

IEA Wind TCP Task 32

Wind lidar for wind energy applications

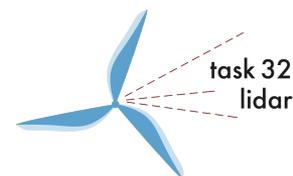


Workshop on the future of the Task (2022-25)

Andy Clifton, David Schlipf, Julia Gottschall · 04 August 2021

www.iea-wind.org/task32

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Today's agenda

:02	Welcome
:04	Presentation of the new Task 32 concept
:15	Q&A
:20	Breakout rooms – tell us your opinions
:40	Summary of feedback (from room moderators) and next steps



Dr. Andrew Clifton
University of Stuttgart

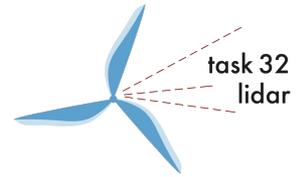


Prof. Dr. David Schlipf
University of Flensburg

Dr. Julia Gottschall
Fraunhofer IWES



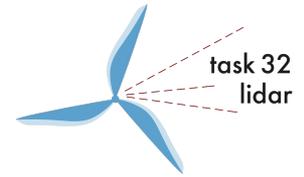
Where we are today



**Vertical-profiling lidar
are replacing 5-10%
of masts for resource
assessment and
operational plants**

[Ryan Duffy on Unsplash](#)

Where we are today



Floating lidar have almost completely replaced masts offshore



Photo from AXYS Technologies via NREL

Where we are today

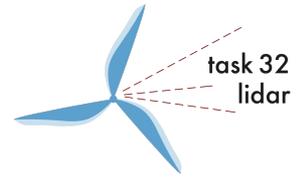
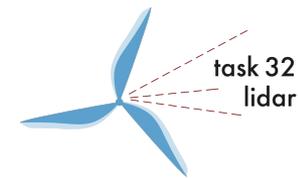


Photo by Dennis Schroeder / NREL

The 2021 lidar market

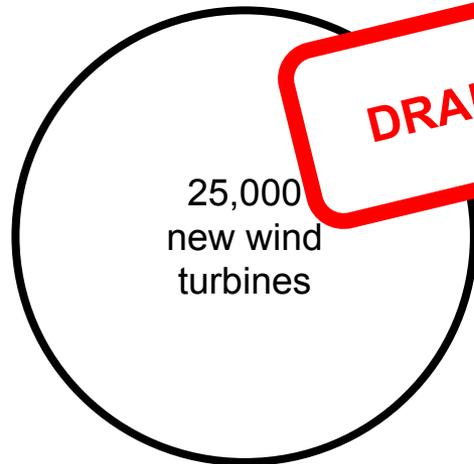


How many wind lidar are sold each year?

Numbers shown here are indicative and based on freely-available news or marketing information

