How to speed-up innovation in offshore wind maintenance

Lecture rules

This is all about you…
Any intervention / question / discussion is welcome

Lecture plan

Part 1: Innovation in Offshore Wind Maintenance

- Development of offshore wind
- WorldClassMaintenance
- Innovation with Fieldlab Zephyros

Part 2: Use cases

WORLD CLASS MAINTENANCE

Who am I

- Ferry Visser
- Father of four graduates
- Technical- and Social Organizational Business Administration (Radboud University)
- Working with contractors for 30+ yrs. in business management positions
- Passion for Sustainability -> Since 2018 innovation in OW / ORE

WORLD CLASS MAINTENANCE

Who am I

- Bart Vandehoek (49)
- From packaging to coffee machines to wind turbines
- 2017: Use my innovation skills for something with purpose, like renewable energy
- Innovations to help maintenance teams work safer, faster, and smarter

TU Delft
Industrial Design Engineering

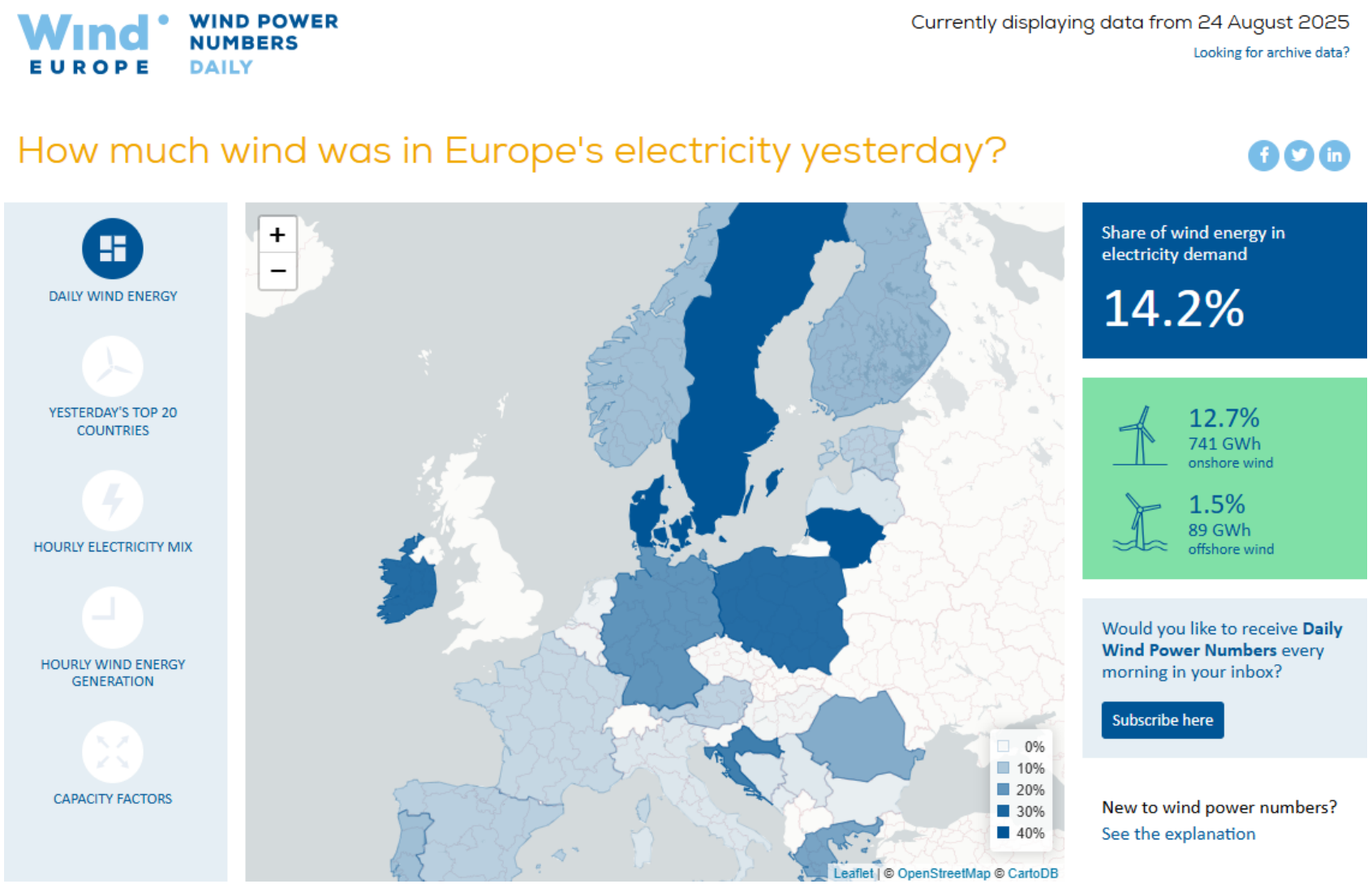
15 years consumer products

7 years Eneco

