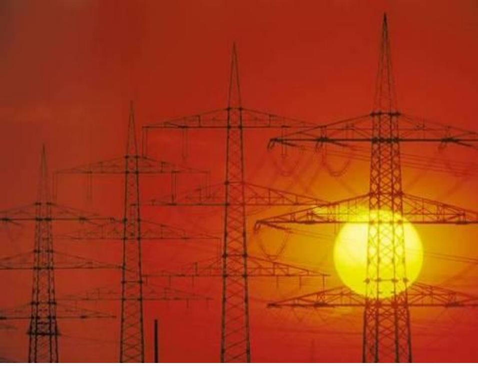
Offshore Renewables - R&D at Fraunhofer

ENERGYIN's 1st Annual Conference, Viseu, Feb 2011

- The Fraunhofer Model
- Fraunhofer IWES
- Offshore Wind and Ocean Energy

Jochen Bard
Head of Marine Energy Department
Fraunhofer Institute for Wind Energy & Energy System Technology - IWES

Fraunhofer IWES




People need the future - The future needs research

Introduction to the Fraunhofer Model

Fraunhofer-Gesellschaft, Munich
www.fraunhofer.de

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The Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft undertakes applied research of direct utility to private and public enterprise and of wide benefit to society.

Our Customers:

- Industry
- Service sector
- Public administration

Joseph von Fraunhofer 1787-1826

The Fraunhofer-Gesellschaft since 1949

Discovery of "Fraunhofer Lines" in the sun spectrum

Researcher

Research and development on behalf of industry and state

New methods of lens processing

Inventor

mp3 music format, white LED, high-resolution thermal camera, 2 patents/d

Head of Royal Glass Factory

Entrepreneur

e.g.: > €450 million revenues from industry (~4000 contracts) p. a.

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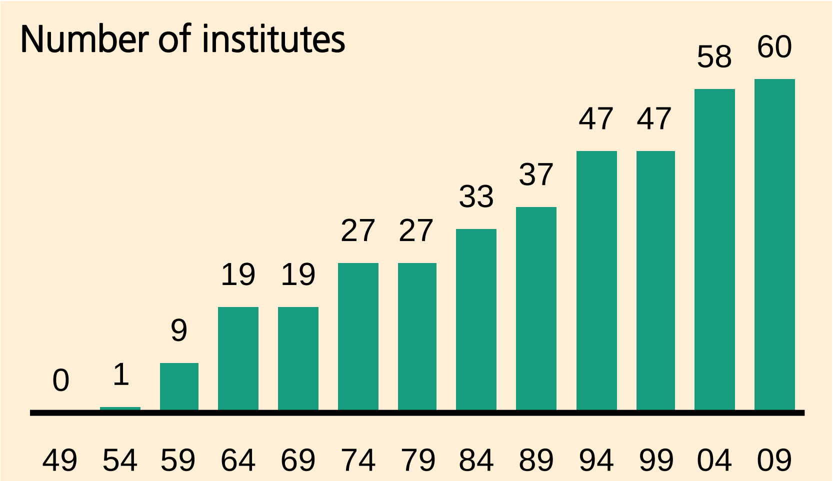
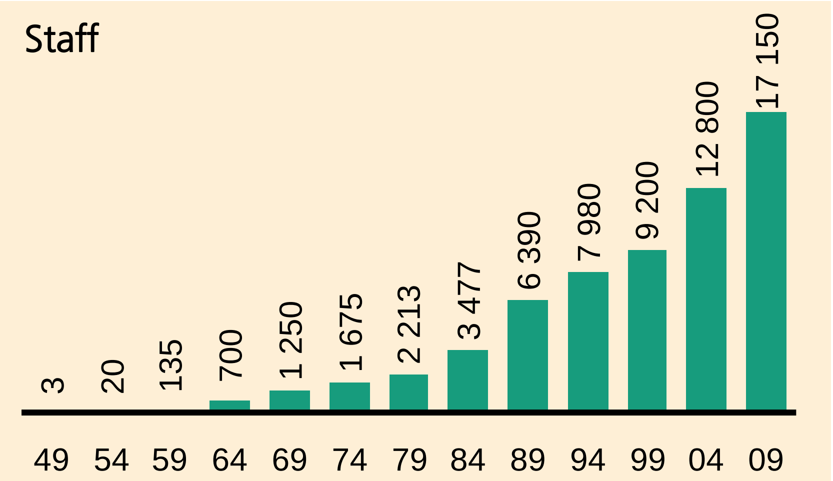
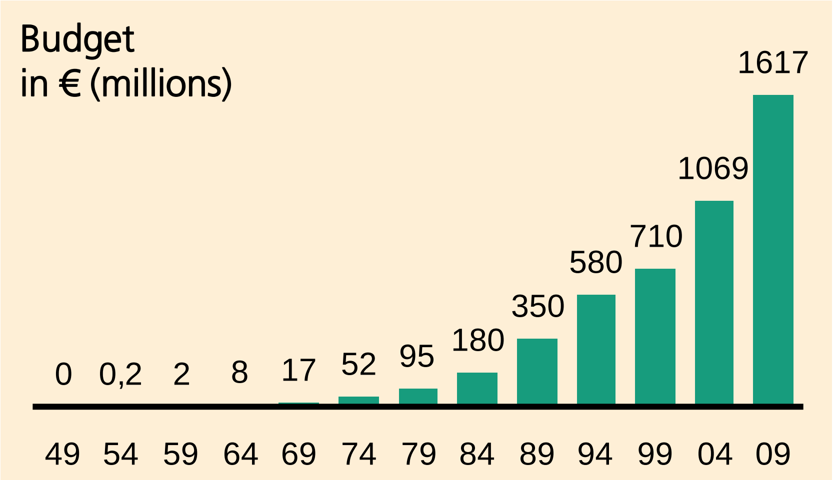
From a small association to the leading organization for applied research in Europe