300,000 installed turbines

DRAFT



New lidar for 0.1% of installed turbines

300

Lidar on 1% of new turbines

250

Lidar replacing 10% masts in Europe & N. America, and also mobile units

300

10% using lidar

100

100% using wind lidar

50

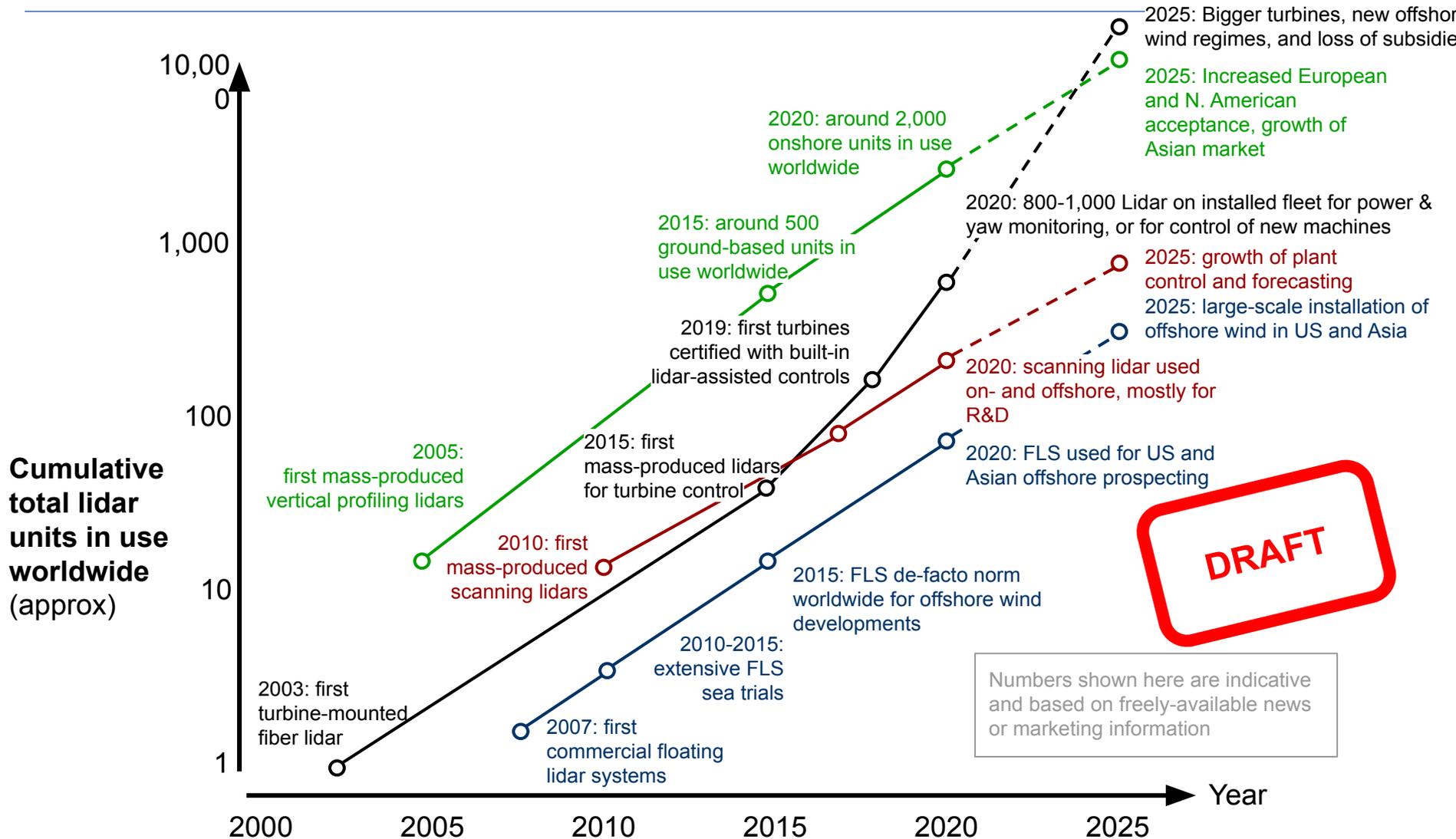
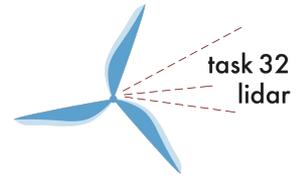
100% using wind lidar

