Fraunhofer UK

Eurogia Pitch, Paris 30th September 2024

Fraunhofer Centre For Applied Photonics CAP

Dr John Macarthur

What is Fraunhofer?

The largest organisation for applied research in Europe

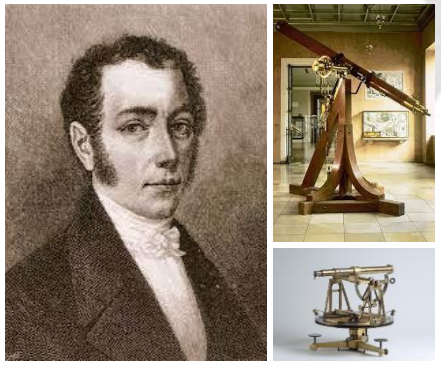
Established 1949 and named for Joseph von Fraunhofer, instrument maker, astronomer and scientist (1787 – 1826)

76 institutes in Germany with 32,000 employees, increasingly international

Innovation as a sustainable not-for-profit business

€3.4 billion annual research budget (2023)

- Roughly 2/3 of this sum is generated through contract research on behalf of industry and publicly funded research projects
- Roughly 1/3 is contributed by government in the form of ‘base funding’



Joseph von Fraunhofer

International profile and co-operation

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Fraunhofer CAP

Fraunhofer UK/CAP founded in 2012 as an RTO partnered with University of Strathclyde and Fraunhofer IAF

Legally independent affiliate of Fraunhofer gesellschaft

- Providing professional R&D services for, and with, industry
- Currently >80 staff and students (including 30 staff with PhDs and 28 PhD/EngD students)
- Specialising in optics and photonics technologies, including:
  - Remote sensing
  - Free-space optical communications
  - Quantum technologies

To date >250 projects of value £30M direct to Fh-CAP

- >£120M total value of projects to all partners
- >130 funded company partners from SMEs to multi-nationals