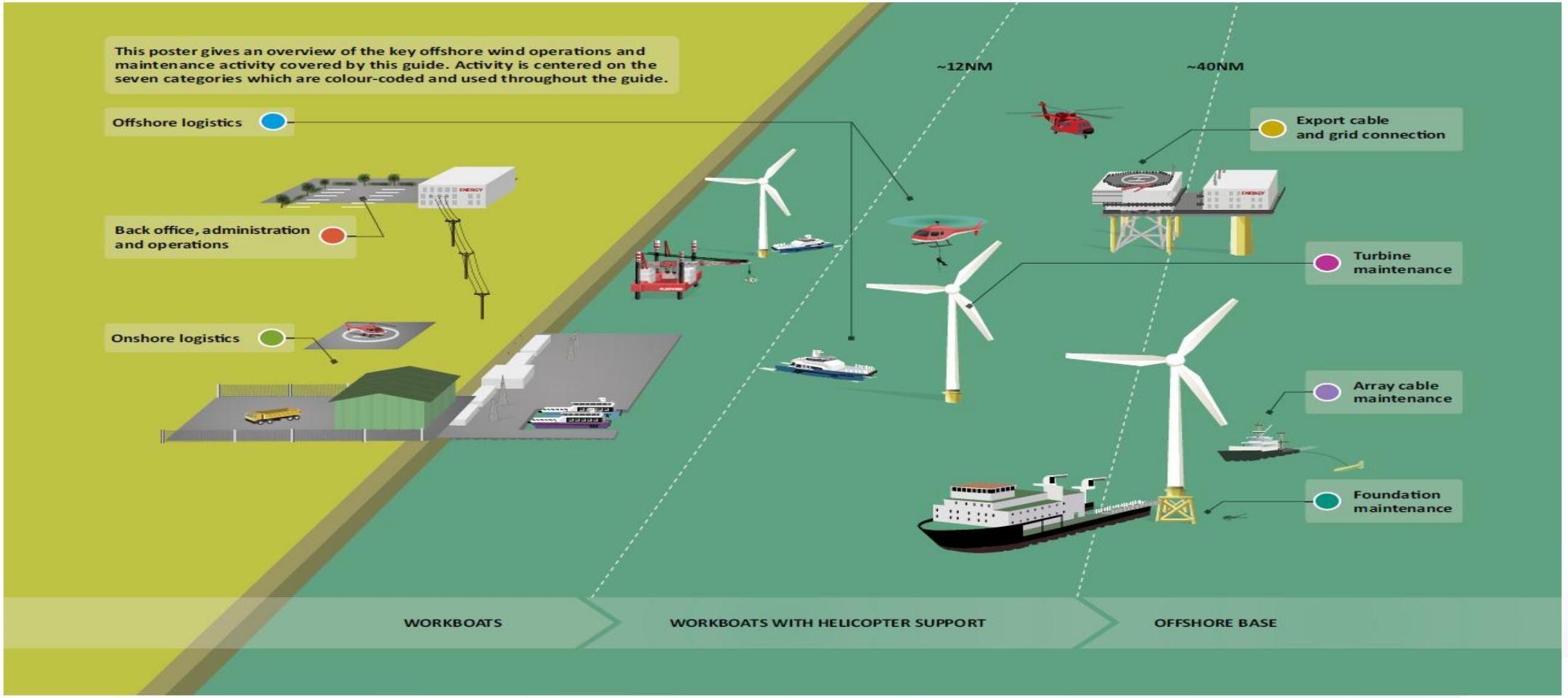
1 year self-employed

WORLD CLASS MAINTENANCE

DAILY UPDATE ON EUROPEAN WIND POWER



A complex system.....



Field lab ZEPHYROS

WORLD CLASS MAINTENANCE

What are we doing every day?

Field lab ZEPHYROS

WORLD CLASS MAINTENANCE

What are we doing every day?

Field lab ZEPHYROS

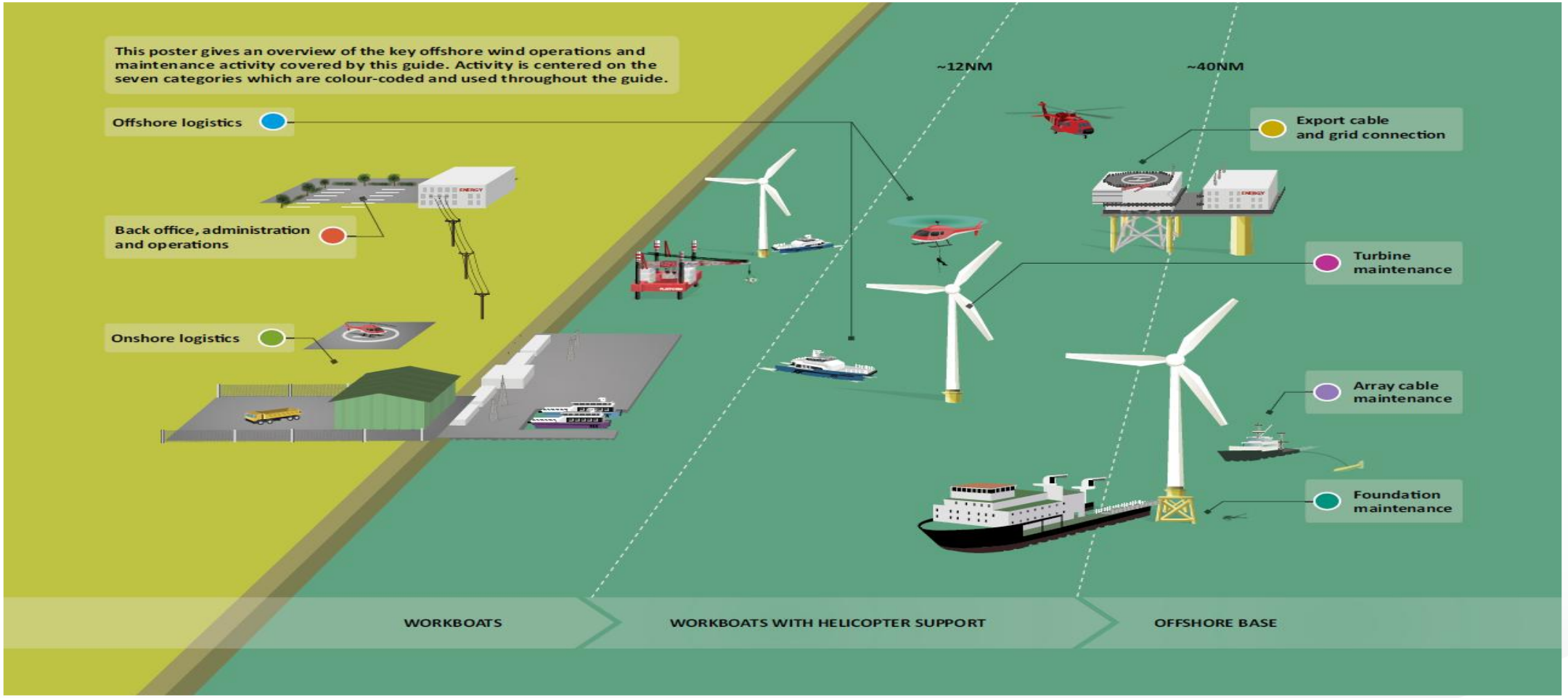
WORLD CLASS MAINTENANCE

What are we doing every day?

Field lab ZEPHYROS

WORLD CLASS MAINTENANCE

A complex system…..in need of Smart Maintenance



Field lab ZEPHYROS

WORLD CLASS MAINTENANCE

WorldClassMaintenance

Field lab ZEPHYROS

WORLD CLASS MAINTENANCE

WorldClassMaintenance


Fieldlabs & projecten


Kennis & achtergrond


Lobby & politiek


Netwerk & ledenvoordeel

- **The Network for Smart Maintenance**
- Development and execution of cross sectoral innovation projects
- Participation of Asset Owners, - Managers, Service Providers & Knowledge- and Education institutions, Government
- Development of Fieldlab programs for complete industry sectors