10

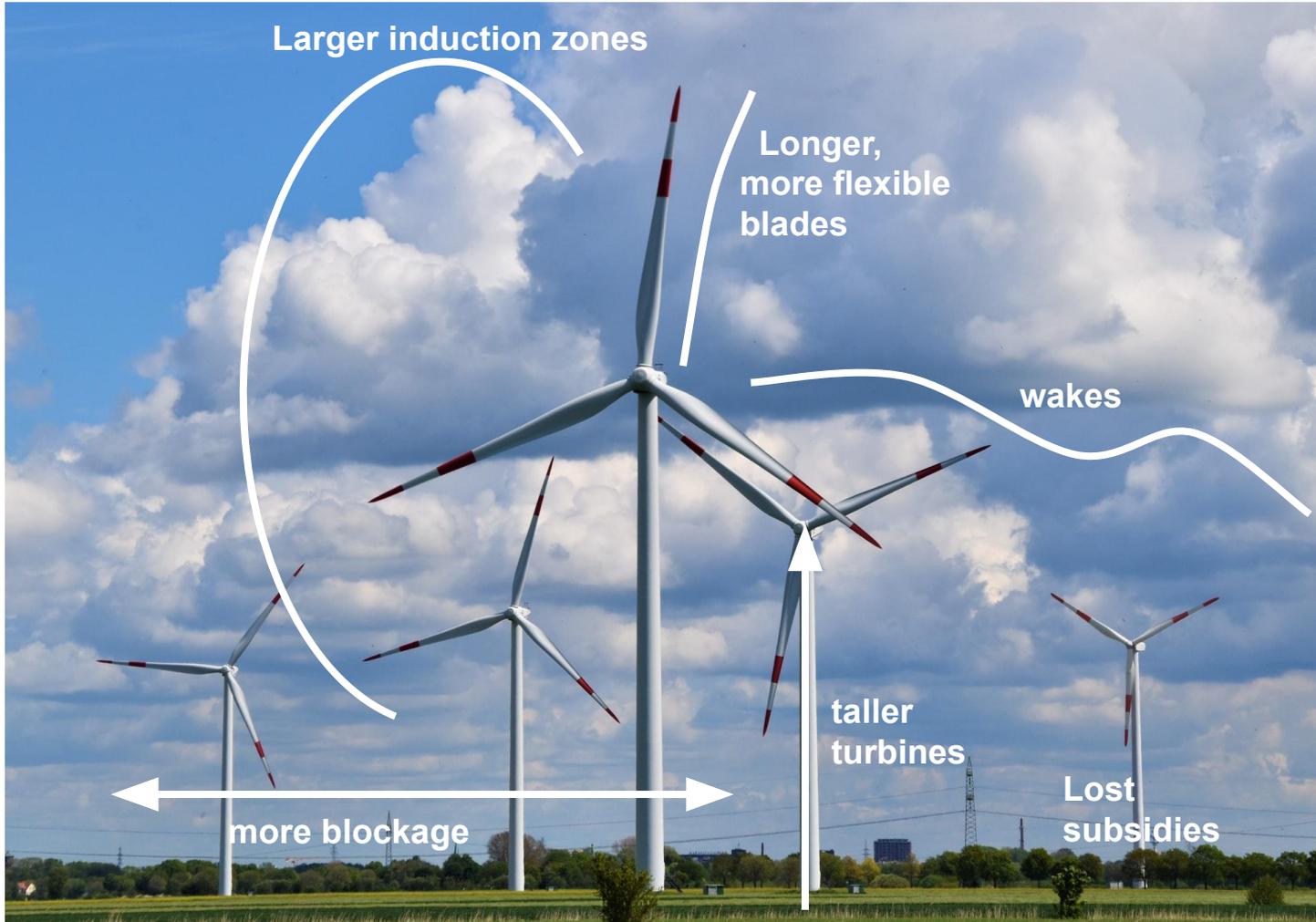
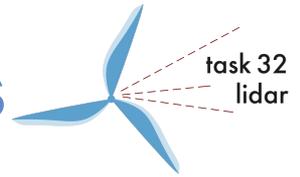
Lidar units

Around 1,000 new lidar units sold **annually** for all applications, worldwide

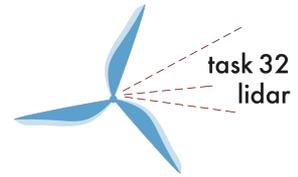
The wind lidar fleet is growing



Modern wind farms need new methods



More lidar mean new questions

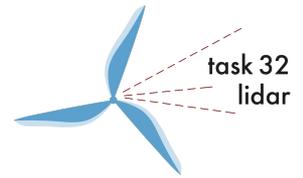


We need to build, install, and operate 5x as many lidar in 5 years time

- How do we transfer our expertise from met masts and anemometers, to lidars?
- How do we simplify lidar?
- How do we better use lidar?

Our current phase ends this year, but the need for a Task is still there. What should we be doing next?

The next phase: 2021-2025



How do we make the wind plants of tomorrow possible?



