International Energy Agency (IEA)
Implementing Agreement for Co-operation in the Research and Development of Wind Energy Systems (IEA Wind TCP)

Task 39 Extension Proposal
Quiet wind turbine technology

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in collaboration with Task 39 expected future participants

1 Scope

The integration of wind turbines in the energy system is subject to a number of environmental, societal and regulatory constraints. An important impact of wind turbines on the community derives from the emission of wind turbine noise. In many jurisdictions, there are concerns about the potential impacts of wind turbine noise on health and wellbeing. Perceptions of wind turbine noise can also negatively affect societal acceptance, a key to the successful adoption of new technologies, both at the local and global levels (see Figure 1). The goal of IEA Wind TCP Task 39 is to mitigate the generation of negative health, wellbeing and consent effects by consolidating the understanding of wind turbine sound emission, propagation and noise perception, in order to accelerate the development and deployment of quiet wind turbine technology. The Task will convene an international expert panel to identify best practices in the prediction, measurement and assessment of the impact of wind turbine noise, as well as reviewing regulatory aspects.

A first objective is to ensure that the best available information on quiet noise technology is available to consultants, regulators, developers, and the public to inform relevant international standards and government regulations. A second objective is to promote collaborative work between engineers and researchers across different countries and disciplines on selected topics relevant for wind turbine noise related technologies. The collaboration has, to date, addressed these objectives via a series of focused work packages 1) addressing interdisciplinary education and guidance, and support interdisciplinary discussion, 2) addressing technical aspects of design, modeling, assessment, and measurement, including subjective effects, and 3) developing recommended practices. In the 2nd phase of the Task, it is planned to address, in addition, to interdisciplinary education and guidance, four specific topics: two concerning more engineering related aspects (noise generation and propagation), and two concerning the socio-psychology of noise (assessing noise effects on human and the investigation of non-noise effects on perception).

The above objectives are well in-line with IEA Wind TCP priority areas of advancing technology (for the more engineering part) and of social and environmental impacts (for the psychological part). In addition, the Task activities aim at fostering collaborative research as well as an exchange of knowledge and data, while also facilitating wind energy deployment through social support and environmental compatibility.

2 Introduction

Task 39 was initiated in Ireland by Trinity College Dublin, and the Sustainable Energy Authority of Ireland took the lead as Operating Agent.

The Task 39 Phase 1 work programme was articulated around three work packages corresponding to key aspects of wind turbine noise. In each of these, a number of potential sub-tasks to be addressed were identified, and some of them were selected as collaborative work activities.

The first work package focused on Interdisciplinary Education and Guidance. The corresponding activities encompass the writing of fact sheets and technical documents. A Catalogue of International Wind Turbine Noise Limits and Regulations is currently being drafted, and should be available online in the near future so that it can be consulted and updated interactively. Further development in Phase 2 will help provide some guidelines for countries in the process of developing new or more specific policy frameworks.

The second work package dealt with physics of noise and technical aspects of wind turbine noise. Two distinct benchmark exercises have been initiated. The first one is a wind turbine noise simulation codes benchmark that is conducted in collaboration with Task 29, the latter Task dealing with the aerodynamics of wind turbines. The second benchmark is concerned with the creation of a database of aerodynamic and noise measurements for the validation of noise models for serrated airfoils. Improvements of the serration design as a noise mitigation technique can yield to further reduction of wind turbine noise emissions. The final goal is to produce an experimental database reliable enough for the validation of numerical models that are used for the prediction of serration noise, in order to improve their design. These efforts will be continued in the 2nd Phase of the Task.

The third work packages was concerned about the psychology of noise, including psycho-acoustic and human perception of wind turbine noise. Unfortunately, there has been no contributions to this part of the Task from specialists in this domain during the 1st phase of the task.

In the 2nd Phase of the Task 39, the objective is to propose a work programme with a more balanced approach for addressing both engineering and socio-psychological aspects, as detailed later in this document.

3 Objectives and Expected Results

From a general point of view, developing noise mitigation technologies and recommending best practices for regulatory and siting processes is regarded as an important step toward public acceptance. IEA Wind Task 28 has already advanced the potential for enhanced community engagement to address that particular issue. It is proposed to work with IEA Wind Task 28 to align research to reduce the non-acoustic influences on wind turbine acceptance. This combination of effort should eventually facilitate the wider deployment of wind energy.

As indicated in the foregoing section, the human response component of the wind turbine noise impact model did not attract the necessary investment of research personnel or time in the previous phase. The work programme for Phase 2 provides a greater focus on the propagation and perception of wind turbine noise.

Through the collaborative research that will be undertaken in the different work packages, it is expected that new knowledge about wind turbine noise generation, propagation, its impact on people living near wind turbines and acceptance by the public in general, can be generated. In addition, best practices should be established for a number of domains addressed in the different activities of the Task.

4 Approach and Methodologies

Human response to wind farm noise is the subject of considerable research and there continues to be disagreement among researchers and the general public regarding whether or not wind farms are directly and/or indirectly responsible for adverse health effects. There is a consensus, however, that noise perception interacts with non-noise variables to produce annoyance, which mediates health, wellbeing and consent effects.

