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Truth | Justice | Sustainability

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An Coimisiún Pleanála (formally k/a An Bord Pleanála),
64 Marlborough Street,
Dublin 1,
D01 V902

21st November 2025

Planning Reference:	PAX07.323761 – 9 no. Wind Turbines
Received Date:	29/09/2025
Submissions By:	21/11/2025
Applicant/s:	**Neoen Renewables Ireland Limited**
Dev. Address:	located within Cloondahamper, Cloonascragh, Elmhill, Cooloo, Lecarrow, Dangan Eighter, Lissavally and Slievegorm, Co.Galway [www.cooloowfplanning.com]
Brief Description:	'Construction of wind energy development and all associated works'
URL:	https://www.pleanala.ie/en-ie/case/323761 **(9 no. Turbines)**
Submission Fee:	€ 50.00

Dear Sir/ Madam

Note that there are **42 pages** (+ 22 page chapter on Infrasound) in total to this submission inclusive of the cover page.

At the outset, it is considered that this application is **premature** pending the awaited updated **guidelines** for utility scale solar instillations. It is further premature pending a full **national led SEA assessment** of utility scale wind instillations.

We are aware that numerous other submissions and reports are also being submitted by or on behalf of other groups. We hereby adopt all of these other submissions as part of our submission.

Yours faithfully,

Kieran Cummins

SUBMISSION re. PAX07.323761 re 9 Wind Turbines by Neoen Renewables Ireland Limited

APPLICATION

We are alarmed at the way this application is displayed in the website of *An Coimisiún Pleanála*, which merely states: '***Construction of wind energy development and all associated works***'. There is no mention of how many turbines! Why? A reader is obliged to go searching for this information. This is unacceptable.

We eventually found the project description on the Applicants Planning Notice which states as follows: -

"In accordance with Section 37E of the Planning and Development Act 2000 (as amended), Neoen Renewables Ireland Ltd. gives notice of its intention to make an application to An Coimisiún Pleanála for a ten-year planning permission in relation to the following proposed development in the townlands of Cloondahamper (Blake), Cloonascragh, Elmhill, Cooloo, Lecarrow, Dangan Eighter, Lissavally and Slievegorm in Co. Galway which comprises a renewable energy development as defined by The European Union (Planning and Development) (Renewable Energy) Regulations 2025.

The proposed development will consist of the provision of the following:
(i) 9 no. wind turbines with the following parameters:
- *Total turbine tip height of 180 metres;*
- *A rotor blade diameter of 150 to 162 metres;*
- *A hub height of 99 to 105 metres;*

(ii) Permanent turbine foundations, hard-standing and assembly areas;
(iii) Underground electrical (33kV) and communications cabling;
(iv) 1 no. temporary construction compound (including site offices and welfare facilities);
(v) A meteorological mast with a height of 100 metres, security fencing and associated foundation and hard-standing area;
(vi) 1 no. new site entrance on the R332 in the townland Lisavally;
(vii) 1 no. new access and egress point off the L6056 Local Road in the townland of Dangan Eighter;
(viii) 1 no. new access and egress point on to an existing access track in the townland of Dangan Eighter;
(ix) 2 no. new access and egress points off the L6301 Local Road in the townland of Cooloo and Lecarrow;
(x) Upgrade of existing site tracks/roads and provision of new site access roads, clear span crossings, junctions and hard-standing areas;
(xi) A new temporary access road from N63 national road and to R332 Regional Road in the townland of Slievegorm to facilitate the delivery of turbine components and other abnormal sized loads; (xii) Demolition of an existing derelict house and adjacent outbuilding in the townland of Cooloo; (xiii) Peat and Spoil Management Areas;
(xiv) Tree felling and hedgerow removal;
(xv) Biodiversity Management and Enhancement measures; (xvi) Site Drainage;
(xvii) Operational Stage site signage; and
(xviii) All ancillary apparatus and site development works above and below ground, including soft and hard landscaping.

A 10-year planning permission and 35-year operational life of the wind farm from the date of commissioning of the entire wind farm is sought (other than temporary and permanent works specified above).

A design flexibility opinion issued by An Coimisiún Pleanála on 19th September 2025 accompanies this application. The details unconfirmed in the application are the turbine rotor diameter and hub height. The range of parameters under which the turbine dimensions will fall are specified on this notice and in the design flexibility opinion that accompanies this application.

This development is covered by the provisions of the Renewable Energy Directive III (Directive (EU) 2023/2413) and it is important to note that the planning application may be subject to section 37JA of the Planning and Development Act 2000, as amended. When a notice issues in accordance with section 37JA(b), the provisions of article 216A of the Planning and Development Regulations 2001 to 2025 shall apply.

An Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS) have been prepared in respect of the proposed development and accompany the planning application. The EIAR assesses the proposed development, as specified above, as well as integral elements of the wider project consisting of grid connection and battery storage infrastructure which constitutes a 110kV electrical substation and battery energy storage system in the townland of Dangan Eighter, Co. Galway and underground electrical cabling in the townlands of Lissavally, Dangan Eighter, Dangan Oughter, Polladooey, Slievegorm, Dangan Beg, Sunhill, Derreen, Moyne, Newtown, Abbey, Feagh West, Garra, Ballina, Gortbeg, Ballynastuckaun, Doonbeg, Rathmore, Ballindery, Ballykeaghra and Cloonascragh, Co. Galway. The grid connection and battery storage infrastructure will be the subject of a separate, future planning application to the relevant consenting authority.

The planning application, EIAR and NIS may be inspected free of charge or purchased on payment of a specified fee (which shall not exceed the reasonable cost of making such a copy) during public opening hours for a period of seven weeks commencing on the 3 rd October 2025 at the following locations: ..."

PRELIMINARY ISSUES

1. Before getting into the planning application per se, we are obliged to make some general observations. These applications are grossly unfair and unreasonable on any community. The following aspects are very troubling indeed: -

    a. When simultaneous applications (even by different applicants) are lodged, it places the public and NGO's under enormous pressure in that they have to wade through very large volumes of information in a **very short time frame** of weeks and devote enormous amount of their precious time to address these. The applicants on the other hand had no time limits when preparing their application. This is manifestly unfair and unreasonable.

    b. The public / NGO's also has to pay submission fees on all of these thereby further stretching their resources. Aspects of this may well in itself be in breach of the Aarhus convention and we question whether aspects of this is an abuse of process? Article 6 the Aarhus Convention and of the EIA Directive require early, informed, and effective public participation.

2. Given the very tight timeframes coupled with the volume of documents, which had to be examined, it has been very difficult to prepare appropriate commentary the application. We are not resouresed in terms of time, professionals or financially to adequately assess and comment on the within application to the standard we would like to have done. There is much more we would like to have stated in our submissions, but time limitations meant that we were unable to conduct the necessary research to do so. As these submissions are rather hurried, its inevitable that there will be some omissions and some grammatical errors and so we ask the reader to kindly bare these factors in mind.

3. Over the years, we have repeatedly asserted over the years that EIAR's, which are prepared directly by a developer/ applicant or their agents, are in our opinion unreliable, self-serving and contrived statements in support of a given development. We have found the current application/s to be particularly so in that respect and in our opinion to some extend glamorises an operation that is anything but glamorous. What EIAR's omit to state is also of concern. In this case for example we were unable to find any reference infrasound or the sustainability of finite resources. In summary we remind the statutory authorities of their duty of care to each individual, the wider community and to the environment.

HEIGHT

4. The height of the proposed turbines is stated to be ***180m***. This is unacceptable and un-in-keeping with this area of the midlands.

5. Wind turbines deliver intermittent energy and have to be backed up by dispatchable sources of energy such as gas, etc. Generations to come will no thank us for our wanton wastage of these resources and leaving them with little or none.

6. The applicants attempt to justify the proposal on the basis that the country must meet renewable energy targets. We take issue with the way this is presented. First and foremost the application is made by a commercial company presumably in the expectation of exploiting the very favorable grant regime whish is currently in place and also to at value to its capital investment. We have previously seen some developments sold on when built. There is also none of the issues of being visually obtrusive.

7. We are disappointed to note that other forms of renewable energy such as Deep Bore Geothermal Energy are not mentioned. We will be talking further about Deep Bore Geothermal Energy later in this submission, but for now it suffices to state that we believe that Deep Bore Geothermal Energy is far more efficient than Wind Energy, the later of which is currently heavily supported by grants which we believe is the real purpose of the current spate of applications here and elsewhere. Curiously we were unable to find ANY reference in the planning application to this form of energy!

8. Please note that we only had a very short timeframe of a few weeks to review the EIAR. Given the size, volume and complexity of the documents presented, we are commenting from a very high level. It is manifestly unfair to expect a community to analyse such a volume of documents in such a short time frame. This compares with the years the applicants had to prepare such documents coupled with a very large team of paid people. Notwithstanding, we make the below submissions based on a rather cursory review of the EIAR and related documents presented by the applicants.

9. **Grants**: We are aware that there are significant grants available for the construction of wind turbines. We believe that they are completely unsustainable without such grant aiding. We therefore submit that it is unethical to use so large amounts of finite natural resources constructing machines, which would otherwise be unviable. We also consider that the provision of grants to aid one form of renewable energy over other forms of meritorious renewable energy gives an unfair advantage and artificially makes one form of energy more attractive than another. We are mindful of the exclusion of Deep Bore Geothermal energy in this context. Available evidence demonstrates that Deep Bore Geothermal energy is far more sustainable than wind.

PRELIMINARY LEGAL MATTER – SUBSTITUTE CONSENT

10. We were unable to find any planning consent for the existing development which consists of peat extraction on cut-away raised bog.

11. The case re Derrybrian wind farm should also be noted in this regard.

    C-215/06: Commission v. Ireland: Failure of a Member State to fulfill obligations – No assessment of the environmental effects of projects within the scope of Directive 85/337/EEC – Regularisation after the event not permissible under EU law where E.I.A. and A.A. should have been prepared prior to development. By failing to adopt all measures necessary to ensure that the development consents given for and the execution of wind-farm developments and associated works at Derrybrien, County Galway were preceded by an assessment with regard to their effects in accordance with Articles 5 to 10 of Directive 85/337/EEC, Ireland has failed to comply with the obligations that it has under Articles 2, 4 and 5 to 10 of the said Directive 85/337/EEC.

    An application was later made to *An Bord Pleanála* for substitute consent in an attempt to regularise the issues at the Galway side, but this was ultimately declined and we understand that the wind turbines have since been turned off and are awaiting removal.

Galway County Council
Substitute Consent Application
Bord Pleanála Case reference: SU07.308019
Applicant: Gort Windfarms Limited
Lands at: Coppanagh, Slieveanore, Loughatorick North, Boleyneendorrish, Kilbeg, Toormacnevin, Funshadaun, Derrybrien North, Derrybrien South, Bohaboy, Derrybrien West, Derrybrien East, Derreennamucka, County Galway.
Decision: Application refused
Date signed: 04/02/2022
https://www.pleanala.ie/en-ie/case/308019

We ask An Coimisiún Pleanála to carefully assess this application to satisfy itself that there are no elements, which may require substitute consent.

Without prejudice to the above and to our view this application cannot be considered until the previous use and the current planning issues have been determined, we now make the following observations on the current application.

12. There was a myriad of other issues, which, we submit this proposals should be declined. Issues which we feel this developments should be refused on include: -

    a. Adverse affect to Tourism and Amenity,
    b. Adverse affect to local amenity and of peoples enjoyment of the area and of their private homes,
    c. HEALTH AND SAFETY: Infrasound, etc
    d. Landscape and Visual across a very wide area,
    e. Biodiversity (in addition to bats),
    f. Archaeology, Architectural and Cultural Heritage,
    g. Landscape Character Assessment,
    h. Various legal issues,
    i. Drainage and wells,
    j. Disruption to Utilities
    k. Devaluation,
    l. THE PROPOSAL is NOT SUSTAINABLE
        i. **STEEL,**
        ii. **CONCRETE,**
        iii. **ROADS,**
        iv. **RARE EARTH METALS (MAGNETS in Machines, etc),**
        v. **Human Rights issues regarding the sourcing of rare-earth metals such as Cobalt, Neodymium, etc**
        vi. **The FUEL (the amount of diesel required in the construction),**
        vii. **Aggregates required for internal road network and foundations,**
        viii. **Sporadic nature of wind power (intermittent energy),**
        ix. **Spinning Reserve,**
        x. **Efficiency of Wind Turbines,**
        xi. **Dependant on Grants/ Subsidies for viability,**
        xii. **RoCoF**
    m. Other Sources of Alternative Energy. Why isn't Deep Bore Geothermal considered?

SOURCES OF AGGRIGATE

13. **Where is the aggregate to come from?**

    a. Further to the above, sourcing such an enormous quantity of aggregate would pose enormous challenges. Aggregate is a major constituent of concrete. Aggregate will also be required to construct all the hard standing areas and access roads. It is submitted that this is squandering of national resources.

b. Much of the aggregate on the market currently is from unauthorized/ illegal developments. Sources needs to be established with certainly.

c. The sighting of turbines should be in a situation where naturally occurring bedrock can be utilised, obviating the need for the requirement of such vast amounts of concrete and aggregate. Furthermore, in addition to aggregate, sand and gravel are also component constituents of concrete. Through our experience and understanding of the quarry industry, we know that supplies of sand and gravel are rapidly dwindling. It is therefore essential that such schemes be situate on naturally occurring bedrock!

ESKERS

14. Most of the sand and gravel requirements in Ireland come from Eskers laid down in the last Ice Age. Sadly in the space of no more that about 2 generations, we have near exhausted all our reserves from these eskers without any thought for future generations. The situation is so bad in the UK and China (to mention but two other countries) that they have now resorted to dredging estuaries in an effort to get sand. Being the principle constituent of concrete, to see so much buried under wind turbines which will without any doubt become white elephants is utterly crazy.

HABITAT'S

15. **Stability of Foundations**: We raise concerns about possible adverse affects to the stability of foundations as a result of the proposed excavations necessary to accommodate the proposed wind turbines. This is a significant issue given the low-lying topography of the surrounding landscape. The removal of large parts of the bog and replacement with hard surface will naturally mean that essential soakage area will be removed. Also given the amount of road network required to service the development, it is submitted that newly constructed roads comprising aggregate will largely be impermeable and thereby act as a barrier to drainage. This is a cause of great concern for local residents. We therefore submit that the proposed development is not in accordance with proper planning and sustainable development.

16. It is submitted that the excavations necessary to lay infrastructure i.e. haul routes and service roads together with foundations will likely have an adverse affect on the hydrology of the area. It follows that excavation the naturally occurring porous material and replacing it with hardcore will almost certainly give rise to trapped bodies of water. The large foundations necessary to ground such large turbines may also give rise to displacement of significant volumes of water.

17. Many of the residents also take issue with the amount of traffic that would be necessary to ship so much excavated material out and ship in very significant quantities of aggregate together with the machinery and component parts of the turbines themselves.

18. We must further caution about the removal of peat and interference with bog land. It is not as simple as stating that a certain % of land will be taken up by the wind turbine equipment itself. Interference with a bog may in itself effect the whole bog. We have seen what happened at the Derrybrian site in Galway, were excavations were being conducted to facilitate a wind farm and which caused significant subsidence. This later gave rise to a significant case brought against Ireland by the European commission. We must therefore caution about interference in any way with bog land and the groundwater table.

19. It is appropriate to make a general observation on Atlantic Salmon at this point. We understand that over the last 10 or so years, numbers of returning Atlantic Salmon have been massively dwindling. I had the privilege of meting the late *Éamon de Buitléar* in 2010 and this was the one issue that really concerned him. He spoke at length about this. It is therefore submitted that the wider river catchment area be scrutinised for records and evidence of Atlantic Salmon. We urge the utmost of caution about any development which may in any way negatively impact on Atlantic Salmon.

20. Wind turbines affect bats in a number of different ways. Striking is perhaps the most common and most obvious, but a lesser-known significant issues is that bats lungs may explode under pressure from the turbines. This also causes significant fatalities. Accordingly we raise concerns about the compatibility of the current proposals with flying bats.

SCALE of the current proposals

21. It is considered helpful to demonstrate the scale of the proposals by reference by reference to the below photograph.

This is in Bellacorrick, Co. Mayo

22. The above photograph shows wind turbines of 167 meters in height beside the small turbines of the 1992 ESB/ *Bord na Mona* development, situated in forestry on a flat landscape with hills in the distance on this side of the development. The smaller turbines, were decommissioned and removed after the larger ones had been built, are tiny in comparison. The nacelle on the smaller turbine clearly demonstrates the enormity of the scale of these **167-meter** high turbines. It is worth noting that the 2006 guidelines were drafted at a time when turbines were much smaller. Note that the current proposals are for turbines some **200 meters** in height; some 33 meters higher again.

23. It would appear that the proposed turbines would cause significant issues for aviators and airplanes. This is hardly surprising as 200 meters translates into 656 feet. To put that in context, it is worth noting he height of some of Irelands' tall structures: -
24. the very tall spire on Trim Roman Catholic church is 208 feet,
25. Dublin's liberty hall with its 16 floors is 193 feet. The currant proposals amount to about 50-story building (nearly half the height of the Empire Estate building in New York).
26. Dublin's spire is 121 meters or 396 feet.
    Therefore the height of the proposed turbines is completely unacceptable in a rural landscape.

SHADOW FLICKER

27. We have read elsewhere in the EIAR that measures are proposed to limit shadow flicker. Our information from other parts of he country where such measures are installed is that they don't work effectively. Shadow flicker of any type is unacceptable. This supports our view that turbines should not be permitted within 10 rotor diameters of any residence.

VISUAL

28. Limerick is n the Wild Atlantic way. It follows that great care should be taken about permitting further wind turbines in order to protect the touristic and amenity value. It is clear that the height and number of turbines are very problematic.

29. It is submitted that taller turbines will have an overbearing affect on the landscape. Furthermore, taller turbines have a greater dominating effect on rural dwellings. To suggest that trees could screen structures the equivalent of 50 stories in height is frankly ludicrous. Moreover, trees are often felled to make way for turbines. It should also be borne in mind that the onset of Ash Dieback disease is devastating the population of ash trees in the countryside.

TRAFFIC AND TRANSPORTATION

30. **Diesel** – Particulate matter from diesel fueled trucks; This is considered to be carcinogenic and poses a major health and safety risk to local residents. There will be enormous volumes of diesel consumed both by on-site machinery and by truck movements to and from the proposed development. In addition to the health issues associated with NO2 particulates, there are also significant greenhouse gas emissions.

31. Air Pollution: Particulate Matter [P.M.]. Diesel particulate matter (DPM), sometimes also called diesel exhaust particles (DEP), is the particulate component of diesel exhaust, which includes diesel soot and aerosols such as ash particulates, metallic abrasion particles, sulfates, and silicates. When released into the atmosphere, DPM can take the form of individual particles or chain aggregates, with most in the invisible sub-micrometre range of 100 nanometers, also known as ultrafine particles (UFP) or PM0.1. Exposure to diesel exhaust and diesel particulate matter (DPM) is a known occupational hazard to truckers, railroad workers, and miners using diesel-powered equipment.

32. In 2012, the World Health Organization (WHO) declared the emissions from diesel combustion to be carcinogenic. The WHO also released data showing that more than 7 million deaths are caused by indoor and outdoor air pollution. The black smoke from diesel engines is a part of outdoor air pollution contributed by buses and trucks. A study by a team of international scientists in 2013 noted that diesel smoke consists primarily of black carbon, which has a strong global warming impact on the climate; nearly 3,300 time more than that of carbon dioxide over a 20-year time period. [http://onlinelibrary.wiley.com/store/10.1002/jgrd.50171/asset/jgrd50171.pdf]

33. We were unable to find an analysis of the quantities of diesel fuel (fossil fuel) required together with the environmental and health affects of this. In this regard, we ask the planning authority to conduct a full analysis of these issues. The irony of using so much fossil fuel together with significant quantities of rare earth metals and finite resources to construct an energy source, which is intermittent at best, is not lost on us.

CUMULATIVE EFFECT

34. The cumulative affect of other wind farms in the area should also be considered. In this regard we note the recent grant of planning consent of to the adjoining area of Bracklin (an area that also features in the current application). The one which was recently granted consists of a Wind Farm Development including 9 turbines and all associated works. Specifically we refer to: -
    c. Cloncant; Edenderry
    d. Yellow River
    e. Mount Lucas

35. With regard to **Counties Limerick, Kerry, Cork, Tipperary and Clare**, please clarify what other wind farm applications are: -
    i. applied for ?
    ii. granted ?
    iii. commenced ? and
    iv. in operation ?

36. We raise concerns at the manor in which planning consent for wind turbines is being sought. Other wind farms in Limerick should not have been considered in isolation to all of the others and is evidence of poor strategic planning on the part of the statutory authorities. This is essentially project splitting often referred to at the ***salami principal***. The current application should be examined in conjunction with others within a radius of c.30km.

HEALTH AND SAFETY

37. There have been many newspaper reports about the safety of industrial wind turbines and indeed there is much available evidence of fires and accidents which can be easily sourced on the internet. We invite the planning authority to see for itself just how unsafe industrial wind turbines can be. The information may be assessed at: http://www.caithnesswindfarms.co.uk/fullaccidents.pdf

38. **Infrasound**: Moreover, there is significant evidence from outside of Ireland that Infrasound is an issue for people who live very close to wind turbines. *Dr Mariana Alves-Pereira* of Portugal has written and talked extensively on this issue. Further evidence is also available from *Bruce Rapley, Huub Bakker* and *Rachel Summers*. Curiously we were unable to find any reference in the EIAR to 'Infrasound'.

39. The bog has been dried out over the period of its working life. There have been fires at the bog over the past decades. Post its former use of peat harvesting, non rewetting on turbine sites leading to dry and drained bogs with high growth of highly combustible dry material such as heather scrub. Heather grows taller and more dense in dry bog than it does in wet bog naturally. Consequently, if Bord na Mona/ Powergen are the custodians and operators of this wind-farm, one must inquire as to who is responsible for future fire incidents and how are neighboring properties protected against this expanded and increased risk ? Moreover, if the bog is already historically susceptible to fires in its current state so this proposal must now consider this potential extreme hazard capacity on local dwelling/property holders and the health of the people that live within proximity to this bog if a fire broke out through the inhalation of smoke pollutants. Furthermore, fires on a bog would also pose a risk for the turbines themselves. All the available evidence would lead us to the conclusion that a rewetting of the bog (or large parts of it) would be the more sustainable option and also provide a valuable carbon sink.

40. Have all related **health and safety** issues been reviewed? This should include lightening strikes, storm damage, glare, etc. Are there batteries to be installed? We understand that transformers are often colossal and often weigh up to 70 tons and more. Is the local fire services equipped to deal with fires at the proposed instillation? Please establish risks associated with the following hazards: -
    a. Hazard 1. Shock or electrocution from energized conductors
    b. Hazard 2. Arc faults that spark fires
    c. Hazard 3. Arc flash leading to explosions

AVIATION

41. Please consider safety issues for airfields having regard to the proposed turbines.

TOURISM AND AMENITY

42. A landscape blighted with wind turbines is unattractive to tourists. The proposed height of the turbines in the current application will make them all the more imposing. Parts of Scotland have suffered enormously from inappropriate and indiscriminate sighting of wind turbines, which is having a significant negative affect on their tourism industry. We do not wish to see Ireland follow in he same direction. When people visit such beauty spots, they typically want to view an un-spoilt Ireland.