Photo by [Nicholas Doherty](#) on [Unsplash](#)

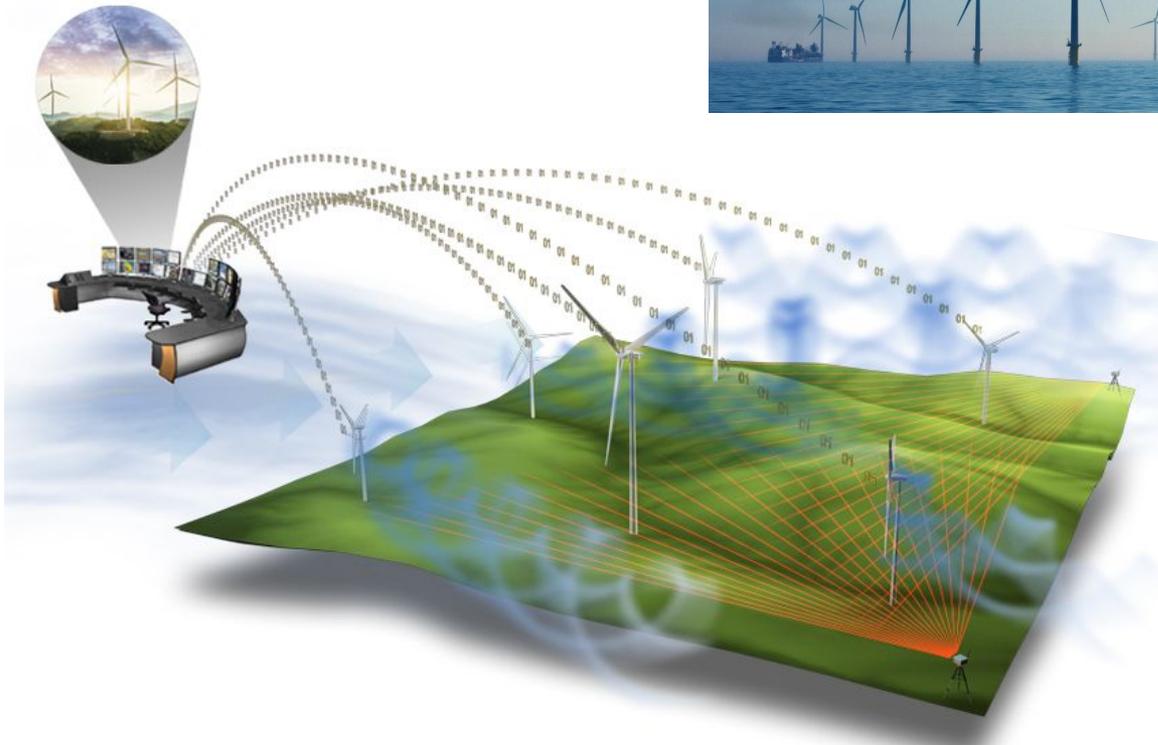
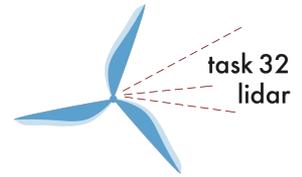


Illustration by Josh Bauer, NREL.
From NREL/TP-5000-68123 (2017)

Updating the Operating Agents



Dr. Andrew Clifton
University of Stuttgart

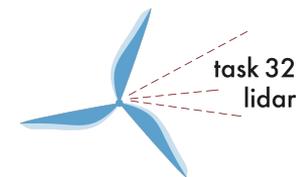


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A new Task 32 strategy



Mission

Task 32 members work together on research to make wind lidar the best and preferred wind measurement tool for wind energy applications.

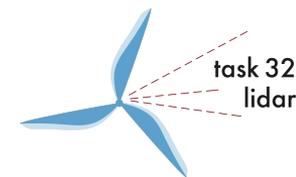
Vision

Using wind lidar will be easy. It will bring advantages and opportunities that enable the deployment of wind energy.

Values

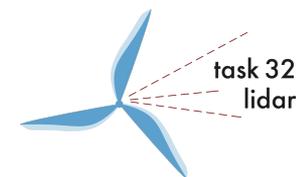
Innovation, inclusion, diversity, cooperation, and openness.

