Realizing the Far and Large Offshore Wind Innovation Program (FLOW)

Presentation at We@Sea conference

Den Helder, December 1, 2009

A. Vision and objectives: FLOW is instrumental to realizing the Netherlands' renewable energy goals, and will create sustainable, knowledge intensive employment

The Founding Fathers of FLOW represent essential parts of the offshore wind energy value chain – other partners can join

Founding Fathers of the FLOW consortium

WIND FARM DEVELOPMENT AND OPERATION	RWE The energy to lead, Eneco
ELECTRICAL SYSTEM AND GRID INTEGRATION	TenneT
OFFSHORE ENGINEERING, CONSTRUCTION AND MAINTENANCE	Ballast Nedam, Van Oord
VESSELS AND EQUIPMENT FOR OFFSHORE INSTALLATION AND FOUNDATIONS	IHC MERWEDE
WIND TURBINE DESIGN AND MANUFACTURING	2-B Energy, DARWIND Sea-change in wind energy
WIND ENERGY R&D	ECN Energy research Centre of the Netherlands, TU Delft

Source: FLOW

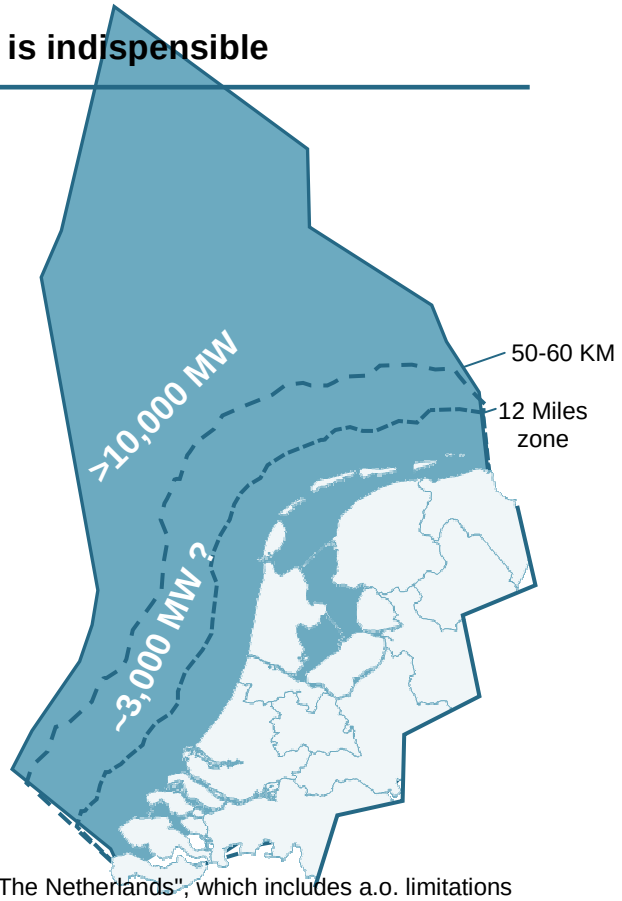
Far-offshore wind energy is indispensible for realizing the Netherlands' renewable energy goals

Dutch renewable energy goals 2020

- Target 2020: **CO_2 reduction of 30%** compared to 1990
- Realizing the target includes a requirement of **20% renewable energy**
- Towards 2020 **6,000 MW offshore wind energy**

Far-offshore (>50-60 km) wind energy is indispensible

- Considering the interests of other users, near shore locations (<50-60 km off-coast, <30 m water depth) can only accommodate ~3,000 MW[1)]? Limiting factors are:
  - Special areas
  - Oil and gas platforms
  - Shipping routes
- Far-offshore locations offer room for more than 10,000 MW with the least impact on other users and the environment



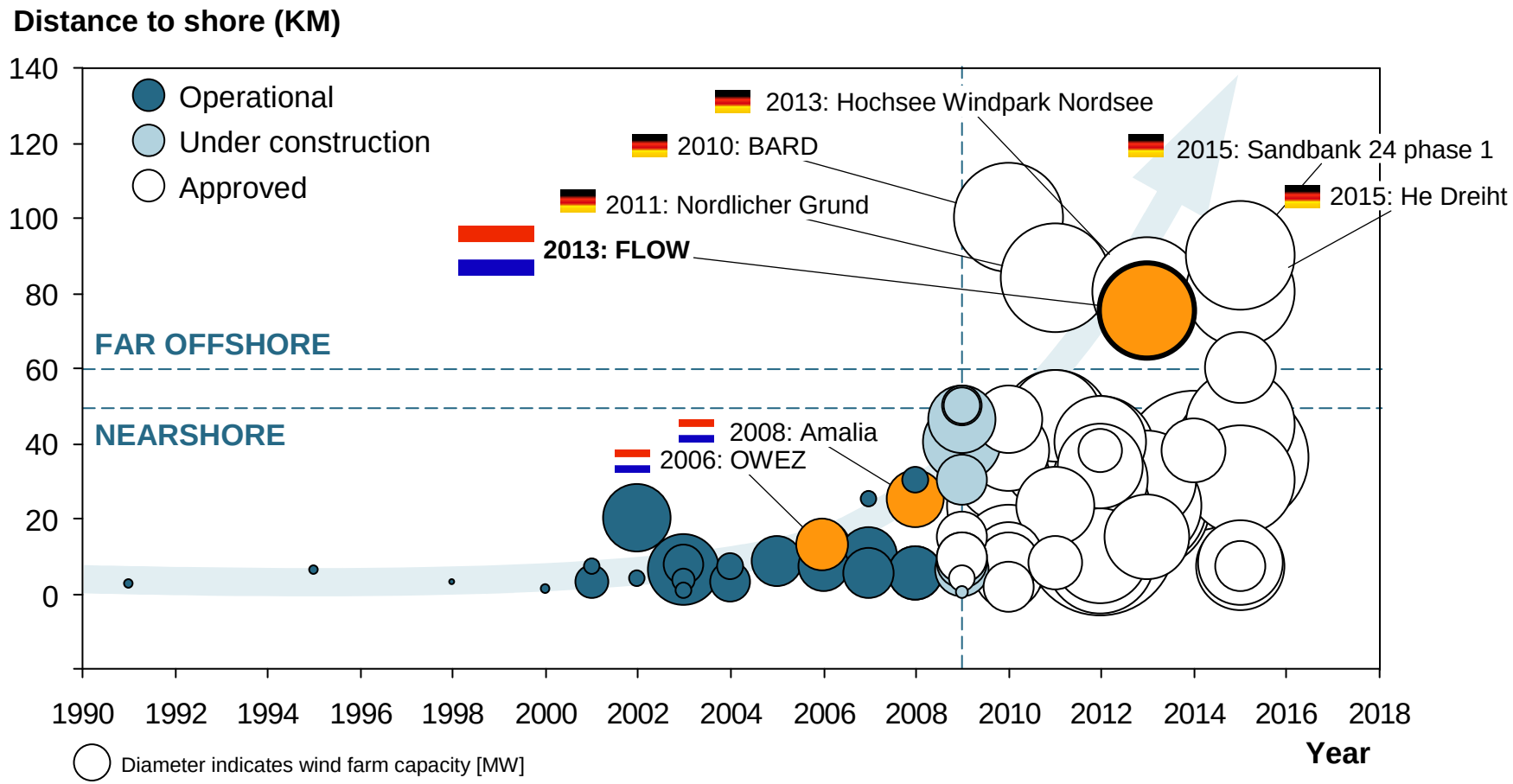
1) Scenario 2 in DNV report "Identification of Suitable Sea Areas for Wind Farms with Respect to Shipping and Safety, The Netherlands", which includes a.o. limitations by shipping routes (no rerouting), ship approach to ports, oil and gas installations, present nature reserve areas, military zones