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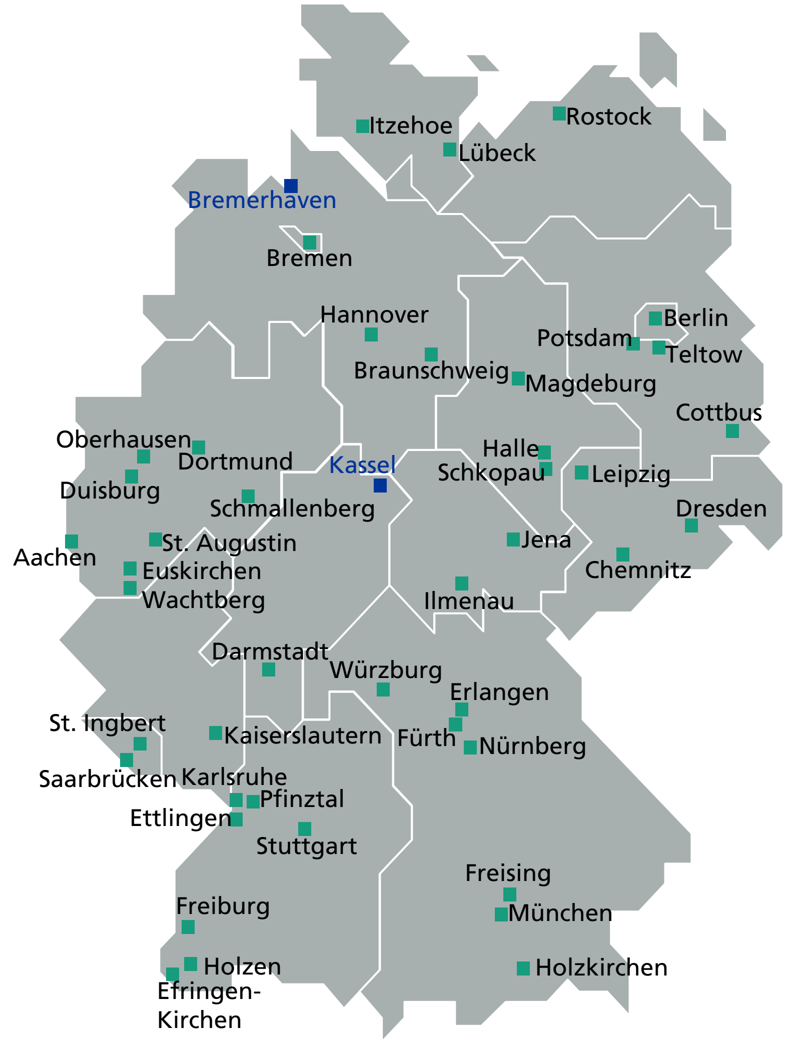
The Fraunhofer-Gesellschaft in Germany

60 Institutes at 40 locations

- ■ Institutes
- • Branches of Institutes, Research Institutions, Working Groups, Branch Labs and Application Centers

2010

Staff	18.130
R&D-budget	1.653 Million €



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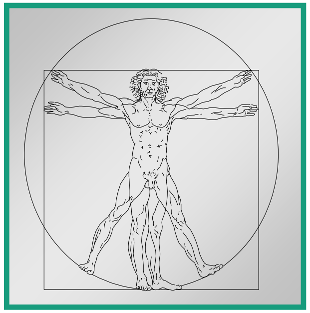
Demands on a Fraunhofer Institute



Scientific competence

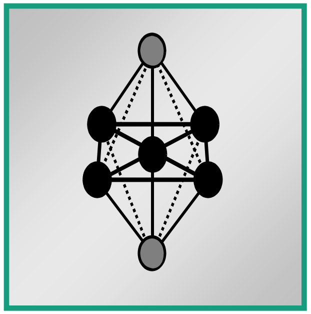
proved by the recognition of the scientific community

