



Associatie Technologie Overdracht

Business Centre Offshore Wind Den Helder

Den Helder as Design, Production,
Maintenance & Training Centre
North Sea Wind Farms

ATO - NH J.M. Bais
Den Helder, april 2007



Development Cluster Wind Energy

Offshore Wind: new opportunities for North-Holland

- Target Europe: > 60.000 MW in 2020
- 1000-nds of jobs in the Netherlands
- Hundreds of jobs in the region of Den Helder
- Engineering, production, maintenance offshore
 - 2 MW production in Den Helder (Harakosan)
 - 4,5 MW offshore turbine development & production (DarwinD)
- A proactive region creates their own opportunities



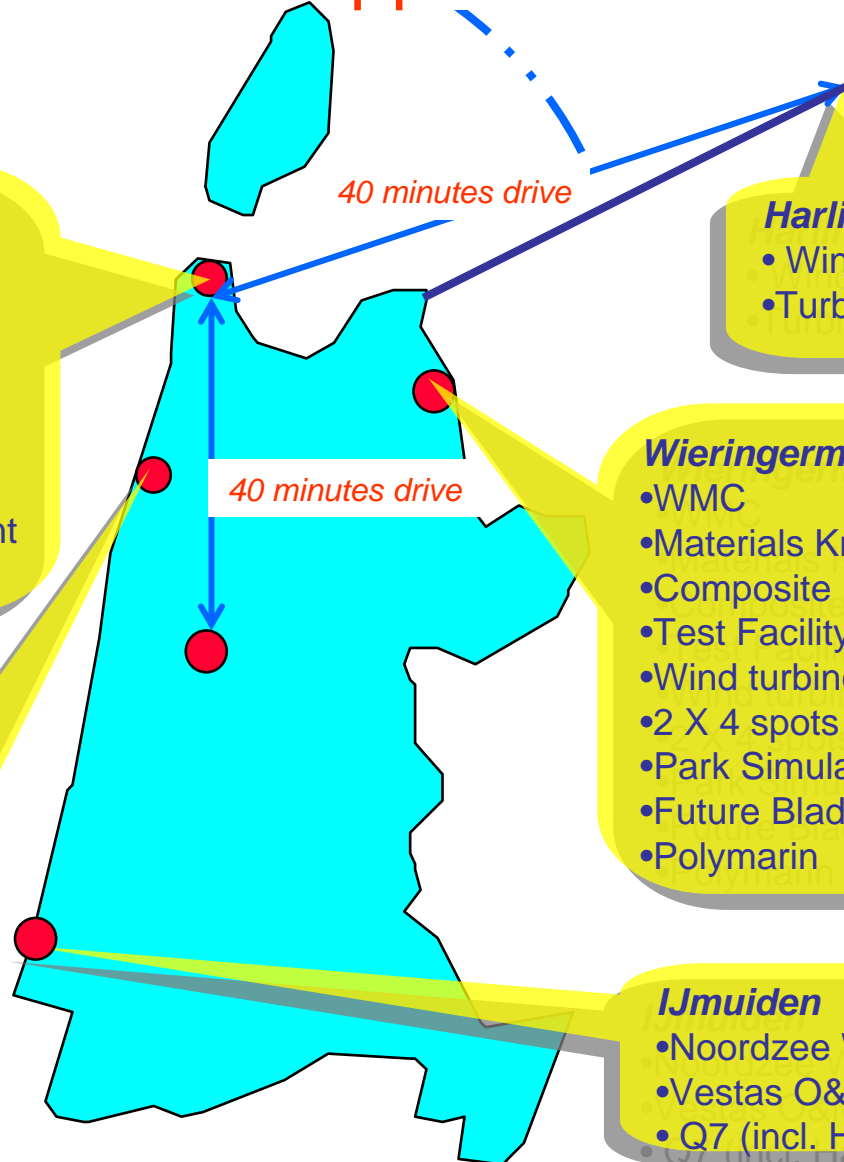
Connection Offshore Wind



Research Wind Energy
Marine en Maritime Technology
Asset Management Control



Network creates opportunities



Den Helder

- Direct Drive Technology
- Harakosan (> 2MW onshore)
- DarwinD (> 4.5 MWW Offshore)
- AMC-RF Asset management
- Peterson (Logistics North Sea)
- IMARES / TNO / LUWageningen
- ATO-NH Marketing / Development
- DHTC offshore training centre

