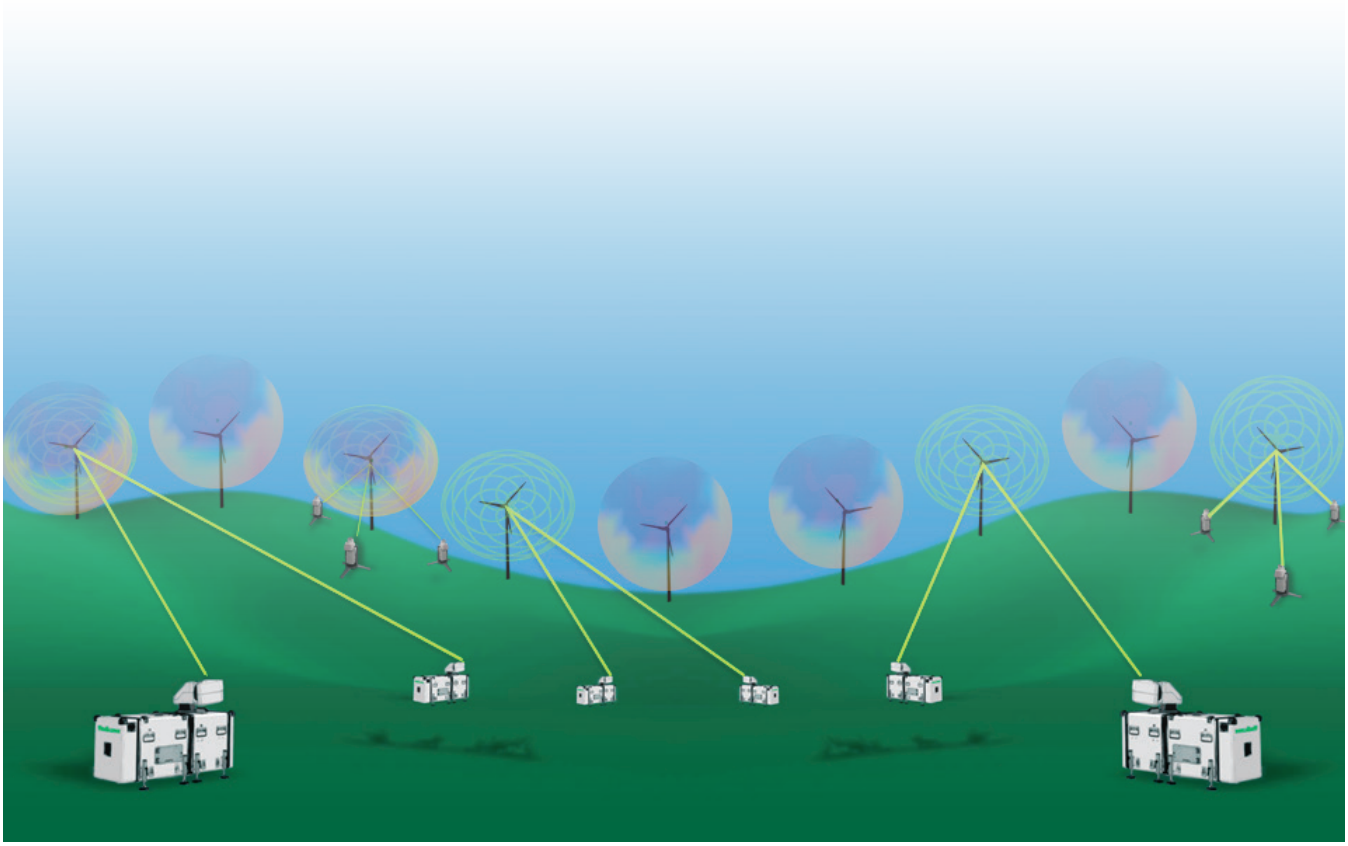
Business Plan
WindScanner.eu ERIC



WindScanner.eu ERIC
Business Plan

Partners

DTU Wind Energy (Denmark) (Coordinator)	Technical University of Denmark, The Department of Wind Energy
Fraunhofer IWES (Germany)	Fraunhofer Institute for Wind Energy and Energy System Technology
ECN (The Netherlands)	Energy research Centre of the Netherlands
ForWind Oldenburg (Germany)	Center for Wind Energy Research of the Universities of Oldenburg, Hannover and Bremen
CENER (Spain)	The National Renewable Energy Centre
SINTEF (Norway)	The Foundation of Scientific and Industrial Research
LNEG (Portugal)	The National Laboratory for Energy and Geology
UPorto	The University of Porto
CRES (Greece)	Centre for Renewable Energy Sources
IPU (Denmark)	The Department of Product Development

Purpose of Document

This document is intended for stakeholders, national research funding agencies, business and industry as well as NGOs and policy makers concerned with wind energy, renewable energy, as well as basic and applied scientific research.

Pictures by

Mikael Sjöholm, Andrea Vignaroli, Torben Krogh Mikkelsen, Guillaume Lea & Lee Jay Fingersh

Website

www.windscanner.eu

Contact

Søren Siggaard Knudsen (sknu@dtu.dk), Senior Executive Officer, DTU Wind Energy

WindScanner.eu

ESFRI

November 2015

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Executive Summary

Wind energy is on course to become the leading electricity generating technology across Europe. In 2014, the wind energy sector reached 128.8 GW of installed capacity in Europe (121 GW onshore and 8 GW offshore). In an average wind year, this would be equivalent to the production of 283.7 TWh of electricity, enough to cover 10.1% of the EU's electricity consumption. The sector already employs 259,715 people.

This remarkable performance has been made possible and will continue only with significant R&I efforts from industry, the research community and a decisive political support at national and European level. WindScanner.eu ERIC aims at making a significant contribution to these R&I efforts by promoting scientific excellence and strengthening the European Research Area (ERA).

Huge progress on industrializing wind energy has already been achieved in the past 25 years, but **there is still a massive potential for cost reductions,** through market development and R&I, for wind energy to reach its full potential for large-scale supply of electricity.

WindScanner.eu ERIC will be a unique, and mobile European scale research infrastructure, capable of scanning 3D wind fields with high precision in the atmospheric boundary-layer flow and turbulence [i]**.** The facility thereby enables the European wind energy society to experimentally investigate the complex flow and turbulence that creates loads and causes fatigue on wind turbines and wind plants in operation. A better understanding of the flow is key to optimize turbine's design and siting and thus an important drive for reducing the cost of energy. **WindScanner.eu ERIC will therefore directly support wind energy to become cheaper and more reliable.**

The cornerstone in the WindScanner infrastructure is state-of-the-art WindScanners for 3D wind speed vector measurements consisting of space- and time synchronized wind LiDARs (Laser Doppler-based wind measuring systems), to remotely sense and scan the 3D wind vectors at distant points. By steering the laser beams, the WindScanners are able to map out the 3D wind fields in huge air mass volumes surrounding the operating wind turbine rotors.

The research infrastructure has its primary use within the fields of measurements around large wind turbines, on and offshore. However, it also serves other purposes such as atmospheric boundary layer research, air safety, wind loads on buildings and bridges, wind circulation in streets and the urban environment in general, etc., which are all examples of activities with high priority in the years to come.

WindScanner.eu ERIC will be a **legal entity based on the European Research Infrastructure Consortium (ERIC)** model, jointly owned by the participating Member States. **The facility will consist of a set of National Nodes from leading European wind energy research organizations,** with mobile WindScanners, linked together by the **WindScanner Central Hub.** The system of governance in WindScanner.eu ERIC has been established considering the fact that the distributed National Nodes have different potentials, needs and ambitions.

WindScanner.eu ERIC will develop and implement services tailored to the needs of the users and operators of the scanners and ensure a coordinated and complementary infrastructure development and functionality. This includes establishment of a unique one-point-of-entry **WindScanner e-Science and User Platform** that facilitates a wide range of users - from industry and the research community - to use these unique 3D scanned wind field research data. This will contribute to bring together national facilities to enhance and further develop cutting-edge experimental research in complex wind flows, supporting the further development of synergies and alliances, which will not be possible within national facilities only.

Vision

To provide researchers within the European wind community with unprecedented possibilities for mapping the 3-D wind surrounding full scale wind turbines, wind farms, forests and mountains. These data will spurn enhancements and ultimately raise confidence in the mathematical models that we need to further drive technological cost cutting in the wind industry, contributing to cheaper and even more reliable wind energy.

Mission

To establish and operate a powerful WindScanner.eu ERIC that will provide:

- Planning and coordination of WindScanner measurement activities
- Coordination of purchasing, commissioning, calibration and maintenance of WindScanner equipment
- Training and education in WindScanner operation and data analysis
- Development of e-science facilities for campaign design, documentation, data management and data analysis
- Provide access to research data
- Dissemination of WindScanner opportunities and achievements to foster optimal stakeholder collaboration.

[i] Mikkelsen, T. (2014). Lidar-based Research and Innovation at DTU Wind Energy – a Review. Journal of Physics: Conference Series, 524, 012007. doi:10.1088/1742-6596/524/1/012007.


WindScanner.eu
Vestas

1 Introduction

1.1 The need and added value for Europe

In order to meet the goals of the European Strategic Energy Technology Plan[i] (SET plan), Europe needs a massive increase in its installed wind power capacity – essentially, a required amount corresponding to the installation of one large wind turbine every hour for the next ten years.

WindScanner.eu ERIC will contribute significantly to this demanding goal by building a unique research infrastructure capable of performing in-situ, high resolution wind measurements using remote laser scanning technology. Previously we were limited to performing detailed measurements at special test stations, using expensive and immobile measuring masts. The new laser-based infrastructure will provide both industry and research institutes within the European wind community, with unique tools capable of measuring flow around wind turbines and over hills, forests and mountains . These new measurements will lead to improved mathematical models for many aspects of both wind turbines and atmospheric flow. Through these improvements, wind energy will become cheaper and more reliable.

Equally relevant, for wind turbines that will be installed offshore, the WindScanner.eu infrastructure will be able to measure and provide unique insight into intra and inter park wake phenomena that are becoming so important for future offshore wind clusters. Here the economic benefits of even marginal improvements are massive.

Finally, WindScanner.eu ERIC will provide an exceptional added value to the European research community and industry by providing access to unique research data; contribute to the mobility of knowledge; standardization; and further optimization of advanced technological equipment to facilitate the cutting edge research throughout Europe. This will strengthen the ERA.