Well-balanced financial mix

of different independent sources

Market success and entrepreneurial competence

proved by contracts with industry and government



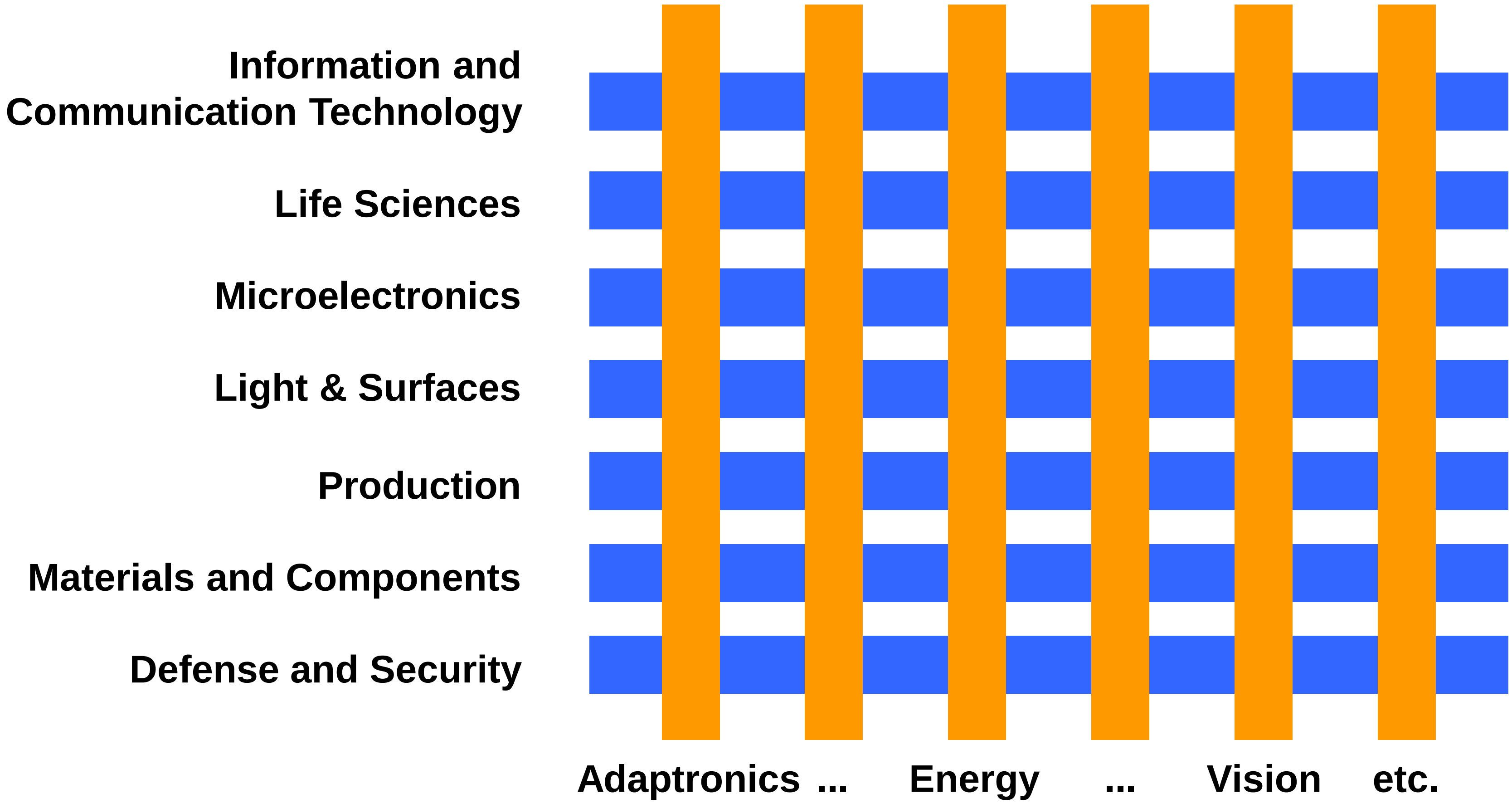
Professional networking

with other Fraunhofer Institutes and externals

Fraunhofer institutes network among themselves
- 1st level - network along related subject areas:
7 Fraunhofer Groups

Information and Communication Technology	institute	institute	institute	institute	institute
Life Sciences	institute	institute	institute	institute	institute
Microelectronics	institute	institute	institute	institute	institute
Light & Surfaces	institute	institute	institute	institute	institute
Production	institute	institute	institute	institute	institute
Materials and Components	institute	institute	institute	institute	institute
Defense and Security	institute	institute	institute	institute	institute

Fraunhofer institutes network among themselves
- 2nd level - network along interdisciplinary fields of research: 19 Fraunhofer Alliances



Fraunhofer Alliances

 Adaptronics

 Ambient Assisted Living AAL

 Automobile Production

 Building Innovation

 Cloud Computing

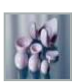
 Digital Cinema

 E-Government

 Energy

 Food Chain Management

 Additive Manufacturing

 Advancer

 Lightweight Structures

 Nanotechnology

 Optic Surfaces

 Photocatalysis

 Polymer Surfaces POLO

 Cleaning Technology

 Simulation

 Water Systems (SysWasser)

 Traffic and Transportation

 Vision

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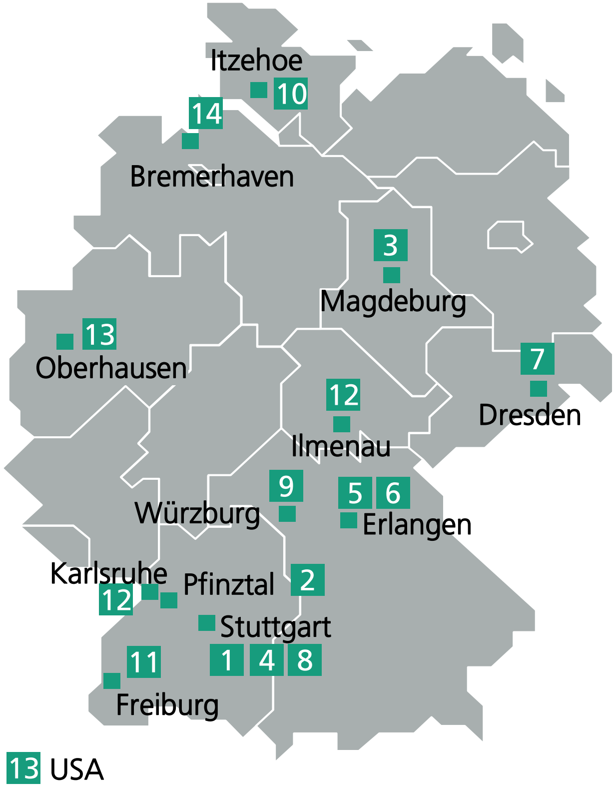
Fraunhofer Alliance Energy

- > 1500 employees
- Renewable energies
  - Photovoltaics, Solar thermal, concentrating solar plants
  - Biomass, biogas and bio fuels
  - Fraunhofer Wind Energy Network
- Efficient use of energy
- Energy in buildings
- Smart grids
- Storage technologies



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»Network of innovators« explores the entire process chain