Source: Innovatie Agenda Energie, DNV, ECN

If we act now, we can be among the leaders in far-offshore wind energy – to date, no far-offshore wind farms are operational

Europe – Distance to shore/year

INDICATIVE

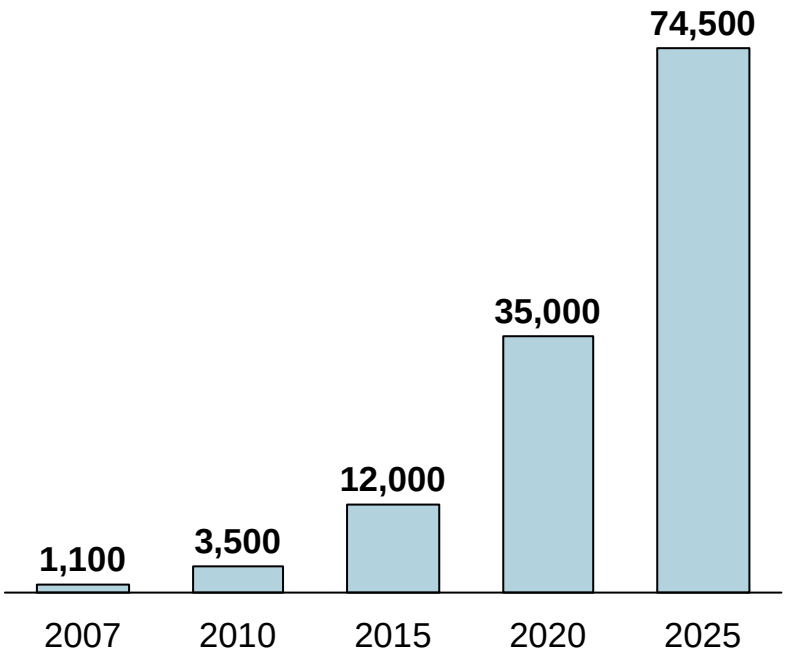


Source: EWEA 2009, Ecorys 2009, Project websites, Roland Berger Analysis

A strong Dutch value chain, combined with our ideal location, can claim a large market share in a rapidly developing new sector

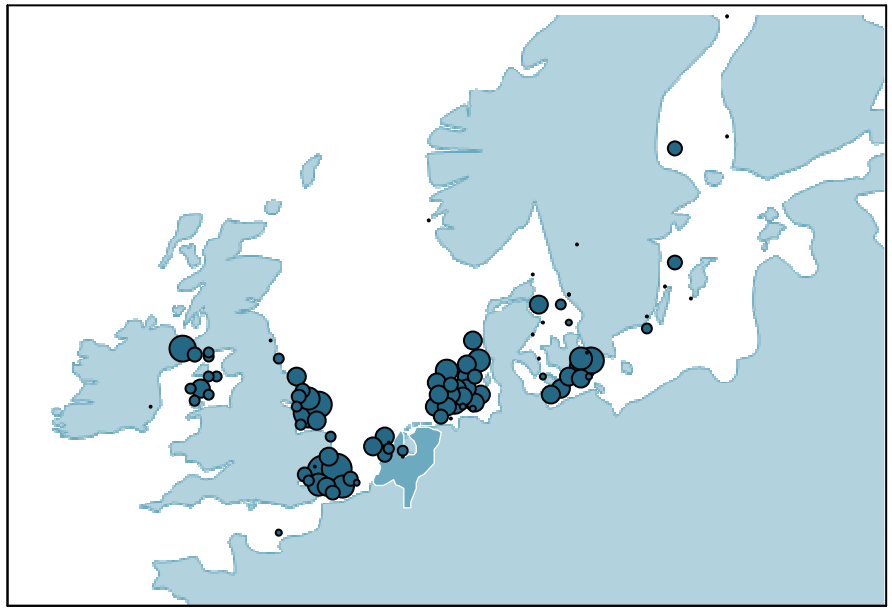
Total installed offshore capacity in Europe [MW] will increase according to EWEA reference scenario

INDICATIVE



Ideal location of the Netherlands among the most important offshore wind energy countries

Expected commissioning before 2015 **ILLUSTRATIVE**

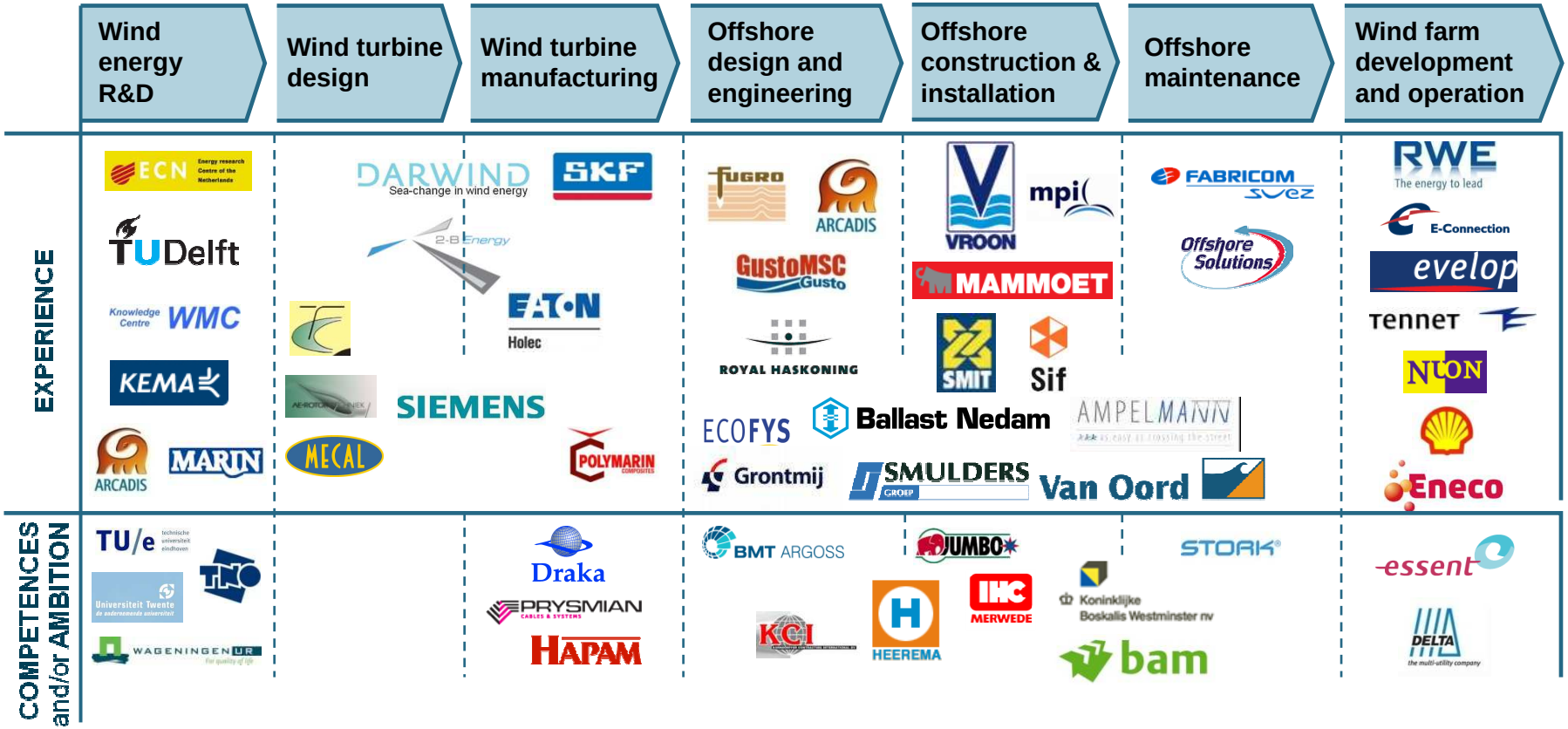


Source: EWEA reference scenario, Windpower.org, BWEA, Ecorys 2009, Project websites