Fraunhofer CAP as a delivery partner

University

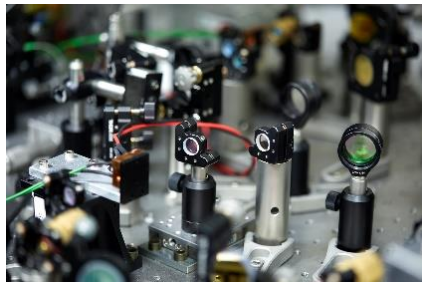
Fraunhofer CAP

Professional R&D services for industry

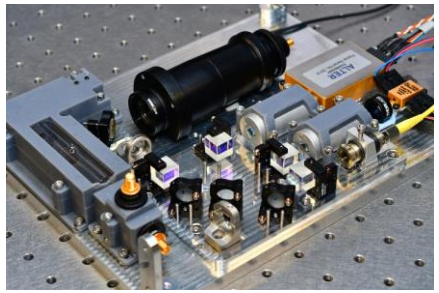
Industry

*TRL indicative only

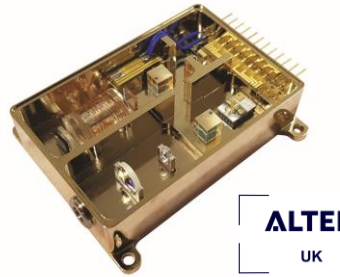
From laboratory bench-top

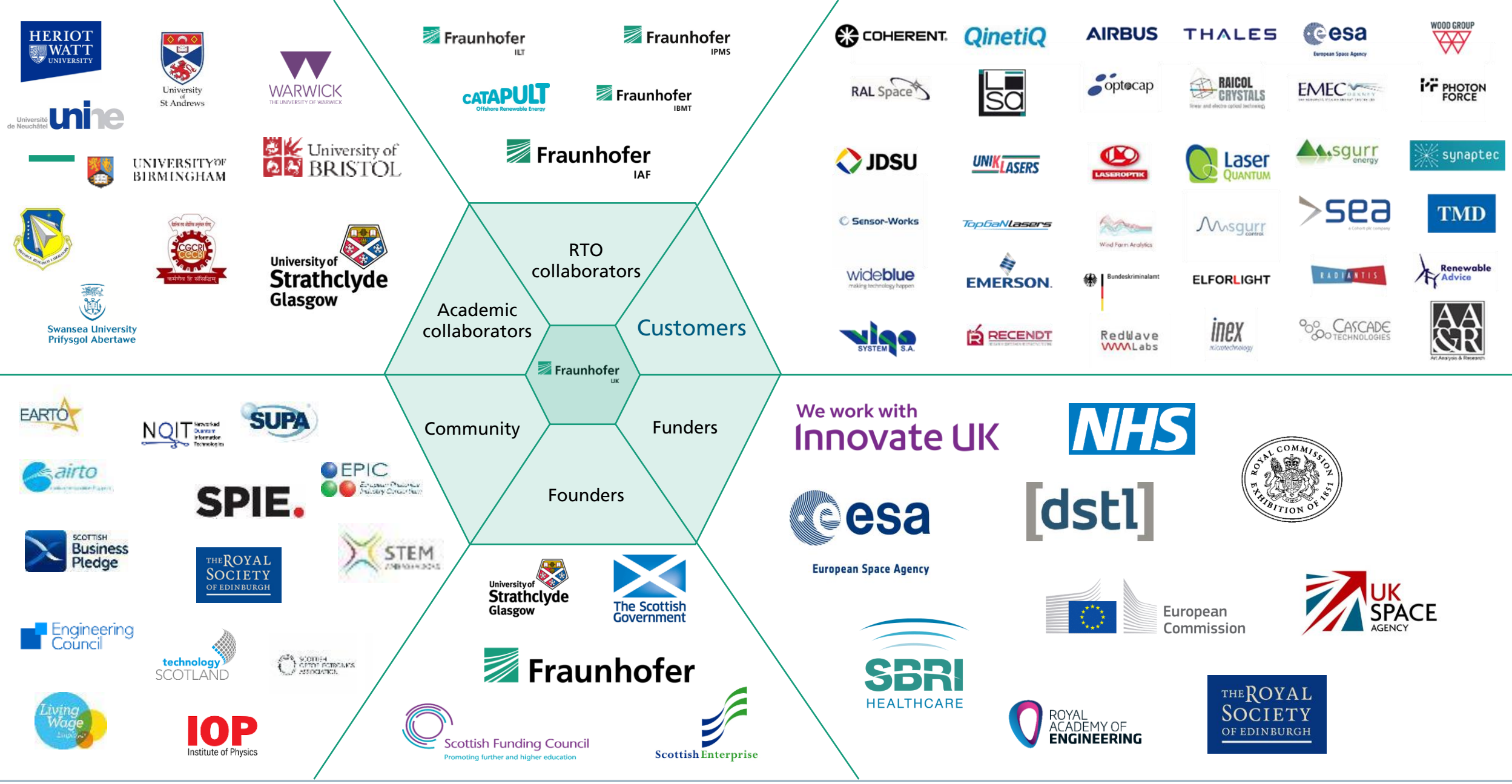


To engineered Proof of Concept



To Product





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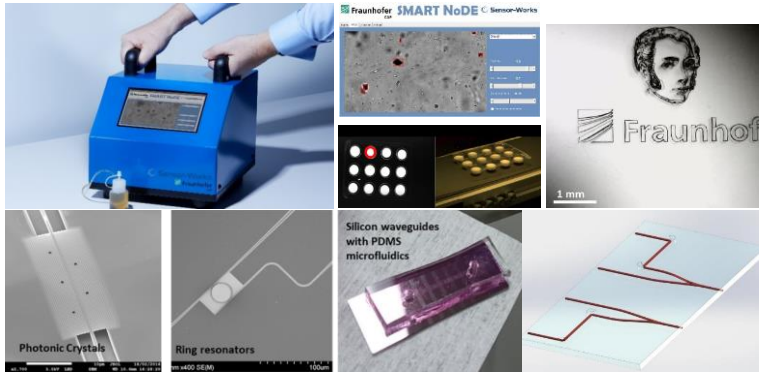