1.2 What is WindScanner.eu?

1.2.1 The WindScanner.eu ERIC research infrastructure

WindScanner.eu ERIC will consist of a set of **National Nodes** from leading European wind energy research organizations, with mobile, deployable WindScanners, bound together by the **WindScanner Central Hub,** which will implement the **WindScanner e-Science and User platform.**

WindScanner.eu ERIC will develop and implement services adjusted to the needs of the users and National Nodes, as listed in the box to the right.

Windscanner Central Hub (WCH)

WindScanner Central Hub is envisioned to be based at DTU Wind Energy in Denmark.
The size and functionality of WCH will be limited in the beginning, focusing on targeted activites to establish the legal entity and start the provision of specific services. The WCH will have the obligation to handle most administrative matters and will have, as an important task, to ensure additional financing, also in the operational phase. The WCH will develop and implement service stailored to the needs of users and National Nodes and ensure a coordinated and complementary infrastucture development and functionalality.

More details are given in chapter 2.

National Nodes

When WindScanner.eu ERIC has been established, the distributed research infrastructure is expected to consist of 6-8 National Nodes in Europe. The National Nodes will be comprised of leading universities and research institutes in Europe within wind energy research.

WindScanner e-Science and User Platform

This will provide a unique one-point-entry for a wide range of users, who can access the research data. WindScanners generate very detailed and vast amounts of data which may be difficult for researchers and other users to comprehend and interpret. Therefore, in the years to come, the user-interface needs to be made widely available and data interpretation less complex.

[i] http://ec.europa.eu/energy/en/topics/technology-and-innovation/strategic-energy-technology-plan

WindScanner.eu ERIC services and contributions

✓ **Access to WindScanner equipment**

- Access to state-of-the-art WindScanner equipment, which are currently only available for few scientists in Europe.

✓ **Access to and use of WindScanner data**

- Handle data flow and data management to provide users access to research data.
- Data analysis support for users.
- High Quality Data standards for acquisition and data management.
- Linking modelers and operators of the WindScanner Systems to enable better data analyses and experimental verification of models.
- Facilitate excellence in planning, implementation and utilization of data from measurement campaigns.

✓ **Training**

- Training for technicians/operators of the WindScanners (train the trainer).
- Hands-on training of users to enable better analysis of the data.
- Training of scientists on WindScanners and remote sensing technologies (courses, modules for master ar Ph.D. students, summer schools, e-learning etc.)

✓ **To Industry**

- Provide a platform for interaction with industry, LiDAR developers, wind farm developers and wind turbine manufacturers, as well as other industry sectors (e.g. aviation and civil construction industry), and the European research community within advanced remote sensing technologies.

✓ **Facilitate standardization and excellence in European experiments**

- Planning and coordinating research programmes for European wind energy measurement campaigns based on key contributions from WindScanner equipment.
- Standardize the use of WindScanner equipment from different nodes, as well as exploiting similar datasets for easier analysis.

1.2.2 The WindScanner technology

Traditional wind speed measurements are made using mechanical devices such as cup anemometers and wind vanes that need to be mounted at the point of interest, usually using a measuring tower.

A WindScanner System is composed of several coordinated LiDARs, being remote-sensors using laser light to measure wind speeds. The actual measurement instrument can be placed remotely (usually on the ground), several kilometers from the point of interest. Single LiDARs can only measure the wind speed along the line of the laser beam. In order to measure wind speed and direction, at least two separated LiDARs are needed; for 3D wind (speed, direction and flow inclination) three separated LiDARs are needed. In a WindScanner System, the beams of the separated LiDARs can be steered in coordination so that the wind speeds over a whole area or volume can be measured.

The WindScanner infrastructure will consist of two types

of continuously updated state-of-the-art WindScanners, which have radically different optical architectures that are suited to short-range and long-range measurements, respectively (Figure 2). The WindScanner type to use will depend largely on the scanning range but sometimes a hybrid system will be the best solution.

Short-range WindScanners measure currently to around 250m in range (as high as the largest existing wind turbines). Since the laser light is focused, they are able to measure very quickly (at several hundred scans per second) and, especially at very close range, have very good spatial resolution (they can distinguish fine details in the flow). Developments in this type of WindScanner will increase the maximum range to around 300m. Classical tasks for short-range WindScanners are flow measurements (inflow and wake) around full-size wind turbines. Other exciting possibilities include helicopter downwash measurements, outdoor instrument calibration and detailed flow mapping over small-scale terrain features.

For distances beyond the envelope of the short-range scanners, pulsed lidar technology is used instead of focusing. Depending on their design, these long-range WindScanners can measure at ranges of up to 10 km and potentially in the future, to both 15 and 30km. The price to be paid for the extra range is a reduced spatial resolution (they can 'see' less detail in the flow) and the weaker signals from the far distance mean that they can only measure at up to a few scans per second. Long-range WindScanners can reveal larger scale details in the wind turbine wakes (meandering and recovery) and here hybrid systems could also be beneficial. Another classical long-range WindScanner measurement discipline is the mapping of larger-scale flow features over hills and escarpments. Outside wind energy, long-range WindScanners could be highly beneficial in studying the flow over towns (with short-range systems possibly providing simultaneous detailed information of the flow in the street 'canyon').

The WindScanner infrastructure includes not only the WindScanners themselves but also the associated logistical equipment – trucks, lifting equipment, power supplies, surveying equipment, etc. An essential part is also the data-management and database support that facilitates the detailed and extensive data analysis that is necessary to retrieve valuable data from the large volumes collected.

Wind-Scanner

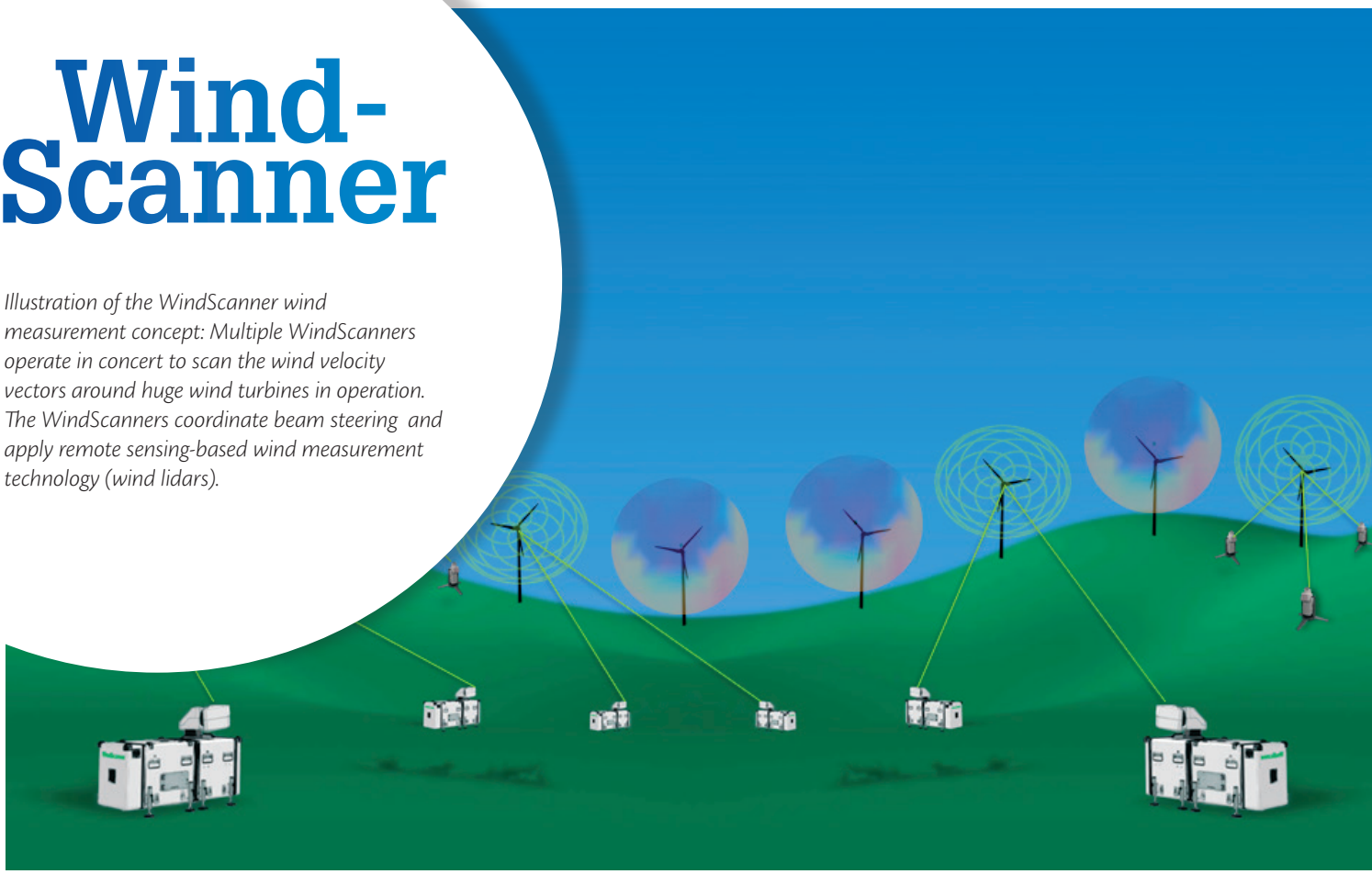


Illustration of the WindScanner wind measurement concept: Multiple WindScanners operate in concert to scan the wind velocity vectors around huge wind turbines in operation. The WindScanners coordinate beam steering and apply remote sensing-based wind measurement technology (wind lidars).

2

The Infrastructure Model

The following chapter describes the structural and legal setup of the research infrastructure, as well as the interaction and roles of the different governing bodies.

2.1 Legal structure

Based on an analysis performed in the WindScanner.eu Preparatory Phase (PP) project, it was decided that WindScanner.eu shall be constructed as a ERIC as this is assessed to be the preeminent legal model for the distributed research infrastructure. This model will allow WindScanner.eu ERIC to have a permanent structure and to profit from having a legal identity recognized by all EU Member States, as well as privileges linked to it.