Goals & deliverables



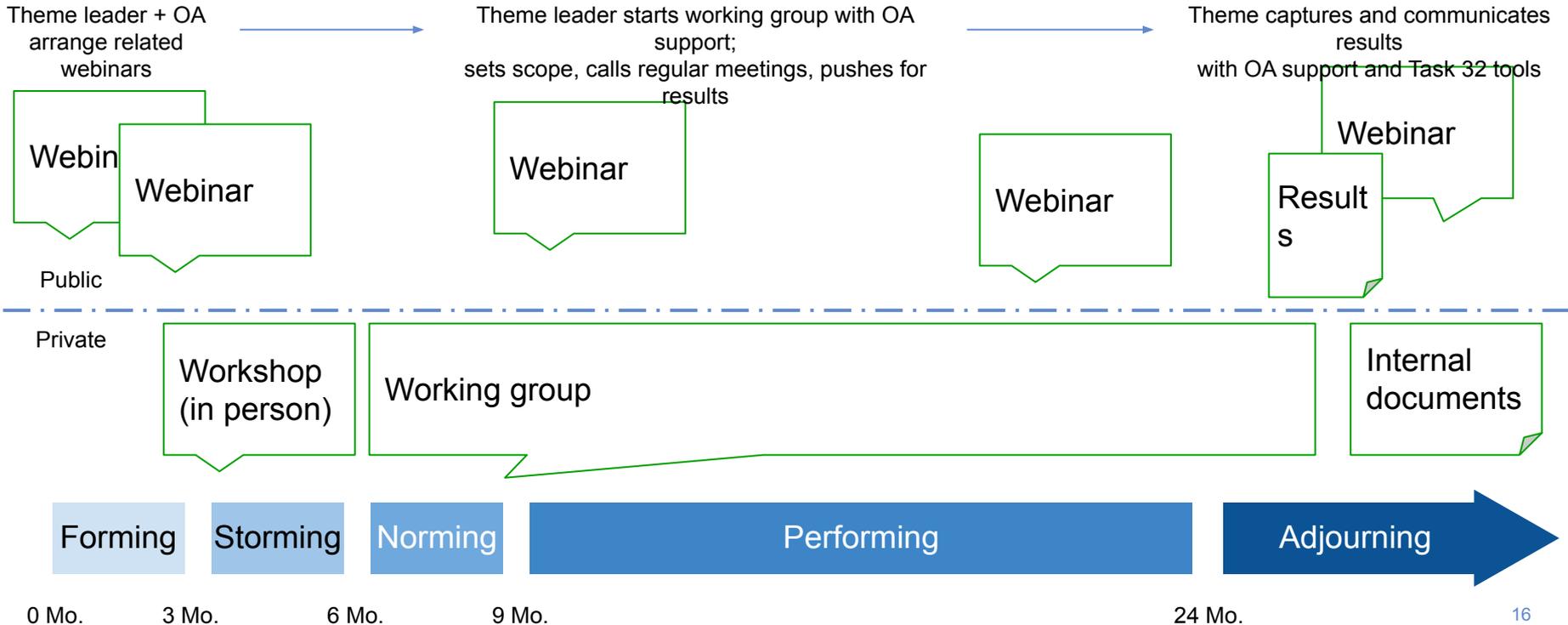
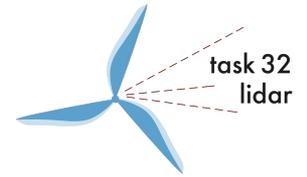
	Theme	Mission	Deliverables
1.	Universal inflow characterisation	Working towards tools and methodologies to get and use the best information about inflow conditions to any wind turbine, anywhere.	
2.	Replacing met masts	Creating guidelines for the selection and use of different types of wind lidar and software for site assessment	
3.	Connecting wind lidar	Helping users to improve measurements and extract value from their lidar(s) and data by making lidar data FAIR. Enable them to connect to an ecosystem of service providers.	
4.	Accelerating offshore wind deployment	Promoting wind lidar as a key enabling technology throughout the offshore wind project lifecycle	