Activity areas and experience

Space, aerospace & defence

- Satellite, drone and aircraft communications
- Airborne inertial navigation
- Earth observation
- Handheld explosives detection

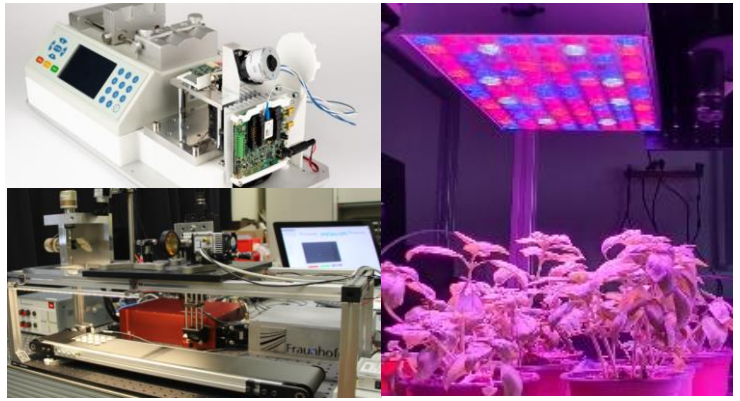
High-value manufacturing

- Particulate-in-oil monitoring
- Advanced lasers and sensors for manufacturing
- Manufacturing of advanced integrated photonics