This is aligned with the ambition to have a jointly managed distributed research infrastructure that will enable a faster, more strategic dissemination, planning and exploitation of the currently national research infrastructures in a limited number of countries. The ambition is to plan and implement unprecedented, measurement campaigns in various countries, terrains and climate conditions taking advantage of nationally owned equipment – and to develop an efficient data access scheme to be used towards the European scientific community and industry.

The ERIC has been chosen as WindScanner.eu meets all the criteria for setting up an ERIC. Hence, the facility is necessary for European research activities; open to the European research community; and will be a distributed research infrastructure that provide added value in the development of the WindScanner technology. The facility will furthermore contribute to mobility of knowledge in ERA as well as to the dissemination and optimization of the results of the activities.

By having the WindScanner.eu based on a ERIC entails the possibility that the members' liability is limited to their committed contributions; there will be no capital requirement; members may specify in the statutes a fixed liability above their respective contributions or unlimited liability; and appropriate insurance to cover risks of the construction and operation can be taken by the ERIC. These principles will, to a high extent, be in conformity with the policies, the research institutions and universities being part of the National Nodes have to adhere to, as well as the Member States that are members of the legal entity.

By choosing the ERIC, WindScanner.eu will have a set of rights and obligations. First of all, the facility has primarily to operate on a non-economic basis. However, the facility will also have limited economic activities. This is in compliance with the fact that commercial work and services will normally only be provided by the National Nodes. WindScanner.eu ERIC will, as a rule, only provide

internal services and work for the National Nodes. The economic activities will be limited to income generated by giving access to specific data and measurements to third parties.

The following assessment criteria have been used when defining the most appropriate legal form:

- Short time of implementation
- Complexity of setting up
- Suitable for research institutions and universities
- The legal form is European/international and recognized in EU countries
- Support access to available funding
- Flexible concerning membership levels
- Strong National Nodes with ownership
- Not-for-profit, but not excluding relations with industry
- Tax exemption
- Supports decision of hub location

The business plan and statutes are structured according to the requirements of the ERIC Council regulations. Thus, the WindScanner.eu facility will, when an appropriate number of National Nodes (at least three) have been established, initiate the transformation from a phase with no legal entity into a ERIC legal entity where Member States will be members of the WindScanner.eu ERIC.

2.2 Governance structure

WindScanner.eu ERIC will be governed as a distributed research infrastructure of National Nodes located in different countries.

The system of governance in WindScanner.eu ERIC has been established considering the fact that the distributed National Nodes have different potentials, needs and ambitions.

The governance model has to meet the regulation set out for establishing an ERIC. Therefore, the statutory seat will be located in an EU Member State and the members have to agree on the governance structure of the ERIC in the statutes. Moreover, the structure has to include two mandatory bodies: a members' assembly and either a director or a board of directors. On that basis it has been decided that the highest decision making body in WindScanner.eu ERIC is the General Assembly, consisting of Member State representatives from the participating countries (hereinafter called Partner Country). The Partner Countries might delegate some of their decision making powers to their National Nodes or to a specific institution in their National Node. The General Assembly is assisted by an international Advisory Board (see Figure 3).

The day-to-day management is in the hands of the Board of Directors, which is supported by the Secretariat, based at the WindScanner Central Hub at DTU – Department of Wind Energy, Denmark.

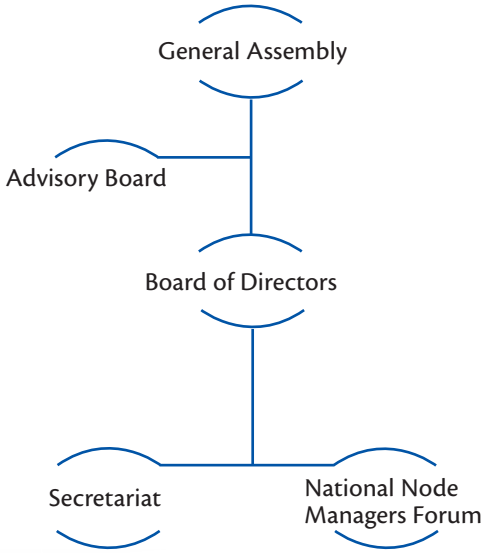


Figure 3: *Governance structure of WindScanner.eu ERIC.*

All WindScanner.eu ERIC infrastructure operations are run and financed by the Partner Countries. Each Partner Country is committed to setting up and funding a national WindScanner consortium forming a National Node. Finally, it is planned to setup a National Node Managers Forum, consisting of the heads of each National Node. Further working groups and committees can be established, such as a Committee for WindScanner Instrumentation.

Please find further detailed information in the draft statutes for WindScanner.eu ERIC that was drafted in the WindScanner.eu PP project.

2.2.1 General Assembly

The General Assembly will be established to be the principle decision-making body for overall strategy and policy for the WindScanner.eu ERIC, as set out in the statutes. The General Assembly will be composed of representatives of the WindScanner.eu ERIC Partner Countries, and will:

- Elect a Chairperson from the representatives of the Partner Countries for a period of two years.
- Meet at least once a year.
- Make all strategic decisions including appointing the members of the Advisory Board and the Board of Directors.
- Receive and approve the annual report, the financial statement and the annual spending plan submitted by the Board of Directors.
- Review, at least annually, the actual and forecasted survey and operating costs.
- Receive and approve the annual activity plan from the Board of Directors, which contains the broad scientific aims of WindScanner.eu ERIC.
- Review performed tasks and activities.

2.2.2 Board of Directors

The Board of Directors is headed by WindScanner.eu ERIC´ Executive Director and will provide support to the General Assembly. As core role, the Board will support and coordinate the activities of the infrastructure as well as managing resources.

The Board of Directors will be appointed by the General Assembly. The Executive Director will work full time, while the Deputy Directors can work part time, on the basis of secondment from their home institution.

2.2.3 Advisory board

The General Assembly and the Board of Directors will be advised by an independent Advisory Board, which oversees the quality of WindScanner.eu ERIC activities. The independent Advisory Board will be composed of 6 key stakeholders from industry as well as independent and highly qualified, international scientists, widely recognized as leading experts in the relevant fields of WindScanner.eu ERIC. The representatives are appointed by the General Assembly upon nomination by the Board of Directors.

The Advisory Board will report and give advice on issues like the overall quality assurance, strategic planning, evaluations and reviews. It is not a decision making body.

The Advisory Board will, when relevant, and at least once a year, be summoned to meet with the Board of Directors.

2.2.4 Secretariat

The Secretariat will assist the Board of Directors in implementing the decisions made by the General Assembly, including planning measurement campaigns, hosting and updating the WindScanner.eu ERIC website, and organizing training and education for the members of WindScanner.eu ERIC.

The staff will be employed by WindScanner.eu ERIC in the WindScanner Central Hub based at DTU Wind Energy, Technical University of Denmark.

The staff will consist of IT and LiDAR specialists that can assist both the National Nodes and WindScanner.eu ERIC with a wide range of tasks. There will, furthermore, be IT specialists to develop, establish and operate the WindScanner e-Science and User Platform.

It is furthermore foreseen that employment based on part time secondment of staff from the universities and research institutions of the National Nodes can be used to ensure well-balanced costs and a flexible secretariat. Salary and working terms will be handled by the institution and shall be in accordance with the HR policy of WindScanner.eu ERIC.

2.2.5 National Node Managers Forum

The National Node Managers Forum comprises the heads from each Node and serves as a forum for sharing information on best practices for the National Nodes, and to provide advice and input to the operation and development of WindScanner.eu ERIC when requested by the Board of Directors or General Assembly.

2.3 WindScanner Central Hub (WCH)

WindScanner.eu ERIC will establish a centralized hub to enable and strengthen stakeholders' ability to perform cutting-edge research and create impact in society. This WindScanner Central Hub will be managed by the Board of Directors and operated by the Secretariat.

The WindScanner Central Hub will coordinate the joint planning of national and European measurement campaigns to ensure efficient use of the dedicated WindScanner equipment and assist to exploit the scientific merit of the proposed campaigns. Each measurement campaign will be financed through the National Nodes by specific funding sources, each applying their own rules for evaluation of proposals, open access etc.

Moreover, the WindScanner Central Hub will, as a rule, not perform commercial

activities, as this will be done by the National Nodes. However, the WCH can assist the National Nodes when there are joint calls for commercial tenders etc. Thus, any responsibility or liability issues related to commercial activities are placed at the nodes.

The WindScanner Central Hub will – from the outset – not own WindScanners as the WindScanners will be owned by the individual partners within each National Node. However, the legal model will be constructed in a way that will allow the entity to purchase and own WindScanners if decided by the General Assembly. The hub will, on the other hand, be able to provide dedicated support allowing users to identify, locate and apply for "beam time" at the requested WindScanners available at one or more of the National Nodes.

The WindScanner Central Hub will provide a range of the services to the National Nodes and users that include:

Training: Education and training of technicians and researchers in operating the WindScanner Systems owned by each node (e.g. through summer schools, exchange courses, Master and PhD classes, etc.); organizing and providing information on available services and updates of the equipment owned by each node.

Data management: Management and handling of the data flow from the National Nodes; storing of data generated by the infrastructure; hosting of servers necessary for storing, processing and dissemination of data as part of the WindScanner e-Science and User Platform; hosting the website for WindScanner.eu ERIC; analysis and processing of data.

Administrative tasks: Manage an administrative office covering issues like standardization, organizing and defining the needs/requirements of further prototype WindScanners; organize exchange of researchers among the nodes; organize training, summer schools and exchange courses and, possibly, even modules for master students and Ph.D's etc.; assist scientifically, technically and administratively when a National Node has issues related to WindScanner Systems.

2.4 WindScanner National Nodes

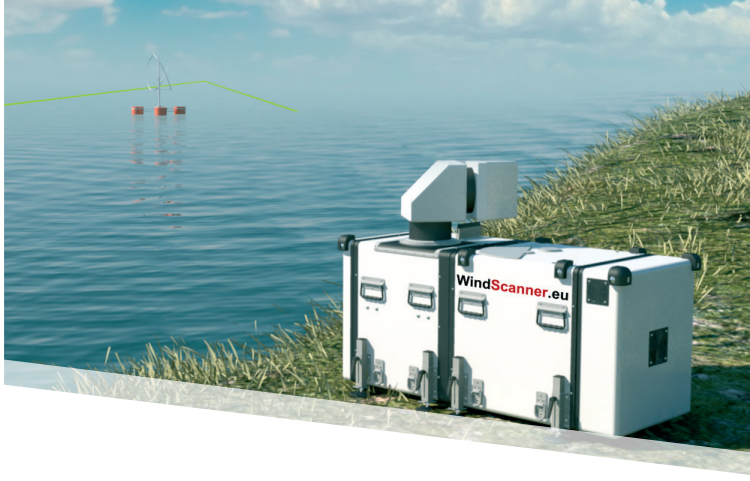
The universities and research institutes involved in the WindScanner.eu PP ensured that the possibility to create a national consortium in each Partner Country was explored and that the respective Partner Country approved the configuration of the National Node composition.