Goals & deliverables

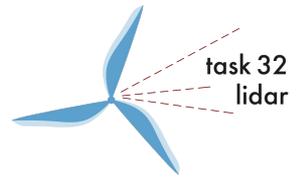


	Theme	Mission	Deliverables (ideas - TBC)
1.	Universal inflow characterisation	Working towards tools and methodologies to get and use the best information about inflow conditions to any wind turbine, anywhere.	<ol style="list-style-type: none"> 1. RP for lidar-assisted controls 2. Expert Report addressing further applications (load verification, TI focus, ...)
2.	Replacing met masts	Creating guidelines for the selection and use of different types of wind lidar and software for site assessment	<ol style="list-style-type: none"> 1. Share-X exercise with CFARS to compare results from different complex terrain correction methods
3.	Connecting wind lidar	Helping users to improve measurements and extract value from their lidar(s) and data by making lidar data FAIR. Enable them to connect to an ecosystem of service providers.	<ol style="list-style-type: none"> 1. Extend the e-wind lidar common data format to work with Task 43's wind resource data model 2. OpenLidar modular wind lidar architecture and wind lidar ontology
4.	Accelerating offshore wind deployment	Promoting wind lidar as a key enabling technology throughout the offshore wind project lifecycle	<ol style="list-style-type: none"> 1. RP for the application of scanning lidars 2. Continuation of work on floating lidars (?)

Task format



Task 32 has a powerful brand



Regular events with 60 attendees

30 publications in 2020 and 2021



IEA Wind Task 32 webinar summary
Approaches in filtering data from pulsed wind lidar

Authors: Leonardo Alcayaga, Rogier Floors, Pedro Santos, Editor: Andrew Clifton

Can more of a pulsed wind lidar's output data be used to get more accurate results and increased coverage?

This is a summary of the "Filtering lidar data" webinar given by Rogier Floors and Leonardo Alcayaga on 7 April 2020 in the IEA Wind Task 32 webinar series. It represents the authors' opinions.

Wind lidar and other wind measurement devices often report a range of data metrics in the output files. It is sometimes tempting to use these data as filters. One metric often used for filtering is the Carrier-to-noise ratio (CNR). The CNR of a pulsed lidar indicates the relative strength of the signal versus background noise. It depends, among other things, on the backscatter properties of the atmosphere, the range, and the strength of the laser used in the lidar device [1]. Therefore, care must be taken to select appropriate CNR levels and not systematically exclude data.

This paper has two main threads. Firstly, the authors outline the effect of data selection on the wind climatology using ground-based profiling pulsed lidars, and how this might be mitigated. And, they present a way to achieve better spatial coverage by applying a filtering algorithm that uses several metrics.

How to determine wind climatology from profiling lidar

Wind climatologies are sensitive to data availability. Therefore the choice of CNR threshold for 10-minute mean wind speeds can impact the wind climatology.

Data collected at the FINO3 platform in the North Sea was recently used to quantify this effect [2]. When the Carrier-to-Noise-Ratio (CNR) threshold value is increased, the wind speed distribution is shifted to higher values (Fig. 1).

The factory setting of the CNR threshold for this long-range lidar was -35 dB. The data availability from this CNR threshold gives the lowest annual mean wind speed estimate using the range gate at 126 m. The mean wind speed increases to $\approx 13 \text{ m s}^{-1}$ when the filtering threshold is set to -17 dB. The mean wind from the cup anemometer measured at 90 m shows very similar increase, showing that the bias is induced by the lidar, but is a consequence of data availability. Finally, filtering by requiring that data at a CNR threshold at all range gates from 100 m to 626 m results in an even stronger effect, because fulfil this criterion at all heights are rare.

This effect of CNR threshold on data served for both short- and long-range vertical and for scanning lidars (see Fig. 10 in [2] or presentation [3] for more examples). This is described here as hard to detect from e.g. a comparison between a lidar and a met met cup anemometer; there may be a perfect between the two, but the climatological at the same location can still be different with arguments do not cover 100% of the pe because lower CNR values apparently of lower wind speeds. The physical mechanism correlation was not investigated, but it w data collected in Germany, Denmark, and [3] or the publication [2].

For more information see the webinar [3] or the publication [2].