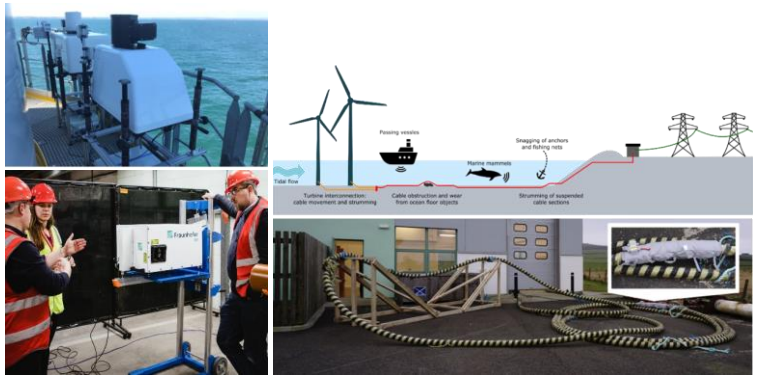
Health, pharma & agritech

- Optimised light for agritech
- Pharmaceutical content authentication
- Diagnosis, phototherapy, biochemical detection



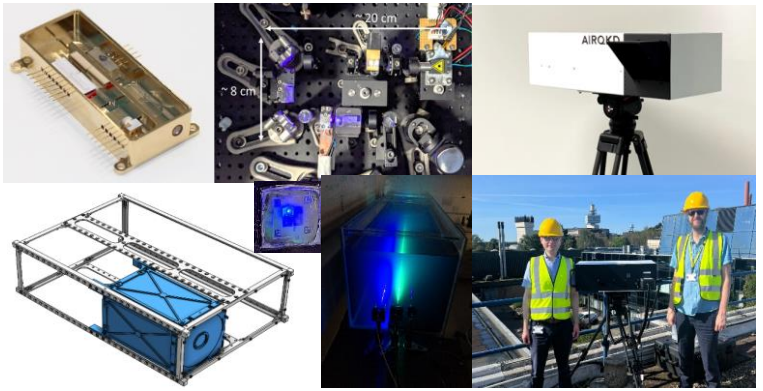
Net-zero

- Wind energy LIDAR
- Off-shore cable monitoring
- Hydrogen detection and imaging
- Satellite LIDAR vegetation monitoring



Communications

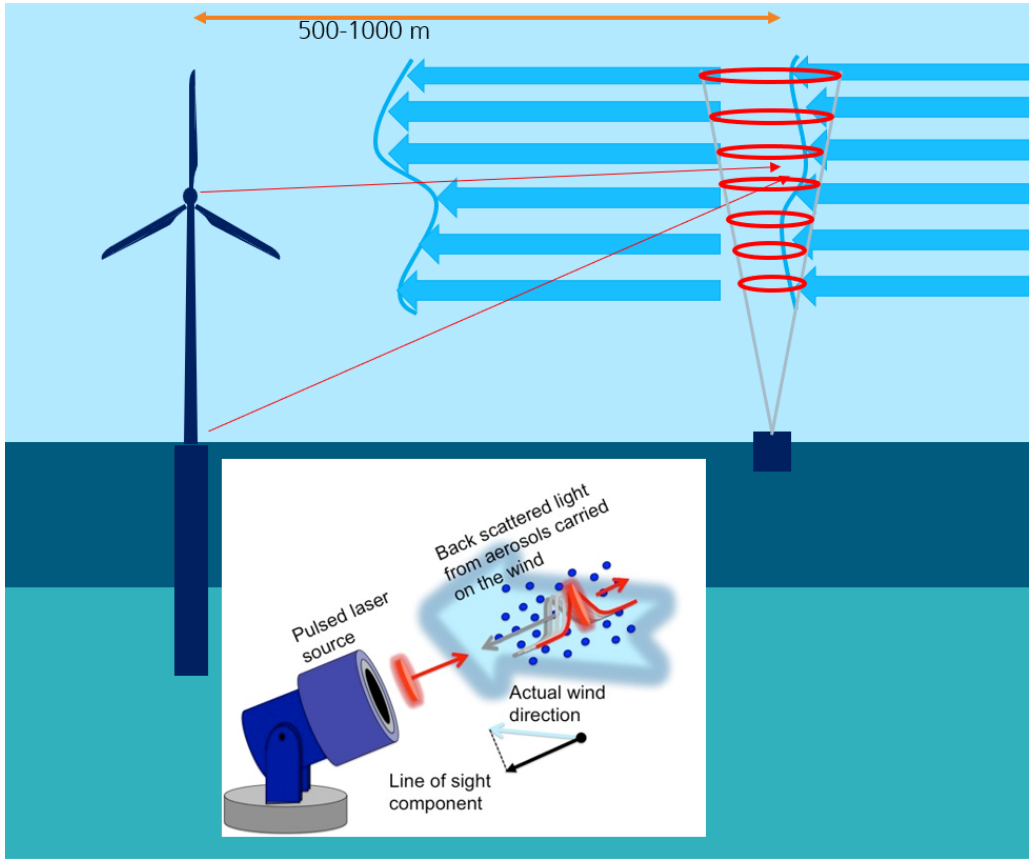
- Underwater communications and sensing
- Quantum secure comms
- Free-space optical
- Ground, air and space