In order to encourage contributions by researchers on the human response to wind turbine noise, we have re-organised the work programme to highlight opportunities for such researchers to collaborate. The new work programme is summarised in Figure 1 and includes 5 Work Packages. This WPs are described in more details below. The overall approach however is to address the broad wind turbine noise topic in successive steps, from wind turbine noise generation (WP2), to airborne noise propagation over large distances (WP3). The assessment of wind turbine noise and its impact on humans is addressed in WP4, while WP5 is dealing with other aspects of perception and acceptance which may not be related directly to noise itself. Cross-cutting topics (e.g. Amplitude modulation or Low-frequency noise or other specifics) can be used as vectors for interactions between engineering and social/psychological sciences. WP1 is about dissemination and will be also considered in each of the above WPs.

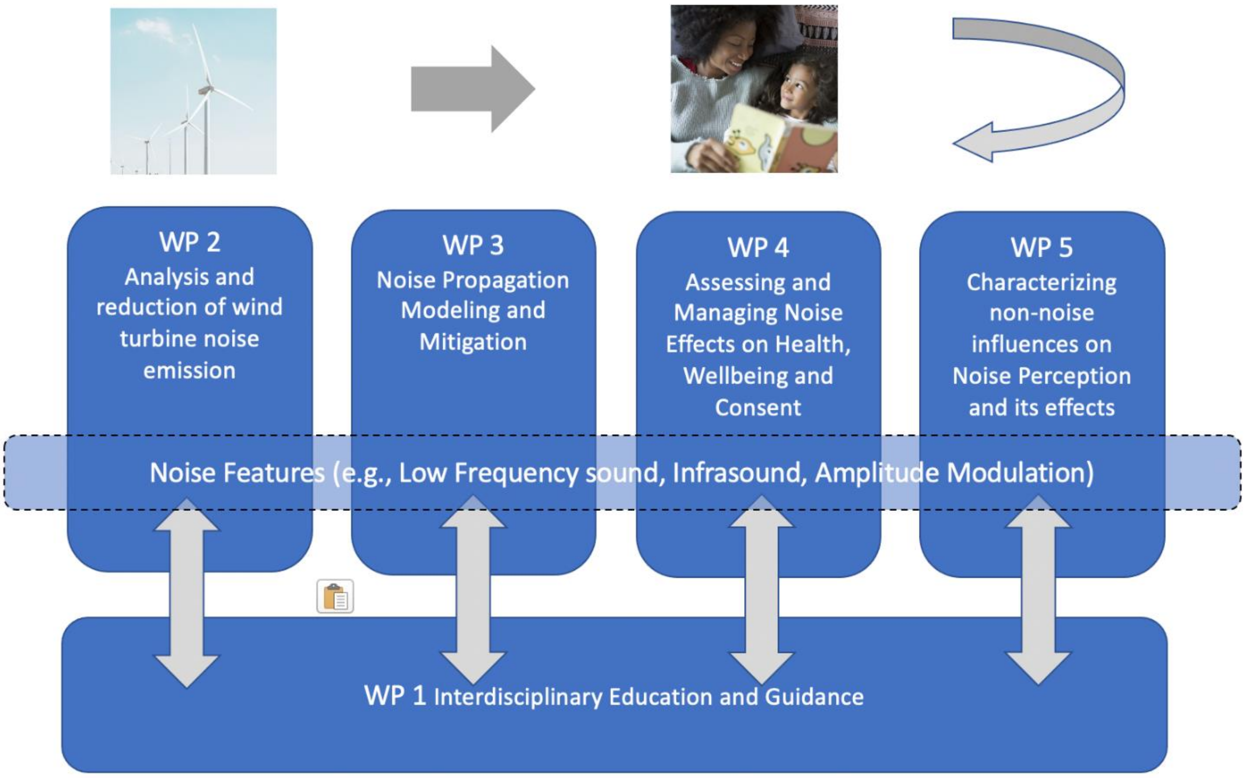

Figure 1 - Task 39 Phase 2 Work Packages

Draft Work Plan

WP1. Interdisciplinary Education and Guidance

These question of how wind turbine noise affects people and how best to quantify the effects are not yet fully answered. Much work has been conducted at international level across disciplines including engineering, physiology, psychology and sociology. This work package supports interdisciplinary discussions, as well as dissemination to the broader public. Communication within and across work packages will be planned and facilitated by this work package. The aim is for a consensus with robust, scientific and widely accepted knowledge, and transparent metrics for the effects of wind turbine noise. This work package will receive outputs from the other work packages to facilitate dissemination of best practice and will inform standards and other relevant inputs to the research work packages.

<u>Proposed activities</u>

- Fact sheets

  The fact sheet on Low-Frequency Noise (LFN) is close to completion.

  A new fact sheet concerning Tonal Noise has been initiated in Phase 1 and drafting will be continued during Phase 2.

  A fact sheet on measurement techniques at the receiver position is planned to be initiated during Phase 2.

- Scientific documents

  A Roadmap for Required Technological Advancements to Further Reduce Onshore Wind Turbine Noise Impact on the Environment should be submitted for publication in WIREs, or other dissemination support if the latter prove not possible.

  Based on the results obtained in WP3, it is intended to develop a methodology and publish guidance on the prediction of noise from offshore wind turbines.
- International Wind Turbine Noise (WTN) regulation database

  The International WTN Regulation Catalogue is currently being drafted by various participants. It is intended to create an online interactive platform so that the database can be updated continuously by experts in the field. A companion document, that summarizes different practices, will be published alongside the database. It will be a distillation of the various approaches, with their advantages and disadvantages, aimed at assisting regulators unfamiliar with WTN regulation to decide on an approach.
- The applicants recognized during discussion of this proposal the difficulty to access publicly available measurement data. It is intended to organize such a 'live' (i.e. online) catalogue of existing publicly available data sets for which noise measurements (including wind tunnel, field measurements, etc) are available.