FME POWERED BY DUTCH TECHNOLOGY

Fieldlab ZEPHYROS

WORLD CLASS MAINTENANCE

WorldClassMaintenance

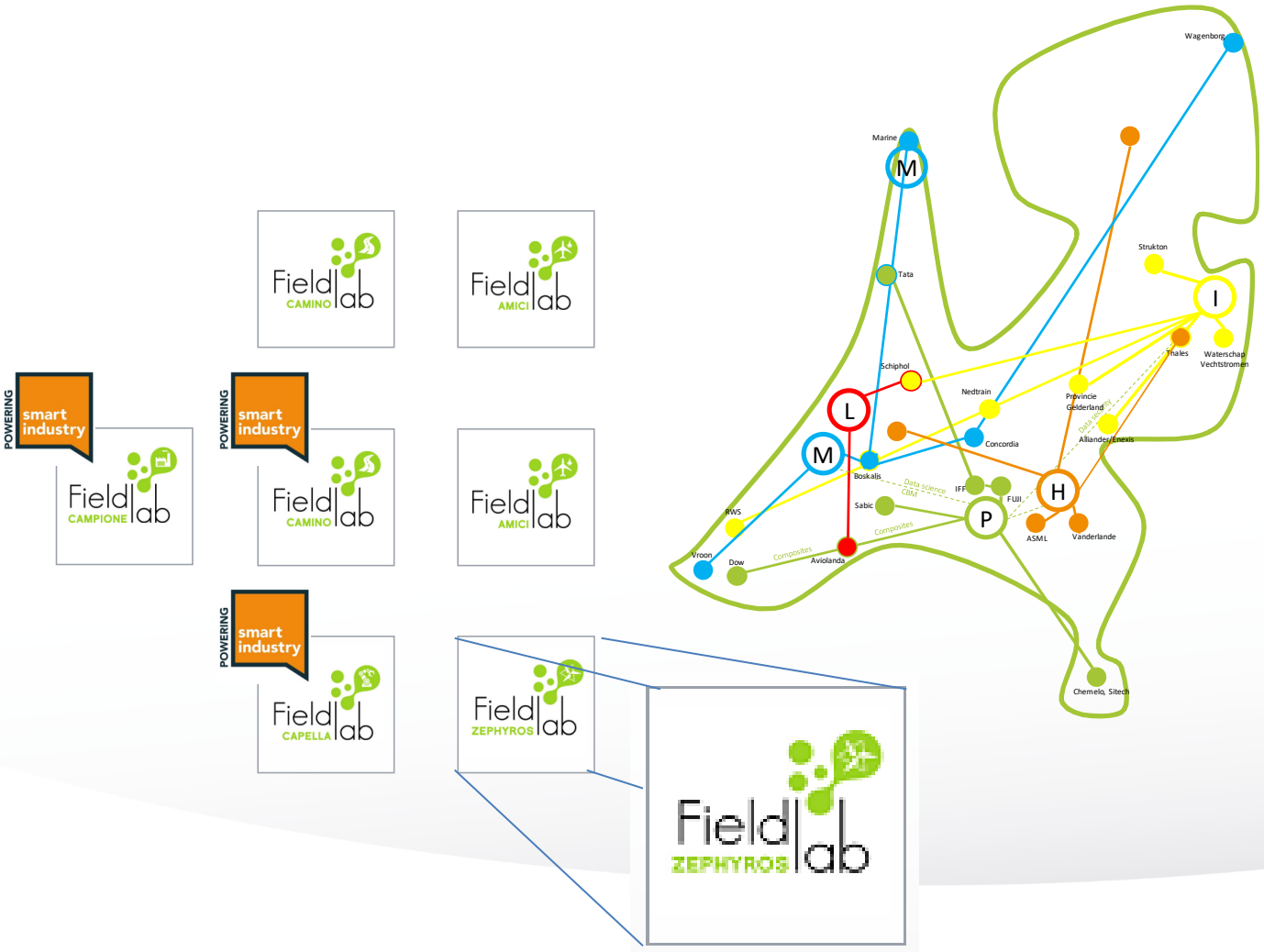


ABB · Ahoy · AkzoNobel · Albeda/Zadkine · Alliander · ASML

Asset Health Dynamics · Avans Hogeschool · Bilfinger · BP · Cargill · Copernicos Groep

Croonwolter&dros · Dimensys · Eneco · Engie Services West Industrie · Gate2 · Gemeente Breda

Gouda Vuurvast Services · Hogeschool Utrecht · Hogeschool Zeeland · Huntsman · ifm electronic · IJssel

IMS International · Jacobs Nederland · Koninklijk Instituut van Ingeni · KPN · MaxGrip · NS Techniek

NVDO · ORTEC · PDM · ProRail · Raad voor de Olie en Gas Ind. · Ricardo Nederland

ROC Scalda · ROC Tilburg · ROC West-Brabant · Schiphol · Semiotic Labs · Service Logistics Forum

Shell · Sitech · SPIE · Stork a Fluor Company · Tata Steel · Tecona

Visser & Smit · IBM

Field lab ZEPHYROS WORLD CLASS MAINTENANCE

Towards: Unmanned Maintenance Offshore

Field lab

ZEPHYROS

WORLD CLASS MAINTENANCE

Zephyros: Call for action 2018

- Government puts great emphasis on offshore wind
- Focus is still on development and new construction
- Offshore wind industry is in pilot phase
- LCOE is largely determined by up-keeping (O & M) and this can be improved
- O & M is strongly logistically oriented and highly fragmented
- Need for Smart (remote) Maintenance
- Technology is available
- Cooperation is the solution (business, knowledge institutes, educational institutions)

Field lab ZEPHYROS WORLD CLASS MAINTENANCE

Pol question:

Is unmanned maintenance offshore realistic?