The Netherlands has the potential to develop a very strong offshore wind energy value chain

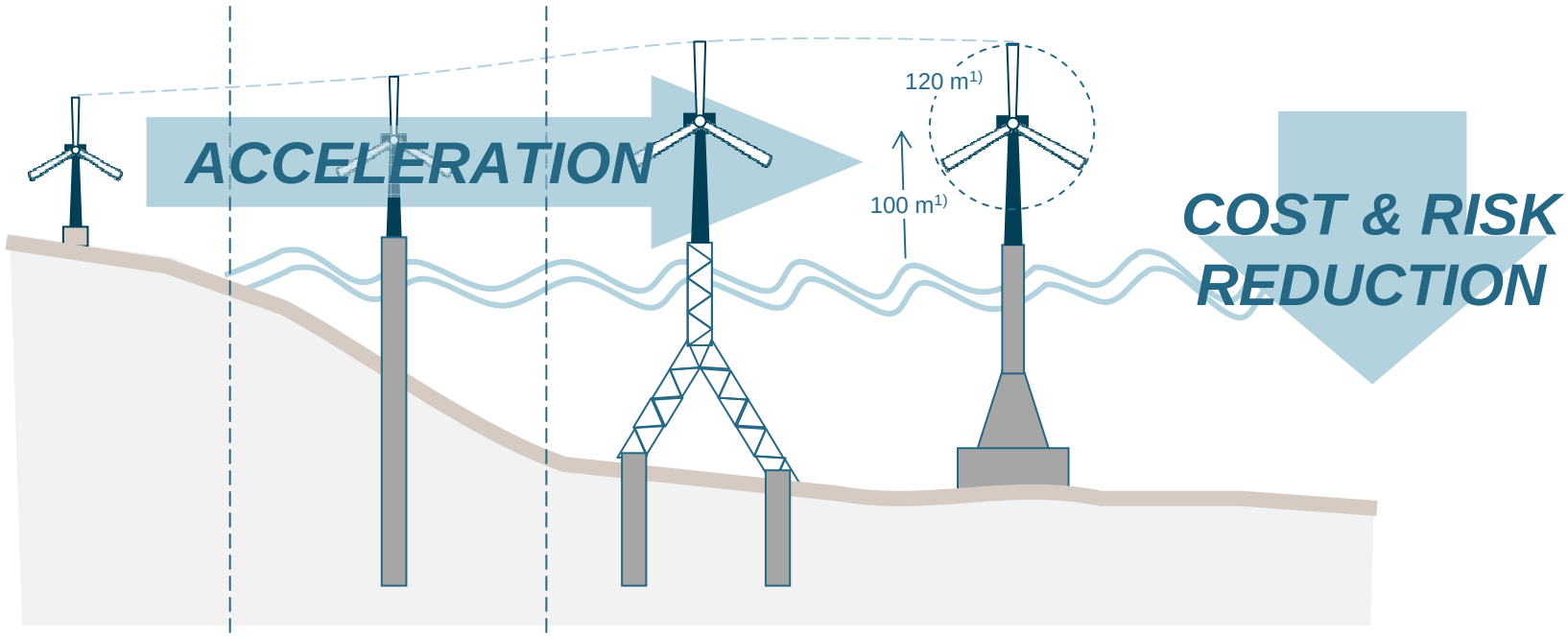
Offshore wind energy value chain (under development)

NON-EXHAUSTIVE



Source: FLOW

FLOW aims to accelerate far-offshore wind energy and to reduce the associated costs and risks



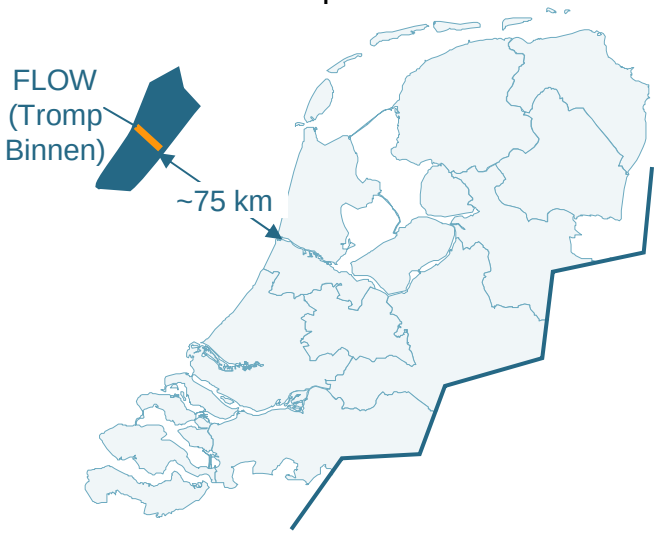
1) Typical dimensions of a 5 MW offshore wind turbine

Source: FLOW

Deliverables of FLOW are the realization of a demo wind farm far offshore by Q3 2013 and > 20% cost/kWh reduction by 2015

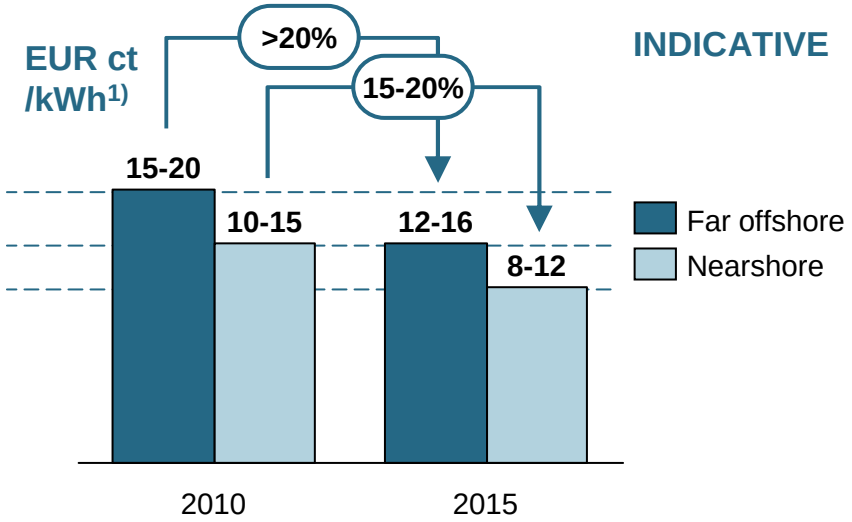
Deliverable 1 – Acceleration: FLOW demo wind farm operational by Q3 2013

- Demonstration wind farm to build knowledge and competence:
  - 20-60 turbines of 5-6 MW
  - >50-60 km offshore
  - >30 m water depth



Deliverable 2 – Cost and risk reduction: Cost/kWh reduction of 20% by 2015

- Same cost reduction target as nearshore wind energy, but in more difficult conditions (>50-60 km offshore, >30 m water depth), reducing the economic gap between nearshore and far-offshore wind energy through development of far-offshore competences