43. Industrial wind turbines are overbearing and adversely interfere with the landscape visually: this is clearly contrary to Irelands touristic objectives, which have been driven in recent years by Irelands Ancient East together with the Wild Atlantic Way. There is nothing ancient about industrial wind turbines. If tourists wished to see industry, we are sure they would be visiting places such as the Ruhr valley in Germany and such like. Giant industrial wind turbines are clearly incompatible with this objective.

DECOMMISSIONING

44. Of concern is that the large concrete bases to support the turbines are to be left in situ following the end of life and decommissioning of the proposed wind turbines. Such wanton destruction of the landscape is utterly unacceptable.

45. Given the finite nature of sand and gravel which is required to construct the foundations for wind turbines in the first place, it is completely unacceptable that they would be just left there following the end of life of the turbines. We have elsewhere in this submission dealt with the finite nature of sand and gravel, but to reiterate, foundations will have been made up of very large amounts of finite resources including sand and gravel, the later of which come from eskers laid down in he last glaciation. Eskers are rapidly disappearing through extremely aggressive quarrying (much of it unauthorised) to feed the insatiable demand for developments such as wind turbines, which is in of itself; totally unsustainable. Moreover it should be noted that large amounts of rebar will also have been buried in the foundations to strengthen them.

46. Wind turbine blades cannot be easily disposed of. There is evidence from he United States of America where these are cut up and land filled. This can hardly be described as beneficial to he environment. We invite you to check out the following link in this regard: https://www.bloomberg.com/news/features/2020-02-05/wind-turbine-blades-can-t-be-recycled-so-they-re-piling-up-in-landfills

REFUSALS

47. It is considered helpful to examine refusals for similar instillations. It is further submitted that there are similarities in the instant case.

48. **MEATH**: PL 17.238669: Highpoint Communications Limited: *Construction of a 30 metre high lattice telecommunications/3G Broadband support structure, carrying 6 number panel antennas and 4 number RT link dishes, with associated telecommunication cabinets and equipment located at ground level, all enclosed in chainlink fencing and all associated works, plus new section of access track, all at Blackshade Townland, Clonard, County Meath.*

49. REFUSE permission. By comparison to the proposed turbines, the mast alluded to in the above was a minnow. The site was also close to the Royal Canal and was refused '*By virtue of its location adjacent to the Royal Canal*'
    a. *REASONS AND CONSIDERATIONS: By virtue of its location adjacent to the Royal Canal, the proposed development would seriously injure the visual character and scenic amenities of the area in general and the canal in particular. As such it would be contrary to the advice given at section 4.3 of the Guidelines for Planning Authorities on Telecommunications Antennae and Support Structures issued by the Depatment of the Environment and Local Government in July 1996 that care should be taken over sensitive landscapes, and policy HER 40 of the Meath County Development Plan, 2007-2013 to protect and enhance the heritage and recreational potential of the Royal Canal. The proposed development would, therefore, be contrary to the proper planning and sustainable development of the area.* [Emphasis added]

This single solitary mast equated to a mere 98.42'. The current proposals are for turbines of 200 meters (656 feet). It follows that would cause a massive intrusion on the landscape and are therefore unacceptable.

50. **WESTMEATH:** PL.237728: Galetech Energy Developments (GED Limited): *Construction of 12 number wind turbines of hub height 85 metres and rotor diameter 100 metres, with an overall height not exceeding 135 metres...situate at Gaybrook Demesne, Mahonstown, Gibbonstown, Ballintlevy, Bellfield or Brannockstown and Gallstown, Mullingar, County Westmeath.*

NOTE: The lands re this planning file are situate very close to the lands re the current file.
REFUSE permission. The proposed windfarm was refused mainly on the basis of landscape quality.

a. *REASONS AND CONSIDERATIONS: The site of the proposed windfarm development is located in the vicinity of Lough Ennell, in an area of good quality, small scale landscape, containing the remnants of 18/19th century demesnes of particular significance in terms of amenity, tourism and heritage. The area also contains a large number of new houses. It is the policy of the planning authority to assess any development proposals in areas of demesne landscape according to best practice guidelines for historic landscapes. It is considered that insertion of a windfarm into this landscape would constitute a dominant and obtrusive feature in the area, which would interfere with the character of the landscape which it is necessary to preserve. Furthermore, having regard to the statements in the current Westmeath County Development Plan 2008-2014, generally advocating accommodation of windfarms in the extensive cut-over peatland areas of the county and also having regard to the sensitivities of the area and its environs, it is considered that the proposed development, notwithstanding its location in an area of "medium capacity" in the Windfarm Capacity Map of the said Development Plan, would not be in accordance with the overall development objectives of the current County Development Plan. The proposed development would, therefore, be contrary to the proper planning and sustainable development of the area.* [Emphasis added]

These turbines equated to 442.91'. Therefore, how did the current proposers consider that turbines of some 607' would somehow be acceptable?

51. **MEATH**: PL 17.203801: PROPOSED DEVELOPMENT: Application by Thornton Waste in 2005: Provision of circa 3.1 hectares of landfill area comprising parts of Phases 1 and 2 of an overall proposed landfill area (25.4 hectares) and the diversion of the southern stream around the perimeter of the landfill area, six metres wide road around landfill area, separate foul and surface water drainage networks, landscaping, berming, screen planting, fencing, boundary treatment and all site development works on a 31.9 hectares site at Boolykeagh, County Meath. These works comprise part of an overall proposed development of an integrated waste management facility comprising a recycling centre and non-hazardous residual waste landfill on a circa 82.5 hectares site at Calf Field, Ballynadrumny, County Kildare near Longwood, County Meath. The overall development site comprises lands in County Meath and County Kildare as follows: circa 31.9 hectares is located in the townland of Boolykeagh, County Meath and circa 50.6 hectares is located in the townlands of Calf Field and Ballynakill in County Kildare. A separate planning application has been lodged with Kildare County Council for the remaining components of the development, which includes: (1) access to the site for all purposes shall be from a new access road on the R160 Regional Road in County Kildare; (2) Phases 3 to 6 and the parts of Phases 1 and 2 of the landfill area in County Kildare, comprising circa 22.3 hectares. (The overall landfill comprises approximately 25.4 hectares to be development in six phases over 13 years at the rate of 220,000 tonnes per annum of residual non-hazardous household, commercial, industrial and construction and demolition wastes); (3) the proposed integrated waste management facility in the County Kildare section of the lands (50.6 hectares).

    a. REFUSE permission: Having regard to the complex hydrological and hydrogeological conditions obtaining on-site, to the limited investigation carried out of those conditions and hence to the potentially inadequate mitigation impacts associated with the proposed development, it is considered that the development site is unsuitable for a development of the nature and scale proposed, having regard to the proximity of the site to the Boyne River, a designated Special Area of Conservation and a source of water supply for the County of Meath. The proposed development would, therefore, have a significant adverse effect on the conservation and protection of the River Boyne, a Special Area of Conservation, would be prejudicial to public health and would be contrary to the proper planning and sustainable development of the area. [Emphasis added]

Note also the earlier grounds on which **Meath County Council** refused the Waste facility, which amongst other issues, stated *"by reason of its siting, context, scale, height and bulk ... would have a detrimental impact on visual amenity, heritage, tourism, recreational and environmental values of designated areas of visual quality identified in the Meath County Development Plan"*.

52. MEATH: 22/552: 2023-02-21: OBTON – Application for solar farm on 124 Hectares at Hawkinstown, Riverstown (ED Ardcath), Scatternagh, Balgeeth, Ardcath, Co. Meath. Application was refused by Meath County Council in March 2023 by reason that: -

> HER POL 52 of the Meath County Development Plan 2021 - 2027 sets out the policy to protect and enhance the quality, character, and distinctiveness of the landscapes of the county in accordance with the national policy and guidelines and the recommendations of the Landscape Character Assessment to ensure that new development meets high standards of siting and design. As set out in the applicable Landscape Character Assessment for County Meath (Appendix 5) and associated maps, the proposed development would be partially sited in Landscape Character Assessment (LCA) 06 Central Lowlands, a landscape of High Landscape Character Value, Moderate Sensitivity and is of Regional Landscape Importance and with a recommendation to maintain the visual quality of the landscape by avoiding development that would adversely affect short range views between drumlins and to have particular regard to the retention of high quality landscapes on the tops of drumlins which are inter-visible with the Hills of Tara and Skryne in LCA 12. Based on the information submitted with the application, it is considered that, by reason of its nature, scale, massing and location, the Planning Authority is not satisfied that the proposed development sufficiently protects and enhances the quality, character, and distinctiveness of this high landscape value. The proposed development would, therefore, be contrary to the above referenced Development plan policy and would not be in accordance with the proper planning and sustainable development of the area.

GRANTS/ SUBSIDIES

53. We are aware that there are significant grants available for the construction of wind turbines. We believe that they are completely unsustainable without such grant aiding. We therefore submit that it is unethical to use so much finite natural resources constructing machines, which would otherwise be unviable.

54. It is also considered that the provision of grants to aid one form of renewable energy over other forms of meritorious renewable energy gives an unfair advantage and artificially makes one form of energy more attractive than another. We are mindful of the exclusion of Deep Bore Geothermal energy in this context. Our research finds that Deep Bore Geothermal energy is far more sustainable than wind.

55. The evidence available suggests that the wind industry have lobbied extensively to retain this subsidy both in Ireland and in the UK. In our view grants to wind and solar instillations is misguided and short-sighted in view of the many other more promising and sustainable energy sources. **Chasing grants/ subsidies makes for very poor planning law and should have no place in any society.**

EU and IRISH LAW

SEA DIRECTIVE

56. We further believe that this contrary to the SEA Directive (Strategic Environmental Assessment); which provides that Programs / Plans / Projects should be conducted as a whole and not in isolation. The current application is a project. It is considered that one cannot jump straight into projects without first having conduced the two earlier stages in the process; i.e. Programmes and Plans.

57. In light of new information we have received; we inquire whether the applicants are embarking on scoping for other Wind Farm Projects in and around the east and midlands regions of the country? It is our belief that they are. In doing so, it is considered that they have completely ignored the requirements of the SEA Directive with regard to plans and programmes.

58. The SEA Directive is to ensure that "plans & programmes" which are likely to have sufficient effects on the environment are subject to an Environmental Assessment when they are prepared and prior to their adoption (note judgment of 28th February 2012, **Inter – Environnement wallonie** and **Terre wallonne,** C41 / 11, EU: C: 2012:103, paragraph 40 and the case – law cited).

59. Article 6(2) of the SEA Directive furthermore tells us that the environmental assessment should be carried out at the earliest possible stage so that the results of that assessment are still capable of influencing any decisions. Indeed it is at that stage that the various elements of an alternative may be analysed and strategic choices made. It is submitted therefore that the current planning application is in fact a project.

60. We contend that no overall plan or programme was prepared by the applicant; Statkraft or Element Power for its projects in Ireland. A project comes out of plans and programmes. Plans are flexible. A programme is comprised of multiple projects that aim at outcomes.

61. We contend that the applicant has ignored its obligations under the SEA Directive and has forged ahead with multiple projects, which in fact should never have been built without fulfilling its obligation with regard to the SEA Directive at the plans and programme level.

EIA and HABITATS DIRECTIVES

62. **EIA Directive and ECJ case law**: we are concerned that the currant application doesn't comply with Article 6 of the Habitats Directive 92/43/EEC. Please establish that the proposal is compatible with **EU law** including case law from the ECJ. The following cases from the **European Court of Justice** [ECJ] may be relevant: -
    a. Case C-258/11, Peter Sweetman and Others v An Bord Pleanála
    b. Case C-164/17, Edel Grace and Peter Sweetman v An Bord Pleanála
    c. Case C-323/17, People Over Wind and Peter Sweetman v Coillte Teoranta
    d. Case C-461/17, Brian Holohan and Others v An Bord Pleanála,

DEVALUATION

63. In most cases a person's private house represents most of that persons/ family's assets and it would be grossly unfair that the local people should suffer as a result of anthers private gain. The Board's attention is specifically drawn to **Section 10. (c) Schedule Four of the 2000 Planning Act** which provides that planning permission may be refused were it would *"seriously injure the amenities, or depreciate the value, of property in the vicinity"*. The Board is therefore requested refuse permission based on the said grounds. Wind turbine industry representatives have claimed that only limited areas of the country would be available to them if significantly longer separation distances than 500m were recommended. That of course is not an argument with any merit if there are objective reasons for the separation distance in the first place. Developers have no right to claim precedence over people's property and family rights.

IRISH CASE LAW

64. There have been health issues for residents in other parts of the country and beyond.

65. We are also aware of the case of **Shivnen & Ors -V- Enercon Wind Farm Services Ireland Ltd & Anor 2011/9955 P**. Seven families from Banteer, North County Cork claimed they had been severely impacted, particularly through noise pollution, since the turbines began operating in November 2011. The case was ultimately settled out of court order stated: *'and the court records that liability has been admitted by the defendants in the action listed in he schedule here-after.'*

66. In February 2020 we read of the case of **Laura, David and Jack Kelleher v. Green Energy Supply Ltd**. The later of which owned and operated a wind turbine installation known as Knockduff Wind Farm in Cork. The applicants claimed that the noise, vibrations and shadow flicker from the turbines, located just over 700m from their family farm resulted in them suffering from various illnesses. These included nosebleeds, ear aches, skin rashes, swollen and painful hands, loss of power in their limbs, sleep disturbance, and headaches.
'Counsel told the court that the settlement, including the ruling of the awards, arose following mediation between the parties conducted by retired Judge Paul Gilligan. He said that given the circumstances, especially given that the medical evidence was hotly contested, he was recommending that the settlement offers be approved by the court. Counsel said that as part of the settlement Laura (aged 15) whose ailments were more severe compared to her brothers was to receive €125,000. Her brothers David (aged 17) and Jack (aged 10) were to receive €50,000, counsel added.'

We submit that the above case is very relevant. While we are unaware of any underlying issues with regard to the Kelleher children (above), this is all the more cause for concern given that local children have underling issues [autism] and would be much more vulnerable. Furthermore, we understand that the turbines in County Cork were smaller than those proposed for this area thereby adding weight to our concerns.

We append Irish Times article dated **13th August 2025**, outlining the experiences of neighbours Living Next Door To ... Ireland's largest onshore wind farm;
Oweninny Wind Farm in Co Mayo meets the power needs of some 140,000 homes a year
Áine Ryan, Wed 13th August 2025
https://www.irishtimes.com/ireland/2025/08/13/living-next-door-to-irelands-largest-onshore-wind-farm/

TO BE ESTABLISHED

67. With regard to any wind farms, which have already come on line, please clarify the **amount of energy actually being delivered** on a per annum basis. Information should include the number of turbines, the area over which they have been installed, the type of turbines involved and compared with any previously stated aspirations in planning documentation.

68. Has a full **SEA (Strategic Environmental Assessment)** analysis been conducted? The SEA Directive provides that Programs / Plans / Projects should be conducted as a whole and not in isolation. Therefore it is essential that all related wind farm applications in this and other counties be examined as part of the broader mix. Has Directive 2001/42/EC been complied with?

69. We note that an **Environmental Impact Assessment** has been submitted with the application. Please establish its adequacy and whether this application in compliance with EU Directives including Directive 85/337/EEC?

70. We note that an **Natura Impact Assessment / Appropriate Assessment** has been submitted with the application. Please establish its adequacy and whether this application in compliance with EU Directives including Directive 92/43/EEC?

71. Please established whether all aspects of the **machinery directive** [2006/42/EC] have been complied with?

72. Having regard to the **county development plans**, we ask the planning authority and ultimately *An Coimisiún Pleanála* to establish whether the proposals are compliant with the country development plans? We believe that they are contrary to proper planning and sustainable development and that they contravene many aspects of the county development plan such as objectives re preservation of heritage and the promotion of tourism. The proposal would also place enormous demand of finite natural resources. In addition we believe that views and prospects as outlined in the county development plan would be heavily compromised.

73. Please establish whether the proposal compatible with the **European Landscape Convention**? The UK and Ireland ratified the convention and it became binding on 1st March 2007.

74. The composition of the proposed turbines will need to be established. This should include all rare earth metals involved in their manufacture. All **runoff** possibilities should be examined having regard to metals/contaminants contained in the proposed machines. Could runoff to nearby watercourses and or seep into the aquifer? Furthermore, in the event of a storm event and proposed wind turbines get damaged; is there a possibility of chemical/ metal escape and contamination of the groundwater aquifer?

75. Significant resources are required to enable this development. Please ensure that there is a full assessment of **all materials required in the construction this development**? Please also quantify the amounts of materials required to construct this proposed development with specific reference to rare earth metals?

76. Has other forms of energy such as **Deep Bore Geothermal Energy** been considered? Unlike solar, Deep Bore Geothermal Energy can deliver **constant energy** and is considered better value for money.

77. Wind technology is rapidly changing. It is highly likely that the turbines of today will be obsolete in a few years. It will be necessary therefore to establish the **afterlife of these turbines** together with the cost factor of disposing of same given the amount of rare earth metals in their construction. The applicants will need to address these issues. It is considered that a significant sum of money would need to be lodged in an escrow account to cover disposal and reinstatement.

78. We recommend that a **full cost/ benefit analysis** be conducted to establish value for money given the resources required to construct. This should also take into account the intermittent nature of wind and solar energy. Additionally this should include comparisons with other forms of sustainable energy with particular reference to Deep-bore geothermal energy, which is fully dispatchable and not intermittent. Such an analysis should ignore completely any artificial grant incentives and focus purely on the real cost of the development together with an assessment of what can realistically be expected in terms of deliverable energy generation at these northerly latitudes. This should also factor in worst-case scenario climatic conditions (light levels) with extensive periods of cloud cover.

79. Furthermore, a full analysis of **impacts upon the surrounding community** should be conducted.

80. Please clarify whether SF6 gas is to be used as an insulant? SF6 Gas is 23,500 times more warming than carbon dioxide (CO2). Sulfur hexafluoride or sulphur hexafluoride is an extremely potent and persistent greenhouse gas that is primarily utilized as an electrical insulator and arc suppressant. The European Commission has proposed that SF6, a fluorinated greenhouse gases with a potency 25,000 times that of carbon dioxide, be banned from new electrical equipment as of 2031, as part of a broader tightening of limits on F-gases. See https://www.bbc.com/news/science-environment-49567197

81. On balance it is considered that this development would create an undesirable precedent and should ultimately be declined.

82. Both Wind and Solar energy are intermittent and not dispatchable. *(Dispatchable generation refers to sources of electricity that can be used on demand and dispatched at the request of power grid operators and according to market needs. Dispatchable generators can be turned on or off, or can adjust their power output according to an order.)*

EMPLOYMNENT

83. **Assertions re Employment**: the EIAR alludes to an alleged employment benefit quiet frequently in an apparent attempt to in part justify the proposed development and were told that there may be up to 20 jobs. That said this was contradicted else where in the EIAR where it stated that '*Human activity associated with the maintenance of the operational windfarm will be infrequent and minimal.*' **Notwithstanding we understand that there are only 2 fulltime employees on the MounLucas Wind farm which has some 28 wind turbines.**

84. Such arguments are of course completely erroneous, as the issues to be determined are compatibility with established planning principles and compliance with EU law and International Conventions.

85. Assertions re Employment: from a cursory search of the E.I.S., the applicants allude to an alleged employment benefit, which would derive from its operation in an apparent attempt to in part justify the proposed development.

    a. **Such arguments are of course completely erroneous, as the issues to be determined are compatibility with established planning principles and compliance with EU law and International Conventions.**
    b. Furthermore, employment results from the requirement of one party to hire another in order to make a profit for the employer and not out of some benevolent motive.
    c. If employment were a genuine concern, then the operator/s would be well advised to explore an intensive industry such as a more labor intensive horticultural development, which would sustain far greater employment over a similar land mass. Furthermore, a horticultural land use would provide sustainable employment unlike construction of a wind farm, which only provides short-term employment.
    d. The use of employment as a justification is regrettable and somewhat of a distraction. Engagement with the planning issues would be far more constructive. In light of the lengthy discourse on this issue, one must be skeptical and therefore proceed with an abundance of caution.
    e. Finally, employment by wind instillations in minimal once constructed.

86. **Effect of wind on other alternative energy sources**: we understand that on occasion Hydropower has to be turned off to let wind energy in. This could be established by appropriate questions directed to the managers of the grid?

CARBON ACCOUNTING

87. **The FUEL**: The sheer volumes of concrete required together with access roads and hard standing areas, which in turn would require massive quantities of infilling to facilitate the construction of the proposed turbines is vast. It follows that the amount of diesel fuel necessary to fuel the truck to haul all this material on site would be enormous. This too must be factored into the carbon footprint equation together with the sustainability of consuming so much fossil fuel in the construction of the proposed wind turbines.

88. The manufacture of cement requires significant temperatures. The carbon footprint / ton is therefore very significant. It is submitted that the use of such a vast quantity of concrete would give rise to an unacceptably high carbon footprint. The reality is that construction and erection of wind turbines will give rise to significant and unsustainable resource consumption.

THE PROPOSAL / SUSTAINABILITY

89. **Developer Led**: the proposal is developer led. The effect of this proposal has already been to divide the local community between landowners benefiting from the revenue from turbine sites on the one hand and others on the other. This is inappropriate developer-led rather than national and strategic based planning. Any future Irish wind energy proposal needs to be plan led and not developer led. This proposal is inappropriately developer-led acting without any proper national and location selection strategy.

90. **The TURBINES**: The manufacture of steel and other components to assemble a turbine (particularly on the scale proposed) must also be assessed as regards its impact on the environment *vis à vis* carbon footprint and environmental sustainability of natural and finite resources.

91. **Carbon footprint of wind energy**: The manufacture of cement requires significant temperatures. The carbon footprint / ton is therefore very significant. It is submitted that the use of such a vast quantity of concrete would give rise to an unacceptably high carbon footprint. The reality is that construction and erection of wind turbines will give rise to significant and unsustainable resource consumption.

92. We were unable to easily find exact grade of aggregate, steel or nm of concrete in any of the works be it bases, culverts, manholes, etc. It would be essential that the applicants provide a table of figures for the amounts of aggregate required to construct the network of access roads.

MATERIALS USED

93. It is considered helpful to provide a short analysis of some of the components of wind turbines, which we will now outline.

94. **STEEL**: To create 1,000 Kg of pig iron, you start with 1,800 Kg of iron ore, 900 Kg of coking coal 450 Kg of limestone. The blast furnace consumes 4,500 Kg of air. The temperature at the core of the blast furnace reaches nearly 1,600 degrees C. The pig iron is then transferred to the basic oxygen furnace to make steel. 1,350 Kg of CO2 is emitted per 1,000 Kg pig iron produced. A further 1,460 Kg CO2 is emitted per 1,000 Kg of Steel produced so all up 2,810 Kg CO2 is emitted. 45 tons of rebar (steel) are required so that equals 126.45 tons of CO2 are emitted.