WP2. Analysis and reduction of wind turbine noise emission

This WP focuses upon the methods that are applied to analyzing, measuring, quantifying and qualifying, the generation of wind turbine noise. In the first term of Task 39 WP2 will focus on modelling of WTN emission; categorization and classification of quiet wind turbine technologies; and, quantification and qualification of the key parameters of wind turbine noise.

Proposed activities

- Benchmark of WTN prediction codes (Continuation of the Phase 1 activity with intended participation of DLR, DTU, IAG, TNO, TUDelft, TUM, NREL)

  This is a continuation of an earlier activity conducted during Phase 1. The benchmark will proceed with the same test cases as defined during Phase 1, but some issues need to be addressed and investigated further, such as noise emission directivity issues.

  In addition, the comparisons between now two high-fidelity models from the participants (DLR & TUD) vs. engineering models should enhance and reinforce the models and their validity.

  Further developments to this benchmark are also considered, e.g. more complex/real-life test cases and comparisons with actual aero/noise field measurement data. Surface pressure are available from the DANAERO experiment. IEC type measurements for the NM80 are available (but subjected to Vestas' approval for dissemination).

  If the participants cannot get access to full wind turbine noise field measurement data with enough information about the operating conditions and geometry, a new reference turbine could also be considered. In this context, a dataset for the NREL 1.5MW GE turbine including noise (incl. LFN), its directivity, met mast data, rpm & pitch could be made public. But the turbine model/geometry cannot be shared. The idea could be to make a replica of the turbine for code benchmarking using established scaling laws such as tip speed ratio, etc. DTU V52 (850kW) noise data could be shared, but again probably not the turbine geometry. DLR has a plan to establish a test center with a test turbine that could be used for noise model validation, but it is not expected to be available before 2023.

If enough participants can include additional models for add-ons (e.g. VGs), leading-edge erosion, separation, it would be possible to further extend the scope of the benchmark.

Finally, a study may be conducted to rank all the different source mechanisms (incl. separation, low-frequency noise, amplitude modulation).

- Linking with Task 40 (Downwind turbines) on the issue of Low-Frequency Noise (NREL, DTU, ULimerick)

  Accessing available LFN measurements among participants and elsewhere will be investigated. The idea is initially to connect with Task 40 (Downwind Turbines – well-known for LFN issues), but although LFN measurements of a 3MW Hitachi turbine exists, it appears that Hitachi recently decided not to share the data with Task 40 participants. DTU have few measurements available for smaller turbines and NREL for their 1.5MW GE turbine, as described above. The issue of the detailed turbine geometry might be less critical for LFN.

  In case measurement data were not available, code-2-code benchmarking would be an option. The idea would be again to compare high-fidelity (LES/FFW from UL/IAG/TUM, Others?) vs. more empirical model (DTU/TUM/NREL, Others?).

  One of the objectives could be a better mapping of the different mechanisms at play and their relative strengths (blade-tower interactions, blade turbulence interactions, etc…). Another purpose of this activity could also be to compare experimental results for find some scaling or other patterns. In addition and if possible, LFN measurement datasets would be used for validating LFN modelling approaches.

- Benchmark of serration noise measurements and models (Continuation of Phase 1 with now 4 participants: DLR, DTU, TUDelft, UTwente)

  Measurements have been conducted in DTU/TUD/DLR wind tunnels during Phase 1 and comparisons of the results has been initiated. In Phase 2, the analysis of results and cross-comparisons between measurement data from the different tunnels is continued.

  During Phase 2, it is also proposed to disseminate these results in conferences and/or workshops. A dissemination plan will be established and a collaboration with the BANC framework is considered. The goal is also to prepare a noise measurement database that will be publicly available.

  A last possible step would be to initiate a comparison of serration modeling methods vs. measurements. It is the plan for a master student (Enercon+TUDelft) to conduct LES calculatoins with LES (Flower & Powerflow) with a test-matrix to be defined, in concertation with Task 39 participants.

- Tip noise (with ULimerick, DTU, DLR) for winglets and other add-ons: VGs, flaps (at airfoil and blade levels)

  Although manufacturers can nowadays handle tip noise quite well by careful design, this may be different in the future with new tip designs (winglets) and other add-ons along the blade (flaps). However, there are few engineering models for tip noise valid for general geometries and high-fidelity models are often required to obtain accurate results.

In this Task, it is proposed to investigate the possibility of developing engineering model(s) for tip noise (and further add-ons), based on high-fidelity CFD models for calibration and validation (UL/DLR). The high-fidelity models themselves should be validated against wind tunnel measurements data.

The plan is to investigate existing (DLR) or conduct new (DTU) wind tunnel experiments to validate both high-fidelity and engineering models. The possibility to conduct an additional experiment or further existing results (using an existing scaled-down winglet from a Vestas/TUDelft collaboration where flow vertical patterns were investigated with Particle Image Velocimetry) may be considered

Other relevant related activities are also considered: VGs, flaps. E.g. earlier studies at IAG on VGs could be used as a starting point.