At present time there are up to 6 European countries creating their own National Nodes considering the general objectives setup by the WindScanner.eu PP project and adapting them to the circumstances and specific requirements of their countries, as well as to the needs raised by their potential stakeholders.

Creating a National Node implies commitment to ensure a continuous development of the WindScanner technology, as well as providing access to the user community. These combined efforts will enhance the joint research and development activities for the technology.

There will be joint research programs coordinated by the WindScanner Central Hub to align and optimize the resources among the National Nodes. Complementarily, the commercial activities in each country will be led by the National Node, ensuring the quality of the work performed and the results obtained.

The National Nodes may show very different configurations from country to country due to their obvious differences, but also due to the different degrees



of WindScanner technology and activities already developed. In all cases, each National Node will have to comply with the minimal set of rules established by WindScanner.eu ERIC.

The subdivision of specific operational areas (technical, commercial, financial, etc.) is a decision to be taken by the National Node coordinator. Nevertheless, the WindScanner Central Hub might request specialized personnel in certain areas to have the same type of response among all National Nodes (i.e. data treatment, databases) and also to provide a physical office for its activities and those of WindScanner.eu in its territory (e.g. meeting and training room, some office space, servers).

Each National Node provides support for experiments in its homeland and/or in other regions where they are the most suitable partner on logistics, transport, permitting, etc. It acts as local representative or plays a local role in topics such as commercial planning and management and/or National events representation, language and uses adaptation.

The role of the National Nodes is to consolidate the national stakeholders in a consortium, act as national point of entry for researchers and industry, and offer several services (detailed next below), thereby safeguarding a strong link with the user community.

2.4.1 Services provided and collaboration with the WindScanner Central Hub

Each National Node is committed to ensure a continuous development and application of the WindScanner technology; therefore, the joint research and development activities between the nodes and hub are expected to be quite substantial. The know-how and services should gradually grow at the nodes, so that the services locally available are continuously enhanced (do measurements for the local industry train users, PhD's etc.). Each National Node will have to make a yearly Activity Plan specifying the services and activities it will perform in connection to WindScanner.eu ERIC. This Plan has to be approved by the General Assembly.

The current foreseen services to be provided by the National Nodes and its collaboration with the WindScanner Central Hub include the following:

Funding program: The consortium is responsible for the funding sources supporting the activities targeted by the stakeholders. It is expected in the initial phase of the National Nodes activity that the main focus will be on research projects, funded by the national governments or the European Commission. Nevertheless, commercial projects for the industry and projects for States' governments will also be performed.

The National Node consortium coordinates the meetings with the research institutes and universities to determine the possibility to launch new research projects at national level. Considering all inputs, a complete planning should be proposed identifying the projects to be completed and the time line for each one.

Scientific program: Each National Node will have to create a research plan collecting the current plans and the consortia members' proposals.

Academic program: WindScanner.eu ERIC will promote the exchange of scientists and engineers among the WindScanner National Nodes within the otherwise normal academic exchange conditions that apply to the universities and research institutes being part of the National Nodes.

The exchange of technicians among National Nodes will be normalized in order to update every progress in the equipment and methodologies employed by the WindScanner community experiments. Additionally, a National Node might need technical support due to the complexity of the experiment and/or for evaluating the number of measurements to perform.

The WindScanner Central Hub will set the rules for exchanging technical staff among National Nodes that will work for their partners´ projects as well as defining how to use the databases generated by WindScanner.eu for academic purposes. Moreover, it will be also proposed Ph.D. and post graduated programs to work with the data generated or to participate in the existing projects at the same time.

Technical Equipment: Equipment is to be bought by each National Node or shared among WindScanner.eu ERIC partners. The Procedures for buying equipment are executed by the National Node according to its law and regulations. The overall specifications of the equipment can be set by the WindScanner.eu ERIC since performance, quality and cross use need to be coherent to the entire WindScanner community.

Staff and training: Each National Node will have to define the necessary staff to support all the activities proposed and the stakeholder's demands. They will decide about

either dedicating some personnel from their organizations or from another associated members or simply hiring new personnel to work exclusively with WindScanner activities. Staff quantity is regulated by the National Node coordinator.

The WindScanner Central Hub may provide guidance on the personnel required to offer technical training if so agreed with the National Node. The type and quality of training will be responsibility of the hub that will also indicate the staff required to set up experiments and to operate the equipment.

National Nodes will train its staff in general wind matters as they wish. However, all staff operating or analyzing data of WindScanners will receive the specific training developed by the WindScanner Central Hub and will be formally qualified.

Qualifying to be a WindScanner.eu trainer will be also required; specific qualification will be set by the WCH.

Sites selection and Measuring Campaigns: National Nodes provide sites, people and equipment to run ad-hoc campaigns as defined and coordinated jointly with the WCH. It is also its responsibility to set up the measuring campaign, starting with the necessary operational specifications and site assessment. These actions will be validated by the WCH to ensure the quality of the experiments and the standardization of operational procedures. The National Nodes can also provide this service to projects in which the National Node is actively participating, or as a service for a third party project. But in all cases, the results obtained will comply with the regulations from WCH and data treatment.

2.4.2 Involvement of stakeholders and users

The involvement of stakeholders and users will include all interest groups linked to WindScanner.eu ERIC, and will be ensured through the following:

- Provide a platform for industry representatives as well as major industry users of the infrastructure.
- Transfer the industry position on wind scanner technologies and thereby allow the industry to be represented emphasizing the importance of wind scanner technologies for European wind energy, its competitiveness and growth.
- Provide valuable input on the needs and developments in the national Wind Energy communities to guarantee

a close communication and collaboration with the European research infrastructure.

2.5 Membership and membership levels

The members for WindScanner.eu ERIC will be EU Member States named "Partner Countries". The WindScanner.eu ERIC will, at all times, have at least three Member States as members and have procedures for accepting new members. It will provide fair conditions for other EU Member States to join.

All members will have the same rights and obligations and there will be only one type of membership, although additional member types, such as observers and associated members, can be implemented by the General Assembly at a later stage. WindScanner.eu ERIC will, at any time, be open to and actively encourage to admission of new members.

Any Member State may accede thereto with the consent of two thirds of the Partner Countries in the General Assembly, upon the conditions negotiated. The conditions of accession shall be the subject of an agreement between the Partner Countries and the acceding Member State.

Upon proposition of the Board of Directors, the accessing Member State shall establish a National Node that is responsible for carrying out the scientific tasks of the WindScanner.eu ERIC in this country.

The Partner Countries are, as members, foreseen to be represented by one or more research institutions or universities being a part of the National Node in each Partner Country.

2.5.1 Membership fee

The Partner Countries will pay a yearly membership fee and provide the services agreed upon in the annual activity plan.

The yearly membership is defined in the statutes for WindScanner.eu ERIC. However, the budget - presented further below in this Business Plan - posits that each Member State in the first five years of operation will pay an annual membership fee of 40,000 EUR.

The membership of WindScanner ERIC gives the members right to get access to data and analysis generated by other members, and to get access to the range of services provided by the WCH. The membership furthermore gives voting rights in the General Assembly.

2.6 IPR management

Intellectual property rights (IPR) of results created by a university or research institution being part of a National Node, shall belong to this university or research institution.

Intellectual property rights of results created by WindScanner.eu ERIC shall belong to WindScanner.eu ERIC and shall be managed by the Board of Directors.

With respect to questions of Intellectual Property Rights, the relations between the Partner Countries, or their National Nodes, will be governed by the national legislation of the involved Partner Countries.

The IPR management of the facility follows the regulation set out in the statutes applying for WindScanner.eu ERIC.

3

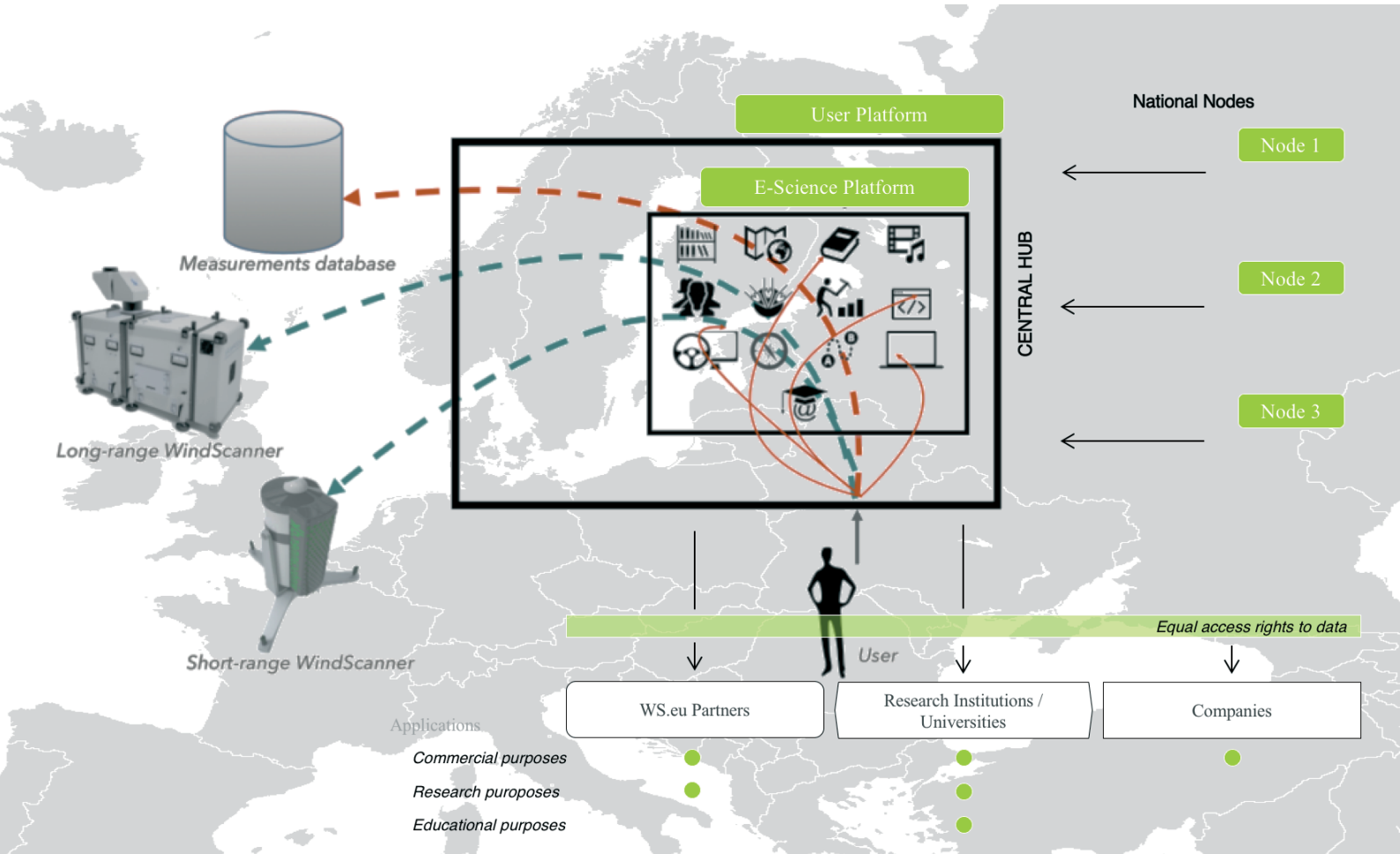
Data Management and the WindScanner e-Science and User Platform