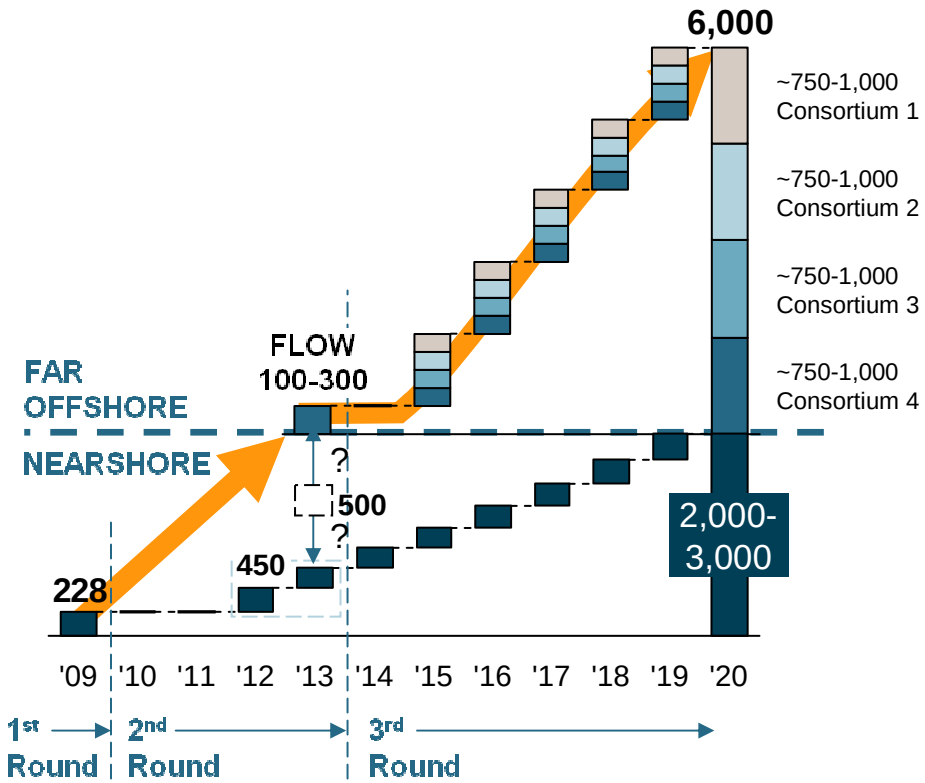


1) Total cost of energy (including grid connection costs) in line with ECN study for SDE in Second Round

Source: FLOW

The 6,000 MW of offshore capacity will be installed in large tranches and by several different consortia

Capacity increase through 2020 [MW]

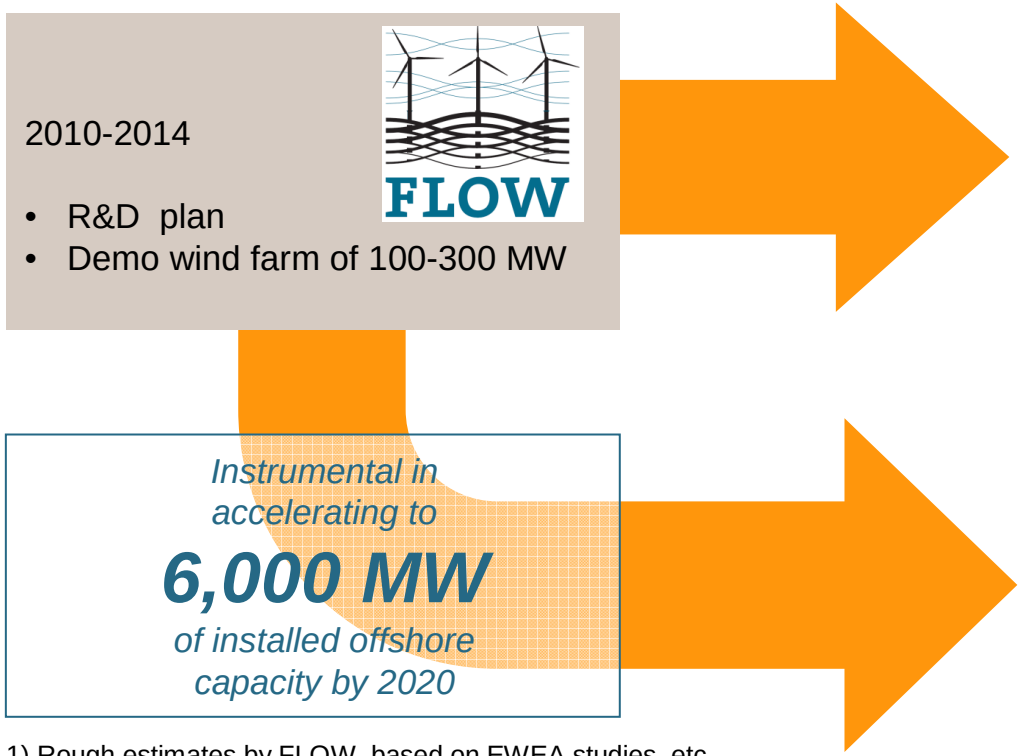


Source: FLOW, Innovatie Agenda, Programma Schoon en Zuinig

Comments

- **The Dutch government aims to realize 6,000 MW in offshore wind energy by 2020**
  - 228 MW realized in the 1st Round
  - 450 MW will be realized in the 2nd Round
  - 5,000 MW will need to be realized in a 3rd Round, of which ~3,0000-4,000 MW will need to be built far offshore
- **FLOW will accelerate the realization of far-offshore wind energy to reach the 6,000 MW goal by 2020 – other consortia will also benefit**
  - FLOW far-offshore knowledge will result in cost and risk reduction required for large-scale investments in the 3rd Round
  - If knowledge building does not start until the 3rd Round, the 6,000 MW target will not be attained by 2020
  - Other consortia will also benefit from knowledge built in FLOW
- **The Dutch government decided to install an additional 500 MW in the 2nd Round – location (near/far-offshore) to be decided**

FLOW directly creates jobs – indirect benefits include savings on governmental wind energy funding and the creation of additional jobs through market leadership of Dutch companies



INDICATIVE

1 DIRECT BENEFITS

- **400-1,000 FTE/year**[1)] from 2010-2014, depending on the FLOW demo wind farm size and the involvement of companies in the Netherlands in the production/ installation of the FLOW demo wind farm

2 INDIRECT BENEFITS

- **~EUR 1.0 – 1.5 billion**[1)] in savings on governmental wind energy funding from 2015-2030
- **~10-15,000 additional FTE**[1)] creation by 2020, depending on the European market share of companies in the Netherlands
- **~ 4-5 Megaton CO_2** emission reduction/year[2)]