95. **CONCRETE**: To create a 1,000 Kg of Portland cement, calcium carbonate (60%), silicon (20%), aluminum (10%), iron (10%) and very small amounts of other ingredients are heated in a large kiln to over 1,500 degrees C to convert the raw materials into clinker. The clinker is then interground with other ingredients to produce the final cement product. When cement is mixed with water, sand and gravel forms the rock-like mass know as concrete. For the turbines currently being proposed, upwards of 200 lorry loads of readymix calculate are required to anchor each turbine (in addition to lots of reinforcing steel).

96. **ROADS**: Infill for access roads: sourced from crushed rock derived from quarrying are also required.

97. **The FUEL**: The sheer volumes of concrete required together with access roads and hard standing areas, which in turn would require massive quantities of infilling to facilitate the construction of the proposed turbines is vast. It follows that the amount of diesel fuel necessary to fuel the truck to haul all this material on site would be enormous. This too must be factored into the carbon footprint equation together with the sustainability of consuming so much fossil fuel in the construction of the proposed wind turbines.

98. **Where does the aggregate come from?**
    Further to the above, sourcing such an enormous quantity of aggregate would pose enormous challenges. Aggregate is a major constituent of concrete. Aggregate will also be required to construct all the hard standing areas and access roads. It is submitted that this is squandering of national resources.

    The sighting of turbines should be in a situation where naturally occurring bedrock can be utilized, obviating the need for the requirement of such vast amounts of concrete and aggregate. Furthermore, in addition to aggregate, sand and gravel are also component constituents of concrete. Through our

experience and understanding of the quarry industry, we know that supplies of sand and gravel are rapidly dwindling. It is therefore essential that such schemes be situate on naturally occurring bedrock!

99. **Sporadic nature of wind power**: terrestrial based wind power is historically very sporadic and erratic. To state the obvious, in periods of static airflow, no wind is produced. This causes all sorts of challenges for management of the grid in that it must be replaced by alternative sources of energy. Alternative Energy Sources are discussed separately in this submission, as are issues pertaining to the management of the grid.

RARE EARTHS

100. **RARE METALS**: Most turbines are fitted with magnets made of a metal called neodymium. The mining and refining of neodymium extraordinarily dirty and toxic – involving repeated boiling in acid, with radioactive thorium as a waste product – 90% of it comes from – Baotou, China. Neodymium is a rare earth metal, which is generally sourced in China and which is causing. There are c. 4 tons of neodymium magnets in each turbine for example. China's Ministry of Industry and Information Technology estimated that the cleanup bill for southern Jiangxi Province could amount to 38 billion yuan, or around $5.5 billion. Only a fraction of that amount has so far been spent.

101. We are obliged to deal with the position *vis à vis* Rare Earth Mining in China. There are very bleak social and environmental costs. The turbines themselves come from a process, which cannot be considered sustainable. In fact the trail of destruction and environmental pollution, which is left behind, is shameful.

102. To quote from one source: - *'Neodymium is commonly used as part of a Neodymium-Iron-Boron alloy (Nd2Fe14B) which, thanks to its tetragonal crystal structure, is used to make the most powerful magnets in the world...There's not one step of the rare earth mining process that is not disastrous for the environment. Ores are being extracted by pumping acid into the ground, and then they are processed using more acid and chemicals. The fact that the wind-turbine industry relies on neodymium, which even in legal factories has a catastrophic environmental impact...Finally they are dumped into tailing lakes that are often very poorly constructed and maintained. And throughout this process, large amounts of highly toxic acids, heavy metals and other chemicals are emitted into the air that people breathe, and leak into surface and ground water. Villagers rely on this for irrigation of their crops and for drinking water. 'Whenever we purchase products that contain rare earth metals, we are unknowingly taking part in massive environmental degradation and the destruction of communities.*

103. Aside from the manufacture of the magnets alluded to above and in the appended enclosure, World Report alluded to the manufacture of Blades for wind turbines together with solar panels. Some statistics about Baoding were that the skies are constantly full of smog from pollution and thus far this year, they had only got 16 days smog free as of [31st May 2015]. The listener was informed that Blue skies are seldom seen. Fine particles (PM 2.5) are double that of recommended levels and the population have respiratory problems/ breathing difficulties and facemasks are frequently worn in an attempt to protect oneself. It is estimated that air pollution is responsible for 100,000 deaths each year. Because of Chinas Censorship, it is difficult to obtain detailed data. To make maters worse, at decommissioning stage, the blades are being chopped up and being land filled. See: https://www.bloomberg.com/news/features/2020-02-05/wind-turbine-blades-can-t-be-recycled-so-they-re-piling-up-in-landfills

104. **The MAGNETS**: The turbines themselves come from a process, which cannot be considered sustainable. In fact the trail of destruction and environmental pollution, which is left behind, is shameful.

To quote from the enclosed article on the issue *'Neodymium is commonly used as part of a Neodymium-Iron-Boron alloy (Nd2Fe14B) which, thanks to its tetragonal crystal structure, is used to make the most powerful magnets in the world...There's not one step of the rare earth mining process that is not disastrous for the environment. Ores are being extracted by pumping acid into the ground, and then they are processed using more acid and chemicals. The fact that the wind-turbine industry relies on neodymium, which even in legal factories has a catastrophic environmental impact...Finally they are dumped into tailing lakes that are often very poorly constructed and maintained. And throughout this process, large amounts of highly toxic acids, heavy metals and other chemicals are emitted into the air*

that people breathe, and leak into surface and ground water. Villagers rely on this for irrigation of their crops and for drinking water. 'Whenever we purchase products that contain rare earth metals, we are unknowingly taking part in massive environmental degradation and the destruction of communities."

Aside from the manufacture of the magnets alluded to above and in the appended enclosure, RTE World Report alluded to the manufacture of Blades for wind turbines together with solar panels. Some statistics about Baoding were that the skies are constantly full of smog from pollution and thus far this year, they had only got 16 days smog free as of [31st May 2015]. The listener was informed that Blue skies are seldom seen. Fine particles (PM 2.5) are double that of recommended levels and the population have respiratory problems/ breathing difficulties and facemasks are frequently worn in an attempt to protect oneself. It is estimated that air pollution is responsible for 100,000 deaths each year. Because of Chinas Censorship, it is difficult to obtain detailed data. To make maters worse, at decommissioning stage, the blades are being chopped up and being land filled. See:
https://www.bloomberg.com/news/features/2020-02-05/wind-turbine-blades-can-t-be-recycled-so-they-re-piling-up-in-landfills

We invite you to review the following links to substantiate what we have outlined above: -

105. China produces 85% of global supply of the 17 chemically similar elements crucial to smartphone, camera lens and magnet manufacture – and half that output is from the city of Baotou
Jonathan Kaiman in Baotou
Thu 20 Mar 2014 14.30 GMT
https://www.theguardian.com/sustainable-business/rare-earth-mining-china-social-environmental-costs

106. **Rare-earth mining in China comes at a heavy cost for local villages**
Pollution is poisoning the farms and villages of the region that processes the precious minerals
Cécile Bontron
Tue 7 Aug 2012 13.59 BST
https://www.theguardian.com/environment/2012/aug/07/china-rare-earth-village-pollution

107. **China Wrestles with the Toxic Aftermath of Rare Earth Mining**
China has been a major source of rare earth metals used in high-tech products, from smartphones to wind turbines. As cleanup of these mining sites begins, experts argue that global companies that have benefited from access to these metals should help foot the bill.
BY MICHAEL STANDAERT
JULY 2, 2019
https://e360.yale.edu/features/china-wrestles-with-the-toxic-aftermath-of-rare-earth-mining

108. **The dystopian lake filled by the world's tech lust**
By Tim Maughan
2nd April 2015
https://www.bbc.com/future/article/20150402-the-worst-place-on-earth

109. RTE's weekly 'World Report programe also alluded to the issues presented in Baoding, China on 31st May 2015; http://www.rte.ie/radio1/world-report/ It was referred to as Chinas most polluted city.

110. **Rare earth mining in China: the bleak social and environmental costs**
China produces 85% of global supply of the 17 chemically similar elements crucial to smartphone, camera lens and magnet manufacture – and half that output is from the city of Baotou
Jonathan Kaiman in Baotou
Thu 20 Mar 2014 14.30 GMT
https://www.theguardian.com/sustainable-business/rare-earth-mining-china-social-environmental-costs

HUMAN RIGHTS

111. In addition to the issue of sustainability raised above, there are clearly significant Human Rights issues to consider here. This is an important area, which is always overlooked. It is submitted therefore that detail be provided on the sourcing of the raw materials together with the component parts required to pull together the proposed instillation. It is therefore unconscionable that the practices alluded to in the appended article should be supported in any way.

112. **Spinning Reserve:**

It follows that alternative sources of energy must be constantly available to provide power when wind isn't blowing. This can be referred to as cycling up and cycling down. During periods of static air mass and nil generation of wind energy, power must be generated from other sources.

Currently the main energy source is at the Moneypoint station in County Clare. Is it not the case that this must be kept burning in order to take up the slack when there is no wind energy coming on stream? We understand that it and similar power plants cannot be turned off, as they take too long to power up (48 hours), which for obvious reasons would not be feasible when wind energy falls off. We further understand that this has been very problematic in Scotland where there are a large numbers of wind turbines. '

The Limits of Wind Power [by William Korchinski] states: - '***The analysis reported in this study indicates that 20% would be the extreme upper limit for wind penetration... Very high wind penetrations are not achievable in practice due to the increased need for power storage, the decrease in grid reliability, and the increased operating costs. Given these constraints, this study concludes that a more practical upper limit for wind penetration is 10%. At 10% wind penetration, the CO2 emissions reduction due to wind is approximately 45g CO2 equivalent/kWh, or about 9% of total.***' [Source: The Limits of Wind Power [by William Korchinski]

In 2012, Ireland was already at 15.3% from wind. This figure is almost certainly higher now with the advent of more energy streams (including wind) since then. '*The Department of Energy figures also show that in 2012 19.6 per cent of our gross electricity production was by renewables. 15.3 per cent of this was wind, followed by 2.7 per cent by hydroelectricity.*'

113. **Efficiency of Wind Turbines:**

'*Not all the energy of blowing wind can be harvested, since conservation of mass requires that as much mass of air exits the turbine as enters it. Betz's law gives the maximal achievable extraction of wind power by a wind turbine as 59% of the total kinetic energy of the air flowing through the turbine*' [Harvesting the Wind: The Physics of Wind Turbines Kira Grogg – 2005]

'*Further inefficiencies, such as rotor blade friction and drag, gearbox losses, generator and converter losses, reduce the power delivered by a wind turbine. Commercial utility-connected turbines deliver 75% to 80% of the Betz limit of power extractable from the wind, at rated operating speed.*' [Tony Burton et al., (ed), Wind Energy Handbook, John Wiley and Sons 2001], See also http://en.wikipedia.org/wiki/Wind_turbine#Efficiency

114. **Sea based Alternatives:**

Having regard to the fact that there is far more wind at sea and as such the sea is a far more suitable location for such units (Subject of course to appropriate citing).

Transporting power from sea-based instillations is also much easier in that there is no 3rd party landowners or upset residents with which to be concerned. Curiously we were unable to find any discussion on locating this project at sea in the non-technical summary of the E.I.S. conducting a simple word search.

Therefore, the discussion on alternative sites without discussion of sea-based turbines significantly calls into question the completeness of the E.I.A.R., which demeans the application in our view. It would therefore appear that the limited discussion on alternatives is more of a box ticking exercise rather than of any real engagement with the spirit of the E.I.A. directive.

RoCoF

115. **RoCoF**: Rate of Change of Frequency (islanding detection method for decentralised generation units). Because wind fluctuates electricity generated changes regularly which can cause problems o the grid. This is difficult to manage on the grid. It follows that the more wind that is put on, the more difficult it is to manage. i.e. the more wind we get the more likely the grid will have problems in managing the fluctuating power intake. We have inserted some quotes taken from a document published in 2011 by the University of Manchester entitled 'Loss of Mains Protection':

'Loss of Mains (or islanding) occurs when part of the public utility network (incorporating generation) loses connection with the rest of the system
If LOM is not detected, then the generator could remain connected, causing a safety hazard within the network.
Automatic reconnection of the generator to the network may occur causing damage to the generator and the network
Islanding is not permitted in most countries. The most challenging scenario is when the local load closely follows the generator output both in terms of active and reactive power.
LOM performance requirements – stability
LOM should be stable under remote faults cleared by the utility system.
It is undesirable to issue a false trip as it leads to the unnecessary disconnection of the generator.'

WIND ENERGY [6.15.3.2]

116. The current wind energy strategy is driven by Irelands National Renewable Energy Action Plan [NREAP], which was submitted to the EU in July 2010 and details the renewable energy plant up to 2020. This is revised every 2 years based on whether Ireland is meeting its targets. As we understand it, currently renewable electricity ambitions are 40% of which 90% is to come from wind, which is ludicrous in the knowledge that there is a much more sustainable and less intrusive solution in the form of Deep-Geothermal.

HAZZARDS

117. **Safety**: There has been a litany of safety issues with wind turbines. One in Tyrone came down despite very little wind. One in Donegal also blew down in a gale. Another in West Cork went on fire. There are numerous other incidents reported on. There is also evidence of oil leaks from wind turbines, which pose a threat to contamination of the groundwater aquifer.

118. **Mental Health**: if people are subjected to constant swishing and flicker, one must have a very real concern for mental health issues. Large-scale wind-energy projects (turbines) may be compared to a neighbour who is always noisy and in your face. This neighbour never once ruptured your eardrums but that neighbour slowly drives you crazy. These turbines are those nightmare neighbours. One must prove it will harm them, whereas conversely a drug company would have to prove they were safe. The promoters of a wind development should likewise be required to prove that. Is even one death worth foisting such an unwanted development on a community?

119. **Physical Health**: On the wider issue of health, there is growing evidence that physical health is effected by nearby Wind Turbines. I refer specifically to recent reports on the matter by Dr. Alun Evan of Queen's University, Belfast. Moreover, the UN Committee Against Torture has explicitly identified prolonged sleep deprivation as a method of torture. The Committee had this to say about the impact of prolonged sleep deprivation: "*The Committee against Torture (CAT) has noted that sleep deprivation used for prolonged periods constitutes a breach of the CAT, and is primarily used to break down the will of the detainee. Sleep deprivation can cause impaired memory and cognitive functioning, decreased short term memory, speech impairment, hallucinations, psychosis, lowered immunity, headaches, high blood pressure, cardiovascular disease, stress, anxiety and depression.*" Source: http://thejusticecampaign.org/?page_id=273#T2

120. **Electromagnetic fields**: a development such as the one proposed will necessitate a significant amount of cabling. This together with the energy fields from the turbines themselves will give rise to significant electromagnetic fields. Given the proximity of the turbines themselves together with the cabling so close to residential and commercial development, there is great concern for the health and welfare of human beings.

121. **Air amenity**: The height of the turbines is alarming. The skies are enjoyed by numerous flying enthusiasts ranging from light aircraft to motorized para-gliders and hot-air ballooning and so on. These flay at much lower altitudes than commercial aircraft. The proposed turbines would with near certainty pose significant health and safety issues. Heretofore, turbines were typically situate on mountain tops and at sea where little or no recreational activity took place.

122. **Entrance onto roads**: In addition to the hazard caused by such entrances to both pedestrians and to road users, it is submitted that service entrances would represent a loss of amenity to local residents.

123. **Infrasound**: There has been many academic papers on the subject of infrasound. Infrasound, sometimes referred to as low-frequency sound, describes sound waves with a frequency below the lower limit of human audibility (generally 20 Hz). A scientist working at Sydney University's Auditory Neuroscience Laboratory reports growing evidence that infrasound may affect some people's nervous system by stimulating the vestibular system, and this has shown in animal models an effect similar to sea-sickness. There is growing evidence that wind turbines are a major source of infrasound and that they have an adverse affect on human health for many miles around as infrasound travels long distances.

124. **Interference with TV reception**: The residents are understandably most concerned that his TV reception would be interfered with. Moreover, some have installed security systems and concern is expressed for fear there may be any interference.

125. **Cabelling**: It is submitted that the cabelling carrying the electricity, would: -

a. Interferer with future planning prospects for certain residents and businesses in the area.
b. Moreover, Pylons would undoubtedly have to be erected to carry the cable, which in turn gives rise to further visually obtrusive issues.

IMPACTS on BIODIVERSITY

126. **Wildlife**: It is submitted that both the EU Birds and Habitats Directives are also, would have a significant impact on the small-scale diverse landscape. [DIRECTIVE 2009/147/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 November 2009 on the conservation of wild birds (codified version) of Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds] together with Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora of 21 May 1992 (Habitats Directive)]. The RSPB state that '*The available evidence suggests that wind farms can harm birds in three possible ways – disturbance, habitat loss (both direct and/or indirect) and collision. Some poorly sited wind farms have caused major bird casualties, particularly at Tarifa and Navarra in Spain, and the Altamont Pass in California. At these sites, planners failed to consider adequately the likely impact of putting hundreds, or even thousands, of turbines in areas that are important for birds of prey.*'

127. BIRDS: Wind turbines if located in this flat low-lying terrene may pose issues for birds. This area is in the path of migrating birds, which can with regularity be seen at specific times of the year on their route North or South depending on the season.

128. BATS: Moreover, the proposed location is in low-lying countryside, which is a habitat for bats. Bats confuse wind turbines for trees. Most of the bats die because their lungs collapse when they run into low air pressure around the tips of the wind turbines — not because they hit the towers or blades.

129. **Loss of Trees**: We understand that a significant quantum of trees would need to be removed to facilitate the current proposal. As things stand, Ireland is already one of the worst countries in Europe for tree cover. Ireland lost most of its residual and indigenous woodland over the centuries. Further felling of trees is absolutely unacceptable. Moreover trees act as a Carbon sink. In addition to the carbon footprint issues alluded to above, the removal of all these trees also raises issues regarding loss of habitat and in consequence biodiversity.

130. **Loss of Agricultural Land**: Be it raised bog or agricultural land, the loss of biodiversity and the disturbance to both nature and humanity is considered unacceptable. Agricultural land and or raised bog is a very valuable resource. This is very evident when one visits other countries such as Spain, where the arid landscape is in stark contrast to the lush green productive landscape that we take for granted here in Ireland. Therefore the proposal to site turbines in the midst of bog or agricultural lands is considered irresponsible. Furthermore, in addition to the actual footprint of the turbines, significant tracts of land will be lost to access roads and the like.

131. There are numerous references to a 500 m buffer zone. A 500m 'buffer zone' cannot be regarded as a buffer at all. No one could be expected to tolerate a turbine of this size and scale so close to their property/ residence. The suggestion is so ridiculous that further comment is considered unnecessary.

132. **Disruption**: Apart from the operational issues, the residents of the area and surrounding areas, would suffer all manor of disruption ranging from: -

a. Construction Traffic
b. Service Entrances
c. Caballing from the proposed turbines would almost certainly need to traverse other properties.

Other Sources of Alternative Energy

133. **Alternative Energy Sources**: Renewable Energy comes in many forms including: - Biomass, Geothermal, Solar Energy, Wave Energy, Tidal Energy, Hydroelectricity, etc. It is appropriate that we should give a brief analysis of each below.

134. **Solar power**: Is the conversion of sunlight into electricity. This is somewhat dependent on technical advances in the conversion rates of the photovoltaic (PV) cells that convert sunlight into electricity. Moreover, battery power would be required during night hours or when there is poor sun during daylight hours.

135. **Biomass:** usually refers to plants, which are specifically grown as a crop for the purposes of energy generation. **Often available in the form of wood pellets that can be produced from crops of plants such as willow. Given the existing Moneypoint Power plant in County Clare, there is potential to convert this plant from burning coal (fossil fuel) to burning biomass.**

136. **Biofuels**: Biofuels have been proposed as an alternative by some commentators. Bioethanol is made by fermenting plant materials and biodiesel is made from vegetable oils, animal fats or recycled grease. Biofuels typically include Biodiesel and Ethanol. In 2008 biofuels provided a mere 1.8% of the world's transport fuel. Bioethanol production relies on the cultivation of large amounts of plant material. A major issue with biofuels is that arable land would have to be taken out of food production to produce bio fuels. Given that the human population of the world is increasing at a rate never before seen, little of no land could be made available for production of biofuels. Moreover, there is a danger that more tropical rain forest would disappear to satisfy the demands for same.

137. **Hydrogen**: Hydrogen can be used to power future transportation and may be the power of the future given that hydrogen is the most common element in the Universe. Power can either be through the use of electric motors powered by fuel cell technology or by improved internal combustion engines. In both cases emissions would be zero. The difficulty is that Hydrogen power is currently prohibitively expensive, but progress is being made in the technology to achieve this. A big challenge is to source the hydrogen from renewable resources. Honda has produced the first 'commercial' hydrogen powered vehicle in the form of the Honda FCX Clarity, although this has limited availability.

138. **Tidal**: Tidal energy capture usually consists of the construction of barrage dam type structures is being examined as a means of converting tidal movements into energy. Turbines installed in the barrage wall generate power as water flows in and out of the estuary basin, bay, or river. There are downsides to this though, the most obvious one being that the structures in themselves are visually obtrusive. There are also ecosystem considerations as the flooding of mud-flats within the estuary together with altered saltwater flow which changes the hydrology and salinity within. That said, they are not near as visually obtrusive as large land based wind turbines.

139. **Wave**: Wave Energy refers to the capture of energy from the motion of surface waves of the ocean. This is still a developing science, which is still in experimental stage but looks promising.

140. **Hydroelectric**: Hydroelectric: the capture of energy from running water such as in a river is perhaps among the oldest of the alternative energy's as was seen in the 17-1800's when countless water mills were erected on river banks to power massive mechanical apparatus. In the 1900's this was developed into a far more commercial scale energy capture with the construction of massive dams. Examples being the famed Hoover Dam on the Colorado River in the USA, The Three Georges Dam on the Yangtze River in China, the Golden Dam situate on the Golden River, in Tasmania, Australia and Ardnacrusha power plant situate on the Shannon River in Ireland.

141. **Geothermal**: Geothermal: work on this form of energy generation is much more advanced that other alternatives. Energy capture ranges from installing a series of pipes in the upper layers of the earths crust typically about a meter deep in domestic type situations. On a commercial basis, exploitation of hot springs, which often occur on fault lines is usually indicative of thermal energy close to the surface.