3.1 Data Management

WindScanner Systems and other LiDAR based sensors create substantial amounts of data demanding a solid e-infrastructure that can support the entire data work-flow process: scanning, data acquisition, collection, processing and visualization, data mining and long-term preservation. In order to facilitate cutting-edge research and impact in society by enabling access to and re-use of the research data generated, extensive data consolidation and structuring is required.

The principles applied to data management in WindScanner.eu ERIC are closely assessed to be in accordance with the requirements of the EC council regulation on the Community legal framework for an ERIC. Consequently, the facility shall contribute to the mobility of knowledge within the ERA as well as the dissemination and optimisation of the results of activities in Community research, technological development and demonstration.

The platform to provide this access is the WindScanner e-Science and User Platform consisting of a database for data storage and access on one hand, **and an e-Science web service** on the other. The WindScanner e-Science and User Platform will be a part of the WindScanner Central Hub, which will provide the possibility to protect and distribute data according to different confidentiality levels etc.



Measurement data generated by WindScanners and related equipment will make use of the database provided by the research infrastructure. The purpose of the database is to secure, store and structure the data. The technical requirements are set and clearly defined such that the anticipated huge amount of data can be stored and validation procedures can be performed.

Furthermore, the WindScanner.eu database also makes sure that data are made available to users. In order to control access, various user profiles and various levels of access and rights are defined. These access rights are coupled to the profile of an identified user. Decisions about this coupling are made by the Access Committee – constituted by a core group of members with a representative from each National Node, and to be elected by the General Assembly. The Access Committee will appoint within its committee a General WindScanner Database Manager whose main responsibility is the overall WindScanner database maintenance.

The Access Committee work load is proposed to be kept limited; therefore some access levels will be predefined such that the committee only needs to approve or decline based on those, without judging on a case to case basis. In any case, the Access Committee will always have the right to decline a proposal.

3.2 WindScanner e-Science and User Platform

The WindScanner e-Science and User Platform represent one-point-of-entry for users where they can acquire necessary knowledge about the technology, have a possibility to run it and obtain access to the acquired measurements and other research data, communicate and collaborate with peers, and contribute.

Thus, the accessibility and facilitation of the technology will be met with this platform. The WindScanner Central Hub will be responsible for its development and implementation.

Building blocks

The **e-Science platform** will comprise a collection of tools accessible via a web-based application that can run on a computer, tablet or smart-phone. A short description of the tools is provided below:

Documentation repository represents an online library consisting of a collection of the essential books and journal articles, internal and external reports, posters and presentations from conferences, and logbooks from experiments.

Experiments overview comprises information where and when experiments with the WindScanners occurred, what measurements are available for the analysis and what documentation exists related to the experiments. Also, this experiment overview will contain direct links to the specific measurement databases. The platform will recognize the user and, based on that, access is provided to the database.

Live logbook is a digital version of experiment logbooks, which allows fast input of the important information during the installation and execution of the experiments.

Media gallery consists of the photos and video material from the experiments, and animations used to depicture experiments' scanning trajectories.

Discussion groups allows online discussion of the results, possible collaborations, ideas for projects, but also it is the place where early stage researchers could ask questions and get answers from more experienced researchers.

Collaborative writing is a tool that facilitates a joint work of a group of authors on publications.

Collaborative data analysis allows multiple people to work together on the data analysis. This tool connected to a well-designed measurements database will simplify data interpretation.

WindScanner simulator represents a tool for simulations of a complete measurement process of a WindScanner for different flow and atmospheric conditions. Using the simulator, experimentalists, modelers and theoreticians can inspect how the WindScanners are best suitable installed for capturing and registering wind flow and turbulence phenomena of interest.

Site assessment tools provide means to optimize positions and alignments of WindScanners for experiments using multiple constraints set by the user (i.e. available space, clear view, etc.).

Trajectory generator creates scanning trajectories for WindScanners based on the positions of the WindScanners and points of interest in the atmosphere.

Master computers with embedded software are used to facilitate synchronized space and time scanning of wind fields by steering the beams from multiple controlled WindScanners.

Code repository represents an online resource of the codes of all the existing tools.

e-Learning consists of online courses, 'how to' examples and exercises, which would help to initialize potential users to comprehend the WindScanner technology with ease.

Campaign management represents a tool for organization and management of experiments.

The **user platform** is used to facilitate the user access to the e-Science platform, WindScanners and measurements database. As such this platform serves as the bridge between the e-Science platform tools, physical instrumentation and measurements database.

The measurements database, possessing measurement data from each National Node, will be a part of the WindScanner Central Hub. The access to this database will be relevant for a range of users. Some of the potential users are presented in the Table 1.

3.2.1 Open Access

Open access is defined by the European Commission as the practice of providing on-line access to scientific information that is free of charge to the end-user.

The WindScanner e-Science and User Platform, including the database as outlined above, will be aligned with the policies on open access as set out by the European Commission to ensure the best possible dissemination of results generated by the facility. Thus, access to research data will be granted free of charge to users, where this obligation is stipulated in the terms from the funding agency that funded the generation of the specific data.

Table 1 *- WindScanner.eu ERIC database users*

User	Purpose and applications	
Scientific research		
Scientists at universities, research institutes etc.	- Wind turbine inflow and their induction zones - Wind wake interactions - Boundary layer meteorology - Testing and validation of methods and models	- Wind effects on structures - Atmospheric modelling - Wind turbine and wind farm control - Dispersion of pollutants
Commercial use		
Wind farm developers *Wind turbine manufacturers* *Wind energy supply industry* *Consultancies*	- Wake effects - Power performance of wind turbines - Prevision of inflow for feed-forward control - Rotor design, wind turbine and wind farm control	- Power production optimization - Resource assessment
Other applications		
Other usage	- Risk/safety (Turbulence, 3D wind speed) - Air traffic control	
Air pollution studies	- Wind Flow above and within urban areas - Better understanding of dispersion of pollutants	
Meteorology	- Short-term forecasting of localized extreme events (e.g. wind speed ramps)	
Civil construction industry	- Turbulence and coherence of wind approaching buildings and bridges	

Photo Credit: Lee Jay Fingersh, NREL 34979

4 Financing and budget

4.1 Cost and Funding model for WindScanner.eu ERIC – Operational Phase

The Cost and Funding model described in this Business Plan will specify the costs and funding for the operational phase of WindScanner.eu ERIC – i.e. the costs and funding involved after the creation of the ERIC legal entity, which is expected to take 2 years from October 2015. As previously described, during this 2-year period the funding model will be different and supported by Denmark, as the Central WindScanner Hub hosting country, with in-kind contributions from other Partner Countries to a set of specific activities.

The **WindScanner Central Hub** will need a physical infrastructure to host and implement its coordination, support and training services for the nodes and the user community. A building will be needed for staff offices, meeting rooms, hosting of servers. This will be financed by the host country. The operational costs for the WCH will be financed by members of WindScanner.eu ERIC.

The **National Nodes** will be funded by the individual Partner Country hosting the specific node. Some nodes will be established from existing equipment and facilities and upgraded with new equipment and infrastructure elements, while other nodes will need to establish their functional nodes mainly based on new investments in equipment, etc. The operational costs of the nodes will be financed by campaigns and measurements done for industry or in national and European projects. WindScanner.eu ERIC will add value to these investments by impacting the broader European community.

WindScanner.eu ERIC is designed to have a limited total budget in the beginning, only concerning the costs and income related to establish and operate the hub. The idea is to start small, demonstrate the added value and then grow gradually. WindScanner.eu ERIC is expected to grow and the costs for both WCH and the nodes are scalable to the actual need. The number of National Nodes will be driven by the needs in the user community, and ultimately decided by the Partner Countries in the WindScanner.eu ERIC.

The WindScanner.eu ERIC will obtain funding from a wide range of sources (see Figure 4). For the services to be provided through the WindScanner Central Hub the funding will, in the beginning, mainly be achieved by annual membership fees paid by contributions from the WindScanner.eu ERIC Partner Countries that are members of the facility. There will also be obtained minor funding from users granted access to data/services from the WindScanner e-Science and User Platform, as well as consultancy work to the National Nodes performed by the WCH secretariat. A more detailed description of these funding sources is provided in the next sub-sections.

The contributions from the Partner Countries and the users will be canalized to the WindScanner Central Hub, and not used for the research measurement campaigns to be performed in the National Nodes. Funding sources for performing the research measurement campaigns will mainly be based, as previously mentioned, on funding from national and international funding agencies, as well as on funding from European research programmes (applied by the National Nodes), such as Horizon 2020 under the European Commission.

