit allowed in EN 55011, we calculate how many dB below that limit a windfarm would have to emit to keep the same threshold level at the telescope for each location (pixel) in the map image. That process accounts for:

- free space path loss (a function of distance) & terrain between telescope and **each map pixel** (taken from Shuttle Radar Topography Mission data).
- reduced sensitivity of the LOFAR antennas as a function of elevation angle from that pixel (LOFAR antennas are less sensitive looking towards the horizon).

Elevation angle increases as distance to the telescope decreases and that fact, together with the reducing path loss, means that as distance between telescope and development reduces, the interference from the windfarm must decrease so as not to breach the threshold at the telescope.

The colour-coded contour maps are made for a number of observing frequencies. The contour steps represent 5dB levels. It can be seen that the contours are frequency-dependant.

A Ballincor-like development would need to be located in the darkest blue sections of the map in Fig. A.2 if emitting at the EN 55011 limits, to not breach the threshold limit at the telescope. If we move the development closer to the telescope, for every change in contour level, the emissions would have to drop by 5dB so as not to violate the threshold. For the Ballincor location, at 110 MHz, the development is shown in the light green coloured contour zone. This suggests that, at that frequency, the development emission levels would have to be up to 30dB below the EN 55011 limits. At 240 MHz, it would need to emit at no more than 40 dB below those limits.

¹ This level is a flux density of 10Jy (1.0×10^{-25} W/(Hz.m²)) at the telescope, the upper limit of acceptability in terms of stand-alone telescope operation.

Figure A.2: This shows the unmitigated scenario (assuming turbines are operating at EN 55011 limits).

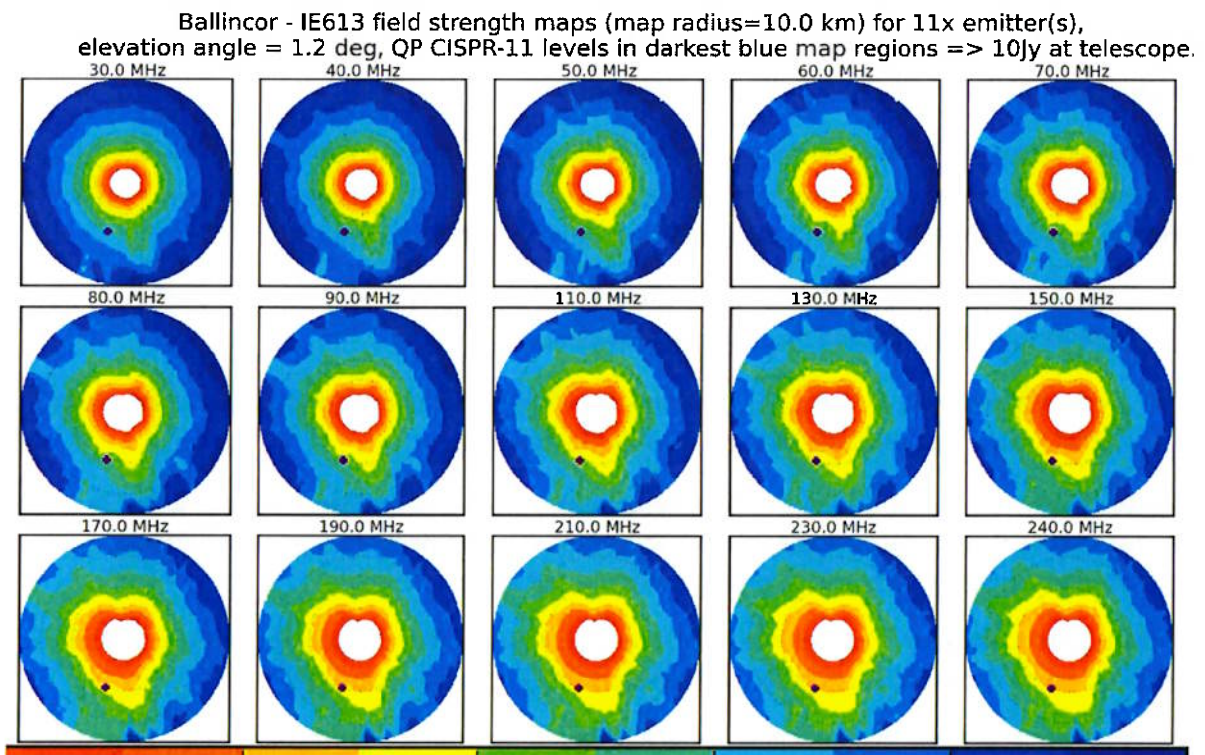


Figure A.3 below shows the scenario where mitigations (as described above in section 5) have been implemented to the level of at least a 35dB below EN 55011 limits. In this map, the Ballincor windfarm emitting at 35dB below EN 55011 limits would be less likely to breach the telescope threshold required for stand-alone operation. As noted above in the main text, this has been achieved in the Netherlands near the LOFAR core. The relative improvement is large and, based on our preliminary modelling, would be less likely to impact the stand-alone telescope operation.