142. **Deep Bore Geothermal**: This is essentially 'free' energy contained within the earths crust. Briefly, it entails boring to depths of between 2 and 3 miles and harnessing energy from the natural heat contained within the earth's crust where temperatures of between 100°c and 200°c can be easily achieved. This is done by circulating water down and back up (rather like a heating system). A very small plant is all that is required on the surface to convert the energy into electricity. There are many examples around Paris, Austria, Germany, Iceland and so on. The Eden Project in Cornwall published plans for such a plant in October of 2019. See: https://www.dailymail.co.uk/sciencetech/article-7571129/Eden-Project-ahead-17m-geothermal-energy-revolution.html

143. **Wind at Sea**: There is a far more constant wind flow at sea which makes sighting them at sea far more advantageous than on land. In addition and subject to appropriate sitting, there isn't near the same visually obtrusive issues. There is also the advantage of utilizing the bedrock and cutting out the cost and wastage of vast amounts of concrete. Apart from fixing them to the seabed as in the case of the Arklow Bank, County Wicklow, there is also the possibility of floating wind farms. See appended article: -

144. Having regard to the foregoing, it is manifestly obvious that wind energy is not a long-term runner and is currently being artificially driven by significant grants, which serve only to create a rush for grants by investors and corporate's driven purely by 'returns' piggybacking on the 'Green' label.

145. Moreover the sighting of the wind turbines in a county that markets itself on its heritage is utterly crazy and unacceptable. The midlands have significant populations, together with significant heritage sites, which is of enormous touristic potential.

146. **If one were to persist with wind energy (even in some small manner), they should at the very least be prohibited in the populated and predominantly flat landscape of the midland counties.**

147. We can understand why Wind Energy became the front-runner as it was perhaps the most visually obvious. However, when all the facts are viewed objectively, it is utterly crazy to persist with this strategy. As we have seen above, this is badly flawed. Moreover, the emphasis on wind is largely derived from a lack of public consultation early on in this debate, which is contrary to basic democratic principles and more recently to the Aarhus convention and the Public Participation Directive.

DEEP BORE GEOTHERMAL

148. Off all the points listed above, Deep Geothermal is extremely promising and warrants further discussion having regard to the local context. Our research as shown this to be by far the most promising. For compression purposes, we thought it would be helpful if we compare Deep Bore Geothermal Energy.

149. This is essentially 'free' energy contained within the earths crust. Briefly, it entails boring 2 boreholes to depths of between 2 and 3 miles. It is dependant on the existence of a particular type of rock to conduct water from A to B. The water coming back up is superheated to temperatures of between 100°c and 200°c. A very small plant is all that is required on the surface to convert the energy into electricity. There are many examples around Paris, Austria, Germany, Iceland and so on. There is comparatively small investment in this energy when compared with that required to site a wind turbine.

150. The Caledonian fault line traverses the Irish and English landscape in a rough line from Limerick Dundalk – Newcastle in the UK. Either side of this, there are two different rock formations on two different tectonic plates. The differences in rock fossils in Scotland and England are well documented. Thermal energy tends to be much closer to the surface on such fault lines. In Ireland a fault line stretching from Limerick to Louth [the Caledonian fault line] where this heat is much closer to the earth's surface than elsewhere. This is where two tectonic plates collided many millions of years ago. All along this fault line there are numerous mines, the most notable being 'Tara Mines' in County Meath. Indeed the management at Tara have shared there knowledge on temperatures/ rock formations, etc to researchers of Deep-geothermal which was most helpful. The correct rock formation [Kentstown Rock Formation] lies beneath this area. Moreover there are numerous 'hot springs' all along this line and there is in fact a townland near Enfield, County Meath known as 'Hotwell'. At times of significant rainfall events, water comes up boreholes at c.22°c, such is the geothermal activity beneath.

151. The irony with the current planning proposal is that alternative energy is virtually underneath the proposed sites. Moreover, as an energy source, it's far more stable and reliable than wind energy. This has been used as an energy source in Austria and other countries. We can inform that legislation is currently being drafted to facilitate this energy source in an Irish context. Therefore, leaving aside all the other planning and related issues, it is submitted that the erection of turbines in the current context is rather ironic. It is unlikely that there would be the same challenging issues re **RoCoF** with the use of Deep Geothermal

152. GT Energy (a specialist Geothermal energy company) had raised capital investment and was ready to begin work here in Ireland in 2011, but due to a minor legal technicality they were unable to proceed. The legislation was to be changed to facilitate this, but sadly this has not thus far happened.

153. The ADVANATAGES of Deep Geothermal over Wind are many and may be summarised as follows:

-

a. no visually obtrusive issues,
b. no property devaluation,
c. no health issues,
d. no fluctuations in the availability of energy,
e. no spinning reserve (backup) requirement,
f. no wastage of finite natural resources such as sand and gravel, steel and so fourth.
g. There are numerous suitable geological bedrock areas in Ireland.

154. There has been major progress in the UK regarding this form of energy and I refer the reader to the following links: -

Eden Project: Drilling starts for geothermal power
The 450-tonne research rig is working to drill down 4.5km (2.8 miles) into granite to test potential power at the Cornwall site as part of a £17m scheme.
19th May 2021
https://www.bbc.com/news/uk-england-cornwall-57171058

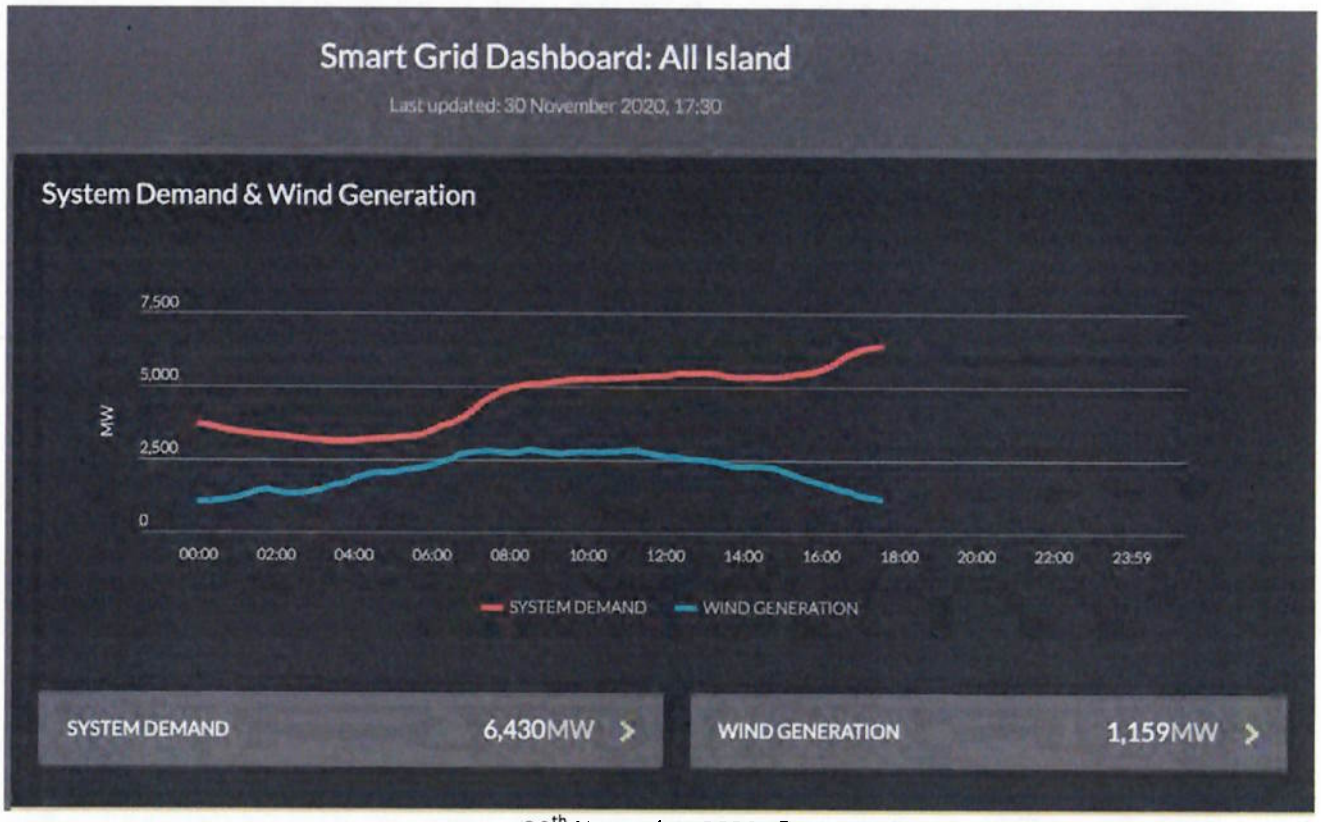
Scientists searching for 'Holy Grail' of energy begin drilling into Earth's crust to power Eden Project
Geothermal energy is energy generated and stored in the earth's crust and the Eden Project site could heat 4,000 local homes.
Thomas Moore
Thursday 20 May 2021
https://news.sky.com/story/scientists-searching-for-holy-grail-of-energy-begin-drilling-into-earths-crust-to-power-eden-project-12311065

UK Geothermal: boiling beneath the surface?
By Scarlett Evans
11 Dec 2019
A new report from the British Geological Survey (BGS) says that the only way the UK can reach its target of net zero emissions by 2050 is to explore below the earth's surface - harnessing geothermal energy to achieve its goal. But just how much geothermal energy is the UK sitting on? We investigate.
https://www.power-technology.com/features/uk-geothermal-boiling-beneath-the-surface/

https://pubs.geoscienceworld.org/pg/article-lookup?doi=10.1144/petgeo2019-084

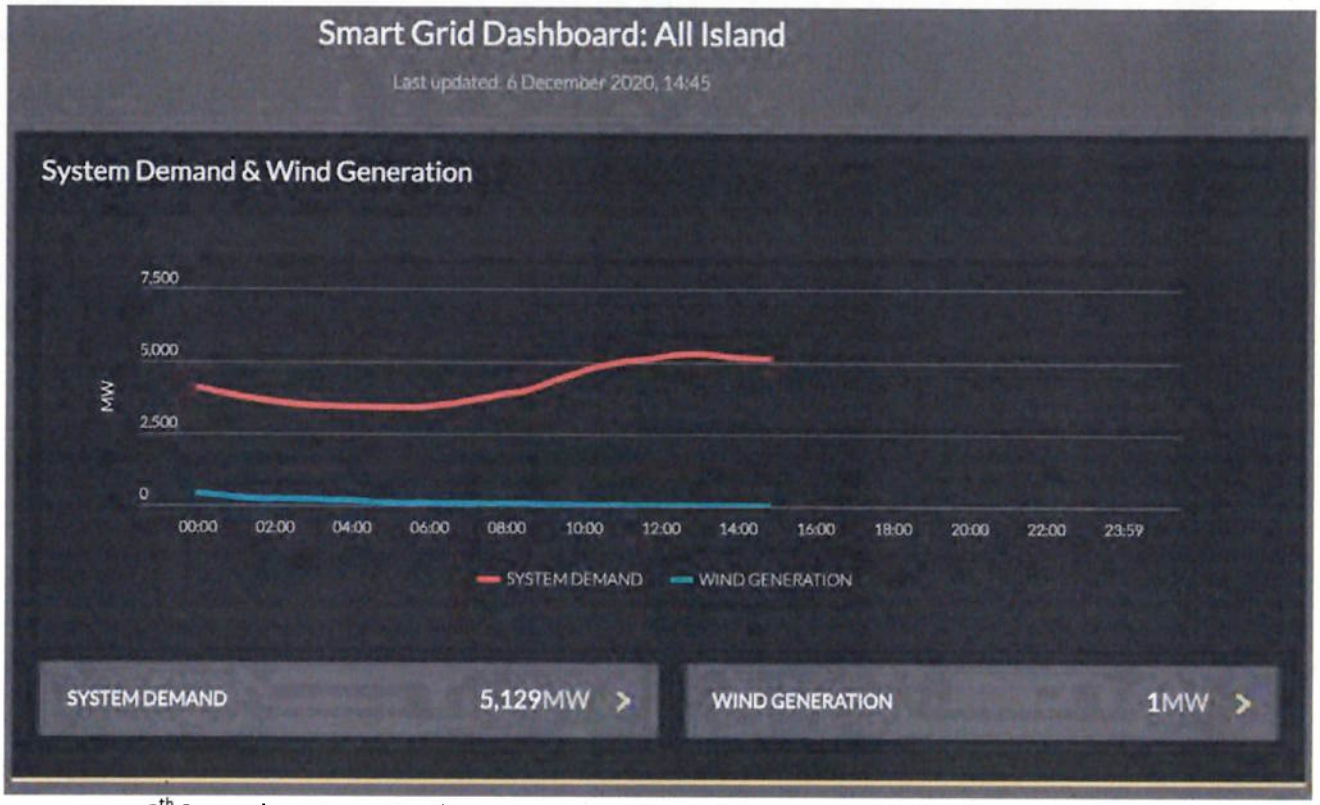
ENERGY MATRIX on RANDOM DATES

To demonstrate just how undependable and unsustainable wind is, I am attaching photographs from various dates since November 2020 which were taken from the Eirgrid Dashboard and which show the system demand together with the contribution from wind energy. These are but a small sample; I have many more [https://www.smartgriddashboard.com]



30th November 2020. ©

Note that the demand for electricity was increasing while at the same time wind supply was decreasing.

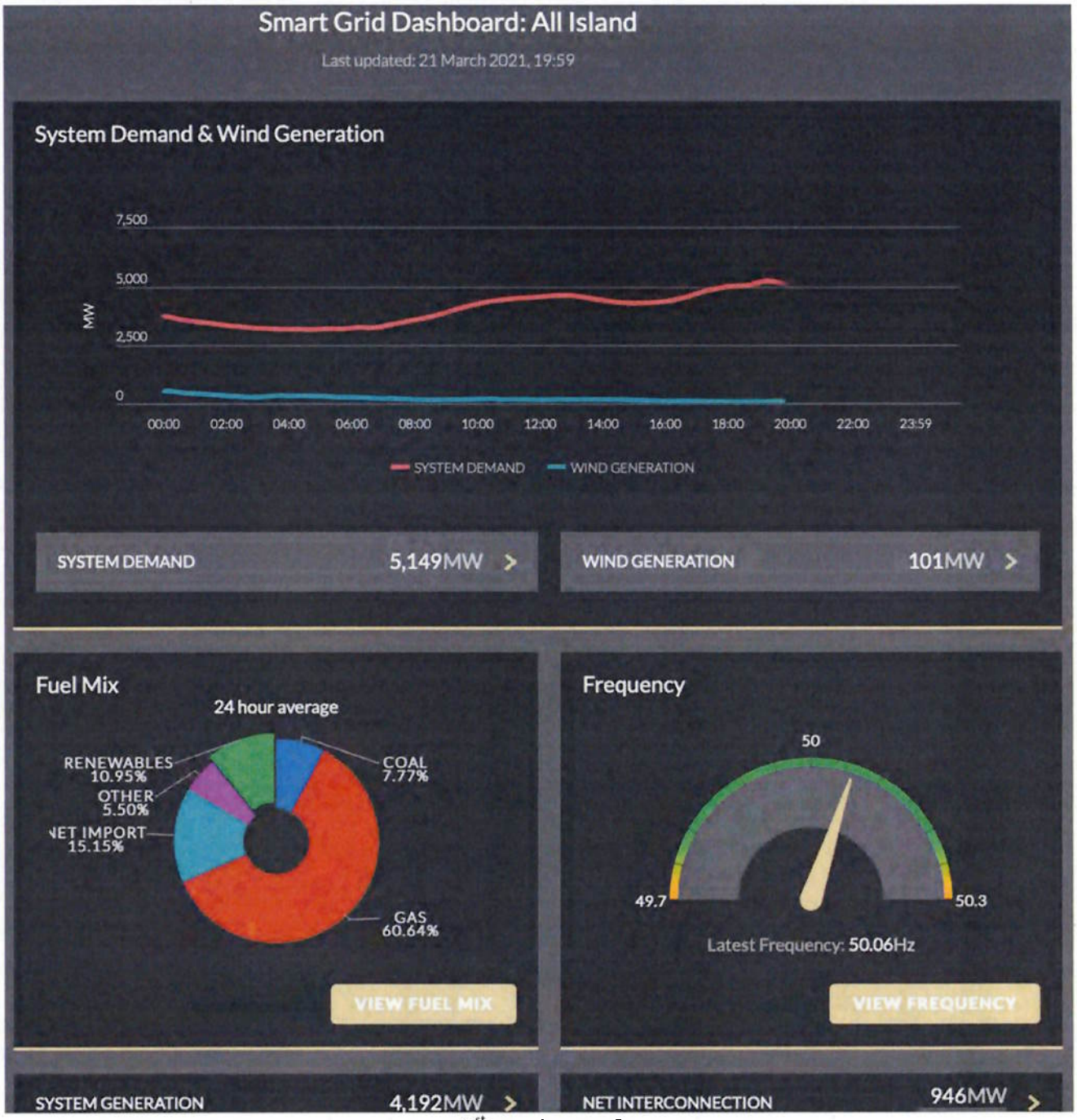


6th December 2020: Weather conditions were freezing fog, which lasted for some days. ©