The contributions for the WindScanner Central Hub will be used on the services provided to the National Nodes as well as on establishing, operating and developing the WindScanner e-Science and User Platform and other dissemination activities. The services, including summer schools for members, internal workshops, mobility and exchange of staff, training and education, are elements that will initially be covered by the membership and user contributions. However, the concept will be developed in a

Figure 4 *- WindScanner.eu ERIC main funding sources.*

way that the WCH will also obtain funding from arranging external workshops and conferences to users.

The cost structure of WindScanner.eu ERIC is constructed to be flexible. Hence, the size of the WCH secretariat and the range of services from the WCH will continually be adjusted according to the amount of contributions obtained from the Partner Countries, users and the consultancy work.

4.1.1 Funding from the Partner Countries

The funding from the Partner Countries is based on an annual contribution of 40,000 EUR from each Partner Country. This will ensure a significant range of services that are necessary for the National Nodes to perform excellent research with WindScanner technology and to be able to disseminate this research to society. The annual contribution will vary depending on the number of members of WindScanner.eu ERIC and will be sufficient with three Founding Members and with just one new Partner Country being a member in two, three and year four of the operational phase.

4.1.2 Funding by consultancy work by the WCH, e.g. training, summer schools etc.

The amount of consultancy work to be performed by the WCH shall at all times be aligned with the principles for

Table 2 *- Overview of the yearly costs (year 1-5) for the Board of Directors, the WCH secretariat staff and office expenses.*

WCH	**Person Months (PM)**	**Labour costs**	**Travel costs**	**Other costs**	**Total costs**
Total management costs	12	€100,000.00	€10,000.00		**€110,000.00**
Total costs of employees WCH secretariat	12	€78,000.00	€6,000.00		**€84,000.00**
Total office expenses				€70,000.00	**€70,000.00**

In addition, there will be some costs for arranging and conducting the General Assembly meetings and the Advisory Board, such as travel costs for the members of the Advisory Board, as presented in the following:

Governance	PM	Labour	Travel	Other	Total
Total governance costs			€4,000.00	€6,000.00	**€10,000.00**

commercial activities set out in the ERIC regulations.

The consultancy work covers the staff from the WCH secretariat assisting the National Nodes with the technical setup of WindScanner Systems as well as dissemination, and data analysis work for both the National Nodes and users. It is not foreseen that the consultancy activities will be very comprehensive in terms of funding but still will fill out an important task to ensure the development of WindScanner.eu ERIC.

4.1.3 Funding by granting access to data to third parties

Funding from granting access to third parties depends on the type of user requesting access and on the terms from the funding sources on potential obligations to provide the research data on open access principles to end users. Companies, universities and research institutions granted access for commercial use shall, as a rule, always pay a user fee.

The price for being granted access to commercial use of the specific measurement data will be on market terms and be paid to the National Node(s) that have performed the research measurement campaign. There will furthermore be an Administrative Fee to be paid by all users not being members of WindScanner.eu ERIC. The Administrative Fee for annual access is expected to be 5.000 EUR/year while access granted for a specific measurement data will be 500 EUR. This contribution will be a part of WindScanner.eu ERIC to be used by the WCH.

4.1.4 Yearly expenses for the operation of WindScanner.eu ERIC

The costs of WindScanner.eu ERIC are closely linked to the services performed by the WCH and especially the WCH secretariat. The main costs of the WCH are related to labour and travel costs regarding the Board of Directors and the employees at the WCH secretariat. To ensure well-balanced costs and ensure a flexible management and secretariat, the employment can be based on part time secondment of staff from the universities and research institutions of the National Nodes.

The work of the necessary IT/LiDAR specialist can be performed by varying staff – the IT specialist will do the initial work regarding the development of the WindScanner e-Science and User Platform, while the LiDAR specialist will work on supporting measurement campaigns and, on consultancy terms, assist the National Nodes with their LiDAR equipment.

Other costs to the WCH will be related, among others, to office expenses, including rental of office, hosting of website, purchase and hosting of the WindScanner e-Science and User Platform server and consultancy services for accountancy.

An overview of the WCH main costs, for the first 5 years, is presented in the Table 2.

4.2 WindScanner.eu ERIC Budget

4.2.1 Estimated budget of the WindScanner.eu ERIC – Operational Phase

The estimated budget for year 1-5 of the WindScanner.eu ERIC Operational Phase is based on the costs stated above together with the income generated by the contributions from the Partner Countries, users, arrangements held by the WCH, including external workshops and conferences, and consultancy work performed by the WCH staff towards the National Nodes and the users, among others. On that basis the total budget for WindScanner.eu ERIC will have a break-even after year five, when the initial three Partner Countries and the Partner Country being member in two, three and year four, each pays and annual contribution of EUR 40,000.

The numbers of Partner Countries being members of WindScanner.eu ERIC in the first five years have been set conservatively to ensure a realistic payment scheme. Thus, if more Partner Countries are applying for membership within the first five years the intention is to maintain the yearly contribution of EUR 40,000 but then strengthen the WCH staff and services.

The budget for year 1-5 for the WindScanner.eu ERIC Operational Phase – presented in Table 3 – does not include any purchase of WindScanner equipment in the WCH. All WindScanner equipment will be purchased, owned and operated by the National Nodes.

Table 3: *Overview of the budget for year 1-5 when each member pays an annual contribution of EUR 40,000.*

Year	Expenses	Nº of new members	Income	Balance
1	€302,000	3	€221,000	€-81,000
2	€282,000	1	€261,000	€-21,000
3	€287,000	1	€301,000	€14,000
4	€302,000	1	€341,000	€39,000
5	€287,000	0	€341,000	€54,000
Total	**€1,460,000**	**6**	**€1,465,000**	**€5,000**

The estimated budget beyond the first five years of the Operational Phase is challenging to assess based on the uncertainties relating to the number of Partner Countries being members of WindScanner.eu ERIC as well as the amount of consultancy work performed. However, the same principle will apply for this period; the yearly contribution will be maintained whereas the WCH staff and services may vary according to the income and costs.

5

Impact

WindScanner.eu ERIC will have a direct impact at three levels: 1) **scientific** – by providing unique advancements within remote sensing-based meteorological measurements; 2) **societal** – by contributing to the realization of the SET-Plan goals; and 3) **economic** – by increasing European industry competitiveness. Below, we provide a brief analysis of each of these impacts.

5.1 Scientific Impact

WindScanner technology provides a new insight into the complex wind field and turbulent features of an atmospheric boundary layer, where wind energy is being harvested. The increase in at least 3 orders of magnitude on high-quality, non-disturbed real flow cannot be replaced by any in-situ array of instruments, thus providing unique sets of real scale data on a larger volume.

Numerous CFD studies assisted by several wind tunnel scale model studies of turbine represent the state-of-the-art experimental research infrastructure to investigate turbine-wind interaction. However, none of these state-of-the art research facilities provide full 3D wind fields, in space and time measurements of the fully developed atmospheric boundary-layer flow and turbulence, embedded with large scale coherent structures and thermal stratification effects.

Attempts to measure full-scale 3D wind field structures include steerable unmanned aircrafts (UAS), tethered balloons, multiple array met-towers, and even a recent study of large scale flow structure in the wake zone of a 2.5 MW wind turbine, investigated experimentally via Particle Image Velocimetry measurement techniques during natural snowfall . Also multiple, time synchronized, but not space synchronized, wind LiDARs have recently been demonstrated to be able to measure the 3D wind velocity vector in one point in space .

Therefore, when fully operational, the new WindScanner.eu ERIC will offer attractive obvious advances of remote sensing-based meteorological measurement techniques. The results obtained will significantly increase the ability to conduct high-impact research for scientists.

From an instrumental point of view the WindScanner technology may be considered a game changer but it is still yet too soon to establish any sound metrics related to the full application of this technology.

Overall, by setting up efforts to jointly address grand scientific and technological challenges (e.g. measure and understand the three-dimensional and time varying wind field), the WindScanner.eu ERIC will work as a common platform for knowledge transfer that can reach out to both scientists and industries in different sectors, increasing the European research added-value and consolidating Europe's leading position of excellence in wind energy research.

5.1.1 Contribution to the realization of ERA

In order to create a genuine ERA, greater coordination between national and EU research activities is needed. A main objective of the **WindScanner.eu ERIC is to support the realisation of the ERA** through the reduction of fragmentation and increased coordination, in order to create a single more efficient research area where there is no unnecessary duplication of effort and where the needed critical mass is achieved at a scale unattainable solely at national level.

Furthermore, previous experience has demonstrated that there is a need for new strategic partnerships, where partners agree on common priorities and longer term strategies. The WindScanner.eu ERIC will underpin such a partnership approach focused on strategic alignment of the partners R&D efforts in this field of research and joint planning that could provide a more integrative approach to research, education and innovation activities. The creation of lasting cooperation between WindScanner.eu Partner Countries will have longer term, broader benefits with an equally important impact on the realisation of the ERA and on the implementation of a competitive and dynamic knowledge-based economy targeted by the Lisbon Strategy.

The WindScanner.eu ERIC will also be promoted together with the European Energy Research Alliance[2] (EERA) Joint Programme on Wind Energy. Before establishing the WindScanner.eu ERIC the +40 partners in EERA JP Wind will be involved in the further development of the user community, expanding the number of partners involved in the WindScanner.eu Preparatory Phase project.

The main objective of EERA is to accelerate the development of new energy technologies in support of the SET-Plan by strengthening, expanding and optimising EU energy research capabilities through **alignment, knowledge sharing, more open access to research and joint, strategic collaboration.**

The outcomes of the WindScanner.eu ERIC facility, derived from an effective joint cooperation between European countries and national research programmes, will thus contribute to the EERA objectives, promoting European research excellence in the field and contributing to the development of the European Research Area.

[2] SEC (2009) 1295. Communication from the Commission "on Investing in the Development of Low Carbon Technologies (SET-Plan) – A Technology Roadmap".

5.2 Societal Impact

The EU binding target of increasing renewables share by 20% in 2020[3] and Europe's commitments to cut the GHGs by 80-95% in 2050[4] makes wind energy an important player in the future energy mix. WindScanner.eu ERIC aims to leverage the long term European wind energy research potential, which will ultimately translate into attaining the demanding European ambitions for wind energy generation in the future (installed capacity is expected to increase by 64% in 2020 compared to 2013 levels)[5].