Example: »Fraunhofer System Research Electro mobility«

Electro mobility as a holistic term

Energy generation

Energy transport and distribution

Interface power grid/ vehicle

Energy storage

New car concepts

Circular flow economy

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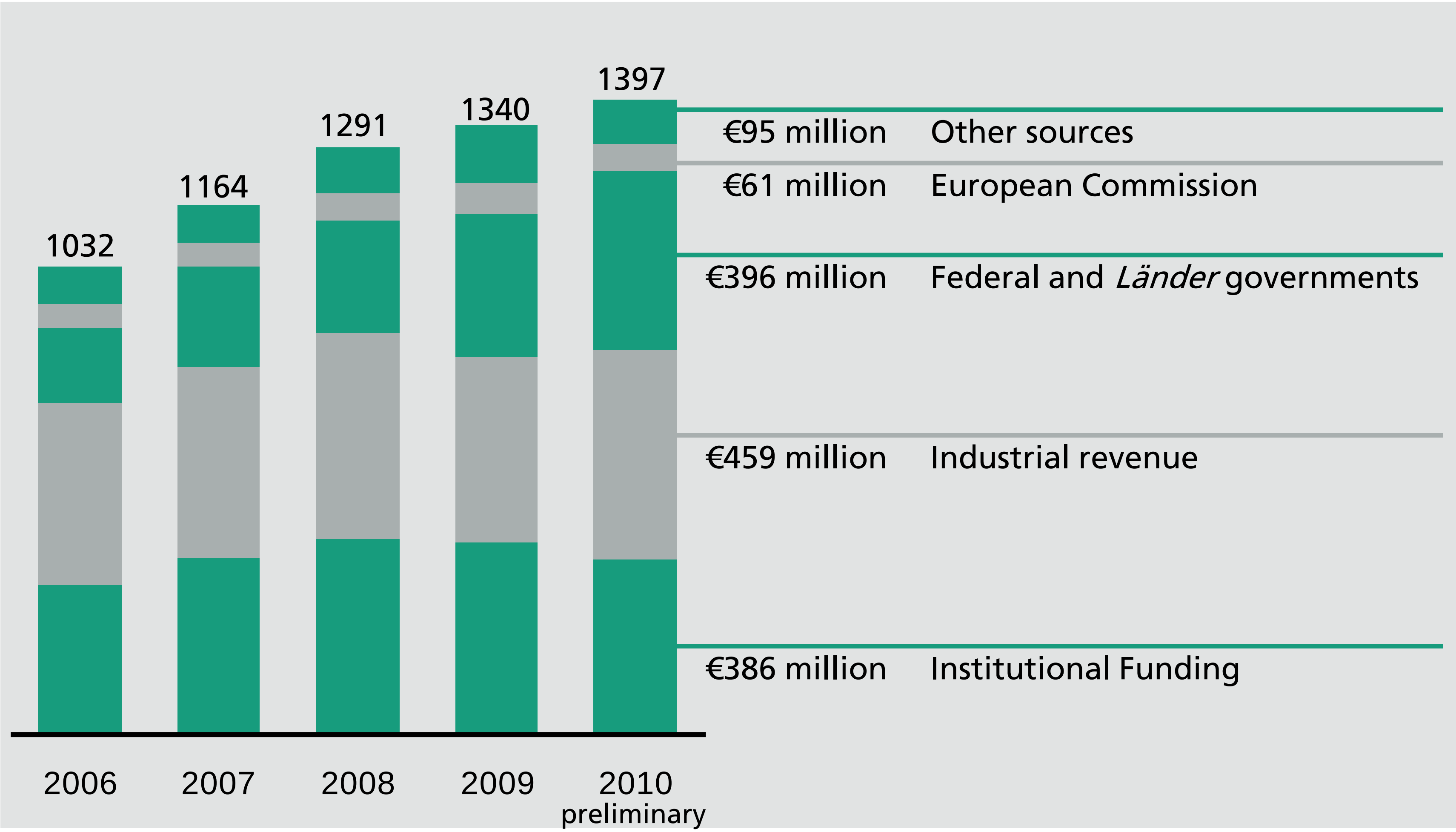
FINANCES: Contract research revenue

(million euros)



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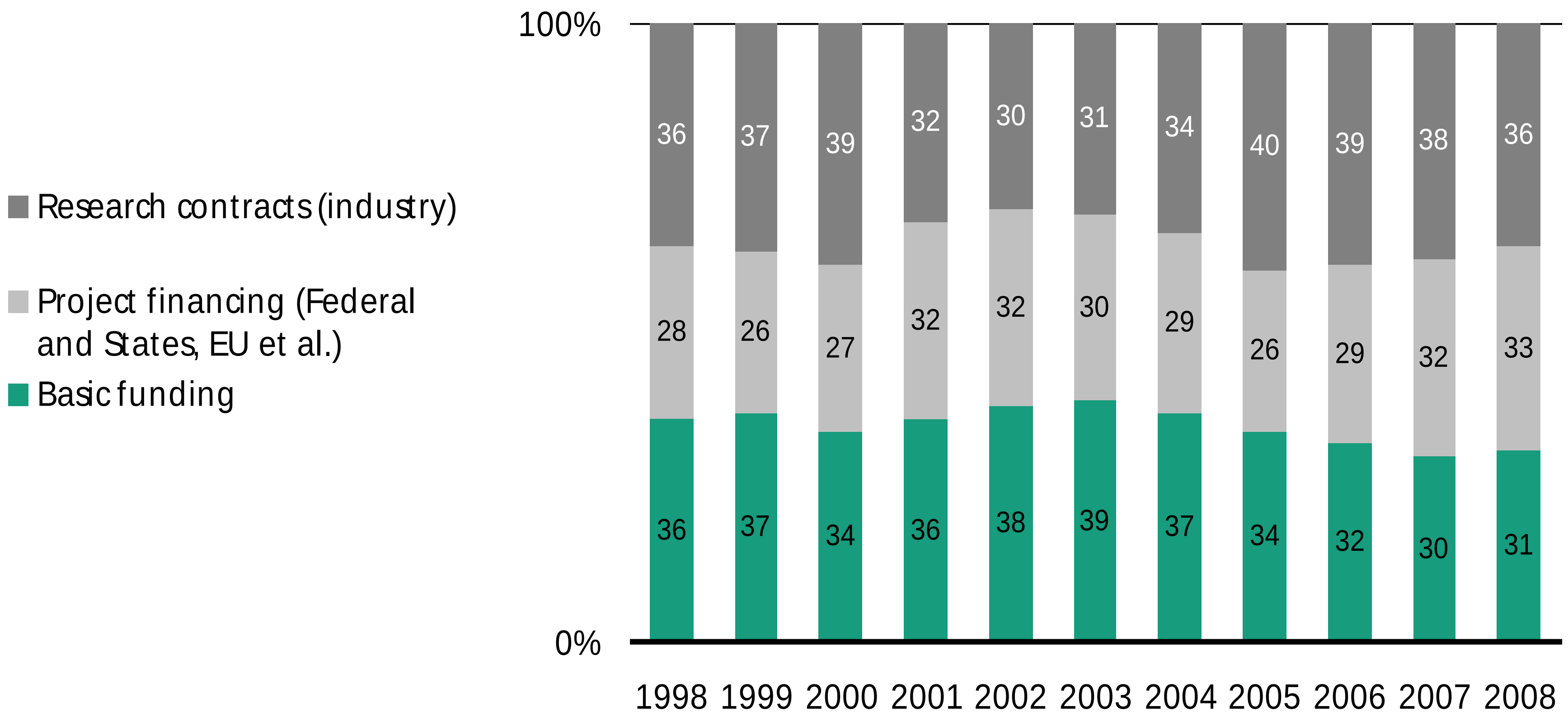
Financing contract research in %