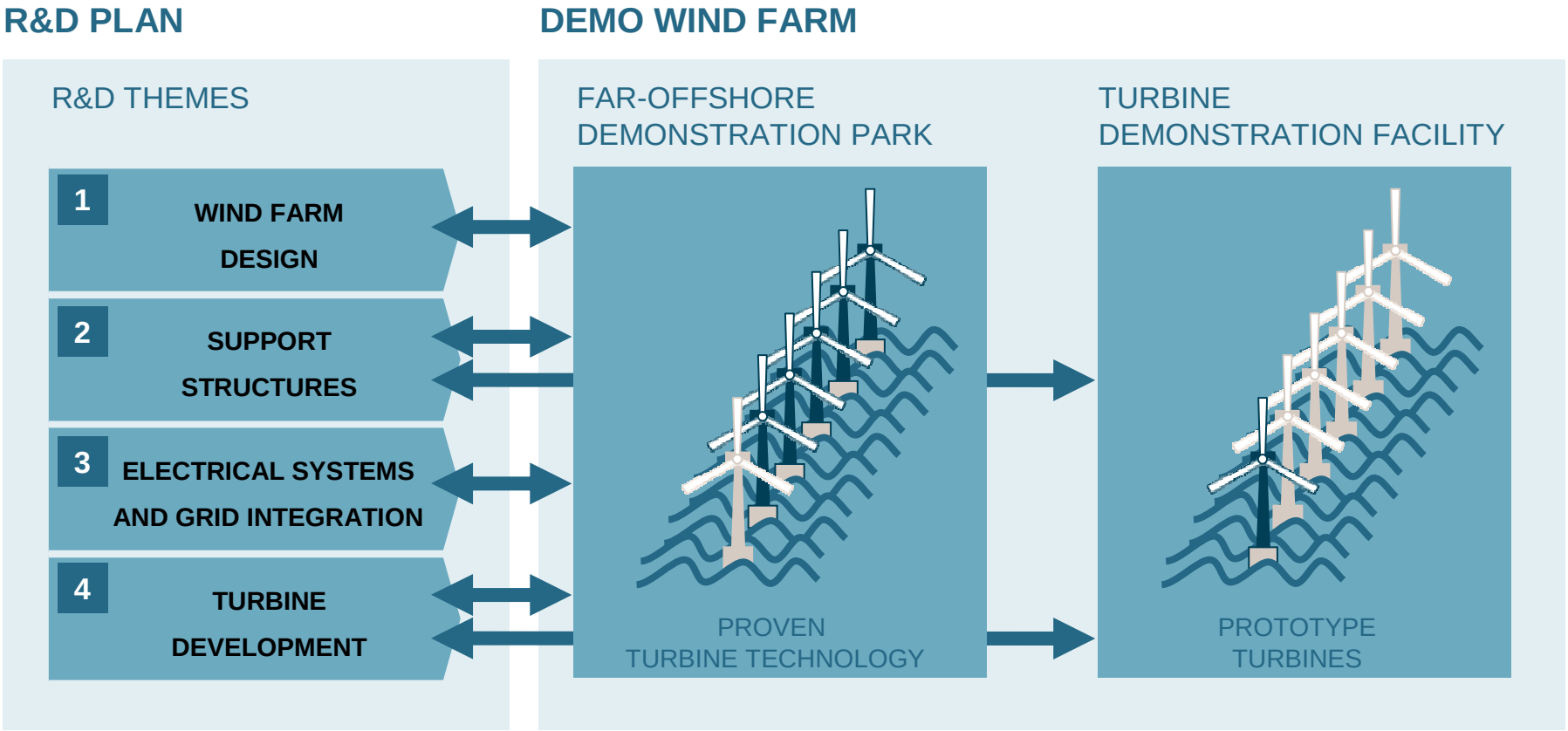
1) Rough estimates by FLOW, based on EWEA studies, etc.
2) Acceleration from 3 .000 to 6.000 MW leads to 3,9 Megaton CO_2 emission reduction/year, based on ECN calculation method, and on average CO_2 emission of 0,6 kg per kWh; adding the international acceleration through FLOW leads to rough indication of 4-5 Megaton

Source: FLOW

B. **Activities:** FLOW will consist of an R&D plan and a demo wind farm far offshore, and will require significant public-private funding

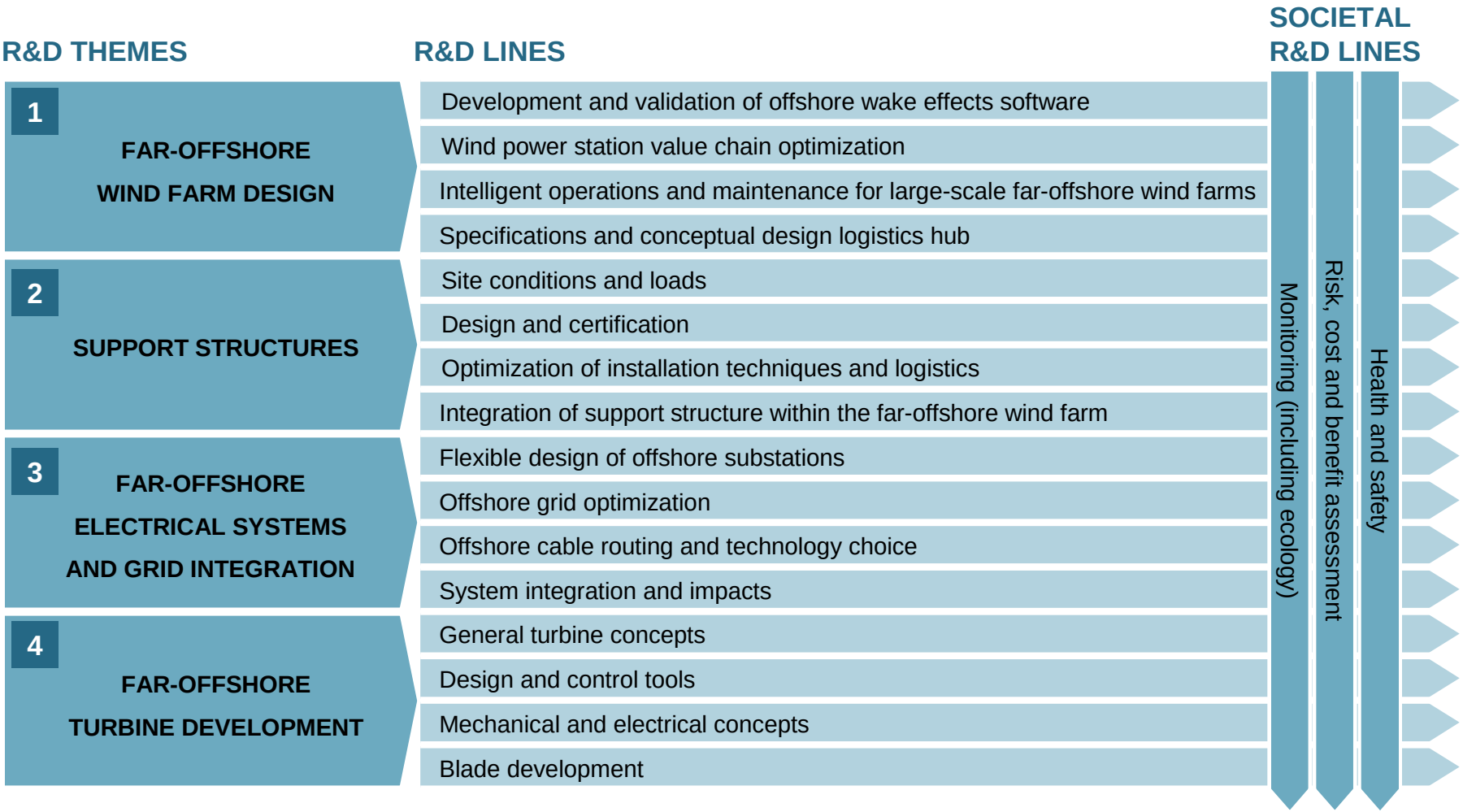
FLOW's R&D plan will develop technology and innovative concepts that will directly be demonstrated in the demo wind farm