WP3. Noise Propagation Modelling

This WP addresses noise propagation from the turbine to the receiver. There are many different empirical approaches to modelling the propagation of wind turbine noise ISO 9613, Nord 2000 and other country specific approaches. These approaches have been validated for predicting wind turbine noise and generally work well, for frequency bands in the range from 63 Hz to 8000Hz, in rather flat and homogeneous terrain. With the advent of larger turbines and increasing offshore deployment some distance from shore, there is no internationally agreed method for predicting noise levels inland from offshore turbines. Noise from offshore turbines arising onshore need to be assessed for environmental impacts. Likewise, the known empirical approaches of wind turbine noise propagation on-shore fail in complex (forested, hilly) terrain and over extended distances. Systematic studies are required to gain knowledge on noise propagation over heterogeneously structured surfaces under different meteorological conditions (e.g., day/night differences). Those studies could be based on available or approaching measurement and simulation data sets, like from the Perdigão-2017 campaign in Portugal or others...

Proposed activities

- A new Benchmark on noise propagation simulation codes (for on-shore wind turbine/farm) is proposed (ForWind/LUH/ISD, DLR-PA, DTU, KTH, Others?).

  Note the existence of a previous benchmark from WindEurope Technology Workshop (Gdansk, 2016) which could be used as a template. Studies have also been carried out to modify the Nord2000 software and could be used as a source of inspiration here.

  In a first place, specific goals for the benchmark need to be defined, in particular, deficiencies of current models need to be properly assessed to better focus the scope of the present study. The requirements for the data set and the specifics of the benchmark (what to look at: e.g. 10mins or months data) should be clarified.

  Several noise measurements data sets have been identified and a combination of them could be used for the benchmark. Three good candidates are reviewed below.

  1) A dataset is available through ForWind/LUH/ISD. It includes wind turbine noise propagation for 5 measurement campaigns at 3 distances, over flat terrain, for different seasons with different meteorological conditions and soil surface conditions.

2) A dataset acquired in Sweden by C. Larsson, that could be provided and made publicly available through a contribution from KTH (K. Bolin/A. Sjöblom) is considered. This is a large dataset containing several years of measurements with 10mins data average, meteorological and turbine operational data are available, up to 1 kms downwind, for mostly 2 sites in forested area.
3) The Perdigão (Portugal) experiment is also a good candidate for such a benchmark for complex terrain with multiple atmospheric sensor data available. A possible study plan using result from this Perdigão experiment is proposed below:

Perdigão-2017 campaign data and suggested benchmark framework *(Input from DLR-PA)*

Data availability must be checked with Enercon and IAG-Uni Stuttgart

- Verification and validation of simulation codes
- Quality check of measurement data, validation of measurement strategies in complex terrain
- Combination and best assessment of sound immission (both from measurement and simulation) at various positions to create a map of spatial sound pressure levels
- Towards a development of norms, standardization and guidelines to assess sound propagation in complex terrain

- Computationally intensive model for offshore wind turbine noise (NUI Galway, DTU, Others?)

Atmospheric noise propagation calculations require consideration of surface/ground and atmospheric effects. Propagation over water has generally been calculated using assumptions of flat water. The issue of multiple reflections and waves may play a significant role. Little work has been done on the transition from water to land surfaces and continuing propagation over land. The effects of a layered and potentially turbulent atmosphere and sea surface also require consideration. The proposed activity includes the development and validation of computational methods for benchmark models. It is planned to conduct sensitivity analysis of these models to determine the critical input parameters and their influence on the result.

Note that an offshore measurement dataset is available at KTH (2007, K. Bolin, 1 week measurements up to 10kms in calm water, and compared with PE method). A study from 2014 about piling noise from wind turbines is mentioned.

One of the goals of the study could be a detailed impedance analysis (incl. sensitivity) related to the presence of waves.

- Validation of simplified empirical model for onshore & offshore wind turbine noise (NUI Galway, DTU, Others?)

Computationally intensive methods, potentially offering greater accuracy, are not always suitable for use in windfarm design or environmental impact studies. The majority of prediction methods used internationally are based on empirical methods validated against computationally intensive calculations and measurements. This activity will follow from the detailed modelling and develop a simplified empirical calculation sufficiently accurate for windfarm design and environmental impact assessment

WP4. Assessing and Managing the Noise effects on Health, Wellbeing and Consent

This WP includes a programme of activities designed to assess the contribution of wind turbine noise to subjective noise perception, annoyance and the effects of these on health, wellbeing and consent.

Proposed activities

- Lab-based psycho-acoustic annoyance testing (NUI Galway, ForWind/LUH/IKT, Others?)

    Samples of wind farm noise sourced from the other collaborators will be calibrated and prepared for experimental psychological investigations. Using a specialized sound laboratory at NUI Galway, individuals will complete a range of tasks (e.g., a simple task, a more complex task or to sit quietly) in the presence of the noise samples. The samples will be presented alone and in combination with relevant or irrelevant visual stimulation (wind farm image or other image) and other sources of auditory stimulation (e.g., background noise). Outcome variables of interest will include annoyance responses (to assess thresholds) and task performance (cognitive effects of noise). Physiological indicators of emotional responses, such as galvanic skin response, may also be measured.

- Field-based psycho-acoustic annoyance testing (NUI Galway, Others?)

    Using approved scales such as the Perception of the Living Environment, data will be collected on the annoyance levels of individuals sampled from specific geographical areas with particular geo-spatial characteristics in terms of the expected propagation of wind farm noise. If possible, samples of noise at these locations will also be collected to verify and/or update the propagation models. Field data from Ireland, Germany and Denmark may be available.