»1/3 : 1/3 : 1/3«



Allocation of Institutional Funding

Expenditure in 2009: €245 million

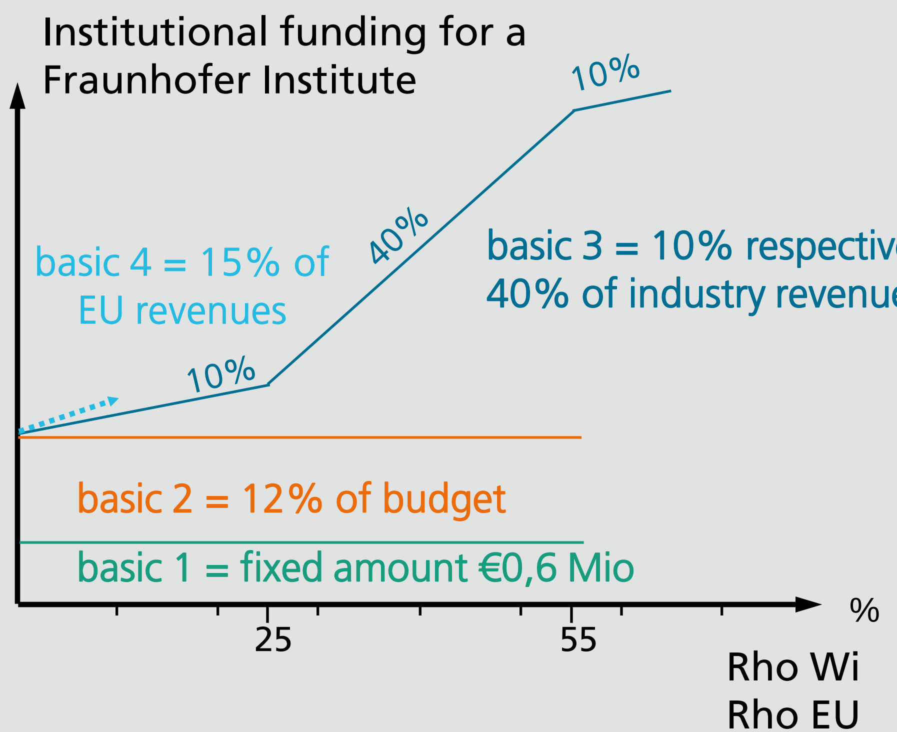
Allocation criteria for institutional funding

Basic 1: Fixed amount

Basic 2: Size of the operating budget

basic 3: Share of industry revenues

basic 4: Share of EU revenues



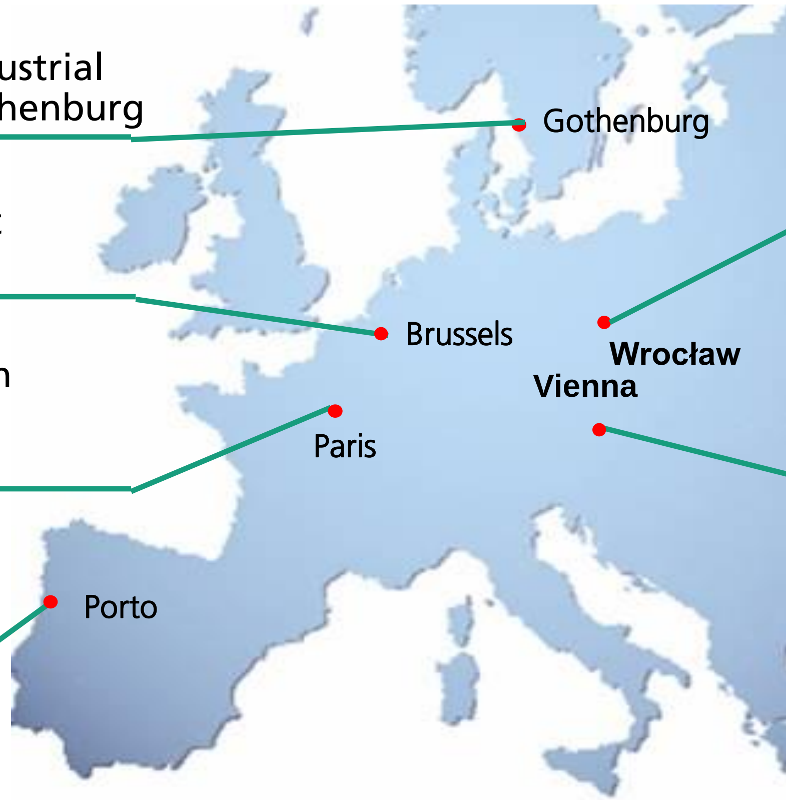
Examples for Fraunhofer Activities in Europe

Fraunhofer-Chalmers Research Centre for Industrial Mathematics (FCC), Gothenburg

Fraunhofer-Gesellschaft Bureau Brussels

Fraunhofer-Cooperation with "Association des Instituts Carnot"

Fraunhofer Portugal Research Associação



Fraunhofer Project Center for Laser Integrated Manufacturing in cooperation with Politechnika Wrocławska