Elements FLOW



Source: FLOW

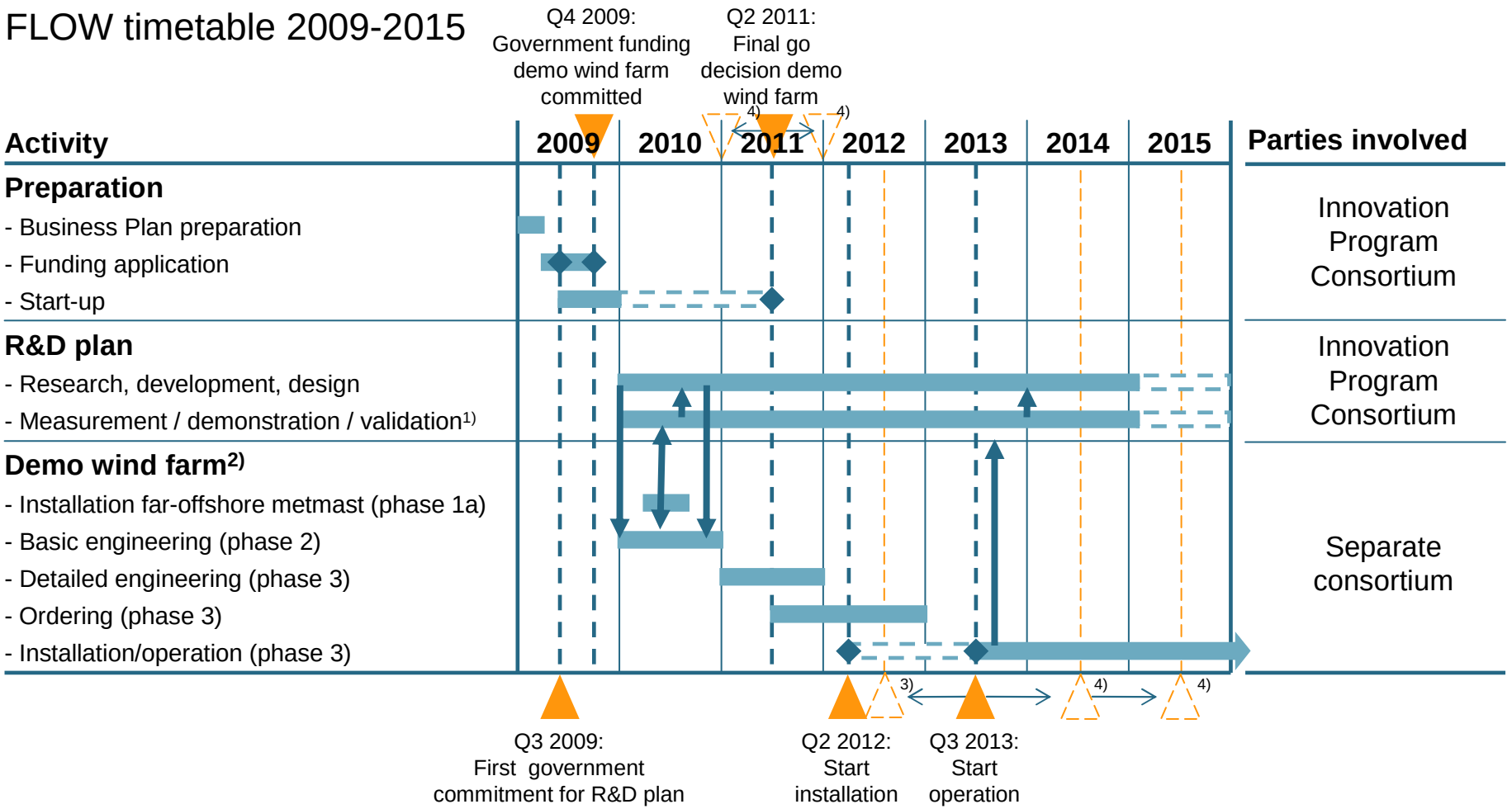
The R&D plan consists of 4 R&D themes, and incorporates 16 R&D Lines and 3 Societal R&D lines



Source: FLOW

The FLOW R&D plan will start in Q1 2010; the ambition is to have the FLOW demo wind farm operational by Q3 2013

FLOW timetable 2009-2015

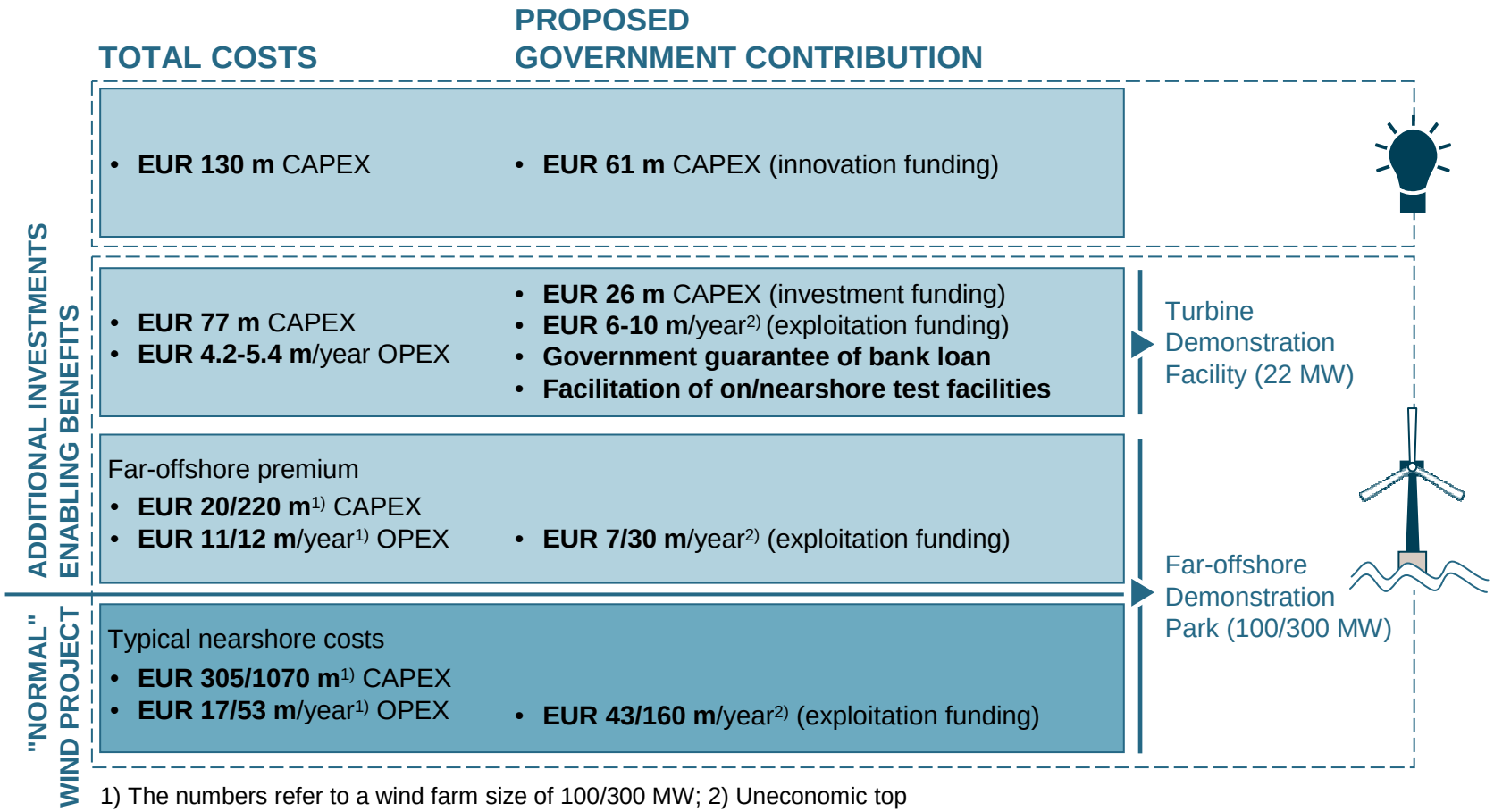


1) Also at readily available on- and nearshore locations; 2) For description of phases see Demo wind farm Plan; 3) If the demo wind far will be only 100 MW instead of 300 MW; 4) Depending on external factors (value chain availability, grid connection capacity, licenses, government funding) and internal factors (IRR, capital availability)

Source: FLOW

The government is asked to contribute to the different cost categories of FLOW

Total public-private costs and proposed government contribution [EUR m]