Field lab

ZEPHYROS

WORLD CLASS MAINTENANCE

Field lab ZEPHYROS

WORLD CLASS MAINTENANCE

Autonomous Remote Systems

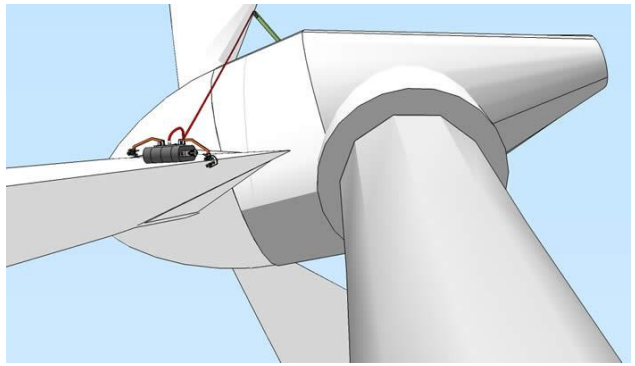
Field lab ZEPHYROS

WORLD CLASS MAINTENANCE

Field lab ZEPHYROS

WORLD CLASS MAINTENANCE

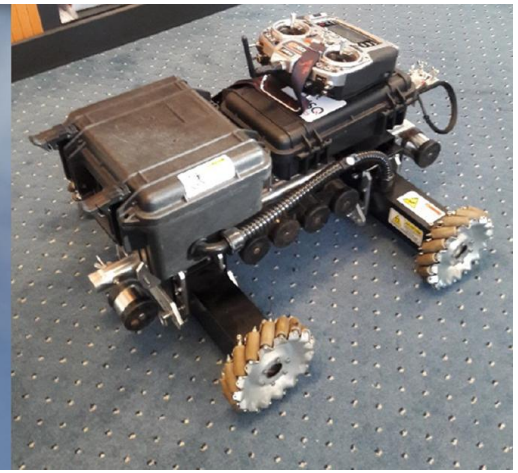
New Technologies must speed-up

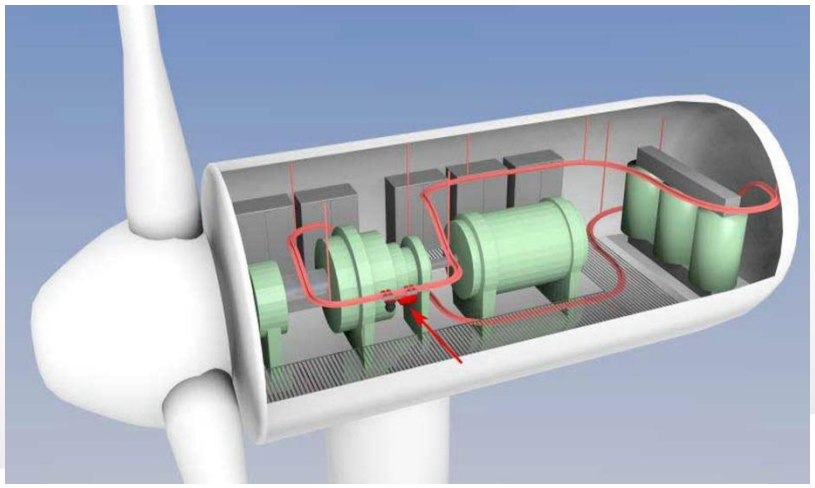


Field lab ZEPHYROS

WORLD CLASS MAINTENANCE

New Technologies must speed-up





Field lab ZEPHYROS

WORLD CLASS MAINTENANCE

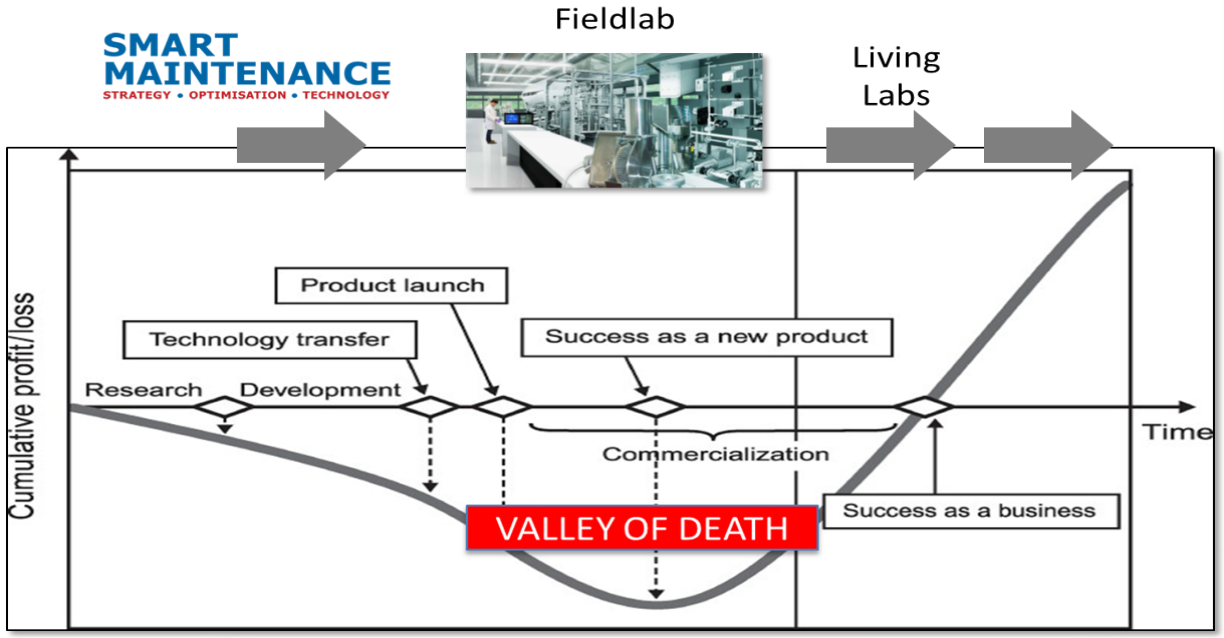
Innovation is needed

WIKIPEDIA:
Innovation in its modern meaning is a "new idea, creative thoughts, new imaginations in form of device or method". Innovation is often also viewed as the application of better solutions that meet new requirements, unarticulated needs, or existing market needs. Such innovation takes place through the provision of more-effective products, processes, services, technologies, or business models that are made available to markets, governments and society. An innovation is something original and more effective and, as a consequence, new, that "breaks into" the market or society.

Aanpassingen		Innovaties		Uitvindingen	
Beperken zich tot de reeds aanwezige systeemeigenschappen (zoals kleur, vorm, toepassing)		Realiseert veranderingen in het systeem door (bv) toevoegingen van nieuwe eigenschappen en functies, door een andere realisatie van bestaande functies		Grensoverschrijdend en systeem ontwerpend, creatie van een nieuw concept	
Stilistische aanpassingen	Gebruiks-aanpassingen	**Marginale, Incrementele innovaties**	**Radicale, Basis innovaties**	Doorbraak uitvindingen	Fundamentele uitvindingen
Voorbeelden uit de elektronica: *Deze voorbeelden zijn een mooie illustratie van een subjectieve beoordeling binnen de wereld van de elektronica.*					
Gekleurde behuizingen	Slimline pc	**Portable pc, Tablet-pc**	**Personal computing (pc)**	Microcomputer IC (Intel 4004)	Halfgeleidertechnologie (1)
Verschillende tv-modellen	Verschillende tv-uitvoeringen	**Plasma-, lcd-, led-televisies**	**Solid state televisieschermen**	Plasma/lcd/led-technologie	Halfgeleidertechnologie (2)

Field lab ZEPHYROS
WORLD CLASS MAINTENANCE

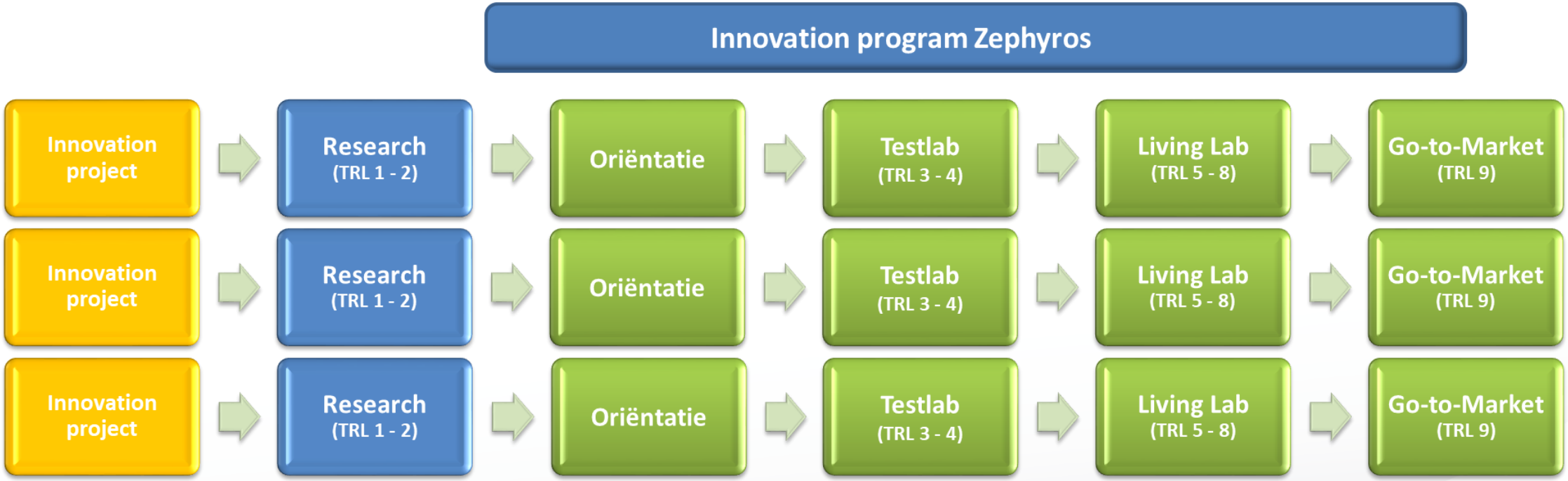
Innovations get stuck in the Valley of



Collaboration in a Smart Maintenance fieldlab is the solution (businesses, knowledge institutions, education, government)