Precision measurement & computing

- Quantum magnetic and gravitational field measurement
- Quantum inertial navigation and clocks
- Quantum computing
- Single-photon imaging

Doppler Wind Lidar

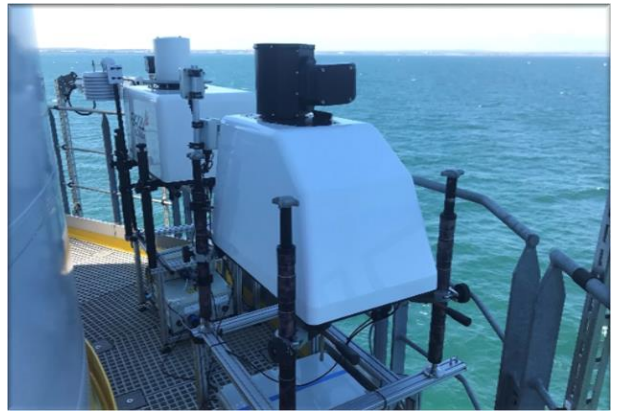


Remote measurement from 10 m to >10 km
Improved accuracy
Reduced costs £10M (met platform) vs <£1M (LIDAR buoy)
Wind field structure measured
3D wind vectors can be directly or indirectly measured – using intersecting or scanning beams

>16 lidar projects over the past 9 years; more in the pipeline.

Project Examples:

- Design, build and testing of a steerable Doppler wind lidar
- Intersecting beams for 3D profiling
- Blade integrated lidar
- Floating lidar
- Investigation of the feasibility of quantum lidar devices



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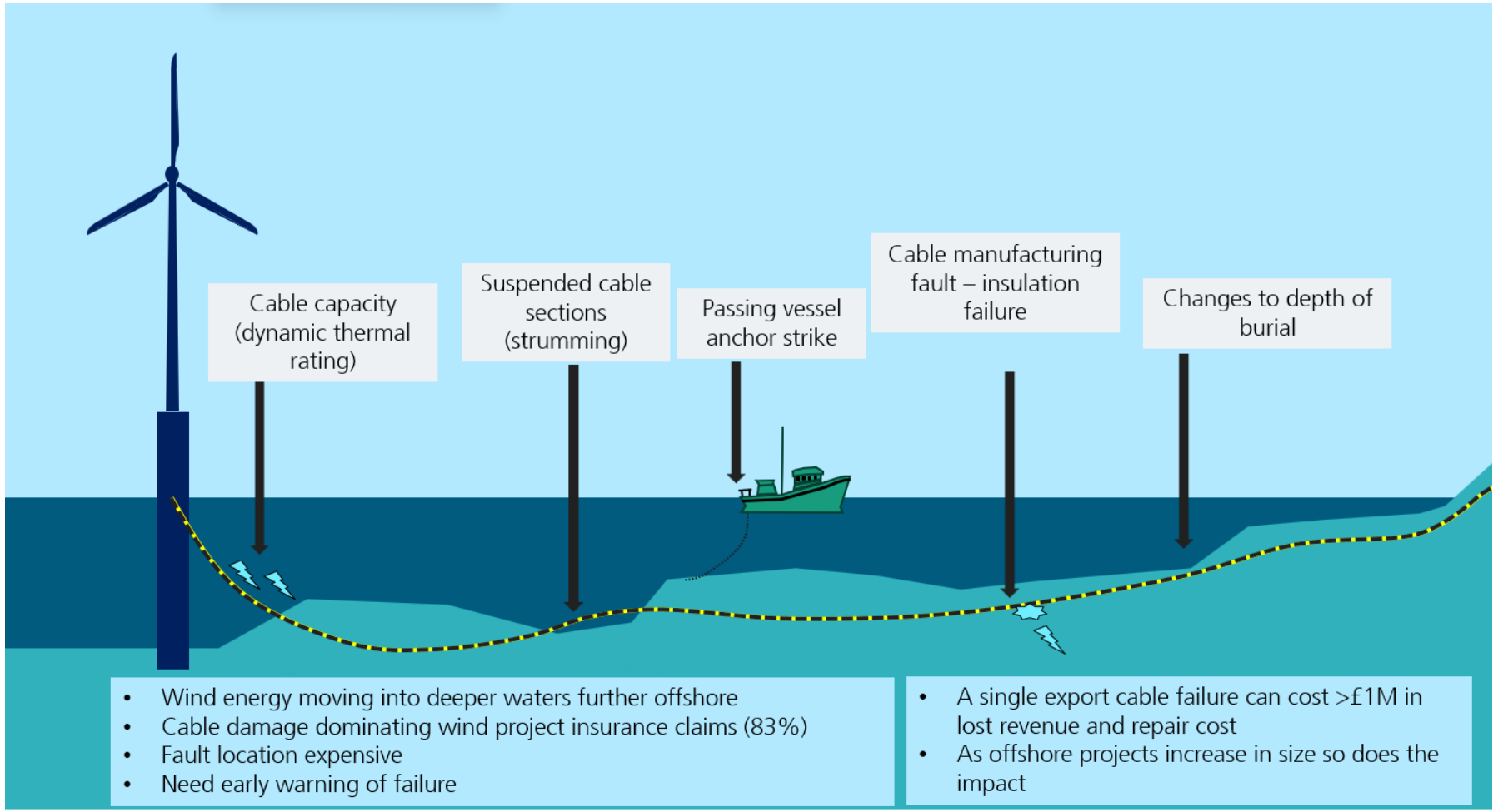
Offshore power cable monitoring