- Piloting online testing of WTN perception (NUI Galway, Others?)

    Laboratory testing enables high fidelity testing of acoustic responses but it is limited in terms of the numbers of people who can be included in testing. We will develop pilot online procedures for psycho-acoustic testing and assess the quality of data obtainable in this way. Investigate the feasibility of a large scale online auralisation test for annoyance of (a) absolute wind turbine noise levels, (b) wind turbine noise levels relative to background noise level and (c) perception of audible characteristics and whether penalty schemes can normalise annoyance.

- Stimulus calibration and validation of reproduction for lab-based and online testing (FORCE, ForWind/LUH/IKT)

    Acoustic properties that are relevant in terms of perception, annoyance and disturbance of the well-being will be identified. It is assumed that in addition to sound pressure level, timbre and modulation other properties like spatial/binaural cues play a role especially when investigating realistic acoustic scenarios (soundscape) rather than isolated WTN. Procedures will be developed to calibrate acoustic (and audiovisual) stimuli as well as reproduction techniques (including headphone/loudspeaker equalization, VR/MR reproduction,…) in order to reproduce the identified relevant stimulus properties properly and thus maintain ecological validity. The challenges of validity that come with online testing will be considered separately.

- Auralization and stimulus synthesis (ForWind/LUH/IKT, FORCE, NUI Galway, Others?)

    Systematic testing of acoustic signal properties in terms of WTN annoyance requires a large stimulus database with controllable feature strengths. Stimuli from measurement data have the advantage of already containing all real-world features (if treated carefully), but may have disadvantages of unwanted interference and/or background noises or only exist for certain environmental conditions. To overcome this drawback, an auralization and stimulus synthesis procedure will be developed that generates controlled stimuli from scenario parameters (which can be obtained from measurements). A subsequent validation step ensures that the (re-)synthesized stimuli reflect the underlying measurement.

- WTN Penalties, perception and annoyance

  When environmental sound includes specific features, such as tonal or impulsive components, many regulations involve a penalty to be added to the measured or predicted A-weighted equivalent SPL, L_{Aeq} [dB], in order to counteract the negative effect of the specific feature on annoyance; e.g., in Finland, the penalty values vary between 3 and 10 dB depending on the regulation. This activity will develop procedures to test the hypothesis that a penalty (in decibels) can normalise the annoyance of audible characteristics of WTN under laboratory conditions.

WP5. Characterising non-noise influences on Noise Perception and its effects

Social acceptance of wind turbines is driven to some extent by noise produced by wind turbines, but there is evidence of an effect in the reverse direction. That is, sensitivity to wind turbine noise may be driven partly by social acceptance with lower acceptance driving greater sensitivity to such noise (See Figure 3). These complex iterative interactions require detailed research to investigate and interactions with Task 28 are likely to be a great benefit to this activity.

Regulations in some countries impose a ‘penalty’ on audible characteristics of wind turbine noise such as tonality. Development of penalty schemes for amplitude modulation is ongoing. Such penalty schemes are predicated on the concept that annoyance is related to a noise level (measured in decibels). A further step assumes that a penalty in decibels can equate the annoyance of a noise with an audible feature with a higher noise level without the audible feature. The annoyance concept is a complex issue and an investigation is required to validate this principle and estimate penalties if appropriate.

<u>Proposed activities</u>

- Conference on Noise Perception and Social Acceptance (joint event with Task 28)

  To facilitate generating a network of researchers to disentangle the effects of social acceptance and other relevant variables on noise perception and vice versa, we will run a boutique conference addressing these issues. We will coordinate this event with Task 28.

- Assessing Social Acceptance of WTN Online

  Dependent on the progress of the online auralisation tests for noise perception and the propagation modelling work, we will investigate whether there may be means to employ online approaches for public consent. For example, it may be possible to enable members of the public to sample projected noise samples at certain locations at different distances from proposed wind turbine installations.

- Ongoing networking with Task 28

  WTN perception and the downstream generation of annoyance is strongly linked to social acceptance of Wind Turbine technology. We will engage in ongoing networking with Task 28 to facilitate communication of the state of the art in terms of the physical noise influences on social acceptance (from Task 39 to Task 28) and the socio-political influence on social acceptance (from Task 28 to Task 39).