IEA Wind Task 32
Webinar summary

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zenodo

June 25, 2020

Working paper | Open Access

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Communities: IEA Wind Task 32: Wind Lidar

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IEA Wind Task 32 - LIDAR

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Identifying and mitigating barriers to the adoption of wind lidar for wind energy applications

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Task 32 brings together researchers and industry to identify and mitigate the barriers to the adoption of wind lidar for wind energy applications

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Want to know more about what #ieawindtask32 does and how you can get involved? Join us Monday morning (21. Sept) at 11:00 Berlin time for an overview. Still a few seats free!

https://lnkd.in/d/vjq9D7

Messaging

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iea wind task 32 lidar

Dear Andrew Clifton,

It is our pleasure to invite you to the next IEA Wind Task 32 workshop:

Workshop #13: Floating Lidar Follow-up

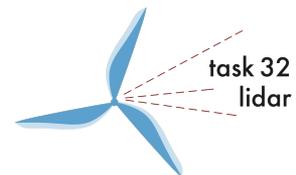
The main objective of IEA Wind Task 32 Phase 2 is to identify and mitigate the barriers to the use of lidar technology in wind energy applications such as site assessment, power performance, loads and control, and complex flow. For each of these applications areas dedicated workshops are organized, each on one specific problem, with a well-defined program and a tangible outcome.

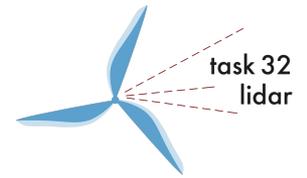
500 people on our mailing list

We'd like your feedback
on our ideas

Today's agenda

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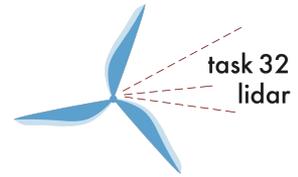




1: Universal Inflow Characterisation

An example of how the breakout rooms will work

Theme 1: Universal Inflow Characterisation



How can we make the vision more attractive and relevant?

Mission

Working towards tools and methodologies to get and use the best information about inflow conditions to any wind turbine and any wind farm, using lidar and other sensors. **We need to add more details in separate text.**

What are meaningful and achievable deliverables? Why? How could we achieve them?

Deliverables

1. RP for lidar-assisted controls

Why? Meaningful: LAC large market, increasing interest. Achievable: motivated participants.

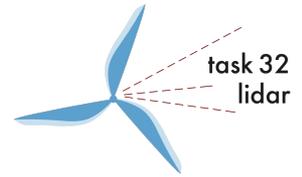
How? Form a working group and get started!

2. Working group/Workshop on inflow characterisation resulting in guidelines e.g. for TI measurement

Why? Industry need and current research

How? Organize a working group

Theme 1: Universal inflow characterisation



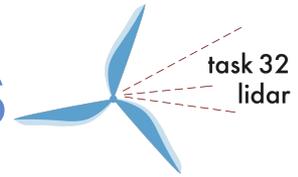
POTENTIAL PARTICIPANTS

Country /Organisation	Topic
.. /

RELATED RESEARCH AND OTHER ACTIVITIES

Country /Organisation	Topic
.. /

Choose your breakout rooms



1. Click **Breakout Rooms**  in your meeting controls.

This will display the list of open breakout rooms created by the host.

2. Hover your pointer over the number to the right of breakout room you wish to join, click **Join**, then confirm by clicking **Join**.

3. Repeat as necessary to join other breakout rooms, or click **Leave Room** to return to the main session.

Room	Theme
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1.	Universal inflow characterisation
----	--

2.	Replacing met masts
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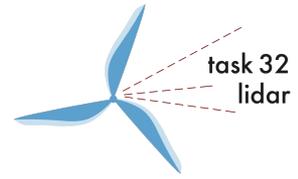
3.	Connecting wind lidar
----	------------------------------

4.	Accelerating offshore wind deployment
----	--

2: Replacing met masts

Theme 2:

Replacing met masts



How can we make the vision more attractive and relevant?

Mission

Creating guidelines for the selection and use of different types of wind lidar and software for site assessment.

What are meaningful and achievable deliverables? Why? How could we achieve them?

Deliverables (ideas - TBC)

1. Share-X exercise with CFARS to compare results from different complex terrain correction methods

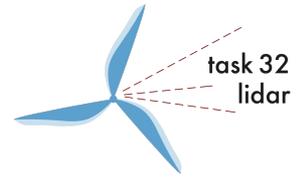
Why?

How?