Offshore power cable monitoring

Exploiting optical fibre found in marine power cables

Optical backscatter can be used to sense strain, temperature and acoustic disturbance

Have taken systems to demonstration on live offshore power cables

Current areas of interest

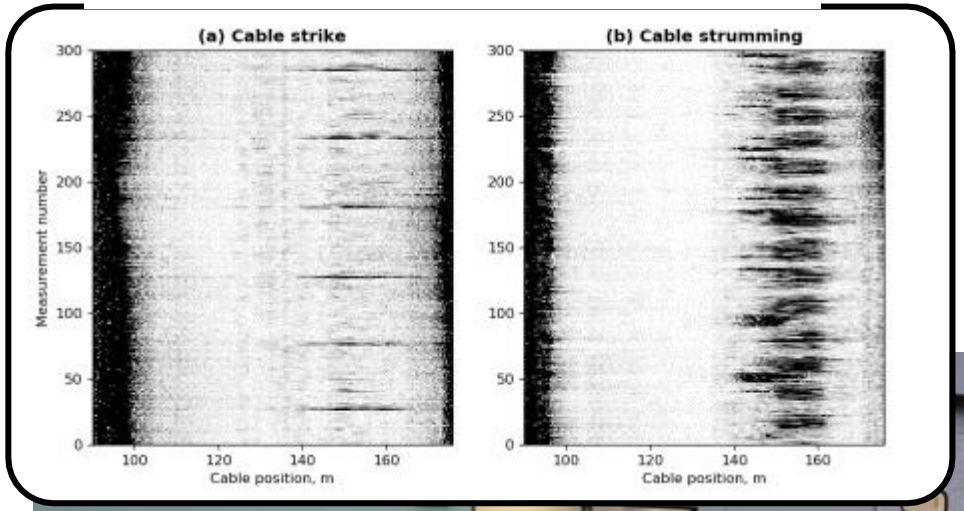
Dynamic cable shape sensing

Enhanced DAS acoustics

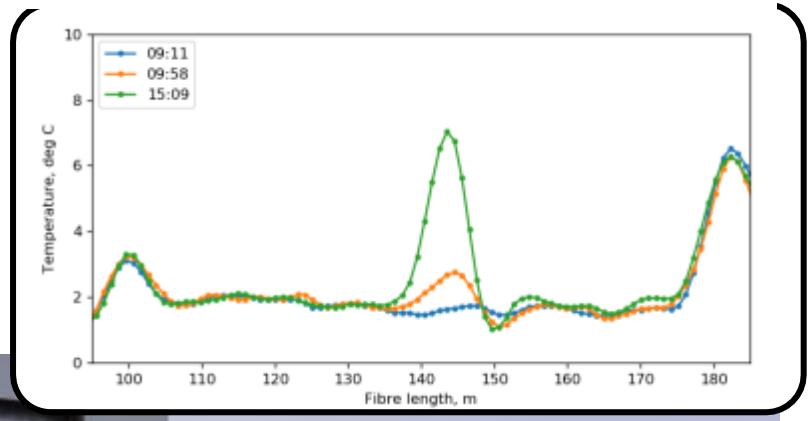
FBG based sensor devices

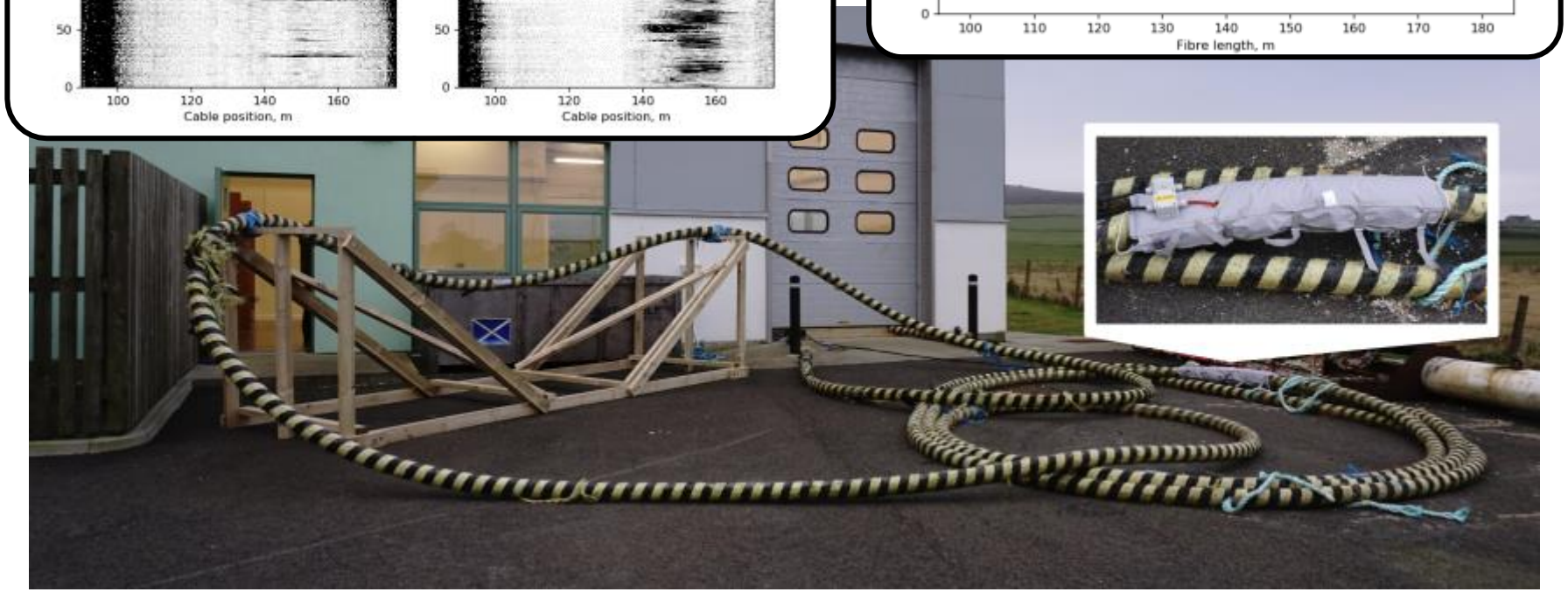
High sensitivity, high spatial resolution temperature sensing

Distributed acoustic sensing



Distributed temperature sensing





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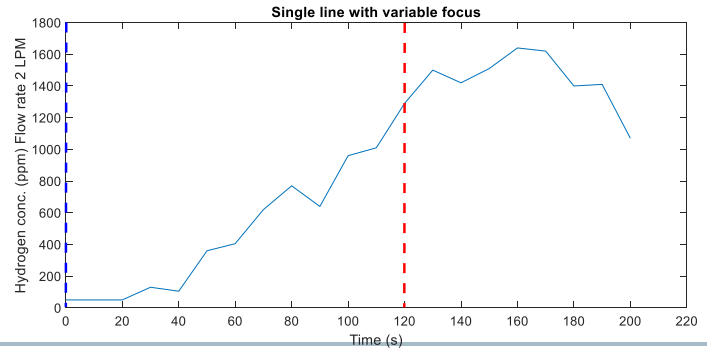
Stand-off and in-situ sensing