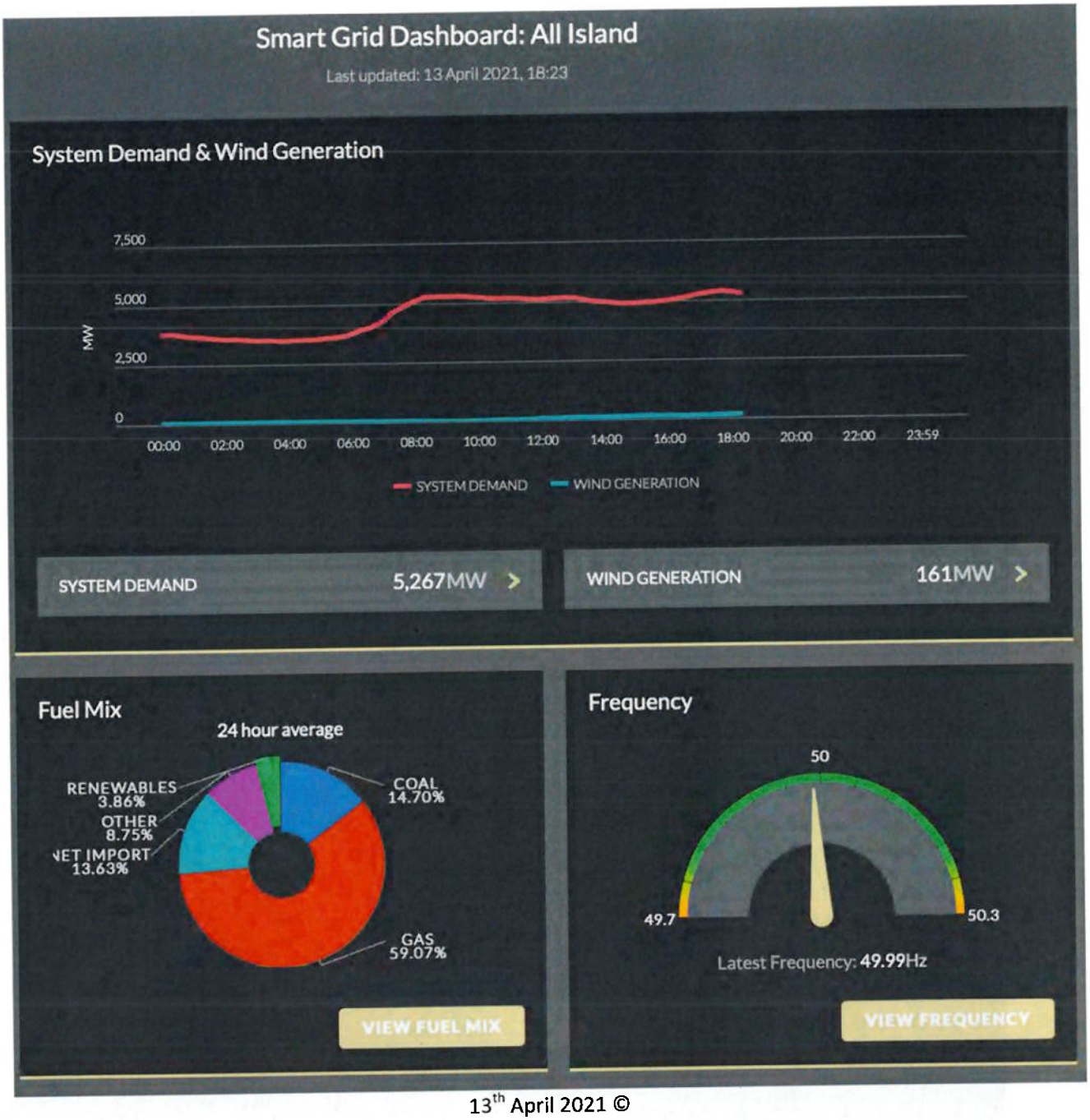
7th December 2020 ©

30th December 2020 ©

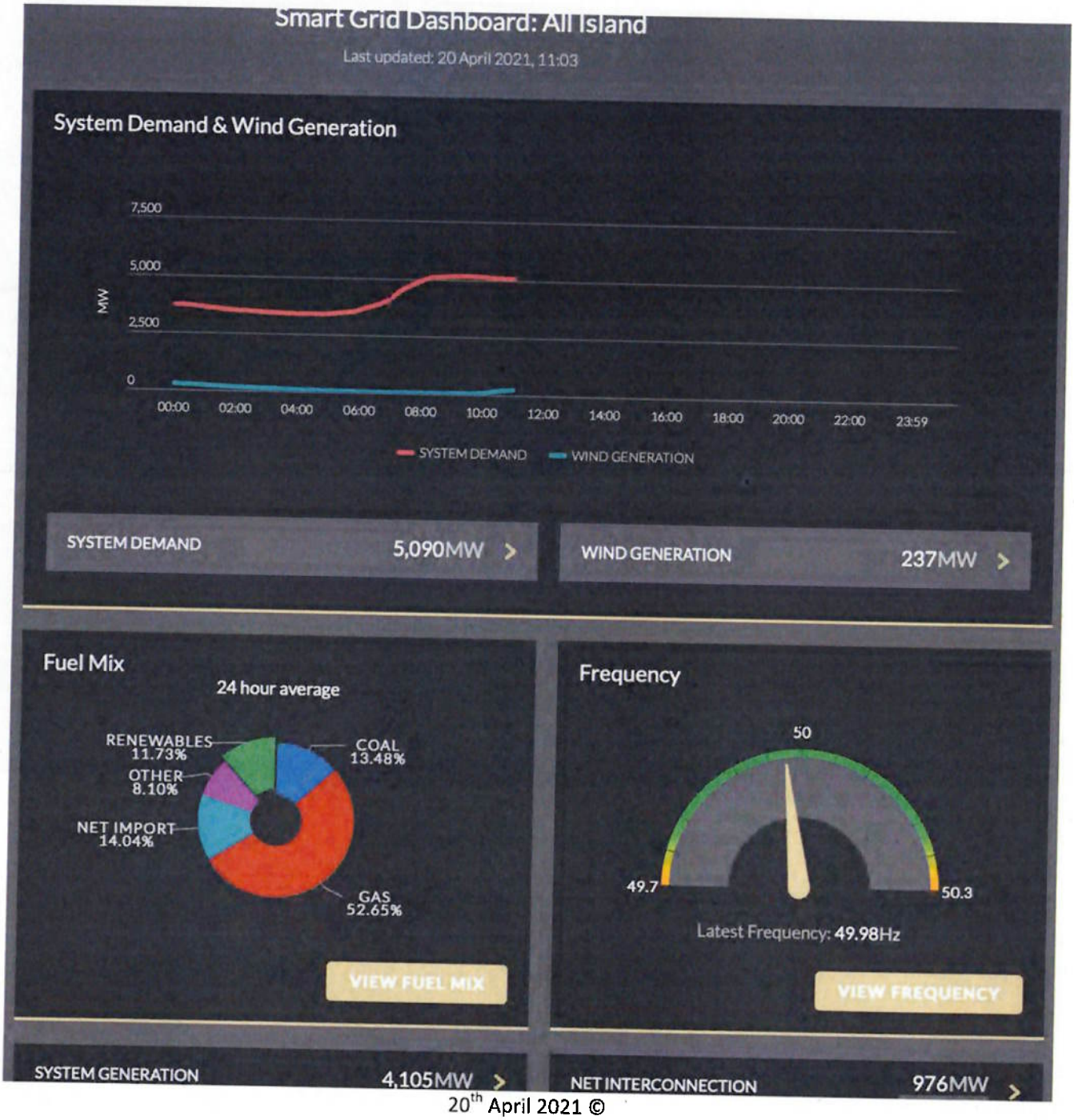
7th March 2021 ©



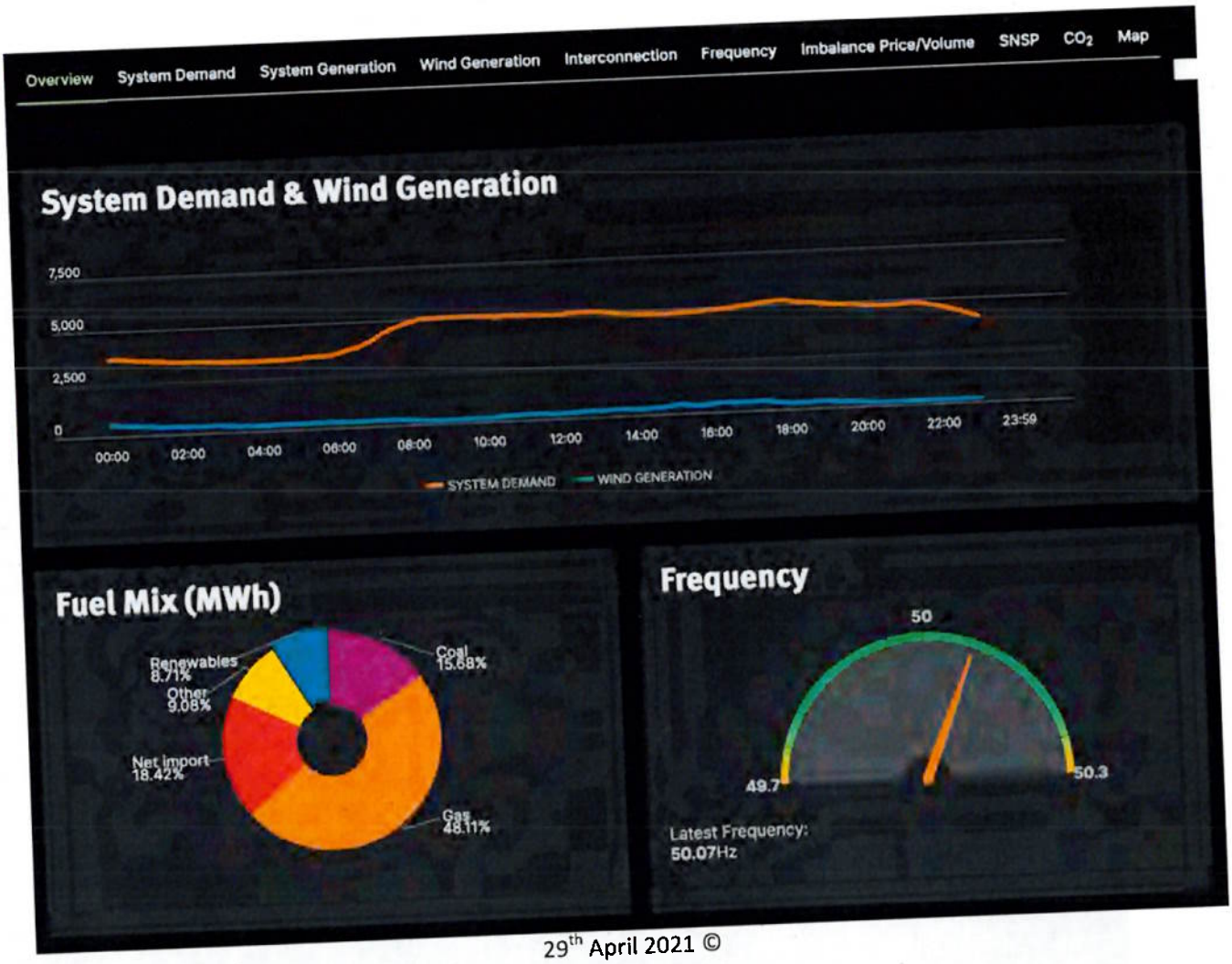
21st March 2021 ©



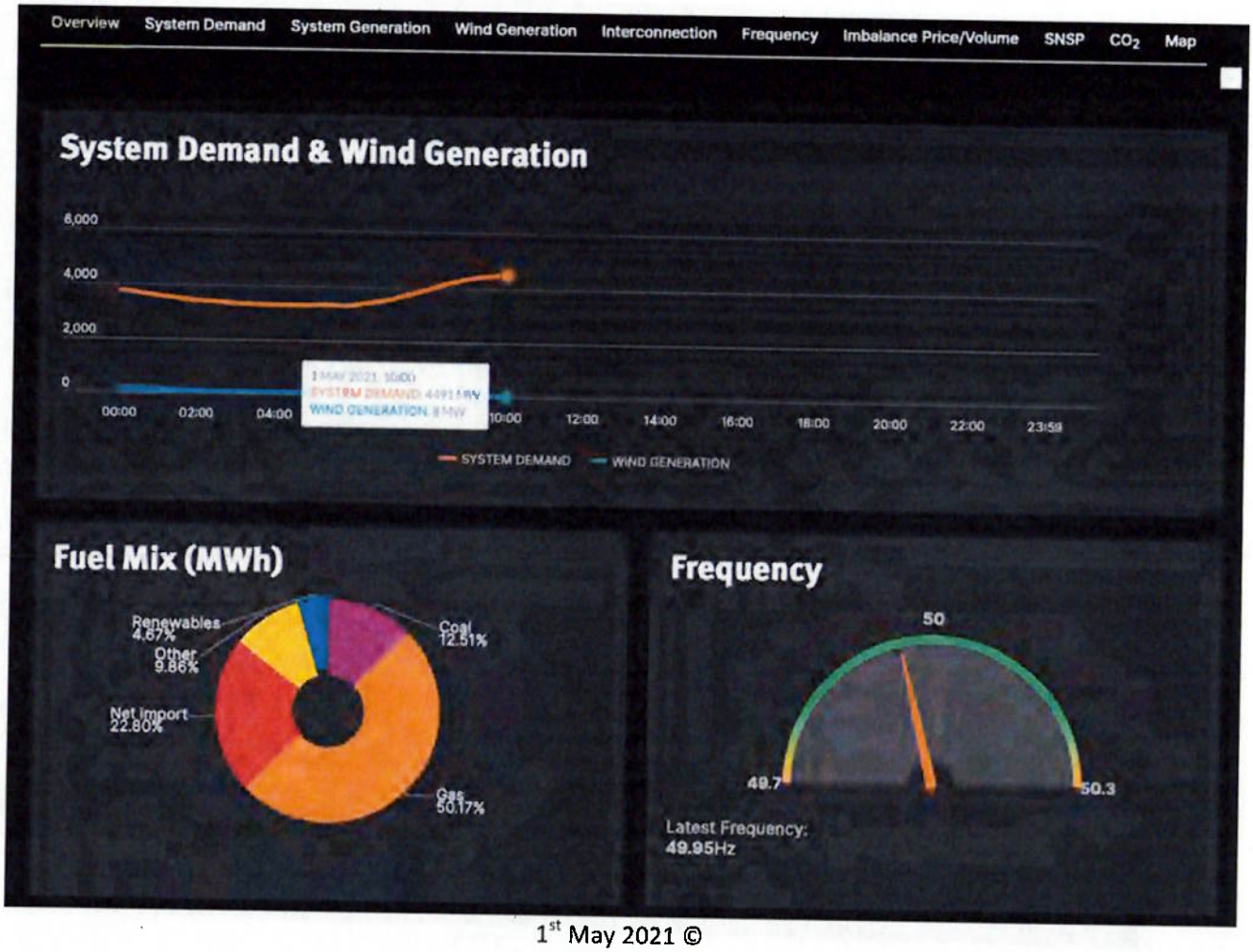
13th April 2021 ©



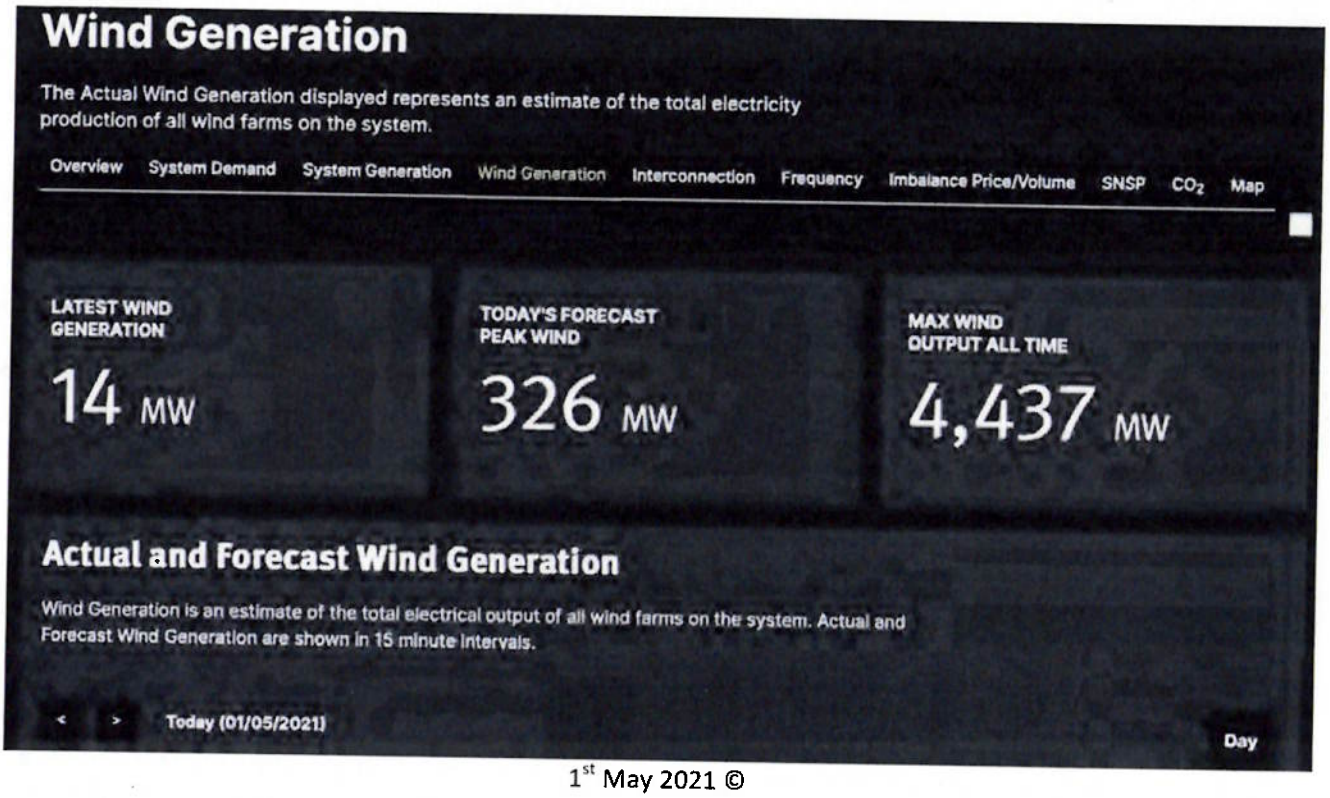
20th April 2021 ©



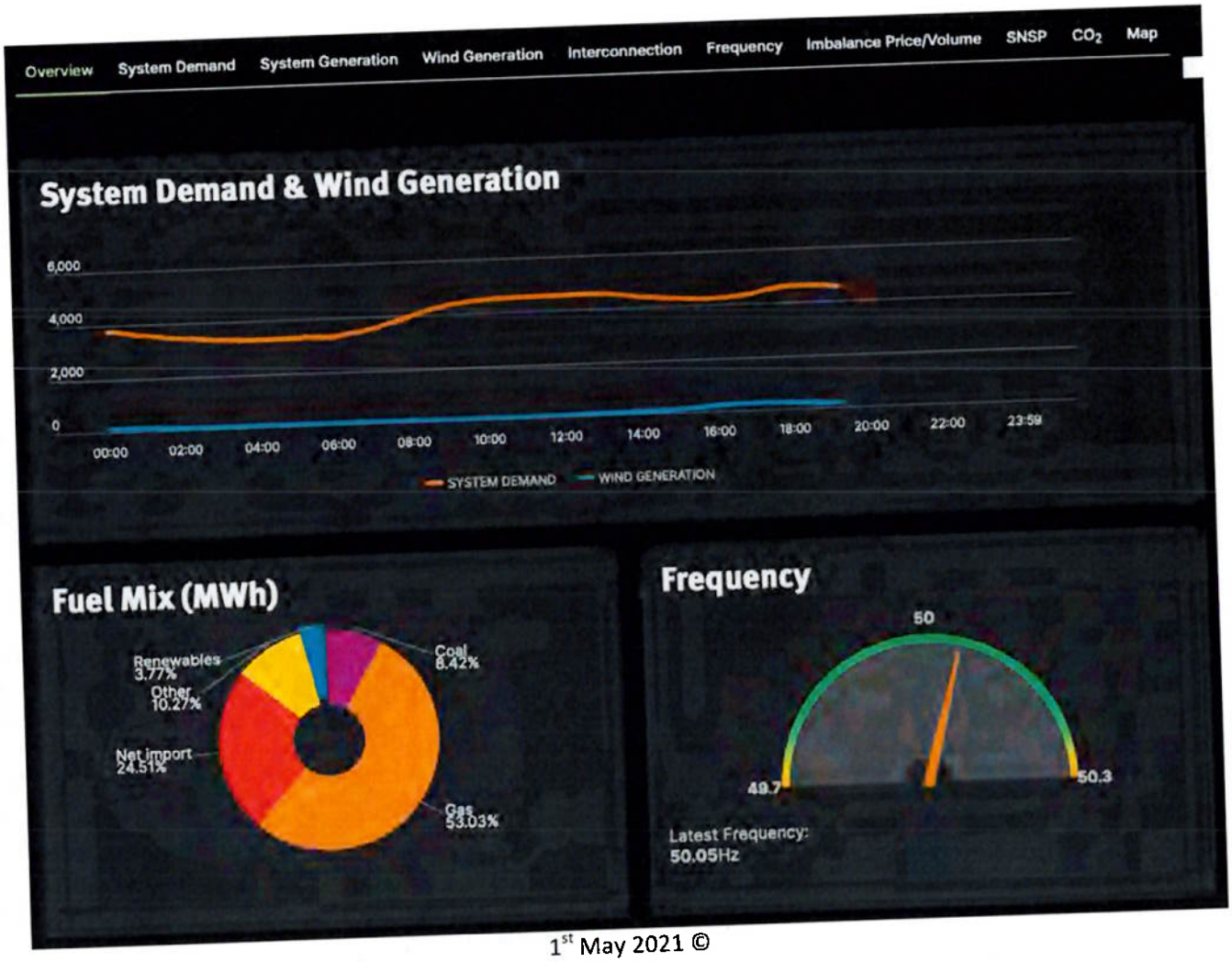
29th April 2021 ©



1st May 2021 ©



1st May 2021 ©



1st May 2021 ©

155. It is remarkable that during times of frosty weather when electricity is at a premium, wind delivers little or nothing. The same can be said when the country is basking in sunshine and there is little or no wind. The converse then occurs with heavy demand on Air Condition units put a heavy draw on electricity and it having to be provided by gas fired plants. This is a ludicrous situation.

156. It is inappropriate that wind should be prioritised over other forms of renewable energy. Why not for example Deep Bore Geothermal energy which is less invasive on humanity and the environment?

157. We recommend that a **full cost/ benefit analysis** be conducted to establish value for money given the resources required taking into account the intermittent nature of solar energy. This should include comparisons with other forms of sustainable energy with particular reference to **Deep-bore geothermal** energy, which is fully dispatchable and not intermittent. Such an analysis should ignore completely any artificial grant incentives and focus purely on the real cost of the development together with an assessment of what can realistically be expected in terms of deliverable energy generation at these northerly latitudes. This should also factor in worst-case scenario climatic conditions (light levels) with extensive periods of cloud cover.

158. Furthermore, a full analysis of **impacts upon the surrounding community** should be conducted.

159. Agricultural/ arable land is an extremely valuable resource for the production of crops. The importance of sustainable homegrown crops has recently come to the fore in light of the war in Ukraine. It transpired that Ukraine was supplying vast quantities of cereals to Europe and there is now a very strong likelihood of food shortages as a result of the Russian aggression towards its neighbor Ukraine. It will be noted that Irish farmers were in the spring of 2022 encouraged to sow more cereals to help bridge the gap. In the circumstances, to use up so much finite agricultural land with solar panels would be irresponsible and wrong. Given that so much roof spaces is available to support solar panels, there are alternatives.

160. On balance it is considered that this development would create an undesirable precedent and should ultimately be declined.

161. **Both Wind and Solar energy is intermittent and not dispatchable.** ***(Dispatchable generation refers to sources of electricity that can be used on demand and dispatched at the request of power grid operators and according to market needs. Dispatchable generators can be turned on or off, or can adjust their power output according to an order.)***

PLANNING ENFORCEMENT/ POLICING

162. Without prejudice to the main rationale advanced in this submission that the current proposal is contrary to numerous planning principles, we are obliged to point out that it has been our experience in a long course of dealings with the enforcement departments of numerous municipal authorities, that enforcement of the planning laws has been poor and lethargic.

163. We regularly, encounter a plethora of conditions pertaining to a given planning permission, which are not enforced or followed up on. This continues to be the case even after specific concerns and issues have been raised. It follows that we would have similar concerns in the current context and other future developments.

164. Moreover, the concept of self-policing, which is where operators are mandated to submit various results to planning authorities on a specified regular basis, has also proved to be extremely problematic. Our experience has been that compliance with such requirements has been poor. Therefore it would be remiss of us not to express similar concerns for this and all other proposed developments of a significant or industrial nature.

GREEN WASHING

165. Having regard to the foregoing, it is submitted that wind energy is not a long-term runner and is currently being artificially driven by significant grants, which serve only to create a rush for grants by investors and corporate's driven purely by 'returns' piggybacking on the 'Green' label.

166. We can understand why Wind Energy became the front-runner as it was perhaps the most visually obvious. However, when all the facts are viewed objectively, it is utterly crazy to persist with this strategy. As we have seen above, this is badly flawed. Moreover, the emphasis on wind is largely derived from a lack of public consultation early on in this debate, which is contrary to basic democratic principles and more recently to the Aarhus convention and the Public Participation Directive.

167. Applicant's assertions about objectives of national policies in so far as they related to energy are nothing short of green washing. Proposals must be looked at in a planning context; all other issues are superfluous. Notwithstanding, we believe that other forms of sustainable energy are far better placed to fulfill national objectives.

168. Significant resources are required to enable this development. Please ensure that there is a full assessment of **all materials required in the construction this development**? Please also quantify the amounts of materials required to construct this proposed development with specific reference to rare earth metals?

CONCLUSIONS

169. **Social**: The proposed development/s are most undesirable from a community perspective. Quite aside from the planning issues which are detailed in this submission, the social effect of such a proposal on a community is unacceptable in that it is very divisive and causes all sorts of unewarrented upset.

170. Having regard to the principles of proper planning and sustainable development, and of the provisions of the Fourth Schedule of the 2000 Planning Act, it is submitted that the proposed development should declined for the foregoing reasons.

171. It is submitted that the proposals would represent disorderluy development.

172. There is no established use in this area for Turbines and certainly not the height and scale proposed.

173. The proposed service entrances would endanger public safety and create a hazard to residents and other road users. **[Section 4. Schedule Four of the 2000 Planning Act]**

174. The proposed development would adversely impact on the property value in the area and would seriously injure the amenity in the vicinity. **[Section 10. Schedule Four of the 2000 Planning Act]**

175. The proposed development would interfere with the character of the landscape and also with the views and prospects, which are considered to be of special amenity value and of natural interest and beauty. **[Section 8. Schedule Four of the 2000 Planning Act]**

176. The road network servasing much of the the proposed development is inadequate to accomadate the large volumes of construction traffic.

177. Having regard to the level of permitted residential development in the area, the proposed development would seriously damage the amenities of properties in the vicinity and would have a negative impact on the quality of life and the residential amenity of those living in the area.

178. The relatively flat landscape of Limerick is totally unsuitable for this type of development which would be visually obtrusive.

179. Furthermore, having regard to the agricultural and tourestic value of this landscape which has a high density of heritage sites together with the new 'Ireland's Ancient East' initiative (launched 14th April 2015), the proposed development is incompatible.

180. Having regard to previous decisions of An Bord Pleanála at nearby locations [aluded to above], the current proposal should be REFUSED. We coupd provide many more examples too.

181. It is desirous that the landscape which amongst other things comprises the Royal Canal, must be considered a unique national resource should be guarded for future generations.

182. The removal of such a large quantity of trees together with the importation of such a large quantum of concrete and aggregate is considered to be an unsustainable development.

183. The proposed development would give rise to degregation of an environment elswhere and indirectly inflict hardship on human beings in another part of the global community

184. The proposed development would contribute to an unsustainable use of natural resources.

185. It is considered that there is currently over capacity of wind on the national grid and that alternative energy sources such as Deep Geothermal would be more suitable and sympathetic to the lush green Irish landscape character.

186. The Proposed Development is incompatible with the County Development Plan.

187. Having regard to the foregoing it is manifestly obvious that wind energy is not a long-term runner and is currently being artificially driven by significant grants, which serve only to create a rush for grants by investors and corporate's driven purely by 'returns' piggybacking on the 'Green' label.

188. Moreover the sighting of the wind turbines in a county that markets itself on its heritage is utterly crazy and unacceptable. The midlands have significant populations, together with important heritage sites, which are of enormous touristic potential.

189. When all the facts are viewed objectively, it is utterly crazy to persist with this current wind energy policy, which having regard to the above is badly flawed. As we have seen above, this is badly flawed. Moreover, the emphasis on wind is largely derived from a lack of public consultation early on in this debate, which is contrary to basic democratic principles and more recently to the Aarhus convention and the Public Participation Directive.

190. Notwithstanding the above, it is considered that all existing roof space should be utilised before using valuable landmass and this important bog land habitat. As such, this application is considered inappropriate for this site.