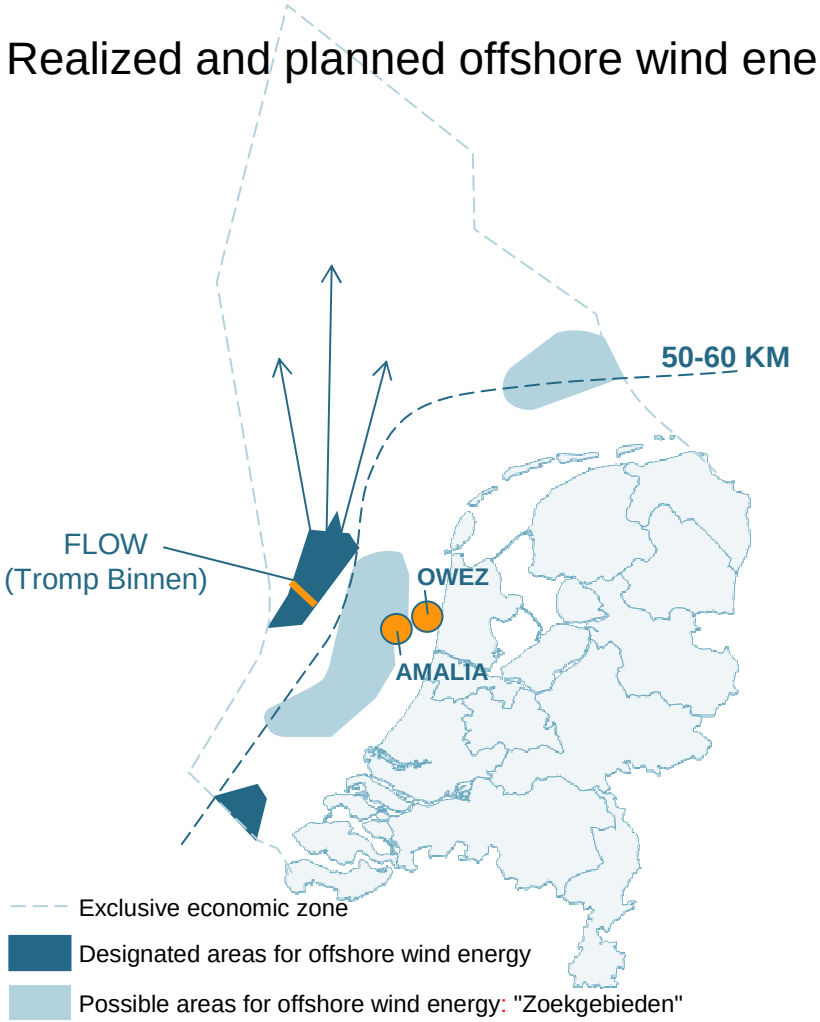
1) The numbers refer to a wind farm size of 100/300 MW; 2) Uneconomic top

Source: FLOW

C. Backup

The FLOW demo wind farm will possibly be established at a designated area ~75 km offshore and at ~30-35 m water depth

Realized and planned offshore wind energy areas



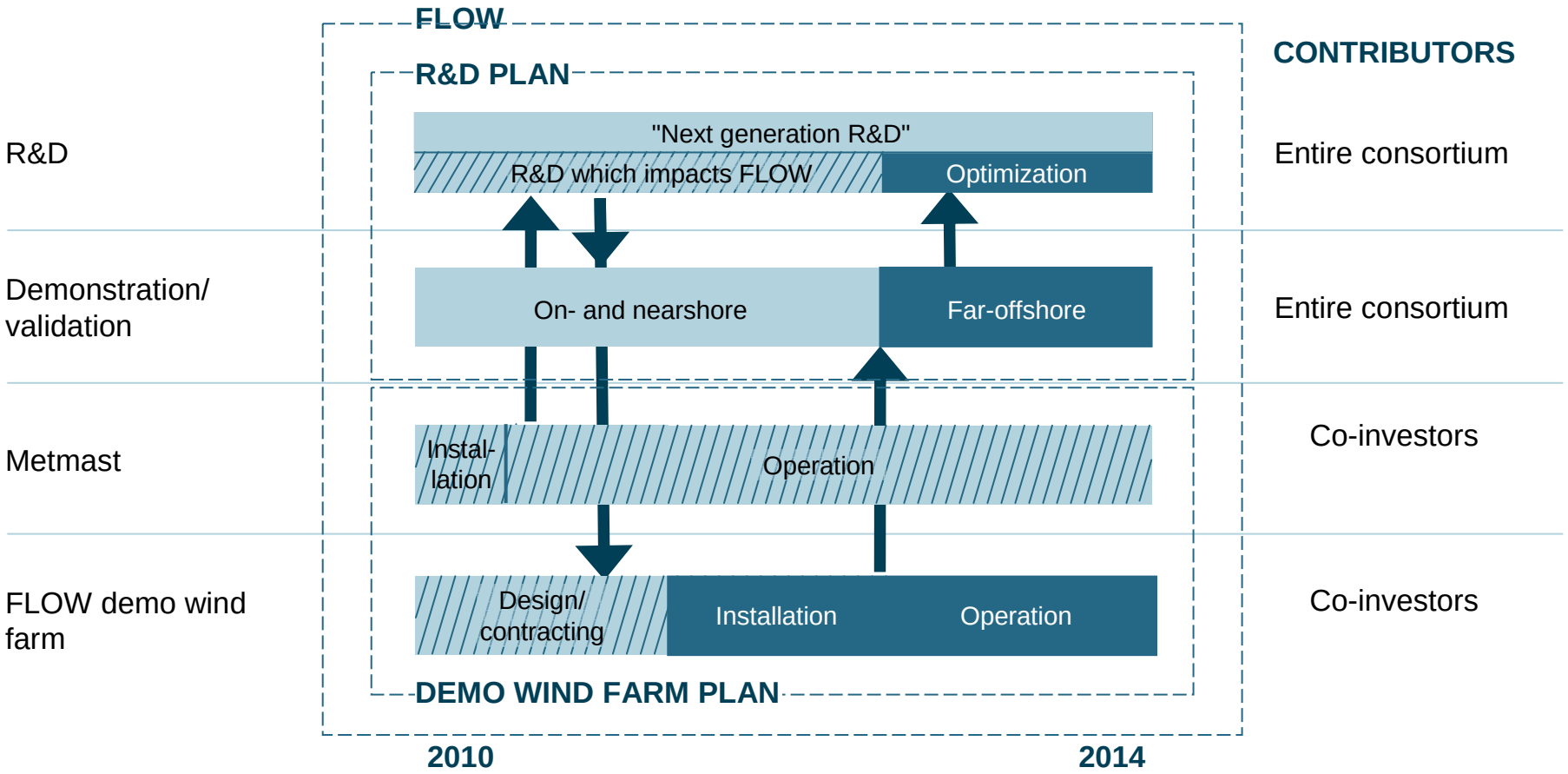
Source: Ontwerp Nationaal Waterplan, December 22 2008

Comments

- The Dutch government has designated two large areas for offshore wind energy, and appointed two possible areas called "Zoekgebieden"
- An important part of the potential areas are far-offshore (>50-60 km from the coast)
- **The FLOW demonstration wind farm will possibly be located at "Tromp Binnen", within one of the designated areas at a distance of ~75 km and a water depth of ~30-35 m**

FLOW includes R&D, demonstration and validation, and will utilize a metmast and a demo wind farm