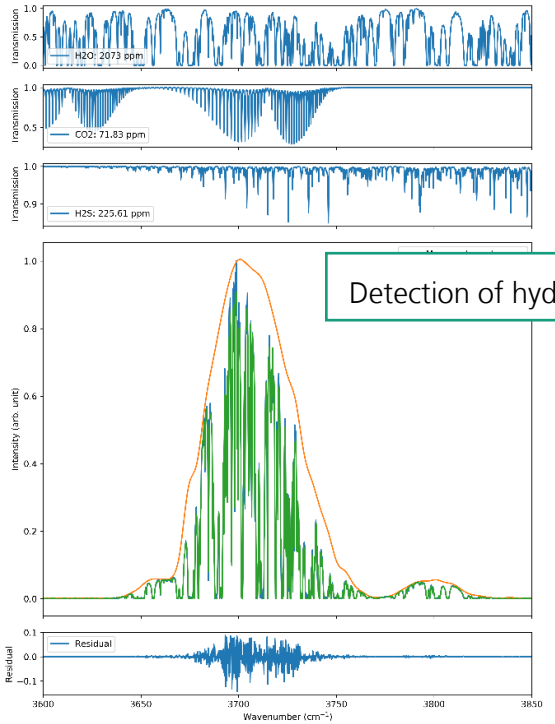
Low Carbon Technologies – projects examples

Measurements of Hydrogen contaminants – developed the prototype instrument and tested using six gases relevant to monitoring contaminants in hydrogen according to ISO 14687, which covers the required purity of hydrogen for use in fuel cells

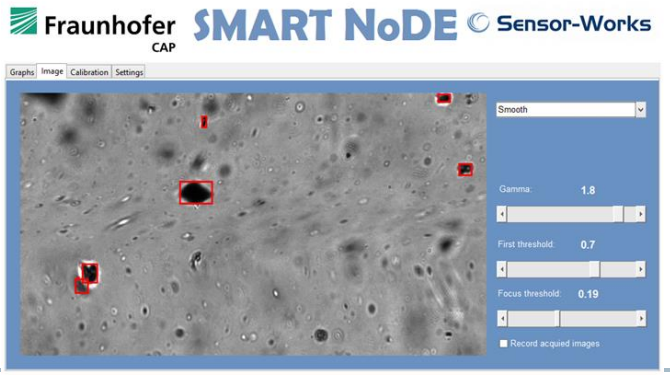
Remote asset monitoring – developed a prototype instrument for automated asset condition monitoring, specifically targeting the condition of the off-shore wind turbines by the monitoring of the lubrication of their gearboxes

Ultrasensitive sniffing technologies for gas and vapour traces measurement applicable to greenhouse gas emissions, with limits of detections to selected molecules down to single parts-per-billion.