Moreover, the **WindScanner.eu ERIC will contribute to the realization of the SET-Plan goals** by establishing a new and truly distributed European facility that will contribute to an optimized design and operation of large-scale turbines and an effective wind farms' siting, by providing unique data on turbulent wind flow and its interaction with wind turbines. Ultimately, this will lead to better located, more efficient, stronger and lighter wind turbines, thus **reducing the cost of renewable energy,** which in turn is expected to accelerate the penetration of wind energy in the EU and increase employment in the sector, benefitting the European economy by attracting the best professionals to the world-class research and technology environment created by the new RI.

Finally, the creation of a new European Research Infrastructure will benefit all Member States by strengthening and extending cross-border cooperation and making a more efficient and effective use of national resources and capacities, overcoming the fragmentation of the European research base currently recognized as a major impediment for further European development. WindScanner.eu ERIC will, therefore, reinforce European Research Excellence, by enabling trans-national research and innovation; exploiting synergies; and strategically aligning different sources of national, European and private funds.

5.3 Economic Impact

Research and innovation play a crucial role in the sustainable growth of productivity. Europe's future economic growth and jobs will increasingly have to come from innovation in products, services and business models[6]. Due to its vital contribution to increase Europe's competitiveness, **innovation is at the core of Europe's 2020 strategy.**

Even though the European wind industry is now at a competitive stage – being established as a driver for economic growth over the next twenty years – further development cannot be left entirely to the industry, which, in the current economic climate, tends to focus on incremental improvement and further upscaling of existing concepts, whereas new concepts and innovations are needed to drive down the costs. To realize this, a **joint strategic, research effort** is needed. WindScanner.eu ERIC will help mobilizing national resources for the development of the research advancements needed to keep Europe in a global leading position.

The WindScanner.eu ERIC facility will offer open access

[3] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources.
[4] EC communicate COM/2011/112: A Roadmap for moving to a competitive low carbon economy in 2050.
[5] The European Wind Energy Association (EWEA), "Wind energy scenarios for 2020", July 2014.
[6] Commission staff working paper Impact assessment, European Commission, 2000

collaboration with all wind energy engaged atmospheric boundary-layer researchers and experimentalists, including the wind energy industry throughout Europe and Overseas. Research and spin off wind lidar products will assist wind energy integration, on and offshore, and, ultimately, help lowering the cost of wind energy.

The innovative products and services derived from WindScanner.eu RI will be disseminated and exploited throughout Europe, contributing to the creation of growth. Furthermore, implementing the RI with its Nodes distributed in different regions will certainly bring new job opportunities and perspectives for researchers, engineers, administrative and related staff in these regions as a result of increased scientific and economic activity. Jobs will be created during the implementation and operational phases, a proportion of which will be highly skilled, in connection to the establishment and build-up of the hub and the National Nodes. Therefore, WindScanner.eu ERIC RI will **spur economic development and innovation,** generating opportunities to **increase Europe's knowledge-based industry competitiveness.**

Overall, besides the major impact on the European Research Area (previously described), it is expected that Europe will benefit economically from the new WindScanner.eu ERIC. The specific economic impacts expected are summarized in the following:

- Development of instruments for specific applications – i.e. licensing deals; WindScanner.eu ERIC will foster the development and commercialization of newly developed technologies, in cooperation with industry, increasing its competitiveness;
- Reduction of loads on wind turbines – increase in units longevity, decrease in the amount of matter thus creating lighter (and cheaper) wind turbines;
- Technological edge on wind engineering helping to optimize the design and performance of equipment and structures – improve innovation and competitiveness of European wind engineering;
- Decrease on the use of Meteorological Towers – lowering the environmental impact of wind resource assessment studies – reduction on the need of spatial distributed measuring tower network, thus reducing man-power and installation set-backs related to tower mounted instruments.

5.4 WindScanner.eu ERIC measures to maximize impact

5.4.1 Dissemination and outreach

The WindScanner dissemination and outreach strategy has been delineated to ensure a high visibility of the facility and to maximize the impact of its results. Marketing of the WindScanner.eu ERIC aims to make it well known among policy makers, industry and research communities, and is of critical importance to ensure the success of the Research Infrastructure. The WindScanner Central Hub will be responsible for further development and implementation of the dissemination and outreach strategy.

The **dissemination and outreach activities** – aiming foremost to establish contacts with potential users and promote the services offered by the facility – will consist of:

- ***WindScanner Website***: as the main public interface and central entry point to information about WindScanner.eu ERIC. The WindScanner website will be managed by the WindScanner Central Hub and provide information about the objectives and status, as well as on the services offered by the facility, to any interested stakeholder.

- Networking activities: with industry and potential users to disseminate the WindScanner.eu ERIC; networking with other Research Infrastructures and EU representatives in order to ensure that synergies are exploited and overlaps avoided;
- Visits to the WindScanners: invite potential users to see the WindScanners used in experimental measurements; the WCH will also facilitate visits in connection to specific campaigns.
- Conferences and publications: the results obtained will be disseminated at international conferences and publications in scientific journals.
- Workshops: including one workshop for modelers, where modelers will be invited to test their models with data from experimental measurement campaigns, etc. See also 5.4.2.
- Newsletters, Social and Popular media: spread of the WindScanner.eu ERIC and of the facility goals/results in newsletters and websites. Furthermore, the WindScanner Central Hub will make use of other media – including blogs (tumblr) – to disseminate the activities when doing campaigns, to interact and to receive feedback.

In summary, the WindScanner Central Hub will maintain a dialogue with stakeholders (e.g. users, funding agencies) and will be the reference point for communication with the European Union and other international organizations, as well as for the establishment of cooperation agreements.

5.4.2 Education and training

The WindScanner.eu ERIC will organize a number of activities aiming at disseminating and facilitating **knowledge exchange and transfer** towards all users, researchers / Ph.D's and Partner Countries. The training strategy focuses, therefore, both on current and future users (Master and Ph.D. students, post-graduates, senior scientists, technicians) as well as on staff of the WindScanner Nodes across Europe.

In specific, and since the users lack specific technology knowledge, the WindScanner.eu ERIC will offer education and training to technicians and researchers regarding the operation of the WindScanner Systems owned by each node (through summer schools, exchange courses, etc.), as well as training, information, and technical support on the available services and other equipment owned by each node. These activities – provided by highly specialized staff – aim to optimize and make the best use of the equipment and generated data.

Additionally, educational training activities (MSc and Ph.D. level) will be offered, including tailor-made classes/courses based on the needs of the community. National Nodes are the ideal places to provide such classes, since they provide direct access to the WindScanner systems, supporting scientific and technological expert personnel, teaching and training. However, in the initial phase, this will be planned and implemented via the WindScanner Central Hub, as part of the existing Remote Sensing Summer School.

The WindScanner.eu ERIC will dedicate a section of its website to training and education.

For quality control purposes, data on performance, effectiveness and impact of WindScanner education and training activities will be collected from participants in order to produce assessment reports.

5.4.3 Link to other existing or planned Research Infrastructures and European projects

The WindScanner.eu ERIC will develop collaborations with other RIs to foster interoperability and explore complementarities, thus contributing to a comprehensive European RI service provision. Examples of activities that can be implemented as part of these collaborations include: coordination of knowledge transfer activities; sharing procedures, databases; joint organization of workshops and events; among others.

The WindScanner.eu ERIC will also liaise with international and national projects within wind energy and related areas of the wind sector, to further strengthen its know-how and enhance the Infrastructure impact at a global level. It will be particularly relevant to create synergies and establish a positive dialogue and exchange of experiences with ongoing or recently finished projects in this area. WindScanner.eu ERIC will mainly benefit from the interaction with the activities in which the Partner Countries' organizations are engaged in.

5.5 Quality management and key performance indicators (KPIs)

The WindScanner.eu ERIC will establish and apply a set of quality management tools at the Central Hub and all Nodes to maintain, standardize and optimize services. WindScanner Nodes will be submitted to regular quality checks – including the evaluation of yearly activity plans and the roadmap of future measurement campaigns; Nodes that do not meet minimum quality levels will be guided through a service improvement process.

The overall progress of the WindScanner will be monitored and reviewed through a set of key performance indicators, easy to use and communicate to decision makers and public. This assessment will be facilitated by a quality control tool at the WindScanner web portal. This will be a fundamental tool to collect performance evaluation data from the users' community, such as users' satisfaction, amount and quality of publications, and other key performance indicators such as research grants in which access to WindScanner.eu is mentioned or acknowledged. Users will be required to complete an on-line satisfaction survey after each project. The quality control tool will also provide templates for acknowledging WindScanner.eu and will also automatically

remind the users about notifying WindScanner.eu when the performed work has been published and/or exploited.

The operational progress of the WindScanner.eu ERIC will be assessed phase by phase based on performance indicators for science, users, and industrial applications, as summarized in appendix 1, to improve quality use working procedures and standardize/harmonize the approach. The impact of the WindScanner.eu ERIC is expected to increase over time. In case it fails to show the expected impact for any specific indicator, an action must then be taken.

Targets for the different KPIs will be identified for what constitutes the quantitative measure of success in the different phases of the research infrastructure. Once the targets are defined to monitor and assess the project success, credible external reviews of the technical, financial and recruiting-related aspects of the project will be performed.

5.6 Risk management

Potential risks associated with the WindScanner.eu ERIC construction/implementation and operational phases were identified in order to develop an adequate contingency plan.

Given the solid organizational and governance structure (described in section 2), it is unlikely that the implementation and operational phases of WindScanner.eu ERIC will entail any major/critical risk or deviation. If any risk happens to be identified, the Director (heading the Board of Directors) will ensure that the adequate contingency plan is put in practice, including alternative financial and technical options.

The General Assembly, together with the WindScanner.eu ERIC Director, will use the Risk Mitigation, Monitoring and Management (RMMM) method to identify risks which require special attention. This method aims at targeting and solving any potential risk before it becomes a problem. The Director will then take actions according to the contingency plan. The WindScanner.eu ERIC risk management procedure will be subject to external validation and review during the implementation phase and should avoid both disruptions to plans and cost escalations.

A rank of the main risks based on likelihood and impact is presented in annex 2 and the respective mitigation measures will guide the Consortium on how to react in the unlikely event that any of the risks become reality.