Fieldlab ZEPHYROS
WORLD CLASS MAINTENANCE

Set-up of a WCM Fieldlab



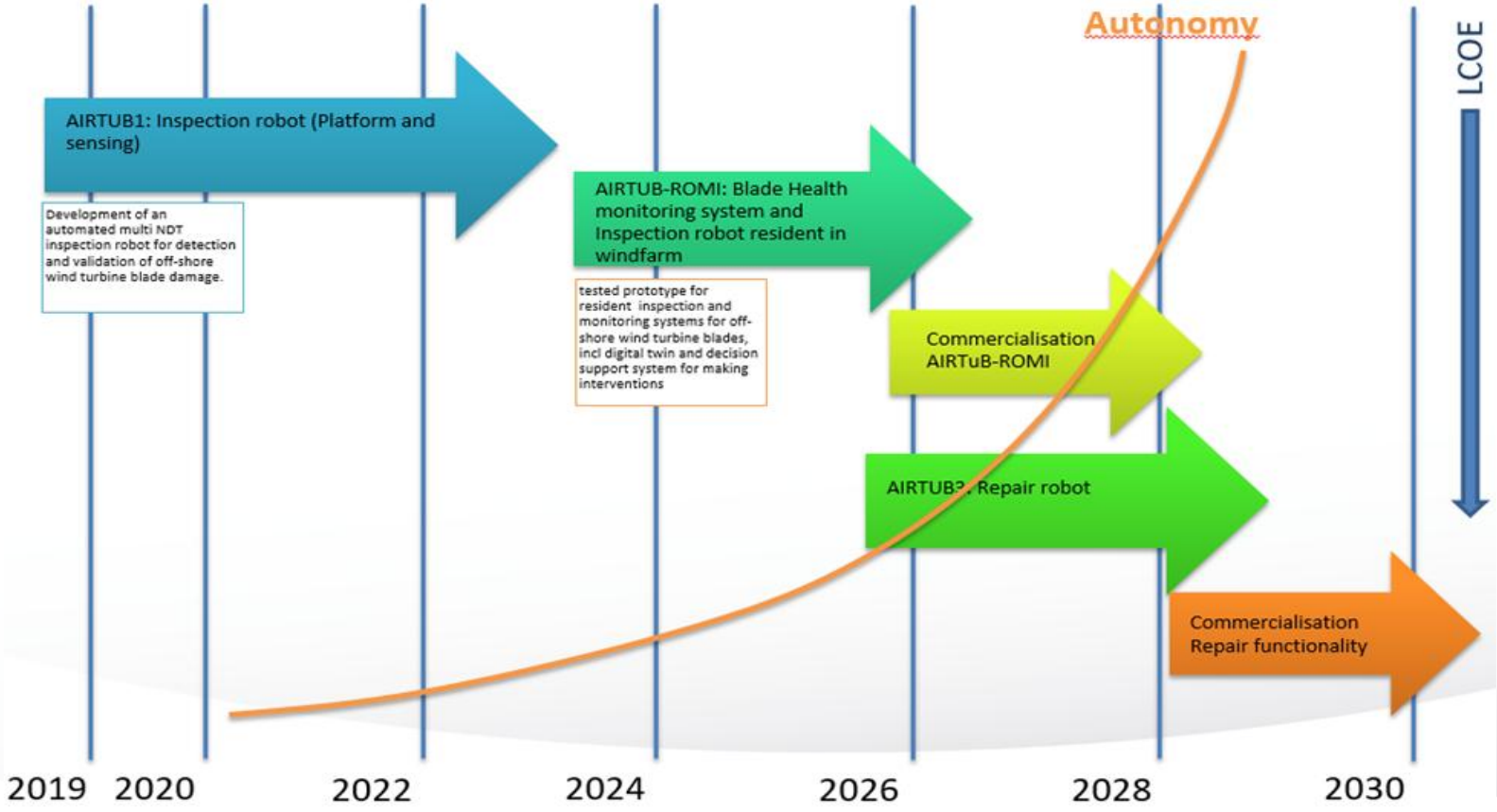
Fieldlab ZEPHYROS

WORLD CLASS MAINTENANCE

Automated Inspection & Repair of Turbine Blades

AIRTuB roadmap

AUTOMATED INSPECTION AND REPAIR OF TURBINE BLADES



Call for Action / Business Driver = Need for LCOE reduction

- Lifetime extension
- AEP improvement
- Maintenance logistics reduction
- Elimination of human presence offshore

AIRTuB solution:

Fully autonomous robotized turbine blade maintenance by:

- Robotized inspection and repair system resident in windfarm
- Condition monitoring
- Frequent small high quality repair interventions

Business model:

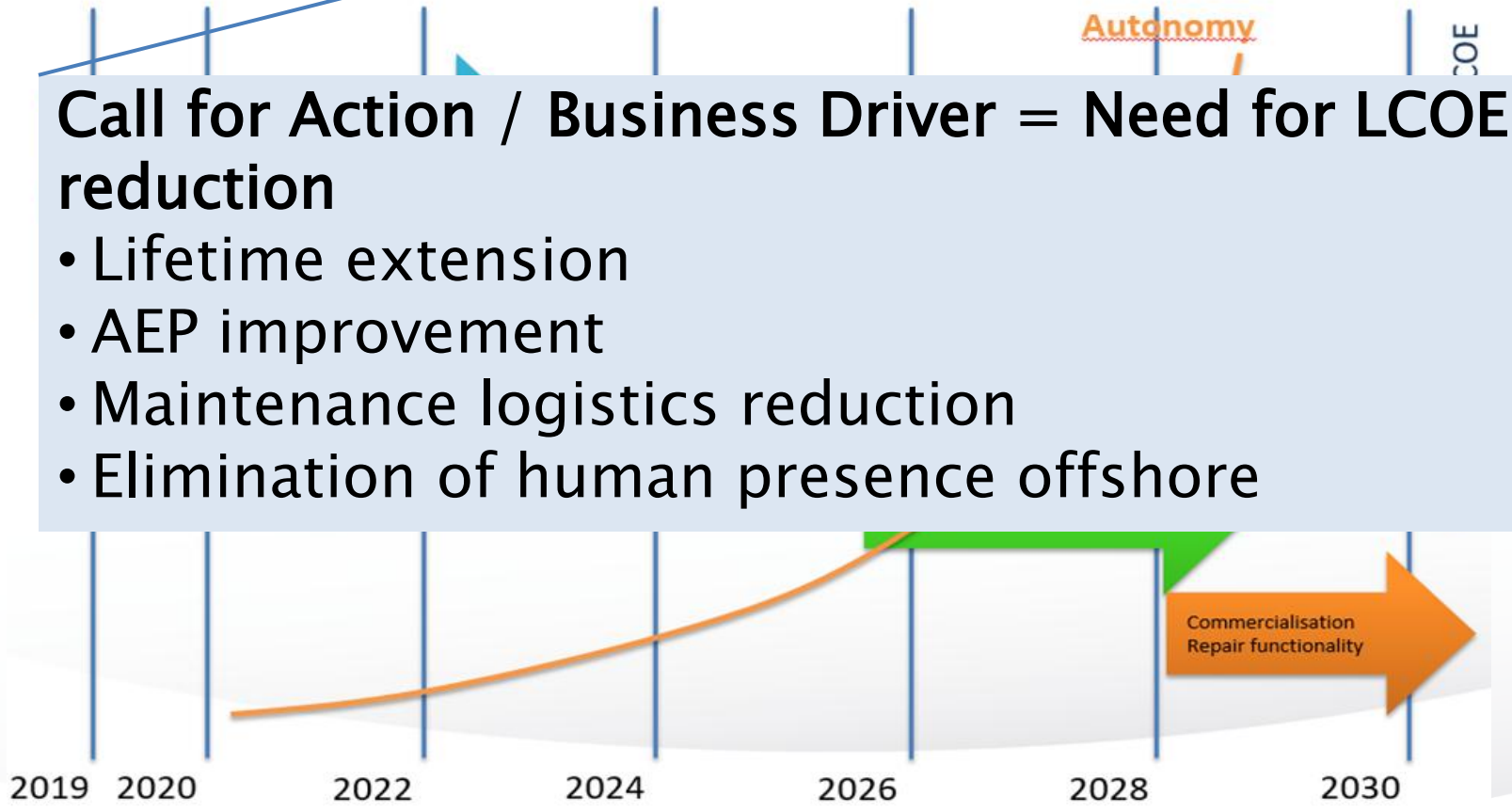
- Owner Operator (OO) contracts AIRTuB as a Service from Service Provider (SP)
- SP operates on performance contract with OO
- OEM of AIRTuB Equipment rents Robots to SP