Harlingen

- Windpowercentre
- Turbine training centre

Wieringermeer

- WMC
- Materials Knowledge
- Composite Expertise
- Test Facility for blades up to 60 m1
- Wind turbine Testpark
- 2 X 4 spots for 1 – 1 testing
- Park Simulation Mini Park
- Future Blade Manufacturing
- Polymarín

Petten

- ECN
- R & D Wind Energy
- We @ Sea

IJmuiden

- Noordzee Wind
- Vestas O&M
- Q7 (incl. Haarlem)

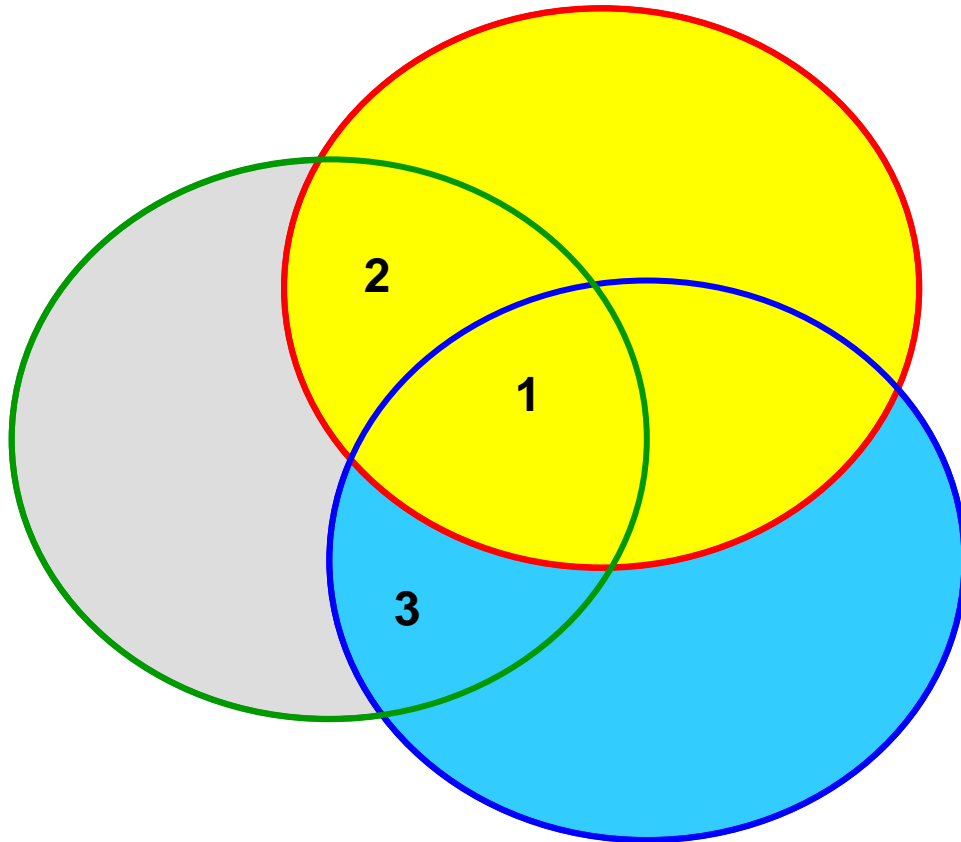


Starting Points Offshore Wind

- Design
 - No maintenance during the operation phase
 - Parts as less as possible
 - Parts as small as possible
 - Monitoring onshore
 - Easy to install; easy to remove
 - Light weight constructions
 - Easy connections
 - Few construction operations on site
 - The challenges
 - Reducing the weight & number of components
 - High quality components
 - Better to invest in quality than to have much maintenance