As previously mentioned, WindScanner.eu aims at becoming a high-class quality research infrastructure by providing open and transparent access to wind energy technologies and state-of-the-art equipment; by offering leading expertise; and by having a structured and solid governance model in place together with an effective quality management. Therefore, in addition to risk management, we have also outlined a strategy to guarantee that quality aspects of the project are met and regularly monitored (see section 5.5).

6

The way forward - towards implementation of WindScanner.eu ERIC

6.1 Status 1st October 2015

The present Business Plan is describing the business model for the realization of WindScanner.eu ERIC as a ERIC that all current partners agree to. However, at the point of finalization of the Preparatory Phase (September 2015) sufficient national funding has not been achieved in order to start the establishment of the ERIC.

The establishing of the ERIC is expected to happen early 2017, the earliest.

Hence, intermediate steps have been agreed upon in order not to lose momentum in the interim phase between the finalization of the Preparatory Phase, and the establishment of the ERIC. The partners have agreed on a framework for involvement of the scientific and industrial community based on the already established EERA Joint Programme (JP) on Wind Energy, where all the present partners are members.

Utilizing the EERA framework will not only provide a familiar and proven effective governance structure, but it will also serve as a way of expanding the number of partners involved among the more than 40 members in the EERA JP Wind from currently 13 different Member States.

The interim phase can be seen as having two phases starting with a phase based on voluntary collaboration in the framework of EERA. This will next be supplemented by a more targeted "Implementation Phase" focusing on the final steps towards establishing an ERIC and gradually starting specific hub activities.

An illustration of the different phases can be seen in the figure on the right.

2012-2015
WindScanner.eu Preparatory Phase

2015-2016/17
WindScanner EERA Alliance

2016-17
Implementation phase

1) Targeted ERIC preparation
Developing, applying and esablishing the ERIC

2) Start-up Hub
Pilot Activities
e-Science and User Platform
Pilot activities

2017-18
WindScanner ERIC established

for the interim phase and an activity plan for 2016 will be decided upon.

6.2 Governance structure in the Interim Phase

An interim governance structure will be put in place in order to ensure a uniform approach and the European added value. All partners have agreed to sign a MoU, where they state their intention to carry on with the work in order to establish WindScanner.eu ERIC in the framework of EERA and to take part in an Interim General Assembly (GA). Members States will be invited to the meetings of the Interim GA in order to ensure timely preparation of the statues of the ERIC and approve a yearly activity plan. The first interim GA is expected to take place in early 2016, where a strategy for the interim phase and an activity plan for 2016 will be decided upon.

6.3 Status on national commitments – 1st October 2015

WindScanner.eu is on the current national road map in Denmark (since 2011), which is currently being updated. The publication of the next Danish Roadmap for Research Infrastructures will happen by the end of 2015. Included in this exercise is the proposal on the Danish contribution to WindScanner.eu, including Denmark hosting the hub of WindScanner.eu (and its preparation). If successful, then the collaboration in the interim phase will be stepped up as indicated in the description of the different phases. WindScanner.pt has been on the Portuguese Roadmap since 2014. In Greece and Norway there is an ongoing road map process in which WindScanner.eu is also considered. In the Netherlands, work is being done on an application on purchasing equipment which will constitute the basis for the establishment of WindScanner.nl. In Germany, a national road map is currently not an option as the minimum amount to merit consideration is very high. However, Germany has already invested substantially in WindScanner equipment.

6.4 WindScanner.eu pilot actions

In connection to the Preparatory Phase project two joint WindScanner Pilot Measurement Campaigns were planned and implemented in order to "learn by doing", and synchronized scanning with WindScanners owned by DTU, FORWind Oldenburg and Fraunhofer IWES was demonstrated in an experiment in Kassel, Germany. During the summer of 2015 another WindScanner Pilot measuring campaign was performed in Portugal. These pilots have been essential in terms of demonstrating the pan-European and international potential of the research infrastructure. It is the intent that such joint, European measurement campaigns will continue so that the capability of the infrastructure is tested and demonstrated. The next large-scale European experiments using WindScanners is already being planned to take place in Rödeserberg, Germany in 2016 and in Perdigao, Portugal in 2017 as part of the ambitious project to develop the New European Wind Atlas.

Professor Torben Krogh Mikkelsen, DTU Wind Energy

7

Abbreviations and glossary

CoE	*Cost of Energy*
EERA	*European Energy Research Allicance*
ERA	*European Research Area*
ERIC	*European Research Infrastructure Consortium*
EWEA	*European Wind Energy Association*
GA	*General Assembly*
GW	*Gigawatt*
IPR	*Intellectual Property Rights*
JP	*Joint Programme*
KPI	*Key Performance indicators*
LiDARs	*Light Detection and Ranging*
PM	*Person Months*
PP	*Preparation phase*
R&I	*Research and Innovation*
RMMM	*Risk mitigation, monitoring and management*
SET•plan	*Strategic Energy Technology Plan*
TNA	*Trans-national access*
TWh	*Terawatt-hours*
UAS	*Unmanned aircrafts*
WCH	*WindScanner Central Hub*

8

Appendixes

Appendix 1 - Key Performance Indicators (KPIs)

A key performance indicator (KPI) is a business metric used to evaluate factors that are crucial to the success of WindScanner.eu ERIC. KPIs are per year and not accumulated and shall be an integer amount.

A. Overall - Level of pan-European distribution

KPI Name	KPI Description	Target Value				
		2017	2018	2019	2020	2021
General - Members	Number of WindScanner.eu ERIC members	3	4	5	6	6

B. Usage – Involvement in research in the wind energy field in Europe

KPI Name	KPI Description	Target Value				
		2017	2018	2019	2020	2021
User access to data	No. of users granted access to data from the WindScanner e-Science and User Platform	40	60	80	100	120
Certified WindScanner Operators	No. of participants being trained as Certified WindScanner Operators	12	6	9	12	12
Usage of WindScanners	Number of national and European research projects using WindScanners	8	10	12	15	20

C. Excellence - Level of collaborative research publications and Conference contributions at International and European level due to the joint work at the WindScanner.

KPI Name	KPI Description	Target Value				
		2017	2018	2019	2020	2021
Excellence – Consortium	Scientific Publications related to the WindScanner facility	4	6	8	10	20
Excellence – International	No. of publications with international scientists	2	3	4	5	8
Excellence – Projects	Number of national and European research projects using WindScanner generated data	5	10	15	20	25
Excellence - Conferences	Contribution to international recognized conferences	5	8	13	17	20

D. Impact – Significance of WindScanner.eu ERIC on innovation and industrial exploitation.

KPI Name	KPI Description	Target Value				
		2017	2018	2019	2020	2021
Impact - PhD	No. of PhD thesis and post-doctoral programmes/ citations related to WindScanner	1	2	5	8	12
Impact - IPR	No. of patents and licenses based on the work of WindScanner	0	0	2	3	4
Impact - Industry	No. of industrial users and projects with industrial cooperation	2	2	3	5	8

Appendix 2 - Critical risks for the implementation of the WindScanner.eu ERIC.

The Risk Level (**RL**) is defined as Likelihood (**L**) of a Risk multiplied by the Impact (**I**) - or Consequence - of the Risk. The risk table below is sorted according to the Risk Level.

Description of risk	L (1-10)	I (1-10)	RL (1-100)	Proposed risk-mitigation measures
Insufficient financial commitment and interest from countries during the Construction Phase	4	8	32	Close dialogue with respective ministries in participating countries and for coordinator. The use of in-kind contributions in initial phase and cost –share model for national nodes. The coordinator will seek to have national funding for Hub operation until Intermediate phase is complete and possible European funding will be sought.
A budget shortfall from one or more Partner Countries during Operational Phase	4	6	24	Commitment by contributing nations will be done through agreements with funding nations. An operative board of directors will oversee the operation.
WindScanner.eu ERIC Business Plan relies on EU funding	8	3	24	In the initial phase of WindScanner.eu the setup of the infrastructure to come into operations will rely on funding. After the 3 initial years, a sustaining model using only funding from national nodes will be used and strict financial control will be done through daily management and oversight by the Board of Directors.
Conflicts within the WindScanner.eu ERIC	3	5	15	Two modes are envisaged to mitigate this: communication and sound formal statutes. Transparency and a good communication flow between the WindScanner.eu Board of Directors and the coordinators of the National Nodes will be key to avoid problems and conflicts before they arise.
Insufficient operation of each National Node, not only regarding support to Hub.	3	5	15	This is regulated by the statutes and will be governed by the General Assembly to ensure the continuous commitment and obligations from the national nodes. A key element in capacitating the national nodes will be the training of personnel, growing the actual number of technicians, engineers and scientists with this new technology.
Differences in national guidelines and regulations regarding the implementation of the infrastructures	6	2	12	Timely preparation of partnership agreements and use of common statutes.
New technology developments will make the WindScanners obsolete	3	4	12	WindScanner.eu ERIC develops continuously as an agile research facility partly based on own-generated improved technology and also via continuously adopting new technologies as they emerge in the science field to ensure that WindScanner.eu continue to stay on top regarding excellence in research for its 3D wind and turbulence scanning-based investigations
Disagreement regarding the IPR policy to be followed	2	4	8	External IPR expertise and advice will be sought and expertise from other ERICs will be studied.
Perceived lack of benefit from being partner of the central hub	2	4	8	The WindScanner.eu ERIC will create added value by focusing on continuously improving the dissemination of the WindScanner technology and operation and to organize the large coordinated measurement campaigns with the mobile, distributed facility.
Difficulties in finding a suitable governance and legal structure	3	2	6	External expertise and legal advice will be sought in addition to follow published ERIC guidelines by the European Commision.
Delays in manufacturing and installation procedures	5	1	5	The experience already shared in the preparatory phase allows nodes to base its learning on experiences gathered. A joint training program and use of similar equipment will ensure joint experience and learning among the national nodes. Equipment share among nodes are made possible through this model
Industry reluctant to take on a role in WindScanner.eu	1	4	4	Integration of wind energy industry in the WindScanner.eu activities early on. Continuing the strong efforts ongoing already dedicated to the dissemination of WindScanner.eu benefits for industry as well. Creation of a Committee to seek dialogue with industry.
Low, or slow, users' engagement from the wind energy community	1	2	2	The WindScanner.eu Partners already represent a broad community of users from the energy sector. The extensive Partners' networks will also be used to recruit external users for the WindScanner.eu services. WindScanner will seek to participate in a number of dissemination events, including relevant conferences.

WindScanner.eu