Having regard to the foregoing, the proposed development is therefore considered wholly incompatible to this area and it follows that *An Coimisiún Pleanála* should therefore REFUSE the proposals and are requested to do so. We trust that the issues highlighted herein, sufficiently clarifies the position of the local community.

ENDS

ENCLOSURES

1. **Irish Times Article** dated 13th August 2025 (appended hereto).

   We append Irish Times article dated **13th August 2025**, outlining the experiences of neighbours Living Next Door To ... Ireland's largest onshore wind farm;
   Oweninny Wind Farm in Co Mayo meets the power needs of some 140,000 homes a year
   Áine Ryan, Wed 13th August 2025
   https://www.irishtimes.com/ireland/2025/08/13/living-next-door-to-irelands-largest-onshore-wind-farm/

   Full article is reproduced hereunder (attached to this document).

2. **Infrasound**: High-resolution measurements near Wind Power Plants

Living Next Door To ... Ireland's largest onshore wind farm

Oweninny Wind Farm in Co Mayo meets the power needs of some 140,000 homes a year

Áine Ryan
Wed 13th August 2025
https://www.irishtimes.com/ireland/2025/08/13/living-next-door-to-irelands-largest-onshore-wind-farm/

Eileen and Alan Mullarkey would never have considered extending their remote home in Erris, Co Mayo, if they had known it would be surrounded by turbines from Ireland's largest wind farm a decade later.

Oweninny Wind Farm is being built in three phases as a joint venture between the ESB and Bord na Móna at a cost to date of €320 million.

The second phase of the farm entered commercial operation in the spring of 2024, with an installed capacity now of 192mw which meets the power needs of some 140,000 homes a year.

With the third phase having received planning permission earlier this year, the Mullarkeys say an estate agent has told them their eight-bedroom house, which they extended in 2016 and once considered opening as a B&B, is now effectively worthless.

The couple saved hard in order to build their dream home, with Alan working in the UK before they were married. It is on a narrow road in the townland of Shanakilla, beside the once booming village of Bellacorick, on a plot of land next to the remote farmhouse where Eileen was reared and where her brother still lives.

The couple, in their early 50s, have five children, aged from 13 to 25, who are still living at home.
"We never had a problem with the original wind farm which has 'toy turbines', as we call them, and are further from the house," Eileen says.

Built in 1992, this was Ireland's first commercial wind farm and it adjoins the new development. Due to be decommissioned in the coming months, 18 new turbines are scheduled to replace the original 21, completing the three phases of the Oweninny project and its 78 turbines.
Speaking last year after the opening of phase two, then minister for energy and Green Party TD Eamon Ryan called it "a significant day for Ireland and for Mayo" in terms of delivering clean energy.

For decades anyone who travelled from Ballina to Belmullet would recall how this vast, bare and boggy landscape was once dominated by the 300ft high (88.82m) Bellacorick Generating Station's cooling tower.
Today, this landscape is dominated by wind turbines double the tower's size, standing 176m (577ft) high.
When the cooling tower was demolished by a controlled explosion in 2007, thousands watched from afar, comparing it to "a wake" for the community.

It serviced Bord na Móna and the ESB's last old-style peat-fired electricity generating plant. Situated north of the N59 between Crossmolina and Bangor Erris, the station burned milled peat from 2,400 hectares (24sq km) of developed bogland which helped to power the national grid from 1962 until 2003.
For an area blighted by emigration driven by economics, the industry, when at peak production, provided employment for up to 500 locals.

'We feel we have been branded as troublemakers just because we didn't agree with everything'

"Back then I worked down in the pub," Eileen says. "It was full of life and there was loads of money around the area. Then, bang – it was gone. We lost the pub. We lost the post office. We lost the petrol pumps. We lost everything once the power station shut down.

"There is almost no direct employment from this project," Alan says of the wind farm. "Its contractors come in, do their maintenance work and disappear again."

The lack of local employment is one of many criticisms the Mullarkeys have about living beside the project.
"When the turbines are running at a high speed, the swishing noise is going to be louder but then during the winter gales and storms you've got the clash of the wind with the blades," says Alan.
The couple claim the project was rushed through the planning process before they realised what was happening.

"When the rumours became a reality, we did object on the grounds that the project was too close to our house, that there would be noise intrusion and our view would be blocked," says Alan.
"At the time we didn't know about shadow flicker," Eileen adds. "That's when the blades are going around and they cast a moving shadow through the house that every now and then obstructs the sunlight ... darkening the rooms.

Eileen said theirs is the only house that has shadow flicker and it occurs in the mornings and the evenings.
"Even the first time we reported shadow flicker, they told us this wouldn't happen, saying there was a sensor on the turbine that shuts it down but I can assure you that is not the case."

It is important to note, says Eileen, that none of their objections and queries were ever about money.
"We feel we have been branded as troublemakers just because we didn't agree with everything. We just want people to understand the realities of wind farms," she says.

"After all, the only compensation households within the 1,000-metre zone get is €1,000 a year, for phase two only, and for 15 years. Ironically, it doesn't even pay our electricity bill for the year. Wouldn't it have been a positive community gesture to allow one of the turbines to generate local electricity?"
Accountant Tommy McHugh's home, in Ballymunnelly, is another of the 22 houses deemed "near neighbours" of the project.

"There were a lot of promises made before the wind turbines were installed and we thought we would be able to negotiate for better compensation but the developer has hidden behind the legislation and has only been open to giving us the minimum amount," says McHugh.

"Our properties have been devalued by at least 50 per cent while the developer has amassed multimillion euro profits."

His neighbour, Madeleine Gallagher, who works as a nurse in Castlebar, has the same criticisms.
"I also understand we need green power and as I drive home from Castlebar at night I find all the lights in the sky from the turbines comforting, even if they look like great grey statues during the day," she says. "But the reality is that we have a very elderly population, no employment in the area and the company could have treated us better."

Locals agree that a €600,000 community benefit fund and educational scholarship scheme have been welcome.
"In 2024 four scholarships were awarded to applicants who live within 5km of Oweninny Wind Farm Phase 2. The scheme may be used towards course fees, accommodation, tools and transport costs," an ESB spokeswoman said.

Some 1,462 pupils from 34 schools have attended the educational programme at the visitor centre, which covers "the history of power generation, peat production, wind energy development, the bog rehabilitation programme, ecological interests and the social history of the area".

Alan and Eileen Mularkey live with the daily hum and flicker of Ireland's largest onshore wind farm

Addressing some of the criticisms made by locals, the spokeswoman stated that the developer was "committed to and rigorously adhering to" all the planning conditions.
She said the wind farm supports 14 direct jobs, employed more than 100 people during construction and that local contractors and service providers "continue to support the operation of the visitor centre on a weekly basis".

For local Fianna Fáil councillor Michael Loftus, the bottom line is that the project has gone through the full planning process and been granted permission.
"The community made their feelings known at the time and some are for it and some are against it but the big win is the community gain fund," he said. "There will be more employment when phase three starts and there is huge potential for employment through the visitor centre."

However, he agrees there should be free electricity for the project's "near neighbours" under that scheme and their annual compensation should be greater than €1,000 per year.
Meanwhile, the Mullarkeys are concerned about practicalities such as their narrow roadway up to the N59 becoming flooded as a result of the huge construction project having involved deep excavation of the bog.

"A bog is like a sponge: they took the bog away to put stone and steel into it to build these monstrosities," says Eileen.

"During the building of the turbines, the big machinery did so much damage to the bog and now they are telling us that people cutting a few yards of turf are damaging the environment," Alan says.
With the construction of phase three of the wind farm in the offing, the Mullarkeys say they are too tired to continue asking questions and putting in queries about the project.

"Last year there was a major cable fault in the system and the turbines were shut down for 12 weeks," says Eileen.

"It was like winning the lotto for us. The silence was just like heaven and most importantly, as we worked in our garden, we could hear the birds singing again."

Chapter

Infrasound Exposure: High-Resolution Measurements Near Wind Power Plants

Huub Bakker, Mariana Alves-Pereira, Richard Mann, Rachel Summers and Philip Dickinson

Abstract

This chapter focuses on infrasonic (≤20 Hz) noise exposure as captured in and around homes located in the vicinity of wind power plants. Despite persistent noise complaints by local residents, no satisfactory acoustical event has yet been identified to justify this troublesome (worldwide) situation. Continuous (days), high-resolution recordings—spectral segmentation of 1/36 of an octave and 1-second temporal increments—have been acquired in many homes across the world revealing the presence of wind turbine acoustic signatures. These consist of trains of airborne pressure pulses, identified in the frequency domain as harmonic series with the fundamental frequency equal to that of the blade-pass frequency of the wind turbine. This report documents three such cases (Portugal and Scotland). The highest peaks of the wind turbine acoustic signature (up to 25 dB over background noise) occurred within the 0.5–5 Hz window which is classically defined as below the human hearing threshold; and yet these 'inaudible' phenomena appear to trigger severe biological reactions. Based on the prominence of the peaks in the harmonic series, a new measure is proposed for use in determining dose–response relationships for infrasonic exposures. This new methodology may be applicable to infrasonic exposures in both environmental and occupational settings.

Keywords: harmonic series, harmonic prominence, wind rose, 1/36-octave bandwidth, time profile, low frequency noise, environmental noise, wind turbines

1. Introduction

Hearing loss, speech intelligibility and noise annoyance are some of the most studied impacts of noise exposures on human health and well-being. A common denominator of these three outcomes is the audibility of the sound. Exposure to loud noise over extended periods of time can cause hearing impairment; noisy environments can interfere with the correct understanding of speech; and certain types of continuous or intermittent sounds can cause people to feel annoyed by noise, which can, in turn, exacerbate underlying disorders or diseases.

There are, however, additional features of sonic environments that are unrelated to the human audibility of sound, but that can also deleteriously affect human health and well-being, specifically, infrasound (≤20 Hz).

1.1 Infrasound and human health: brief overview

With the growing industrialization and mechanization that occurred worldwide in the 1960s, infrasound in the environment began to take its toll on workers and urban citizens. Thus, in 1973, the National Research Council of France organized an International Colloquium entirely dedicated to infrasound [1]. One of the outcomes was the establishment of permissible levels for infrasound exposures in the Russian Federation [2]. **Figure 1** shows the legislated values for the year 2000.

With the introduction of industrial wind turbines (IWT) in mostly rural areas, noise complaints by local residents began to emerge in the media [3, 4, for example] and in scientific journals [5, 6, for example]. And yet, the vast majority of noise measurements performed in and around homes near wind power plants (WPP) showed values well within the established guidelines [7, 8, for example]. This apparently paradoxical situation has even prompted some authors to assume a psychosomatic origin for resident noise complaints [9], or to associate these health complaints with a lack of monetary gain from the WPP [10]. In direct contradiction to the notion of a psychosomatic origin for these noise complaints, are the animal studies showing increased physiological stress when living in the wild, close to WPP [11, for example], or under laboratory conditions, simulating occupational environments [12, 13, for example].

1.2 Frequency-weighting systems, spectral segmentation and temporal resolution as applied to acoustical data acquisition

The ability of the human auditory system to capture sound depends on the combination of the amplitude of the pressure wave (usually evaluated in deciBels, dB, referenced to 20 microPascal), and the frequency (Hz). Different frequencies require different levels of sound pressure in order to be heard. Some decades ago, the International Organization for Standardization (ISO) established a frequency-weighting network that simulated the human hearing threshold and that was specifically focused

No.	Premise	Sound pressure levels, dB, in octaval bands of averaged geometric frequencies, Hz				General sound pressure level dB "Lin"
		2	4	8	16	
1.	Different jobs inside industrial premises and production areas:					
	- Different physical intensity jobs	100	95	90	85	100
	- Different intellectual emotional tension jobs	95	90	85	80	95
2.	Populated area	90	85	80	75	90
3.	Living and public premises	75	70	65	60	75

Figure 1.
Permissible levels for infrasonic exposures (at 2, 4, 8 and 16 Hz) for two occupational and two environmental settings. Values are provided in dB Linear (no weighting) and, as expected, are lower for public areas than for occupational environments [reproduced from 2].

on preventing hearing loss—the "A" frequency-weighting system [14]. The use of the A-weighting system yields sound pressure levels in the dBA metric.

ISO has also ratified procedures for evaluating infrasound and lower-frequency components: ISO 7196:1995(E) defines the "G" frequency-weighting system as appropriate for quantifying acoustic energy within the range of 0.25–250 Hz [15]. The use of the G-weighting system yields sound pressure levels in the dBG metric. **Figure 2** compares data to which A- and G-weighting have been applied. It also shows the values when no weighting is imposed.

The environment shown in **Figure 2** is within a rural home in the proximity of a WPP, and where residents have noise complaints (see Section 2 below, Home 2). In this 10-minute data segment, the average noise level was less than 30 dBA, well within compliance levels for most rural areas around the world. The G-weighting system, while over-evaluating the sound pressure levels within the range of 10–25 Hz, yielded an average noise level of around 55 dBG. In Japan, for example, the limit for infrasound generated by IWT is 92 dBG [16]. The unweighted capture, which measures the actual levels present in the environment, yielded an average noise level above 60 dB. The highest peaks in this environment, measured without weighting, occurred at frequencies below 8 Hz, i.e., below the defined threshold of human audibility. Taken alone, it would seem that these numerical values are insufficient to adequately characterize the instigator of these residents' noise complaints.

In addition to showing the problematic usage of different frequency-weighting systems, **Figure 2** emphasizes two other aspects of noise measurements: the segmentation of the acoustical spectrum into bands of 1/3 of an octave, and the temporal resolution of 10-minute averages, as per ISO guidelines [14]. As for the spectral segmentation, a higher resolution is technologically possible, but the results are considered mostly academic, since practically all tabulated values related to permissible noise exposure levels use 1/3-octave segmentation.

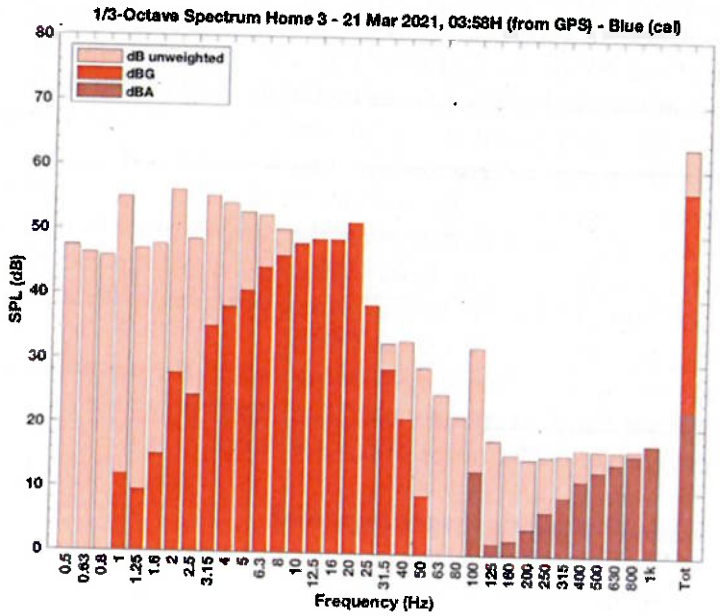


Figure 2.
Comparison of acoustical data acquired with unweighted, G-weighted, and A-weighted systems (10-minute average). Note that between 10 and 25 Hz the G-weighting sound pressure levels are defined to be higher than the unweighted values. (See Section 2 below for detailed methodological capture of this data in Home 2).

1.3 Goal of this report: Going beyond ISO recommendations

Could it be that the spectral segmentation into the 1/3 of an octave and the 10-minute average temporal resolution are too coarse and rudimentary to identify biologically-relevant acoustical phenomena, such as those emanating from WPP?

This report documents the acoustical environments captured in homes located near WPP, using a spectral resolution of 1/36 of an octave, and a temporal resolution of 1-second. Sound pressure levels were analyzed in dB (unweighted).

2. Background and methodology of data collection

Data reported herein were collected in Portugal in Jul-Aug 2020 (Home 1) and in Scotland in Feb-Mar 2021 (Homes 2 and 3), at the invitation of the separate homeowners—usually due to the onset of a pattern of debilitating symptoms which, they claim, only began after WPP became operational in their residential areas [17]. A two-channel sound recording device was placed in and around each home with continuous data acquisition over several days. During the sound recordings, residents were asked to keep a date- and time-logged diary detailing the onset or absence of symptoms, such as sleep disruption. This onset or absence of symptoms could then be compared with changes in the sound recordings that might suggest a causal connection.

2.1 High resolution sound recording

The recording equipment was a SAM Scribe Full Spectrum (FS) system (Soundscape Analytics, Palmerston North, New Zealand), Model Mk1 in Portugal and Mk2 in Scotland [18]. It is a two-channel device with sampling rates up to 44.1 kHz, that is designed to capture recordings of sonic environments with high precision, especially in the infrasonic and low-frequency bands. Data streams are delivered via USB to a Windows notebook computer and stored as uncompressed wav files to a hard disk. GPS information is stored in the files as metadata, which also include a digital signature. Each wav file corresponds to a 10-minute (600-seconds) recording of the sonic environment. The system can accurately record from 0.1–1000 Hz, as per the manufacturer frequency response of the two electret condenser microphones [19].

All measurements reported here cover the range from 0.5–1000 Hz and were captured with a sampling rate of 11.025 kHz. All recordings included a standard reference calibration tone at the start and end, produced with a Type I calibrator (part of the SAM Scribe system) at 1000 Hz/94 dB.

Calibration of the SAM Scribe system rests on 1) the manufacturer's frequency-response curve for the microphone and 2) calibration against a certified Larsen-Davis 831 sound level meter in the range of 6.3–1000 Hz.

2.2 Homes where recordings were captured

2.2.1 Home 1: Portugal (the E. family)

Period of continuous recording: 18 Jul 2020 (00:00)—09 Aug 2020 (10:00).
Microphone location: At the foot of the bed in master bedroom (ground floor), tripod-mounted 1.5 m above the floor.

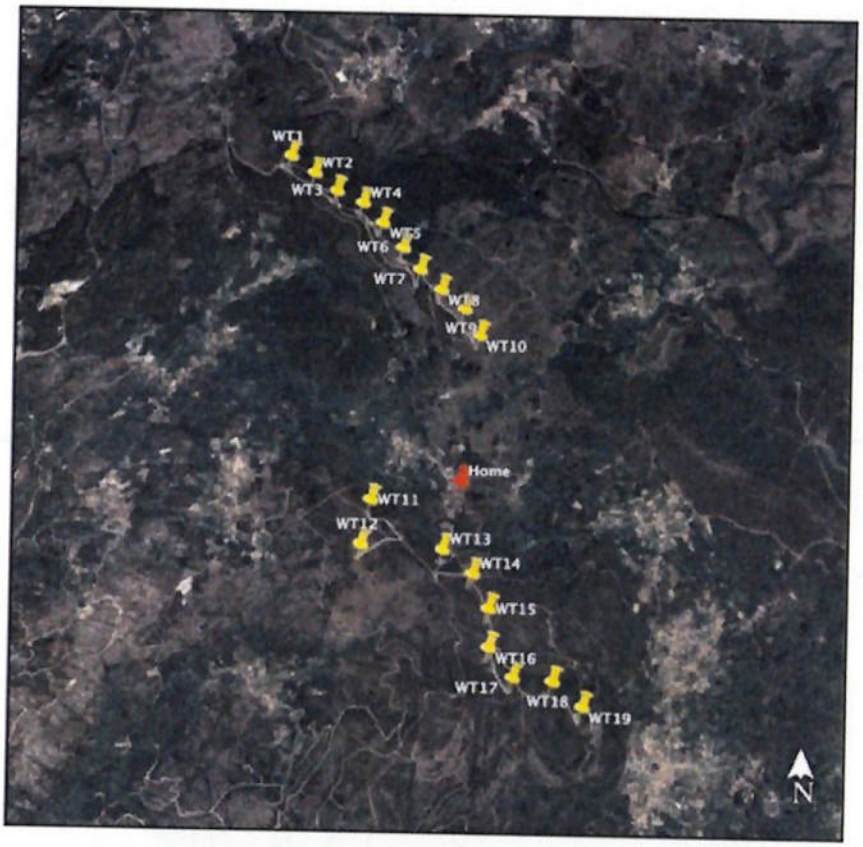


Figure 3.
Relative positions of Home 1 and the 19 industrial wind turbines (labeled WT in the figure) that constitute this wind power plant. (Image adapted from Google Earth).

Figure 3 shows the relative position of Home 1 and the WPP (19 Senvion MM92 turbines of 2 MW each, with blade length 45.2 m). The closest IWTs to the home are numbers 11, 12, 13 and 14, at 843 m, 1085 m, 648 m, and 844 m, respectively. IWT1 and IWT19 are the furthest away, at a distance of 3422 m and 2282 m, respectively.

The E. family—Mr. E. (age 63) and Mrs. E. (age 64)—have lived amid these 19 IWT since 2016. Their health deterioration has been documented by neurological medical reports.

2.2.2 Home 2: Scotland (the P. family)

Period of continuous recording: 24 Feb 2021 (17:30)—07 Mar 2021 (00:00).

Microphone location: Beside the head of the bed in an upstairs bedroom with a dormer, tripod-mounted 1.5 m above the floor.

Mrs. P documented some of her symptoms from Jul 2019 to Mar 2020. **Table 1** shows a 6-month sample (Jul–Dec 2019).

2.2.3 Home 3 – Scotland (The J. Family)

Period of continuous recording: 20 Mar 2021 (16:20)—27 Mar 2021 (18:40).

Microphone location: Middle of attic bedroom, tripod-mounted 1.5 m above the floor.

Symptom	Dates on which symptom was reported
Nausea	6 Jul, 3 Aug, 18 Aug, 12 Oct, 20 Oct, 4 Nov, 6–7 Nov, 10 Nov
Dizziness	7 Jul, 3 Aug, 13–14 Sep, 20–21 Sep, 26 Sep, 28 Sep, 24 Nov, 14–16
Pain in ears	5–9 Jul, 15 Jul, 18 Jul, 22 Jul, 26 Jul, 31 ul, 1 Aug, 3 Aug, 9–12 Aug, 21 Aug, 23 Aug, 13–14 Sep, 2 Oct, 4–5 Oct, 10 Oct, 17 Nov, 22 Dec, 27 Dec, 30 Dec
Sleep disturbance	2 Jul, 4 Jul, 14 Jul, 18 Jul, 22 Jul, 24 Jul, 13 Aug, 25 Aug, 13 Sep, 20 Sep, 12 Oct, 15 Oct, 3–5 Nov, 17 Nov, 23 Nov

Table 1.
Six-month sample of some of the symptoms documented by Mrs. P.