Fraunhofer Austria Research GmbH

- 7 Fraunhofer USA Centers
- 4 offices in Asia
- activities in Russia, the Middle East and India

Fraunhofer Institute for Wind Energy and Energy Systems Technology IWES

Bremerhaven and Kassel

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Fraunhofer Institute for Wind Energy and Energy System Technology

Bremerhaven and Kassel

Advancing Wind Energy and Energy System Technology

Research spectrum:

- Wind energy from material development to grid optimization
- Energy system technology for all renewables

Foundation: 2009

Annual budget: approx. 22 million euros

Personal: approx. 230 (full-time: 160)

Directors: Prof. Dr. Andreas Reuter, Prof. Dr. Jürgen Schmid

Formerly:

- Fraunhofer-Center für Windenergie und Meerestechnik CWMT in Bremerhaven
- Institut für Solare Energieversorgungstechnik ISET in Kassel

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Fraunhofer Institute for Wind Energy and Energy System Technology
Business fields I

- Wind energy technology and operating management
- Elasticity and dynamics of turbines and components
- Competence center rotor blade
- Development of rotors, drive trains and foundations

Fraunhofer Institute for Wind Energy and Energy System Technology
Business fields II

- Environmental analysis for wind and ocean energy
- Control and integration of decentralized converters
- Energy management and grid operation
- Energy supply structures and systems analysis

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Experimental facilities


- Rotor blade test stands
- DyNaLab: Multi-MW nacelle testbench, compl. in 2013
- Component test stands
- Climate chambers
- Offshore test field for materials and systems
- Representative wind measurement network for Germany (200m Metmast, mobile LIDARs)
- DeMoTec – Design center for modular supply technology for components and subsidiary systems
- SysTec – Systems test center, open air test site
- DG (Distributed Generation) test and certification center and European DERlab network
- Accredited test laboratory electromagnetic compatibility with open area test site according to IEC 17025
- Experimental center for bio energy systems technology


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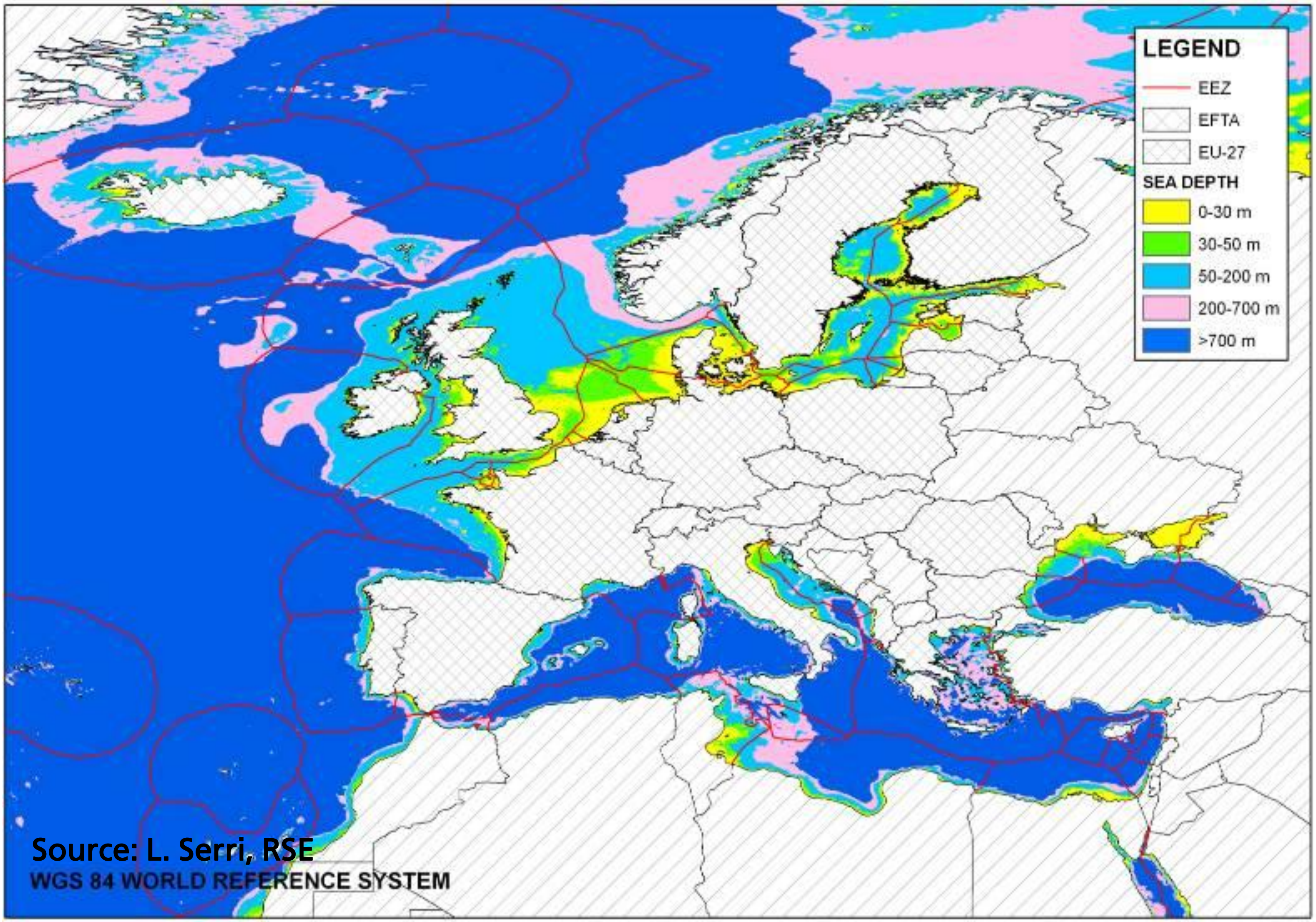
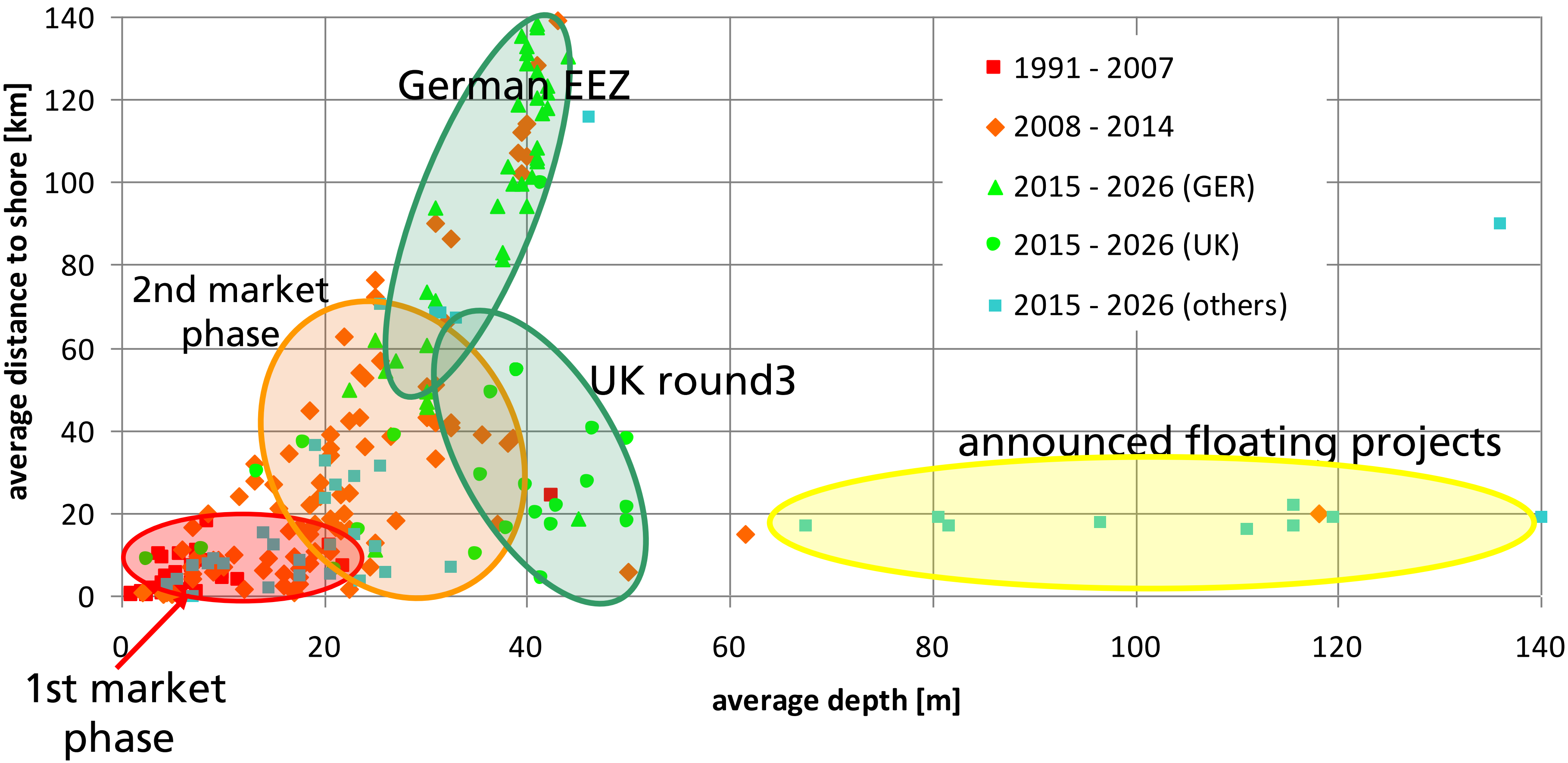
Offshore technology related R&D topics and services