Stand-alone use of lidar in highly complex terrain → benchmark of correction methods (cf. CFARS / alignment!) → develop standard (more statements / position / some agreement within industry)

Also focus on site suitability (turbulence?) + involve more turbine manufacturerere

Theme 2: Replacing met masts



POTENTIAL PARTICIPANTS

Country /Organisation	Topic
.. /

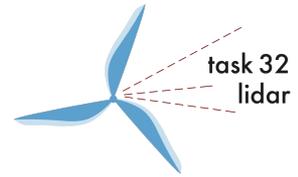
RELATED RESEARCH AND OTHER ACTIVITIES

Country /Organisation	Topic
.. /

3: Connecting wind lidar

Theme 3:

Connecting wind lidar



How can we make the vision more attractive and relevant?

Mission

Helping users to improve measurements and extract value from their lidar(s) and data by making lidar data FAIR. Enable them to connect to an ecosystem of service providers.

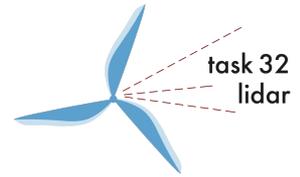
What are meaningful and achievable deliverables? Why? How could we achieve them?

Deliverables (ideas - TBC)

1. Extend the e-wind lidar common data format to work with Task 43's wind resource data model
Why? Ability to create flexible, modular, data processing workflows that combine best-in-class solutions from multiple vendors
How? Demonstration Python / Jupyter notebook
2. OpenLidar modular wind lidar architecture
Why? Ability to collaborate on lidar system design and operation
How? Working group with results captured in SKOS / RDF format (WG already started 2021)
3. Wind Lidar ontology
Why? Common vocabulary / glossary for all wind lidar users to reduce uncertainty and help newbies
How? Working group with results captured in SKOS / RDF format (WG already started 2021)

Theme 3:

Connecting wind lidar



POTENTIAL PARTICIPANTS

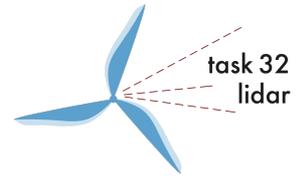
Country /Organisation	Topic
DE / USTUTT	Wind lidar ontology
EU / COST PROBE	Common data format

RELATED RESEARCH AND OTHER ACTIVITIES

Country /Organisation	Topic
DE / USTUTT	Wind lidar ontology (LIKE project)
IEA Wind Task 43	
CFARS	
EU / COST PROBE	Common data format / data processing

4: Accelerating offshore wind deployment

Theme 4: Accelerating offshore wind deployment



How can we make the vision more attractive and relevant?

Mission

Promoting wind lidar as a key enabling technology throughout the offshore wind project lifecycle

What are meaningful and achievable deliverables? Why? How could we achieve them?

Deliverables (ideas - TBC)

1. RP for the application of scanning lidars

Why? Important document, but broad

How? Start with application-independent issues (pointing accuracy, mapping, Dual-Doppler, best-practices for setup, commissioning, monitoring,...)

2. Continuation of work on floating lidars

Why? Motion compensation and TI parameter still a gap

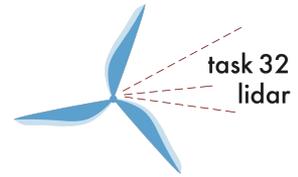
How? High frequency data from floating lidar systems

3. Nacelle lidars offshore

Why? Space for improvements for nacelle lidars offshore (power performance, load verification, ...)

How? Share experiences with

Theme 4: Accelerating offshore wind deployment



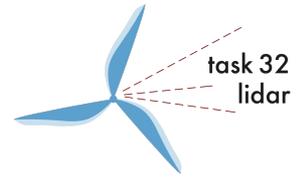
POTENTIAL PARTICIPANTS

Country /Organisation	Topic
.. /

RELATED RESEARCH AND OTHER ACTIVITIES

Country /Organisation	Topic
.. /
UK/OWA	OWA connections with Task 32
NO/UiB	Motion correction topics + Train2Wind PhD project

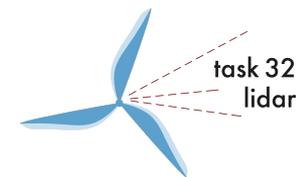
Next Steps



- Consolidate feedback from workshops in July and August
- Task 32 strategy update in August / September
- Task proposal to IEA Wind in October
- New phase starting in January 2021

[Please complete our survey](#)

Get in touch with Task 32



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