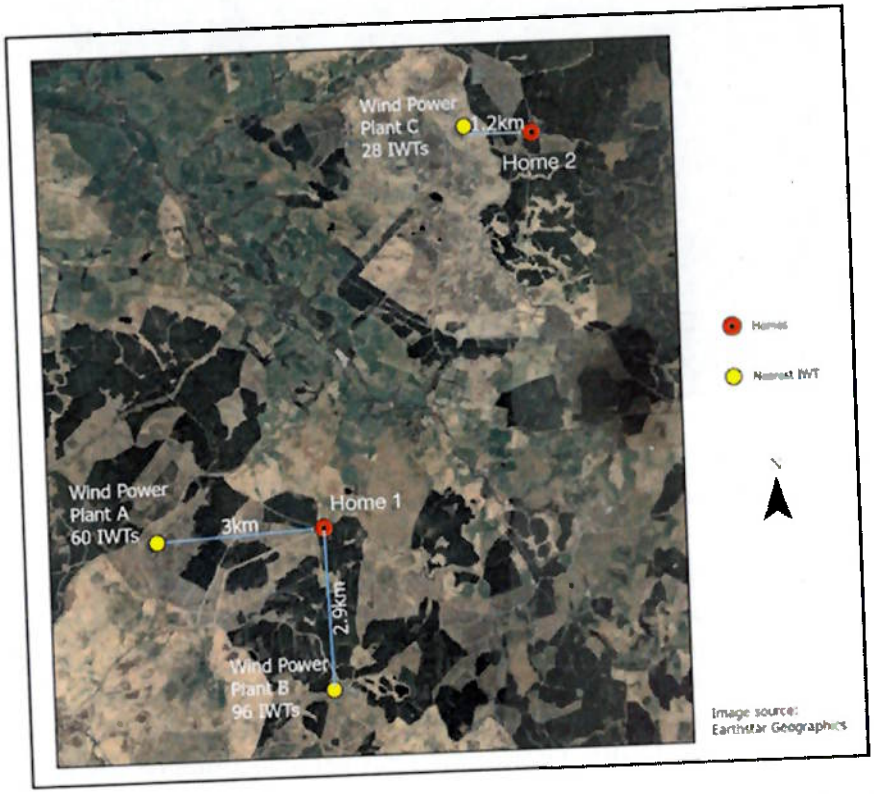


Figure 4.
Relative positions of Home 2 and Home 3 and the closest industrial wind turbines of wind power plants A, B and C.

Figure 4 shows the relative positions between Homes 2 and 3, and the three WPP located in the vicinity.

WPP A has 60 Gamesa G80/2000 turbines of 2 MW each, with blade diameters of 80 m. It is located 4.6 km to the west of Home 2 and 14.5 km to the southwest of Home 3. It has been operational since 2011.

WPP B has 96 Gamesa G114/2500 turbines of 2.5 MW each, with blade diameters of 114 m. It is located approximately 2.9 km to the south of Home 2 and 13.1 km to the south of Home 3. It has been operational since 2007.

WPP C has 28 Gamesa 87/2000 of 2 MW each, with blade diameters of 87 m. It is located approximately 9.5 km to the north of Home 2 and 2.1 km to the southwest of Home 3. It has been operational since 2011.

2.3 Wind data

Information on wind speed and direction was retrieved for the entire period during which recordings were made.

In Portugal, data was obtained from the Portuguese Institute of Sea and Atmosphere (IPMA [20]). Data points were requested in 10-minute increments, from three distinct meteorological stations: at 58 km (altitude above sea level: 995 m), 12.5 km (altitude above sea level: 642 m) and 52.7 km (altitude above sea level: 558 m) away from the E. family home (altitude above sea level: 850 m). In Scotland, weather data was obtained from the British National Weather Institute via the Open Weather service [21] in one-hour intervals. The location for which weather data was obtained was 3.5 km away from Home 2 and 7.8 km from Home 3. Wind data was time-matched to the GPS time-stamped acoustical recordings.

3. Results

3.1 Home 1: Diary

The E. family kept a diary from 13 July through 31 July, 2020.

On 29 July at 04:00, the family's sleep had been disrupted for several hours and Mr. E. felt so unwell that he was compelled to take medication (benzodiazepine) (*'Severe' episode*). By comparison, on the morning of 22 July, Mr. and Mrs. E. slept uninterruptedly until 07:00 (*'Peaceful' episode*).

Priority was therefore given to the analysis of the period between 03:00 and 06:00 (eighteen 10-minute recordings) on both these days, the choice of identical diurnal periods helping to alleviate any extraneous differences between the two mornings.

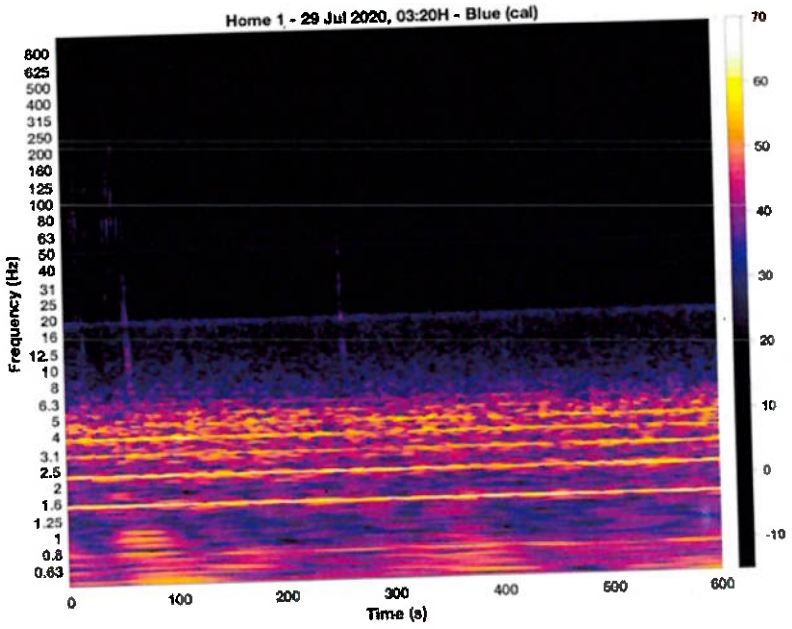
3.2 Home 1: At 03:20 on the morning of the 'severe' episode (29 Jul, 2020)

Figure 5 shows the results of the sound data acquired between 03:20 and 03:30, on the morning of 29 July, when the E. family's sleep was disrupted and Mr. E. felt the need to self-medicate.

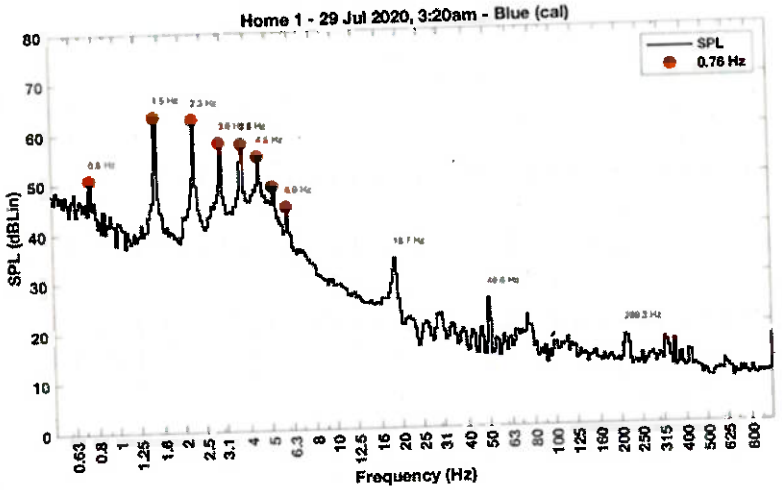
Figure 5A shows a sonogram reflecting the acoustic environment inside the bedroom over a 10-minute period (600 seconds), with 1/36th-octave-band resolution (vertical axis) and 1-second temporal resolution (horizontal axis). The sound pressure level at each frequency and at each second in time, is indicated in the color-coded scale on the right (measured in dB). The yellow color of the straight, horizontal lines visible across the image at 1.5 Hz, 2.3 Hz, 3.0 Hz, and 3.8 Hz reflect the large amount of acoustic energy (50–60 dB) present at these frequencies. Additionally, the lack of discontinuities in these lines indicate that the phenomena were continuously present during the entire 600 seconds.

Figure 5B shows the same numerical data as in **Figure 5A**, but as a frequency spectrum. A series of peaks is readily identifiable, occurring at the same frequencies as the continuous, horizontal lines seen in the sonogram (**Figure 5A**). The mathematical relationship between the frequencies of each peak (red dots) constitutes a harmonic series with a fundamental frequency of 0.76 Hz (0.8 Hz in the figure).

In all 18 recordings (from 03:00 to 06:00, 29 Jul), the sonograms presented similar, continuous horizontal lines and, in all corresponding spectrograms, the same harmonic series (fundamental at 0.76 Hz) was visible. The blade-pass frequency of the IWT



(A)



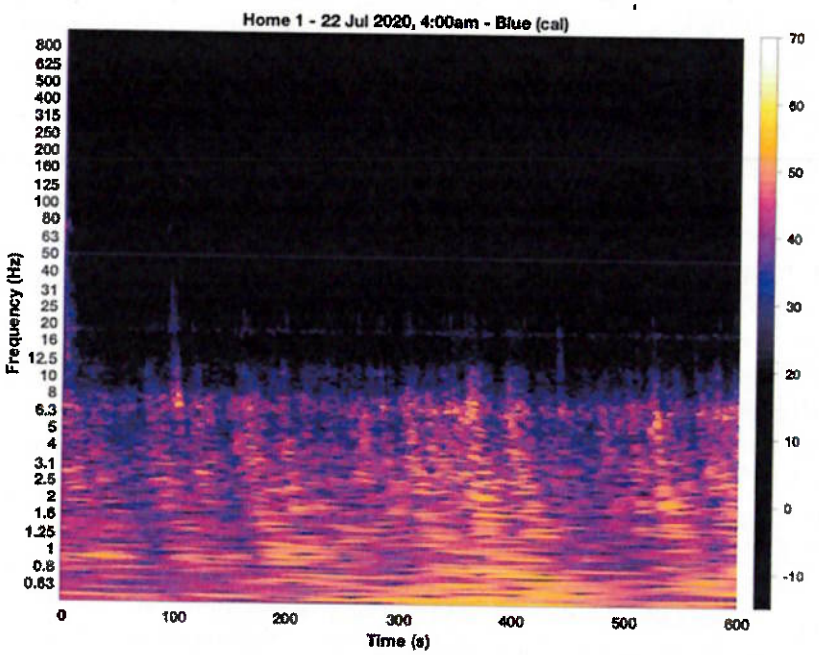
(B)

Figure 5.
(A) Sonogram *showing the sonic environment inside the master bedroom of home 1 (on 29th Jul when sleep was disrupted and medication was required) over a 10-minute period (600 seconds), with 1/36-octave band resolution ('frequency' on vertical axis) and 1-second temporal resolution ('time' on horizontal axis). The color-coded scale on the right measures sound pressure level in (unweighted) dB. Continuous (over the entire 600-second interval), horizontal lines cross the image at 1.5 Hz, 2.3 Hz, 3.0 Hz, and 3.8 Hz with a pressure level of 50–60 dB.* *(B)* Spectrogram *in the form of a frequency distribution, constructed with the same numerical data as in* ***Figure 5A****. A harmonic series is identified when the frequencies of each peak (red dots) are multiples of the fundamental frequency of 0.76 Hz (0.8 Hz in the figure).*

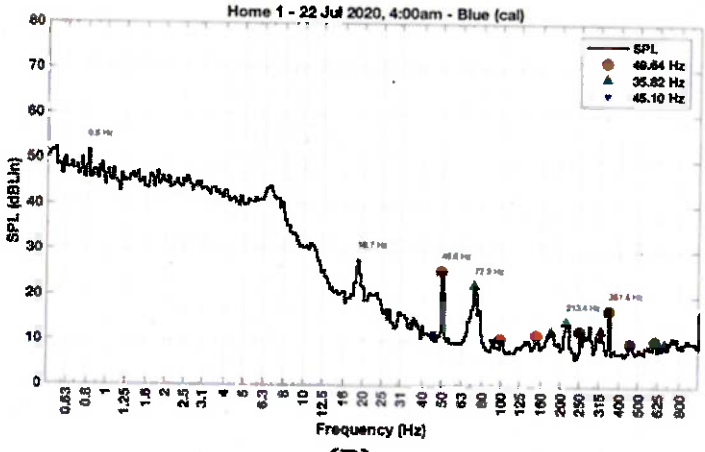
installed around the home of family E. is 0.75 Hz. The harmonic series identified in Home 1 is the acoustic signature that emanates from these machines, and that reflects the airborne propagation of a pulsed, pressure wave generated by rotating IWT blades. This IWT acoustic signature occurs below the threshold of human audibility.

3.3 Home 1: At 04:00 on the morning of the 'peaceful' episode (22 Jul, 2020)

In **Figure 6**, the sonic environment in the master bedroom of family E. is shown, as captured between 04:00 and 04:10, on the morning of 22 July, when the E. family slept peacefully. The lack of continuous, horizontal lines throughout the sonogram (**Figure 6A**) is notable, as is the absence of regular peaks in the corresponding



(A)



(B)

Figure 6.
(A) Sonogram *showing the sonic environment inside the master bedroom of Home 1 (on 22nd Jul when no sleep disruption occurred) over a period of 600 seconds—With 1/36-octave band resolution, 1-second temporal resolution—and pressure levels in dB as indicated by the color-coded scale. The triangular, pink shapes that span various frequencies are due to blowing wind, and do not exceed 50 dB. Continuous, horizontal lines as observed in* ***Figure 5A*** *are absent. (B)* Spectrogram *without any regular, large peaks of acoustic energy in the infrasonic range. Harmonic series, as related to IWT acoustic signatures, are absent.*

spectrogram (**Figure 6B**). The triangular, pink shapes that span various frequencies in the sonogram are due to blowing wind, and do not exceed 50 dB. In all 18 recordings (from 03:00 to 06:00, 22 Jul), no IWT acoustic signature was identified.

3.4 Homes 2 and 3

Regrettably, the residents of these Homes were not sufficiently assiduous with their diary entries so that health-related information could be compared with simultaneous recordings.

Homes 2 and 3 have three different models of IWT among the 3 WPP located in their vicinity, as opposed to Home 1 that only had one type. For asynchronous (constant with varying wind speeds) IWTs, each model will have its own blade-pass frequency and, therefore, their acoustic signatures will be different.

Figure 7 shows the sonogram and spectrogram of the sonic environment captured in the attic bedroom in Home 3. The very clean and continuous horizontal lines that extend throughout the 600-second recording (**Figure 7A**) reflect the existence of a prominent IWT acoustic signature. This is confirmed by the sequence of peaks that constitute the harmonic series, as can be clearly identified in the corresponding spectrogram (**Figure 7B**). The two harmonic series (i.e., IWT acoustic signatures) identified in Home 3 are also present in Home 2, as can be seen in the spectrogram in **Figure 8**.

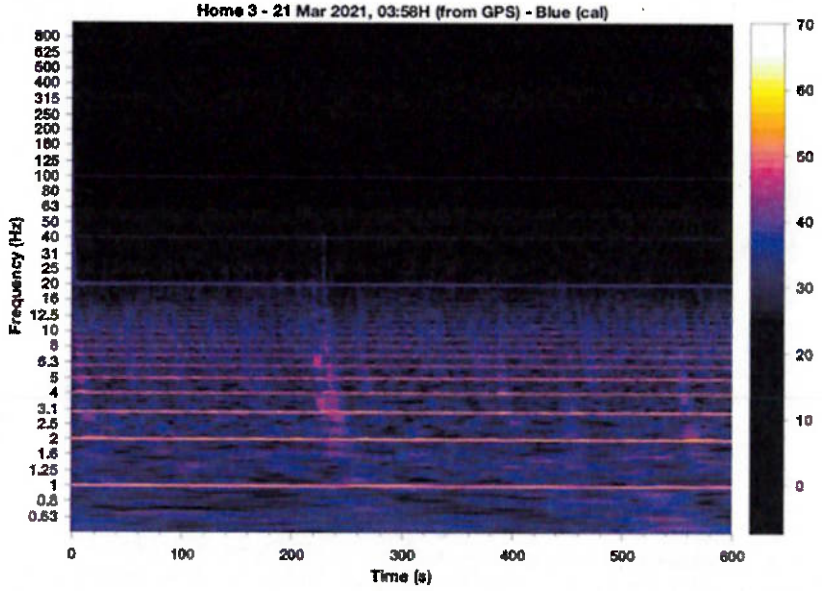
Figures 7B and **8** show very similar examples of dominant IWT acoustic signatures. The harmonic analysis highlights a harmonic series with a fundamental frequency of 1 Hz (0.99 Hz in the figures) and at least the first 19 harmonics. The Gamesa 80 and 87 IWT models have a blade-pass frequency of 1 Hz. A second harmonic series is identified with a fundamental frequency of 0.67 Hz. The blade-pass frequency for the Gamesa 114 model is 0.67 Hz. A separate harmonic series begins at 20 Hz from an unknown source, possibly the IWT gearboxes.

4. Discussion

4.1 Sleep disruption and the prominence of harmonic peaks

The harmonic series observed in all 18 samples of the 'severe' episode, and that were absent in all 18 samples of the 'peaceful' episode, is recognized as the IWT acoustic signature with a blade-pass frequency of 0.75 Hz. The acoustic signature generated by an IWT is a train of pressure pulses, with a period equal to the reciprocal of the blade-pass frequency of the IWT. It presents as a harmonic series of peaks in the infrasonic region of a spectrogram, visible in **Figures 5B, 7B** and **8**, while absent from **Figure 6B**. In the sonograms, the IWT acoustic signature is present as continuous horizontal lines, as seen in **Figures 5A**, and **7A**, while absent from **Figure 6A**.

This new, high-resolution methodology for assessing infrasonic environments is analogous to transitioning from a magnifying glass to a microscope. Previously undetected acoustic events are now identifiable and, even, quantifiable (see Sections 5.2 and 5.3 below). What was undetectable—and thus assumed to be non-existent, presumably justifying a psychosomatic origin for resident complaints—using the classical noise assessment methodologies (1/3-octave band segmentation in 10-minute averages and with sound pressure levels measured in dBA or dBG), became visible with high-resolution observations.



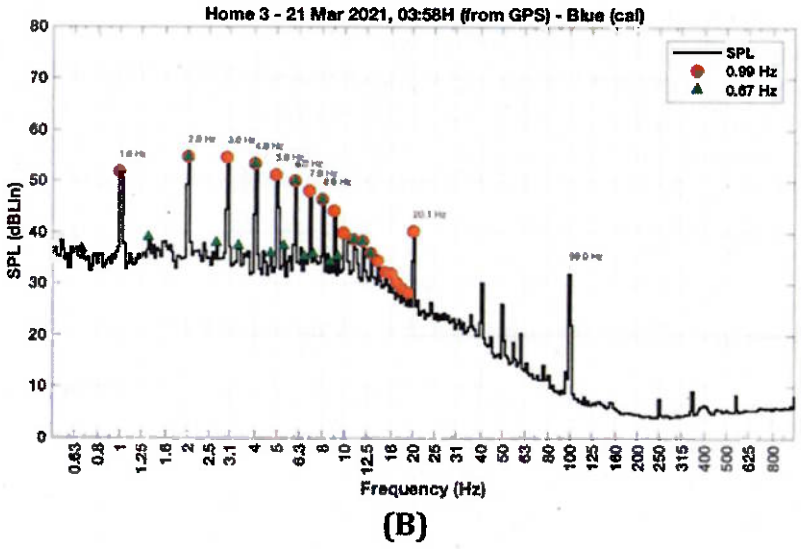


Figure 7.
(A) Sonogram *showing the sonic environment inside the attic bedroom of Home 3 over a period of 600 seconds, with 1/36-octave band resolution, 1-second temporal resolution, and pressure levels in dB, as indicated by the color-coded scale. Continuous, horizontal lines are readily observable at frequencies below the threshold of audibility, and that reflect the existence of IWT acoustic signatures. (B)* Spectrogram *showing the two most prominent harmonic series, with fundamental frequencies at 0.67 Hz and 0.99 Hz, reflecting IWT acoustic signatures from different IWT models, with different blade-pass frequencies.*

Despite being at frequencies and sound pressure levels that are classically considered as 'below the human hearing threshold,' a very clear correlation has been shown between the existence of these peaks in the frequency spectra and disruption of the normal biological function—sleep disruption followed by the need for self-medication with benzodiazepines. Nevertheless, while the correlation is very clear, the confidence of the correlation is reduced by the relatively small timeframe. Improved confidence

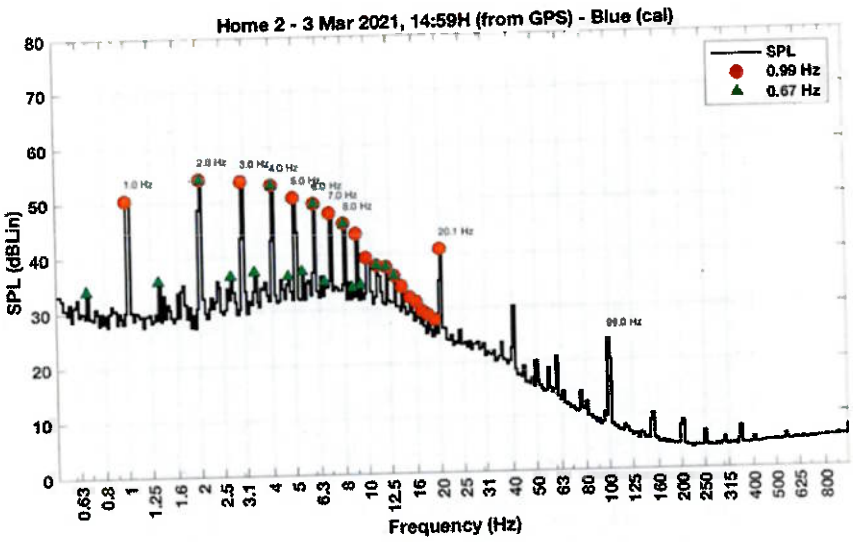


Figure 8.
Spectrogram *showing the sonic environment inside the upstairs bedroom of Home 2, over a period of 600 seconds, with 1/36-octave band resolution and 1-second temporal resolution. Two of the most prominent harmonic series are readily identifiable, with fundamental frequencies at 0.67 Hz and 0.99 Hz, reflecting IWT acoustic signatures from different IWT models, with different blade-pass frequencies.*

can only come from more work to extend the use of this measure to many other cases (an ongoing endeavor by these authors).

The question as to how these infrasonic acoustic events can cause the biological disruption is still unclear. Studies by German scientists, however, using functional magnetic resonance imaging—while exposing subjects to infrasound—may have uncovered a significant clue: in addition to activating the classically identified auditory pathways, infrasonic stimuli also activate regions of the brain that are considered responsible for emotional and autonomic responses [22].

4.2 Prominence of the harmonic peaks—A new metric?

The prominence of these harmonic peaks above the background noise appears to be highly relevant for health-related issues. **Figure 9** depicts a harmonic series as identified in an IWT acoustic signature, an airborne train of pulses occurring within the 0.5–5 Hz window. Note that the persistent or continuous existence of this type of harmonic series ties this acoustic event to human-made sources because the manifestations of such harmonic series from natural sources are exceedingly rare. There is no established methodology to quantify the prominence of these peaks.