- Technical reliability
  - new sensor systems, structural health monitoring, condition monitoring
  - offshore degradation testing
  - Strategies for material protection
- Device simulation and evaluation
  - Monitoring production cost
  - Representation of substructures (ADCoS –offshore for WTs)
  - Adjusting the level of detail in the progress
- Drive train (in planning)
  - Full scale grid connected nacelle testing
- Offshore site assessment
  - Characterisation of environmental conditions
  - Development of innovative measurement methods
- Energy economy and grid operation

European EEZs and bathymetry map



Development phases of the EU offshore wind market in terms of water depth (m) and distance to shore (km) up to 2025



WWW.ORECCA.EU

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Offshore wind and related R&D projects

- RAVE: Coordination and Research
- OGOwin: structural monitoring and modelling of a support structure
- AERTOS
  Breaking the ice: Ice loads on offshore wind turbines, with VTT (Finland)
  Operation and Maintenance Offshore, with VTT (Finland), TNO (NL), Sintef
- FOG: Optimization of construction process for
  offshore wind support structure, with WeserWind (Germany)
- OC4: comparison of aero-hydro coupled simulation software
- ESTIR: technology implementation bottlenecks and perspectives
- PoWWow: wind-wave correlations and prediction
- DENA I+II: National studies on offshore wind exploitation
  and grid integration (explicit scenarios)
- Extools: European study on experience curves in RE
- ….