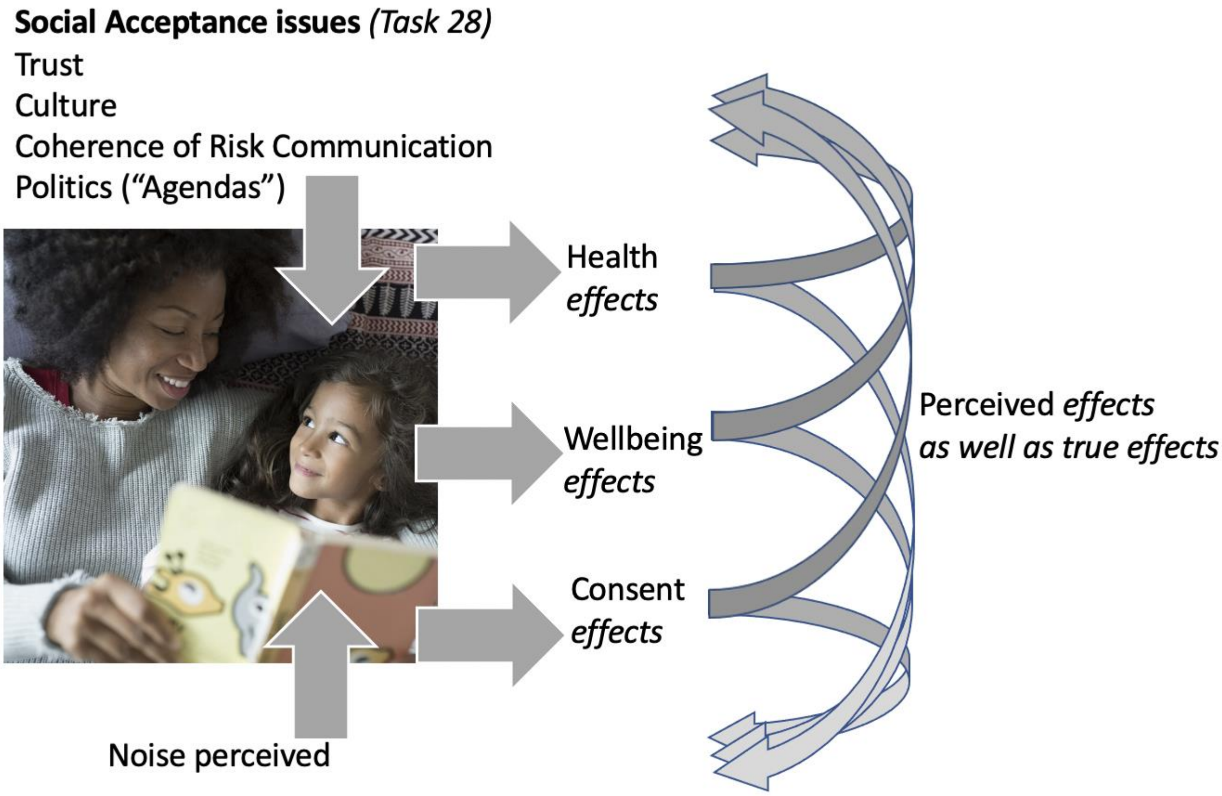

Figure 2 - Interactions and potential cyclical effects among noise perception, its effects and acceptance

5 Time Schedule with Key Dates

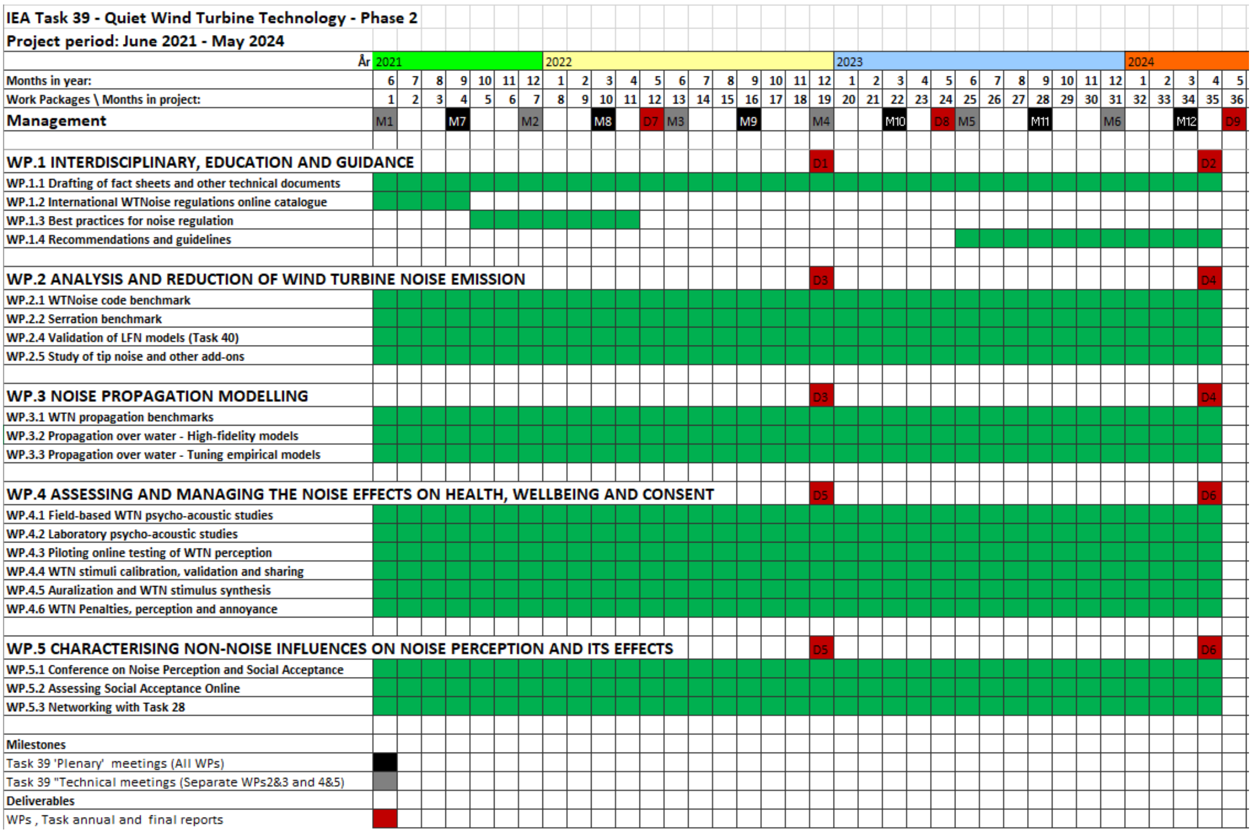

Figure 3 - Work Plan GANTT Chart

6 Reports, Deliverables, and Dissemination of Results

In addition to annual reports to the ExCo final reports at the end of the Task 39 Phase 2, a number of intermediate technical reports are planned. This reporting will be combined for WPs 2&3, and for WPs 4&5, respectively, and will be delivered at the mid-period and at the end of the project.