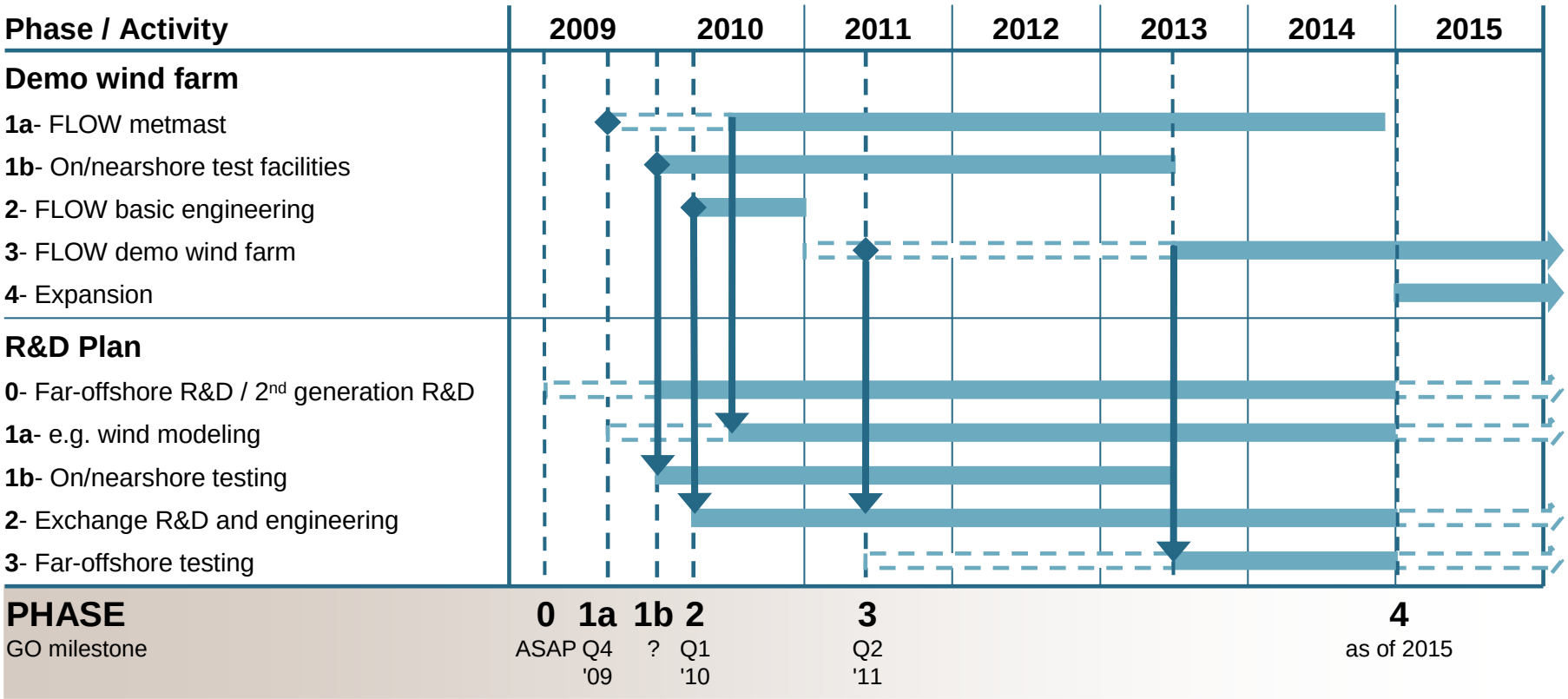
Overview of FLOW



Source: FLOW

The phases of the R&D Plan and the Demo Wind Farm Plan are closely linked

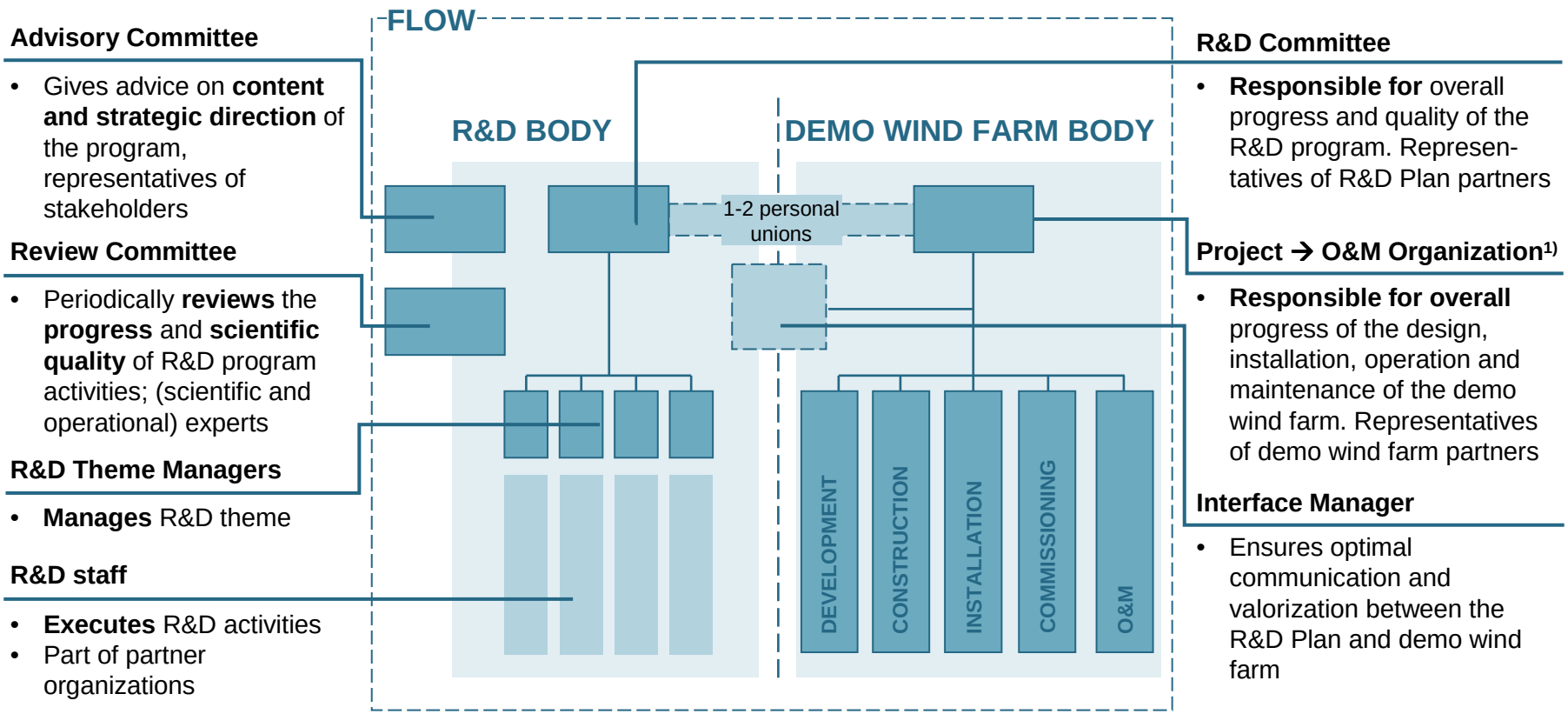
FLOW phasing



Source: FLOW

FLOW will have a practical organizational structure

FLOW organizational structure



Advisory Committee

- Gives advice on **content and strategic direction** of the program, representatives of stakeholders

Review Committee

- Periodically **reviews** the **progress** and **scientific quality** of R&D program activities; (scientific and operational) experts

R&D Theme Managers

- **Manages** R&D theme

R&D staff

- **Executes** R&D activities
- Part of partner organizations

R&D Committee

- **Responsible for** overall progress and quality of the R&D program. Represen-tatives of R&D Plan partners

Project → O&M Organization[1)]

- **Responsible for overall** progress of the design, installation, operation and maintenance of the demo wind farm. Representatives of demo wind farm partners

Interface Manager

- Ensures optimal communication and valorization between the R&D Plan and demo wind farm

1) In base case: separate organization of Turbine demonstration Facility to be added

Source: FLOW