Design



- Direct Drive Turbine Knowledge (DarwinD, Harakosan, TT)
- Knowledge Offshore Materials & Corrosion (TNO Den Helder)
- Knowledge & Test Centres Wind Energy (ECN, WTW, WMC)

Connection of Developments

1. Ultimate — — —
Development Offshore
Wind Farms
2. Strong — —
Materials (steel, composites)
3. Strong — —
Direct Drive Use in Wind Turbines

Den Helder has the opportunity
to become
Design Centre Offshore Wind

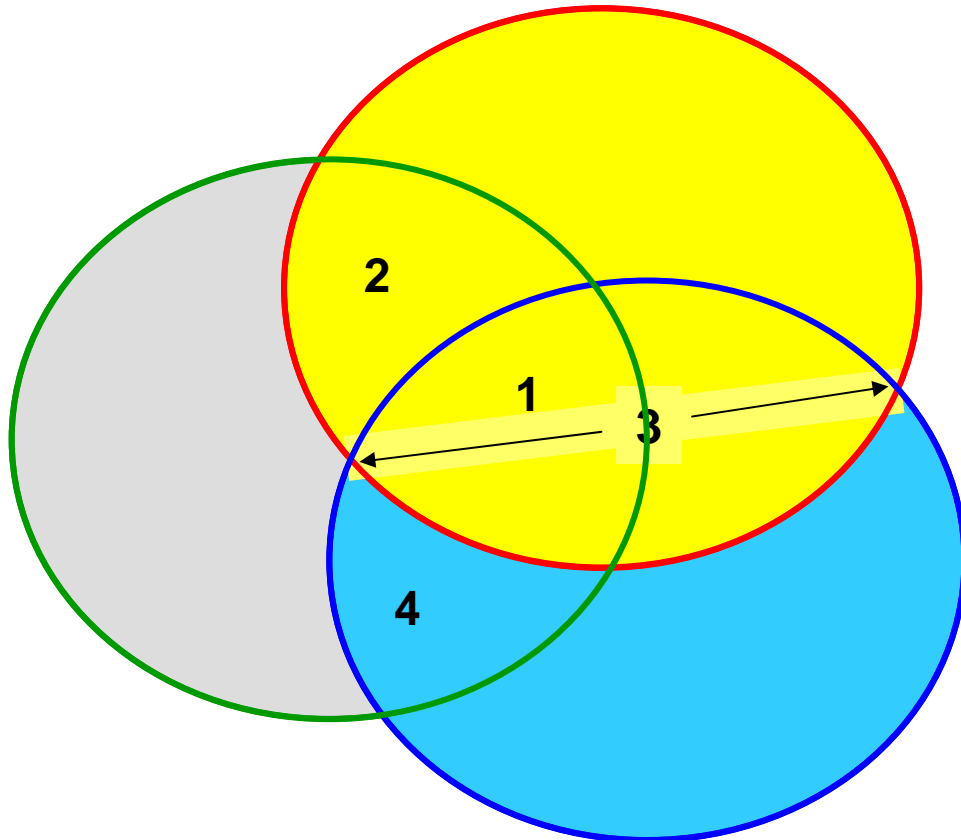


How to Operate & Maintain

- Optimize the design
 - Designed and produced for offshore purposes
 - The use of building blocks en systems integration
 - Design
 - Level of building blocks
 - Easy access and easy to handle equipment
 - Optimization of maintenance operators
 - General
 - Windturbine specific
 - Windturbine producer (brand) specific



Maintenance



- Den Helder Logistics Northsea (Peterson)
- Maintenance Technologies (AMC / ILS)
- Maintenance Knowledge Wind Energy (ECN)

Connection of Developments

1. Ultimate ——— Maintenance Offshore Wind Farms
2. Strong ——— High-Tech AMC / ILS systems
3. Strong ——— Offshore Maintenance Support
4. Strong ——— Offshore Wind & Logistics

Den Helder has the Opportunity to become Maintenance City Offshore Wind



Maintenance Steps

1. Daily Monitoring
2. Preventive Controlling & Small Service
3. Curative Small Scale Repairs
4. Planned Large Scale Maintenance
5. Curative Large Scale Maintenance



Maintenance Economics

Operation Centre in Den Helder

- Operator room, ICT, operators

Yearly preventive check up

- Hotel ship, Spare parts, maintenance operators / sailors

Small curative repairs

- Fast offshore vessel, Spare parts, maintenance operators / sailors

Planned large scale maintenance

- Hotel ship, Spare parts, maintenance operators / sailors

Education, Design, Maintenance, Training, Equipment

Work for many fte's

But how many ??