Table 1 - Planned Deliverables and Schedule

No.	Deliverable	Contributors	Month Due
D1-D2	Work Package 1 report	OAs and others	19, 35
D3-D4	Work Packages 2&3 report	OAs and others	19, 35
D5-D6	Work Packages 4&5 report	OAs and others	19, 35
D7-D8	Annual Progress Reports to ExCo	OAs and others	12, 24
D9	Final Report	OAs and others	36

7 Methods of Review and Evaluation of the Work Progress

The primary mean of evaluating the work progress will be through regular Task 39 meetings, where each of the WPs will be addressed and the different activities will be reviewed and evaluated, and plans of actions will be agreed upon. Note that for 2 meetings per year will convene all participants for all WPs, in so-called “Plenary” meetings. In addition, 2 other “Technical” meetings per year will have a more focus agenda and will be organized separately for WPs 2&3 and for WPs 4&5, respectively. Individual activities and WPs will hold separate meetings as required in order to follow up and further coordinate the on-going collaborative works.

Table 2 - Milestones and Schedule

No.	Milestone	Contributors	Month Due
M1	Meeting #1 (Agree upon detailed work plan and approach - Begin WP1)	All	1
M2-M6	Technical meetings (Coordination and planning of activities - Separate WP 2&3 and WP 4&5)	WPs 2&3 / WPs 4&5	7, 13, 19, 25, 31
M7-M11	Plenary meetings (General status of project – Presentations of activities - All WPs)	All	4, 10, 16, 22, 28
M12	Final meeting (Reporting - All WPs)	All	34

8 Obligations and Responsibilities

Collaboration among Participants and their findings as part of the present project should be conducted with respect of the principle of equitable sharing of obligations, contributions, rights and benefits that are common to such research collaboration projects. In particular, all publications should fairly give credit to all participants that were involved in their content by contributing to the published new knowledge.

Operating Agent

In addition to the responsibilities enumerated in the IEA Wind Agreement, the Operating Agent shall manage the overall progress of the Task different Work Packages, coordinate interactions between WPs when required as well as dissemination and reporting to the, organize four annual meetings, two of them with all Task participants, and two of them more focused on technical activities in WPs 2&3 and WPs 4&5, respectively.

Participants

In addition to any obligations listed in the IEA Wind Agreement, the Task participants should maintain the progresses according to the planned work plan and schedule, attend progress meeting (both for plenary meetings, but also meetings specific to the different WPs and various distinct activities when required), contribute to deliverables and reports.

A country wishing to enter the Task activities will be charged for the Task fees at a pro-rata rate for the joining year from its official data of start. The same holds for a country wishing to withdraw from the Task.

Table 3 - Planned effort from each Participant

Country	**Participant**	**Subject**	**National effort**	**Related effort**	**Total effort**
		Work package	**Person-month**	**Person-month**	**Person-month**
Denmark	DTU, FORCE	WP 1,3	12		
	FORCE Technology	WP 1,4,5	8		
Germany	DLR, IAG	WP 1,3			
	DLR-PA	WP 3	3		
	ForWind/LUH	WP 1,5			
Ireland	ULimerick	WP 2,3			
	NUIGalway	WP 1,3,4,5			
Netherlands	ECN, TUDelft, UTwente	WP 1,3			
Sweden	KTH	WP 3			
USA	NREL	WP 1,2,3			
Total					

9 Funding

Task 39 is based on a combined “Cost shared-Task shared” funding basis.

During Phase 1 of the Task, the Operating Agent did coordinate a number of activities in WPs 1 & 2, mostly focusing on technical and engineering aspects, and was able to convene a number of participants in the corresponding fields of expertise. However, the revised scope of the Task 39 is quite broader. To solve this issue a co-Operating Agent is appointed who can deal with and coordinate activities related to a number of topics that were not fully addressed earlier (such as public acceptance, psycho-acoustics, regulations, etc).

It is proposed to assign a co-Operating Agent whose field of expertise is directed toward this field of expertise, e.g. social acceptance, regulation… and could help 1) define the work programme 2) recruit participants in this field. The expected Operating Agents for the 2nd Phase of Task 39 will be:

- Franck Bertagnolio, DTU Wind Energy, Denmark (Email: frba@dtu.dk)
- Eugene McKeown, RPS Group, Ireland (Email: eugene.mckeown@rpsgroup.com)

10 Budget Plan

The proposed budget model is to be a combination of “Cost shared-Task shared”. The proposed overall yearly budget for the two operating agents is displayed in the table below.