Field lab ZEPHYROS

WORLD CLASS MAINTENANCE

AIRTuB roadmap

AUTOMATED INSPECTION AND REPAIR OF TURBINE BLADES



Call for Action / Business Driver = Need for LCOE reduction

- Lifetime extension
- AEP improvement
- Maintenance logistics reduction
- Elimination of human presence offshore

Call for Action / Business Driver = Need for LCOE reduction
- Lifetime extension
- AEP improvement
- Maintenance logistics reduction
- Elimination of human presence offshore

AIRTuB solution:
Fully autonomous robotized turbine blade maintenance by:
- Robotized inspection and repair system resident in windfarm
- Condition monitoring
- Frequent small high quality repair interventions

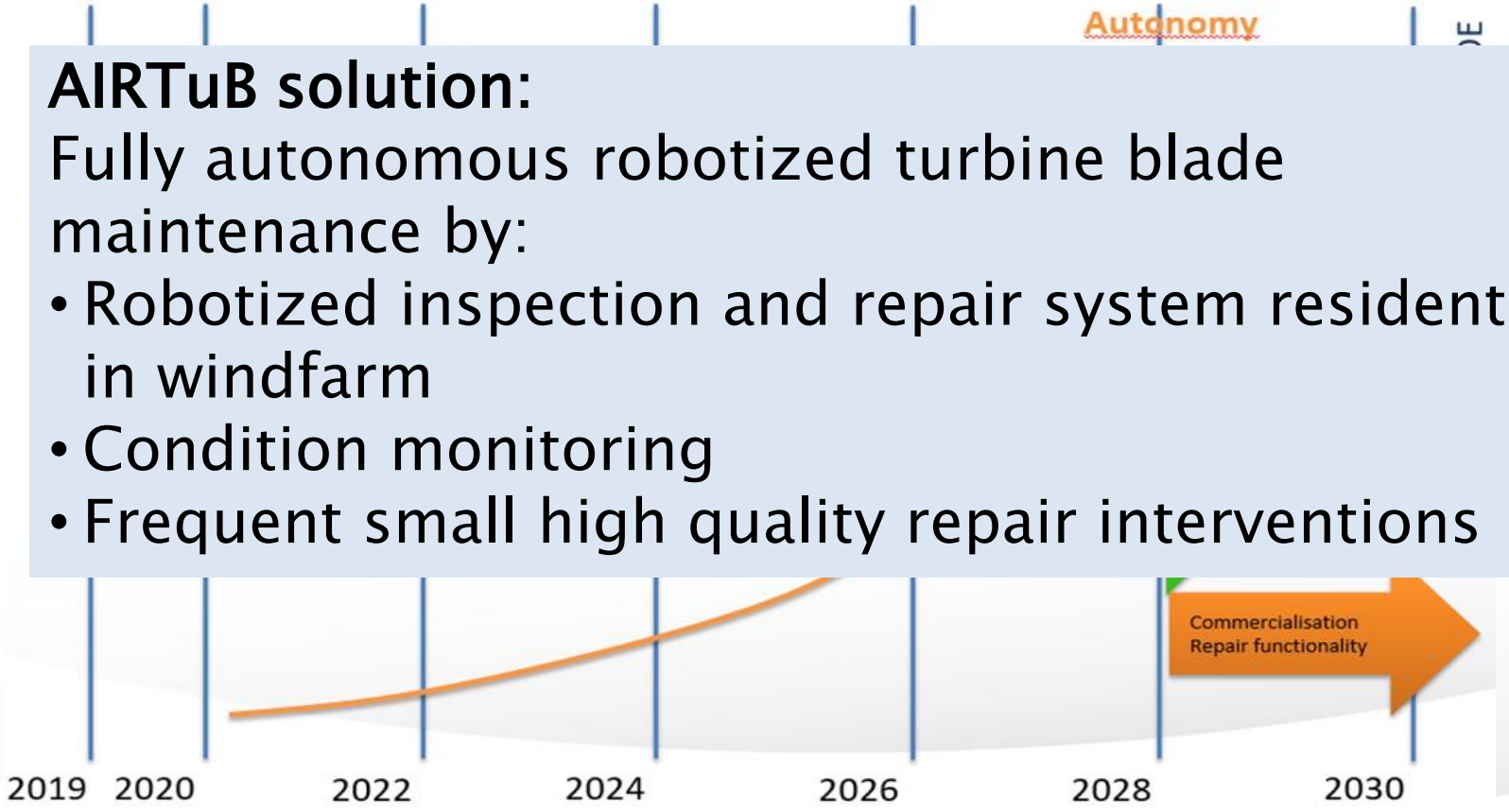
Business model:
- Owner Operator (OO) contracts AIRTuB as a Service from Service Provider (SP)
- SP operates on performance contract with OO
- OEM of AIRTuB Equipment rents Robots to SP

Field lab ZEPHYROS

WORLD CLASS MAINTENANCE

AIRTuB roadmap

AUTOMATED INSPECTION AND REPAIR OF TURBINE BLADES



AIRTuB solution:
Fully autonomous robotized turbine blade maintenance by:

- Robotized inspection and repair system resident in windfarm
- Condition monitoring
- Frequent small high quality repair interventions

Call for Action / Business Driver = Need for LCOE reduction

- Lifetime extension
- AEP improvement
- Maintenance logistics reduction
- Elimination of human presence offshore

AIRTuB solution:
Fully autonomous robotized turbine blade maintenance by:

- Robotized inspection and repair system resident in windfarm
- Condition monitoring
- Frequent small high quality repair interventions

Business model:

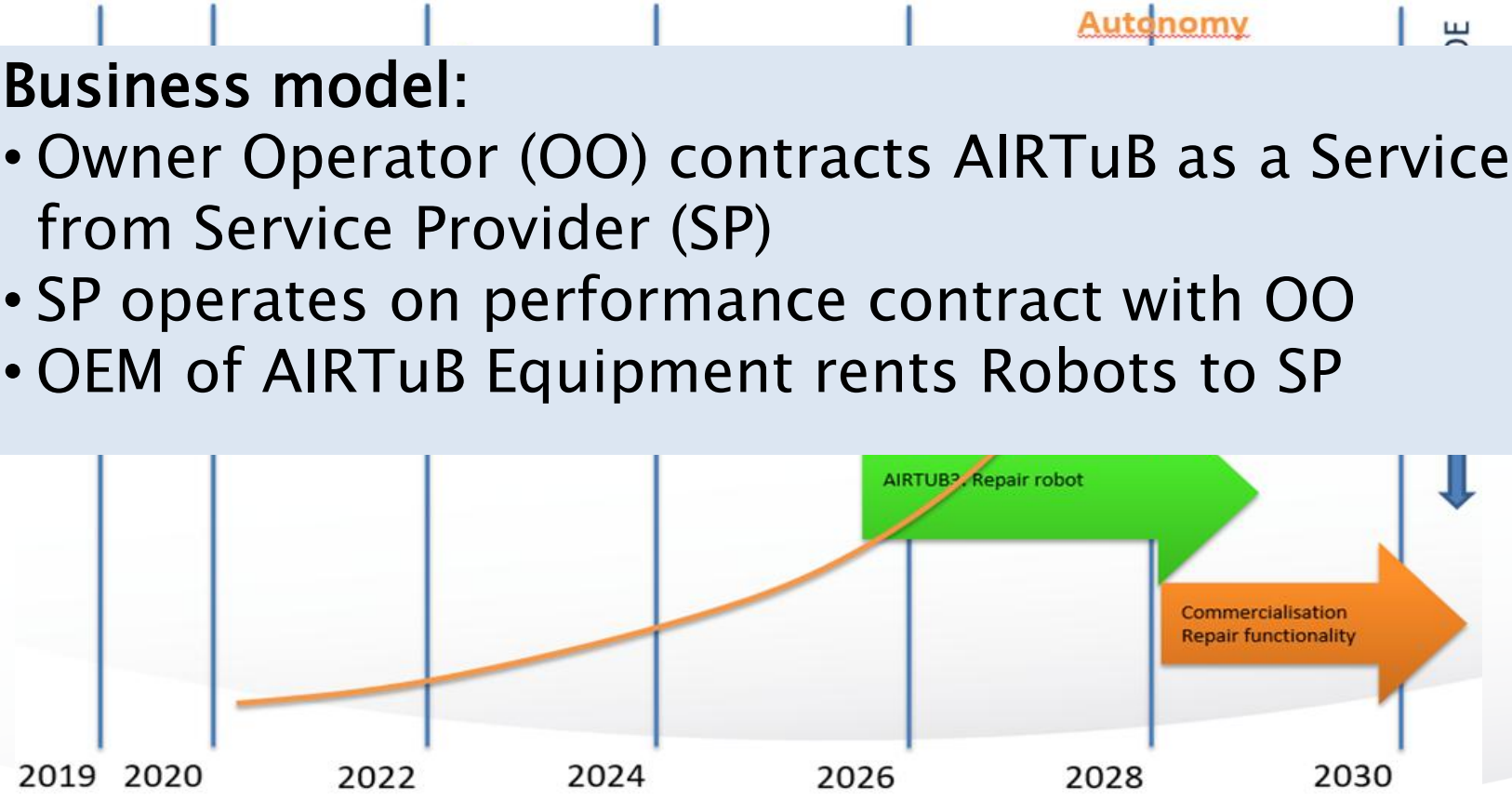
- Owner Operator (OO) contracts AIRTuB as a Service from Service Provider (SP)
- SP operates on performance contract with OO
- OEM of AIRTuB Equipment rents Robots to SP

Field lab ZEPHYROS

WORLD CLASS MAINTENANCE

AIRTuB roadmap

AUTOMATED INSPECTION AND REPAIR OF TURBINE BLADES



Business model:

- Owner Operator (OO) contracts AIRTuB as a Service from Service Provider (SP)
- SP operates on performance contract with OO
- OEM of AIRTuB Equipment rents Robots to SP

Call for Action / Business Driver = Need for LCOE reduction

- Lifetime extension
- AEP improvement
- Maintenance logistics reduction
- Elimination of human presence offshore

AIRTuB solution:

Fully autonomous robotized turbine blade maintenance by:

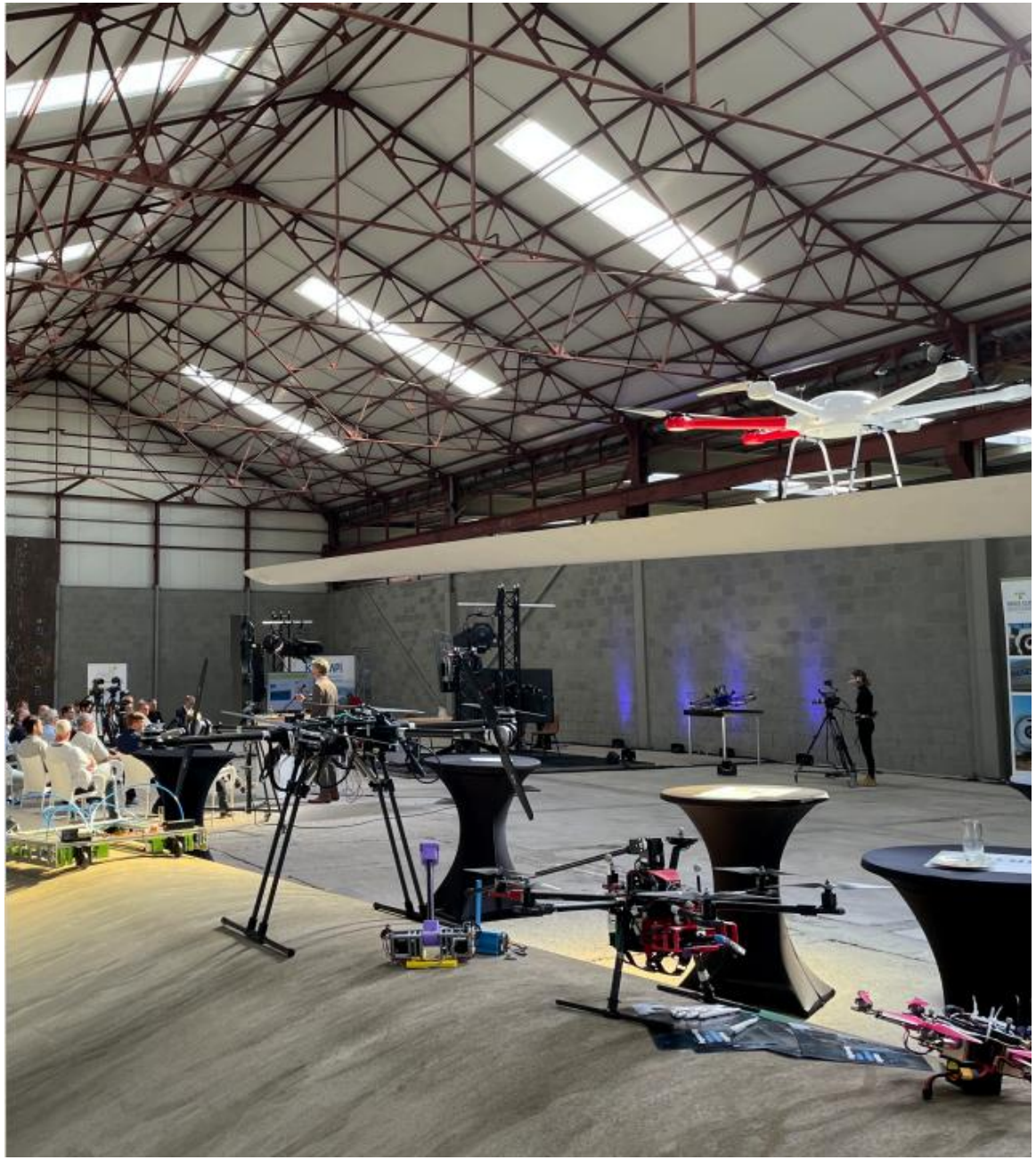
- Robotized inspection and repair system resident in windfarm
- Condition monitoring
- Frequent small high quality repair interventions