A new metric is herein suggested; one that may more accurately provide a measure of the "dose" of this pulsed agent of disease. We have called this measure the *Harmonic Prominence*, H_p, defined as the largest prominence of any harmonic frequency of any harmonic series, within the 0.5–5-hertz frequency window. In **Figure 9**, H_p = 17 dB, at 1.5 Hz. In the specific case of IWT, only harmonic series with a fundamental frequency equal to the IWT blade-pass frequency are considered. In the specific case of the data acquisition methodology detailed above, the highest prominence of the harmonic series is determined in temporal segments of 600-seconds.

There are a variety of mathematical definitions, methodologies and software packages associated with quantifying peak prominence above background, for almost any and all types of wave phenomena. These authors have adhered to the formal

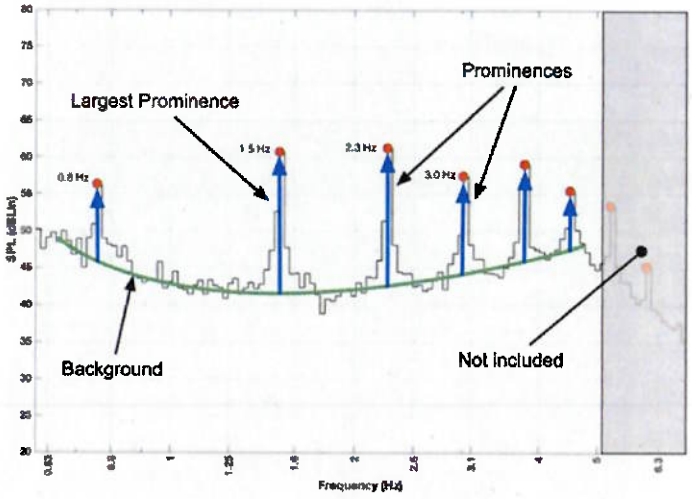


Figure 9.
Determination of prominence levels based on 1/36-octave frequency bands. The largest prominence, H_p (see text), in this series is approximately 17 dB over background. (Numerical data for this figure were obtained in Home 1, during the 'severe' episode).

definition of prominence in a frequency spectrogram as established by MATLAB which has a robust definition of prominence in terms of the peak height and the local background level [23].

The H_p parameter does not measure the total energy of the pulses in the pulse train that emanates from IWT. This energy is spread out over all the harmonic components of the pulses—the peaks in the spectrogram—whereas the measure only looks at the peak with the largest prominence. Therefore, H_p cannot be considered as an energy measure.

Another approach would be to look in the time domain, rather than in the frequency domain. Here a measure such as the crest factor could be used to gain a measure of the 'peakiness' of the pulses, using their total energy. These additional avenues of research are undergoing further scrutiny by these authors and their colleagues [17].

4.3 Day-time plots—Evaluation of long-term infrasound exposures

The H_p parameter can provide health scientists with a rudimentary indicator of the largest prominence above background that exists within a 10-minute measurement. When continuous measurements are maintained over several days (or weeks), a clearer picture regarding the long-term variation of exposure to these trains of pulses is revealed.

Figure 10 shows a Day-Time plot for the data collected in Home 1, 18 Jul-09 Aug, 2020. Here H_p is plotted as a surface with the date as the abscissa and the time of day as the ordinate. For each 24-hour period, there are 144 ten-minute samples. The values of H_p were determined for each 10-minute sample, and then binned (scale: <5 dB, 5–10 dB, 10–15 dB, 15–20 dB, 20–25 dB and > 25 dB), as reflected by the color-coded scale in **Figure 10**.

Similar day-time plots were constructed for Homes 2 and 3, as shown in **Figures 11** and **12**, respectively. While these types of plots are informative as to the time and

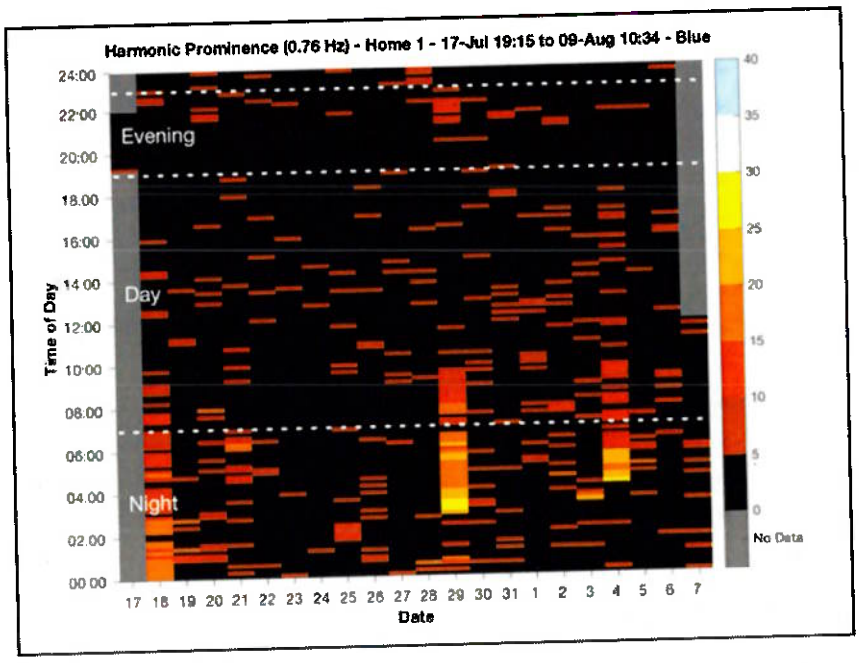


Figure 10.
Day-time plot for Home 1. *The 'severe' episode took place on 29th Jul, while the 'peaceful' episode took place on 22 Jul. The nights of 18 Jul and 4 Aug also show the presence of prominences. The 'peaceful' morning (22 Jul) has only one 10-minute sample with a significant H_p level. The following two mornings also appear to have no significant H_p samples but were not noted in the residents' diary as either peaceful or disturbed. The 'severe' morning (29 Jul), from 3 am until about 9 am shows up in stark contrast to the other mornings, indicating not only that the H_p levels were high but also that they were the highest in the entire length of the recording. The night of 4 Aug also shows an interval of 10-minute samples with severe H_p levels. Since the residents' diary stops on 31 Jul their experience on this day was not recorded. Finally, the night of 18 Jul shows elevated H_p levels from midnight onwards, although these did not reach the same levels as for 29 Jul or 4 Aug. The Es' diary entry for 18 Jul at 04:00 indicated that the "noise was unbearable" and "sounded like a derailing train."*

duration that people are exposed to higher or lower levels of H_p, it is still important to view the sonograms to get a true understanding of the nature of the sonic environment at that point in time. For example, it is not possible from this graph alone to determine if the lower H_p levels seen in Home 2 on the morning of the 27th (**Figure 11**) are caused by the presence of a higher background noise level or whether the levels of H_p were actually diminished.

Note that not all the 10-minute intervals where the H_p is shown as 0 (black) are, in fact, 0. Impulsive sound—caused by such events as people walking over a floor or a door closing—can contaminate an entire 10-minute recording since the impulse is spread over longer and longer time intervals as the frequency of the 1/36-octave bands decrease.

To use the H_p measure as part of a dose–response metric, the simplest method would be to integrate it over time, i.e., multiply each value by 10 minutes and sum for a metric in decibel-minutes. Long-term exposure might be measured in decibel-years. Future research might even develop infrasound dosimeters for workers, similar to those used for radiation exposures.

Comparing the infrasonic environment in Home 1 with those encountered in Homes 2 and 3, a major difference becomes obvious: in the latter two homes, periods of respite (black areas in the day-time plots) are almost non-existent. Periods of respite are understood as biological recovery times, during which the agent of disease is not present and physiological cellular repair can be undertaken unimpeded by the acoustic aggressor. In Home 1 there is the possibility of comparison between the

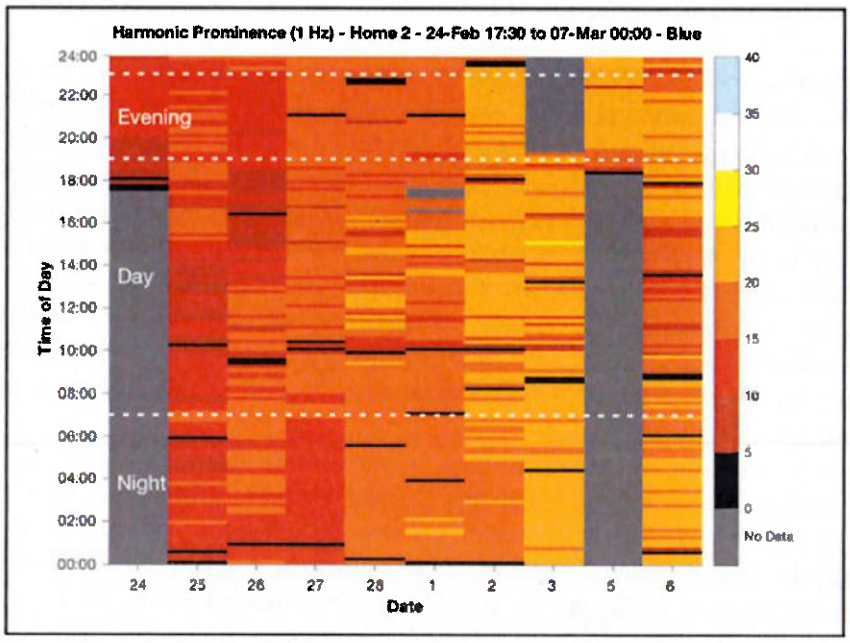


Figure 11.
Day-time plot for Home 2. *A visual inspection shows that the H_p was most dominant from the 2nd through the morning of the 6th reaching its highest value at around 3 pm on the 3rd, with H_p between 25 and 30 dB above background.*

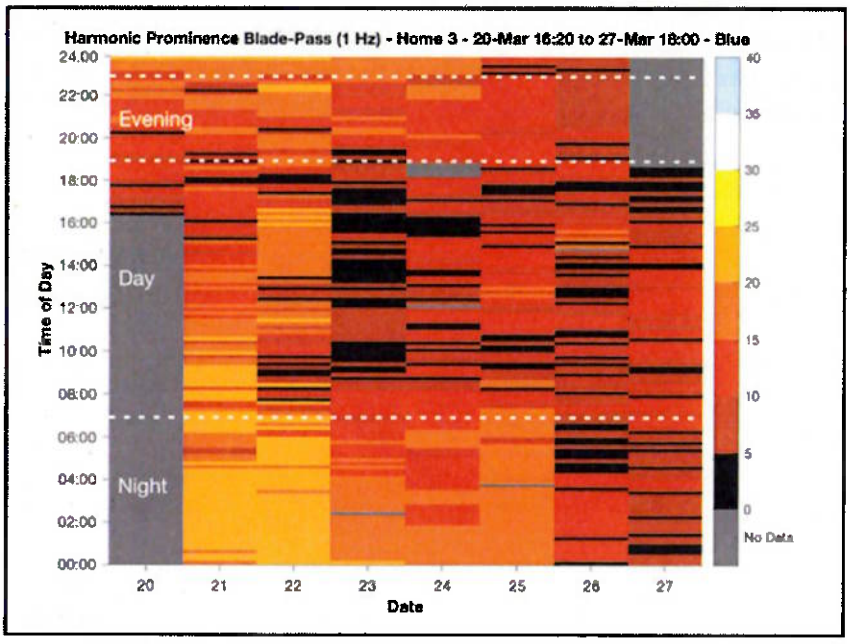


Figure 12.
Day-time plot for Home 3. *The most dominant episodes, i.e., highest level of H_p, were at night. The mornings of the 21st and 22nd registered the strongest H_p (20–25 dB), while the morning of the 27th presented with the weakest.*

periods of time when the IWT acoustic signature is present and when it is absent. Clearly, this is a much more difficult proposition in Homes 2 and 3, where the H_p level indicates that IWT acoustic signatures are almost always present, to a greater or lesser extent (color-coded scale).

4.4 Harmonic prominences wind roses

Airborne sound propagation is affected by wind and weather conditions. In addition to the obvious fact that wind 'carries sound,' thus reducing attenuation downwind, other atmospheric properties can greatly alter both the propagation and attenuation of sound. For instance, increasing humidity will improve propagation, while atmospheric inversion layers can create 'dead zones' where sounds will not be heard despite proximity to the source. Beyond these effects, the propagation and attenuation of infrasound differs in some important respects from sound at higher frequencies. While higher-frequency sound diminishes by 6 dB per doubling of distance—the inverse-square law—infrasound only diminishes by 3 dB. Infrasound is also more prone to refraction around large objects such as hills and to being funneled down valleys.

A data fusion of meteorological data (wind direction) and acoustic data (H_p) can provide insight into these weather- and terrain-induced differences that can significantly influence H_p levels. A *harmonic prominence wind rose*, which takes its inspiration from the common wind rose, is the nomenclature given to this data fusion. An example can be seen in **Figure 13**, reflecting data obtained in Home 1.

The H_p wind rose is a stacked, frequency histogram plotted in polar coordinates. It shows the number of 10-minute samples with an H_p in each dB-level bin in the direction of the then-prevailing wind. Each bin is identified by a color and the number of samples is indicated by the length of each segment in the radial direction. This provides important information if, for instance, the strongest levels of H_p align with a given wind direction.

The closest national meteorological stations must be used to provide wind data if a certified weather station is not available at the site of the sound recordings. This may be problematic since many weather services do not provide data at the closest weather

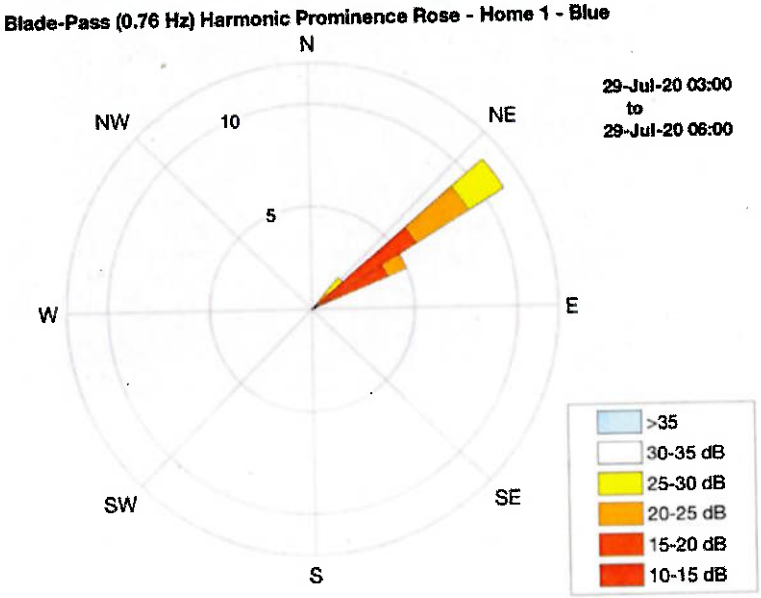


Figure 13.
Harmonic prominence wind rose for Home 1. *Data refers to the 18 samples examined during the 'severe' episode. The highest Hp levels (yellow) were registered when wind was from the north-eastern quadrant. (Wind data from weather station located 12.5 km from Home 1).*

station but rather synthesized weather information, using their proprietary weather models. The wind direction provided is, therefore, not necessarily the same as at the recording site. Moreover, the wind direction at the hub-height of the IWTs may not be the same as at the height of the weather station or the home. The wind direction cannot, therefore, be said to indicate the direction of the source of the IWT acoustic signature in relation to the home.

While the wind direction can provide some understanding, the windspeed may also have a tale to tell. This leads to H_p wind roses plotted for data within wind-speed ranges. Examples are shown in **Figures 14** and **15** for three ranges. The left graph is a H_p wind rose for all 10-minute periods in the recording interval when the wind was between 0 and 10 km/h, the middle graph is for wind speeds of 10–30 km/h and the right graph is for wind speeds of 30–60 km/h.

The fact that the multi-day recording in Home 3 does not include any wind from the eastern half of the compass emphasizes the fact that a reasonable sampling of wind conditions will involve recordings from throughout the year to cover all seasons.

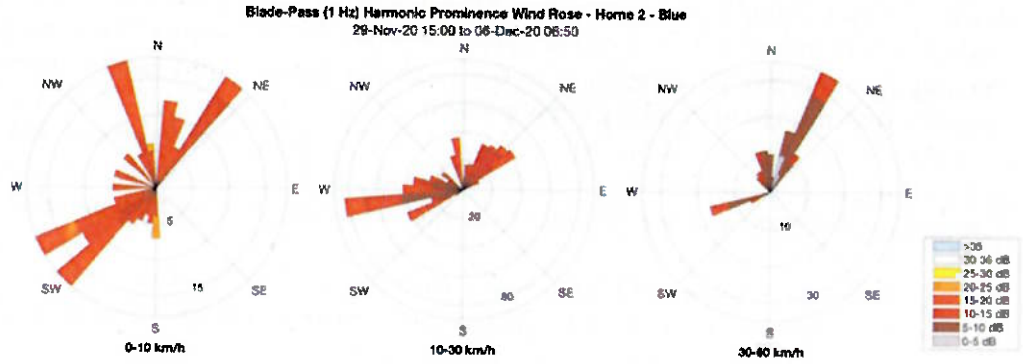


Figure 14.
Harmonic prominence wind roses for three wind-speed ranges for Home 2. *The strongest H_p is at the lowest windspeed, and this is most consistently dominant when the wind is between southwest and north-northeast; i.e., the sectors of the wind rose in these directions are almost entirely made up of 10-minute intervals where the H_p was between 15 and 20 dB (red). By comparison, where the wind was from the northeast, only about 15% of the sound files have this level. At the highest windspeeds, no instances of 15–20 dB H_p can be seen.*

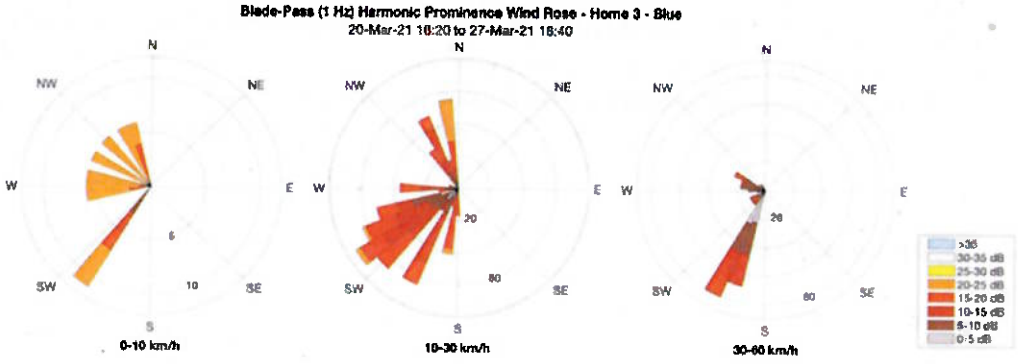


Figure 15.
Harmonic prominence wind roses for three wind-speed ranges for Home 3. *The strongest H_p is at the lowest windspeed and this is most consistently dominant when the wind is from the west through to northwest. That is, the sectors of the wind rose in these directions are almost entirely made up of 10-minute intervals where the H_p was between 20 and 25 dB (orange). By comparison, where the wind was from the southwest, only about 1/3 of the sound files have this level. At the highest windspeeds, no instances of even 15–20 dB H_p can be seen.*

The inverse dependence of H_p on wind speed is because the wind noise increases with wind speed, thus increasing the levels of background noise—including in the infrasound region. The sound pressure levels of the IWT pulses, however, remain constant. Thus, H_p will have lower values (see **Figure 9**). The unanswered question is whether the human brain processes the information of the IWT acoustic signatures when these appear obscured by, or embedded in, the increased background noise, as measured by a machine.

4.5 The position of other authors

In this type of scientific endeavor, it is normally expected that the work of other authors also be presented to form a context and allow a comparative analysis of results obtained and/or of the methodologies used. Regrettably, most, if not all, papers on infrasound are conducted with a ⅓–octave resolution, which immediately precludes any data comparison with that presented here. Due to a variety of conditioning factors that have been in place for decades, sound level meters readily available on the market do not possess the technical capabilities for this type of data acquisition and subsequent analyses. Simultaneously, many of the health-related aspects that are studied within the context of IWT are restricted to measures of "annoyance" (a non-clinical and highly subjective parameter) or to the audibility of the sound, neither of which are very relevant to the results presented here.

In 2018, the World Health Organization (WHO) published a document titled: *Environmental Noise Guidelines for the European Region* [24]. The word "infrasound" has one single entry, on page 85, under the section heading *Wind turbine noise*:

> *"Wind turbines can generate infrasound or lower frequencies of sound than traffic sources. However, few studies relating exposure to such noise from wind turbines to health effects are available. It is also unknown whether lower frequencies of sound generated outdoors are audible indoors, particularly when windows are closed."*

These and other statements reflect a profound misunderstanding of the importance of the time-profile of an exposure to sound as it relates to biological responses (e.g., traffic does not produce harmonic peaks with a one-second pulse rate). However, in defense of this position taken by the WHO, it must be acknowledged that the methodologies it uses for assessing sound necessarily preclude the observation and identification of harmonic series associated with IWT. The suggestion that the audibility of infrasound levels (in itself, an oxymoron by classical definitions) can be mitigated by closed windows clearly indicates a profound lack of knowledge on the physical attributes of propagating airborne pressure waves within the infrasonic range [25–27].

5. Conclusions

This chapter provides a different approach to the measurement and analysis of infrasound in and around homes located in the proximity of wind power plants. Examples show how using higher temporal- and spectral-resolutions (1 second and 1/36 of an octave), and without any frequency weighting, can reveal acoustical features in the infrasonic range that may indicate a causal relationship with self-reported medical symptoms. This possibility is usually considered non-existent since the infrasonic range is generally viewed as inaudible, and thus innocuous, to humans. The

suggestion therefore arises that current noise protection procedures are insufficient to protect public and occupational health. The approach used by these authors offers a more solid framework with which to pursue the establishment of dose–response relationships for infrasonic exposures. Future studies are being extended into noisy occupational environments and different environmental settings where wind power is not the acoustic source.

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This project has received ethical approved from the NZ Ethics Committee (see www.nzethics.com), application number NZEC19_12.

Conflicts of interest

HHCB developed software for capturing and analyzing the sound files for the SAM system, no financial interest. MAP no conflict. RM no conflict. RS contributed to the development of the SAM system, no financial interest. PD no conflict.

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[17] IARO-International Acoustics Research Organization-represents a group of scientists who, collectively, hold over 200 years of scientific experience in the field of infrasound and low frequency noise, and its effects of human health. Since 2016, our researchers have been recording and analysing acoustical data in and near homes located in the vicinity of onshore wind power stations, in the following countries (alphabetical): Australia, Canada, Denmark, England, France, Germany, Ireland, New Zealand, Northern Ireland, Portugal, Scotland, Slovenia, and The Netherlands. Prior to 2016, all IARO scientists were already working either in acoustics alone or in acoustics and health. All research conducted by IARO is part of the Citizen Science Initiative for Acoustic Characterization of Human Environments (CSI-ACHE), the research protocols for which have been approved by the New Zealand Ethics Committee (application number NZEC19_12). www.iaro.org.nz

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