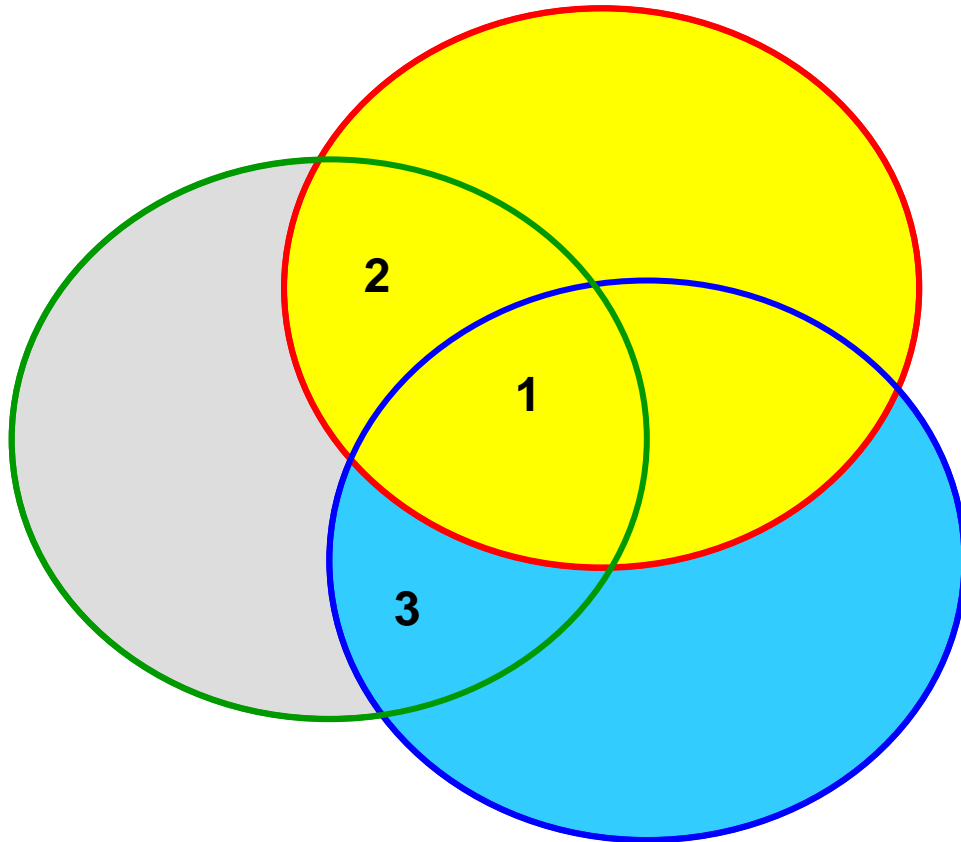
Education & Training

- DHTC Offshore Training Centre
 - In, on and under water safety training
 - Training Equipment
 - swimming pool (600m³) equipped with a heli-duncker
 - training platform in the harbour mouth, operating a variety of rescue boats.
 - a fire fighting exercise building.
- WindpowerCentre Turbine Training
 - Survival and escape training
 - Training Equipment
 - training Turbine in Harlingen





Education & Training



- DHTC Den Helder
- Windpowercentre Harlingen
- Knowledge Wind Energy (Many)

Connection of Developments

1. Ultimate — — —
Offshore Survival Training Turbines
2. Strong — —
Onshore Training Turbine
Training Expertise Wind Turbines
3. Strong — —
In Water training Equipment
Training Expertise Oil & Gas

Collaboration of
DHTC and WindpowerCentre
creates the opportunity
to become the
Education & Training Centre
Offshore Wind