RAVE
RESEARCH AT ALPHA VENTUS
Eine Forschungsinitiative des Bundesumweltministeriums

Patron:
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

Supervisor:
PtJ Projektträger Jülich Forschungszentrum Jülich

Co-ordinator:
Fraunhofer IWES

Project leaders and partners:

AREVA MULTIBRID
BSH Bundesamt für Seeschifffahrt und Hydrographie
REpower Systems
Universität Stuttgart Germany
FH Flensburg
Leibniz Universität Hannover
DEWI
ForWind Zentrum für Windenergieforschung
alpha ventus
BAM

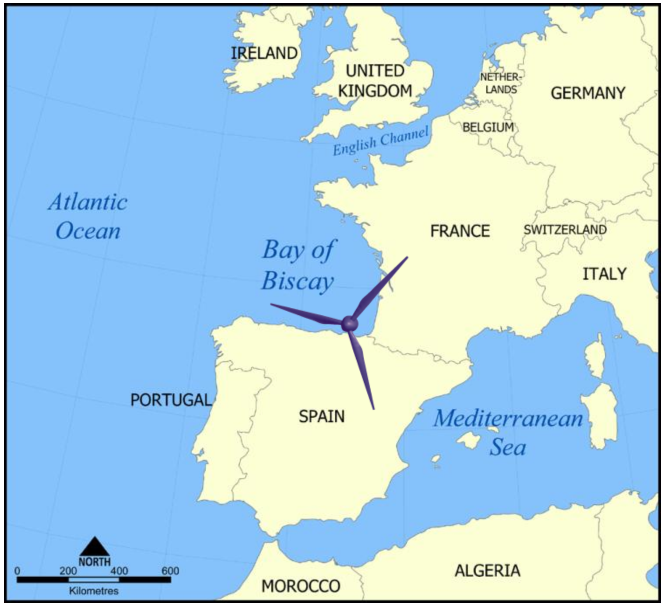
In total the BMU has allocated 50 million Euro for the research and further development of wind energy utilisation at sea

„High Power, high Reliability offshore wind technology“ HiPRWind (www.hyperwind.eu)

Project coordinator: Fraunhofer IWES

SEVENTH FRAMEWORK PROGRAMME

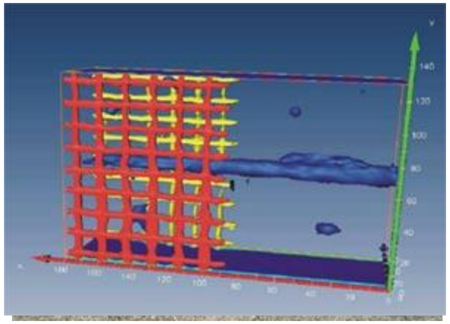
- Aim: install and operate a MW-class wind turbine for research purpose
- Planned location: Bay of Biscay, off Bilbao in Spain
- Total budget 20 M€, total EC-funding 11 M€, 1130 man months
- Duration: 5 years (11/2010-9/2015)



Main research topics:

- Floater and mooring systems
- Controls, power and grid
- Condition and structural health monitoring
- Advanced rotor concepts

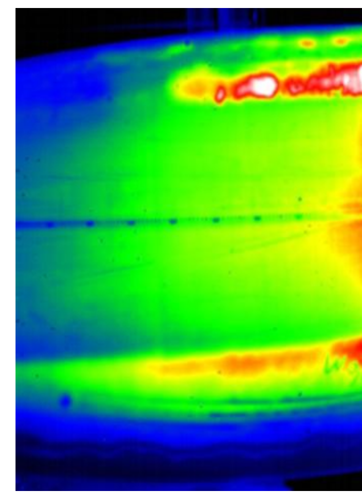
Further R&D projects within the Network Wind Energy



Scanning structures OSSCAR (OnSiteSCAnneR)
Combined ultrasonic, radar and eddy current technique

Inspection robot for rotor blades

MAVI - Microstructure analysis of glass fiber-reinforced plastics in wind turbine rotor blades, Software tool for micro- and nanostructure modelling



Thermographic Testing of rotor blades

Sharkskin for airplanes, ships and wind turbines
Reduce drag and increase efficiency

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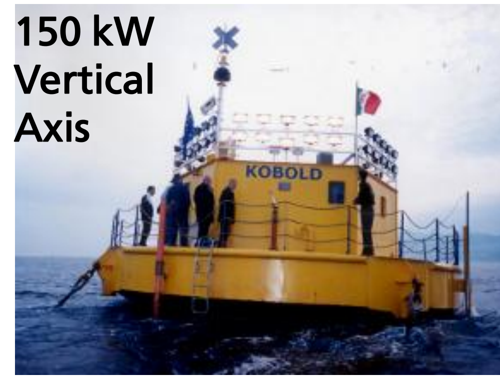
Overview of ocean energy activities @ IWES

- **Technology development**
  SEAFLOW (2003), SEAGEN (2008)
  Kobold I (2007), Kobold II (2010)
  Pulse Tidal 1.2 MW Demonstration project (FP7 2009-2012)
  CORES – Components for Ocean Renewable Energy Systems (FP7 '08-'10)
  SDWED – Structural Design of Wave Energy Devices (Dan. Res. Council)
  Marina Platform – research on multipurpose platforms (FP7 2010-2014)
  Wave Energy Feasibility Study for the German EEZ (Vattenfall)
  New concept for measuring currents, waves (WCI) and turbulence
- **Coordinating Research & Networking**
  Ocean Energy (www.wave-energy.net, FP6)
  ORECCA: Ocean Renewable Energy Conversion Platforms - Coordination Action
  MARINET: research infrastructure project for offshore wind and OE (under neg.)
  EUROCEIN: EU Ocean Energy Initiative (under neg.)
- **IEA**: Implementing Agreement Ocean Energy Systems (www.iea-oceanenergy.org)
- **IEC TC114**, German Mirror committee (DKE, VDE)
- **Publicity**:
  German Marine Energy Forum, since 2006
  International Conference Ocean Energy (ICOE) since 2006

Examples for OE Technology Developments



1 MW
oscillating
hydrofloil

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Cross sectoral projects and vision

- ORECCA:
  Ocean Renewable Energy Conversion Platforms - Coordination Action
- Marina Platform – research on multipurpose platforms (FP7 2010-2014)
- MARINET: EU-research infrastructure project for offshore wind and OE
- Oceans of Tomorrow : sustainable use of the oceans
- Combined Wind-Wave- , Wind-Tidal- etc. under preparation

- EC vision:
  combining Offshore Wind, Ocean Energy and other uses with regard to
  - area (Maritime spatial planning)
  - offshore grid
  - technologies and structures
  - Supply chain…

  ➔ **Create a common offshore renewables market**

Future needs ideas!

10 good ideas a day
keep your competitors away