Business model:

- Owner Operator (OO) contracts AIRTuB as a Service from Service Provider (SP)
- SP operates on performance contract with OO
- OEM of AIRTuB Equipment rents Robots to SP

Field lab ZEPHYROS

WORLD CLASS MAINTENANCE



KAAP
INNOVATIEPUNT VAN ZEELAND

Field lab ZEPHYROS

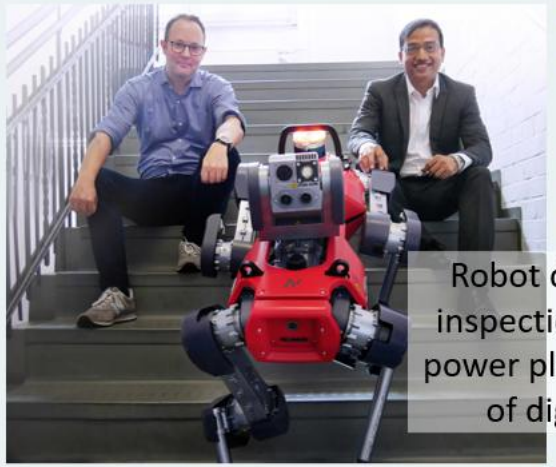
WORLD CLASS MAINTENANCE

Innovate together – JOIN US!

Het Fieldlab ZEPHYROS wordt mede mogelijk gemaakt door:

www.worldclassmaintenance.com

F.C.Th.(Ferry) Visser MSc
fv@worldclassmaintenance.com
+31 6 1928 8256



Unmanned operations @ Vattenfall

Status

- None-blade maintenance examples
- Most applications in testing phase

Why

- Reach hard-to-reach, hazardous areas
- Decreasing CO_2 emissions
- Supporting staff, increase safety
- Better than humans; e.g. finding leaks

Inspections – current state:
High vessel costs, Unplanned maintenance

SkySpecs (Instagram)

SkySpecs (Instagram)

SkySpecs (Instagram)

Future state: BVLOS drone inspections & sensor monitoring

bart-im
DRIVING INNOVATION

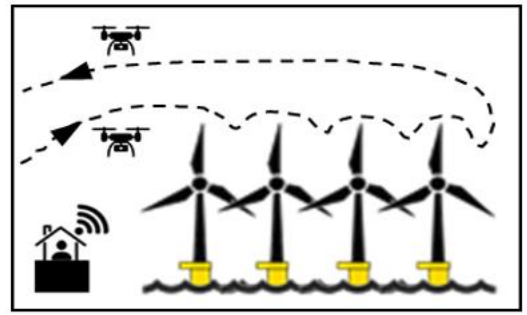
Why?

- Condition-based maintenance
- Reduce costs/vessel occupation/CO_2
- Eliminate workforce bottleneck
- Flexible, when low production

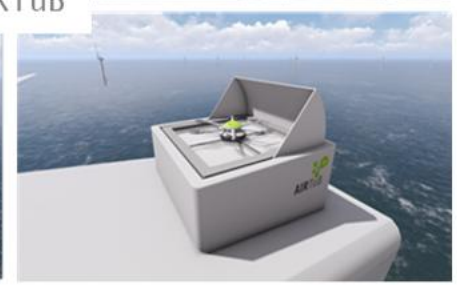
Innovations

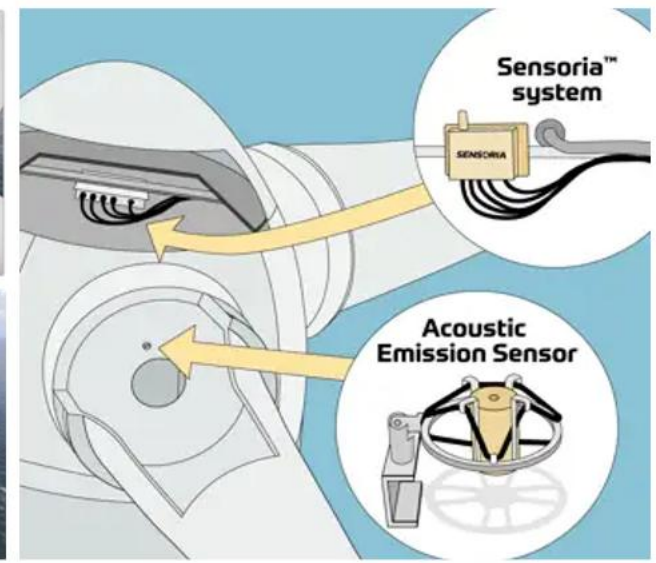
- AIRTuB[1]: drone + in-blade sensors
  - Resident drone-crawler + Ultrasonic
  - Sensors: vibration, acoustic, lightning
  - Digital twin
- Long-range drones: AirSpection, XER
- 24/7 Sensor monitoring: Sensoria, Tarucca, Eologix-Ping, Fibersail

1. TNO, TU Delft, HZ, InHolland, NLR, Tarucca, Mistras, Dehn, various drone & robot SMEs, Eneco, Vattenfall, WCM



AIRTuB





Repairs – current state: Rope Access technicians

Future state: Leading Edge repair robots

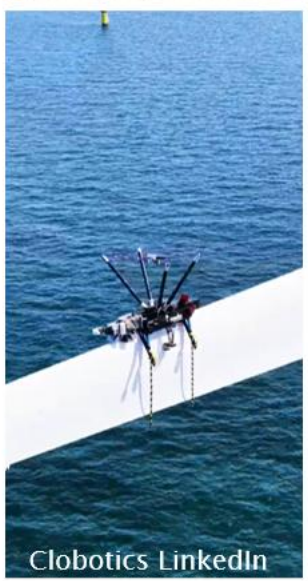
bart-im
DRIVING INNOVATION

Why?

- Safer
- 5x faster and cheaper
- Eliminate workforce bottleneck
- Less vessels movements
- Improved blade integrity
- Increased turbine uptime

Innovations

- ReBlade
- BladeRobots
- Clobotics
- Aerones



How will you contribute

Field lab ZEPHYROS

WORLD CLASS MAINTENANCE