Table 4 - Operating Agents Costs

		USD	USD/yr	Euro	Euro/yr
Meetings, coordination work	2 person-months				30000
Reporting	1 person-months				15000
Travel costs					4500
Other costs					
TOTAL					**49500**

11 Management of Task

There will be quarterly WPs meetings independently for WP 2&3 and 4&5, and bi-annual Task meeting for all WPs. In addition, each of the activities and their leaders will be responsible to organize meetings as the work progresses to coordinate contributions.

The primary method of communications for the activities will be through email between participants and regular meetings (either planned Task and WP meetings, but also as required by the progresses for each activities). Exchange of data will be carried out using the new IEA Wind TCP SharePoint platform.

12 Organisation

The two Operating Agents will be responsible for following up the progresses for the respective WPs. For each specific activity, a leader will be designated to coordinate the progress of these activities by keeping track of advancements.

The expected operating agents are from Denmark (Franck Bertagnolio, DTU) and Ireland (Eugene McKeown, RPS Group). Their administrative work for the Task 39 Phase 2 is expected to come primarily from the fees of participating countries.

For WPs 2&3, various participants are expected to contribute to the activities (DE, DK, IE, US). Each country will be applying for funding to their respective funding authorities.

DLR, IAG, DTU, NUIGalway ULimerick and NREL will contribute to different activities related to wind turbine noise generation and propagation.

NUIGalway, Hannover University, FORCE Technology (and possibly other institutes) will contribute to perception and psychological aspects.

13 Information and Intellectual Property

(a) **Executive Committee's Powers**. The publication, distribution, handling, protection and ownership of information and intellectual property arising from activities conducted under this Annex, and rules and procedures related thereto shall be determined by the Executive Committee, acting by unanimity, in conformity with the Agreement.

(b) **Right to Publish.** Subject only to copyright restrictions, the Annex Participants shall have the right to publish all information provided to or arising from this Task except proprietary information.

(c) **Proprietary Information.** The Operating Agent and the Annex Participants shall take all necessary measures in accordance with this paragraph, the laws of their respective countries and international law to protect proprietary information provided to or arising from the Task. For the purposes of this Annex, proprietary information shall mean information of a confidential nature, such as trade secrets and know-how (for example computer programmes, design procedures and techniques, chemical composition of materials, or manufacturing methods, processes, or treatments) which is appropriately marked, provided such information:

   (1) Is not generally known or publicly available from other sources;

   (2) Has not previously been made available by the owner to others without obligation concerning its confidentiality; and

(3) Is not already in the possession of the recipient Participant without obligation concerning its confidentiality.

It shall be the responsibility of each Participant supplying proprietary information, and of the Operating Agent for arising proprietary information, to identify the information as such and to ensure that it is appropriately marked.

(d) **Use of Confidential Information.** If a Participant has access to confidential information which would be useful to the Operating Agent in conducting studies, assessments, analyses, or evaluations, such information may be communicated to the Operating Agent but shall not become part of reports or other documentation, nor be communicated to the other Participants except as may be agreed between the Operating Agent and the Participant which supplies such information.

(e) **Acquisition of Information for the Task.** Each Participant shall inform the other Participants and the Operating Agent of the existence of information that can be of value for the Task, but which is not freely available, and the Participant shall endeavour to make the information available to the Task under reasonable conditions.

(f) **Reports on Work Performed under the Task.** Each Participant and the Operating Agent shall provide reports on all work performed under the Task and the results thereof, including studies, assessments, analyses, evaluations and other documentation, but excluding proprietary information, to the other Participants. Reports summarizing the work performed and the results thereof shall be prepared by the Operating Agent and forwarded to the Executive Committee.

(g) **Arising Inventions.** Inventions made or conceived in the course of or under the Task (arising inventions) shall be identified promptly and reported to the Operating Agent. Information regarding inventions on which patent protection is to be obtained shall not be published or publicly disclosed by the Operating Agent or the Participants until a patent application has been filed in any of the countries of the Participants, provided, however, that this restriction on publication or disclosure shall not extend beyond six months from the date of reporting the invention. It shall be the responsibility of the Operating Agent to appropriately mark Task reports that disclose inventions that have not been appropriately protected by the filing of a patent application.

(h) **Licensing of Arising Patents.** Each Participant shall have the sole right to license its government and nationals of its country designated by it to use patents and patent applications arising from the Task in its country, and the Participants shall notify the other Participants of the terms of such licences. Royalties obtained by such licensing shall be the property of the Participant.

(i) **Copyright.** The Operating Agent may take appropriate measures necessary to protect copyrightable material generated under the Task. Copyrights obtained shall be held for the benefit of the Annex Participants, provided however, that the Annex Participants may reproduce and distribute such material, but shall not publish it with a view to profit, except as otherwise directed by the Executive Committee, acting by unanimity.

(j) **Inventors and Authors.** Each Annex Participant will, without prejudice to any rights of inventors or authors under its national laws, take necessary steps to provide the co-operation from its inventors and authors required to carry out the provisions of this paragraph. Each

Annex Participant will assume the responsibility to pay awards or compensation required to be paid to its employees according to the law of its country.

14 List of Potential Participants

Table Countries and Organisations Participating in Task 39 (This list is subjected to the approval of each country to participate to the Task 39).

Country	**Institution(s)**
Denmark	DTU, FORCE Technology
Germany	DLR, IAG Uni. Stuttgart, 3DS, ForWind/LUHannover(IKT&ISD)
Netherlands	TNO, TUDelft, UTwente
Ireland	NUIGalway, ULimerick, RPS Group
USA	NREL