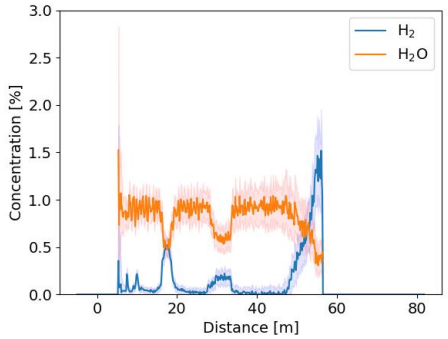


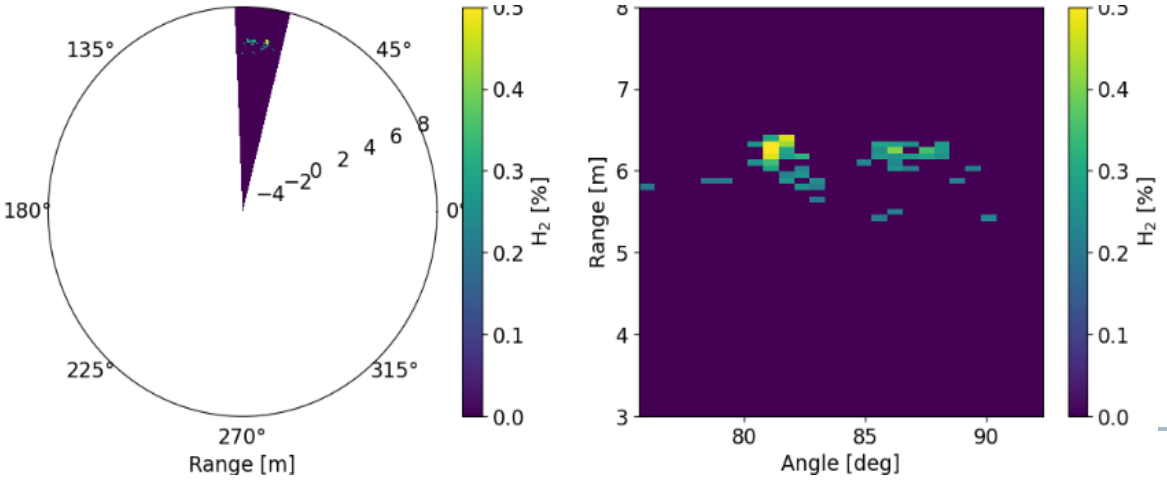
Detection of hydrogen sulphide



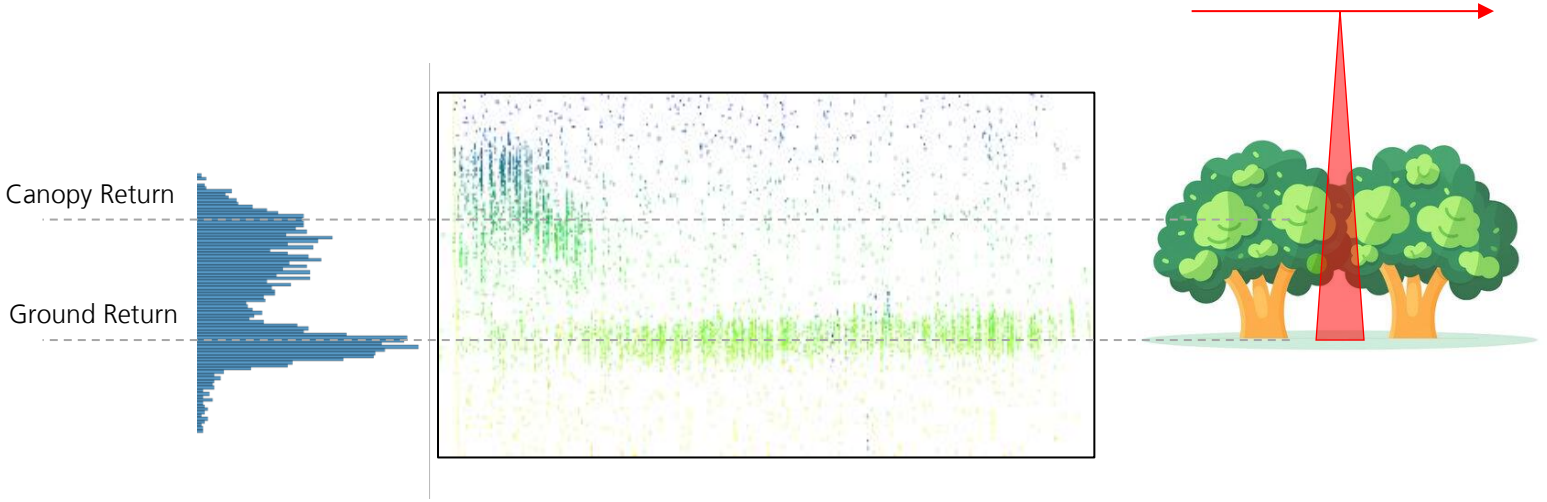
Adventures in H_2 detection

- Raman Lidar for ranged (10's m) concentration (<1%) mapping of hydrogen leaks





GLAMIS – Global Lidar Altimetry MISsion



Mission aims to launch a satellite capable of capturing biomass change on a global scale using time-of-flight lidar.

This requires multiple sources (30+) with fast pulse repetitions (MHz) to achieve maximum resolution whilst having low SWaP.

Diode laser sources are a possibility and need to be able to provide sufficient power & exhibit good spectral & spatial

Verification of noise metrics to provide certified performance specifications for orbit laser systems and single-photon detectors.

Proof-of-principle investigation of measurement techniques in relevant environment.

Lidar unit designed for UAV weighs 2.8 kg

Other?

Please come to us with your problems

Thermal, and 3D imaging (e.g. measurements of building heating and insulation efficiency)

Hyperspectral and multispectral imaging (e.g. monitoring of crops, plant health, natural resources)

Photoacoustic and photothermal gas sensing (e.g. greenhouse gases monitoring, indoor and outdoor air quality, monitoring of ammonia transport)

Photonic integrated circuit development

High bandwidth free space and underwater optical communications

Condition and health monitoring of assets to minimise operation and maintenance costs

Photonics applications in fusion, hydrogen, wind, wave, tidal, solar

Green mobility and Smart cities,

Hydrogen sensing, urban wind lidar for planning and UAV flight

Pollutant mapping

Fleet based sensing for community sensor networks

Smarter housings and constructions,

Integrated fibre sensing of energy use, footfall and building use, fire detection.

Wind lidar for construction – more accurate weather windows

Smart structures – embedded sensing in construction materials, additive manufacturing

Bioreactor monitoring/sensing (biofuel production), agri-photonics in vertical farming, environmental sensing (atmospheric/water/landfill/recycling), water quality, contaminant detection

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