

Experiences in the Development of Wind Energy in Germany

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Federal Ministry for the Environment, Nature Conservation and Nuclear Safety









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Content



- Statistics of wind energy in Germany 2010
- The incentive system for wind energy
- Economic impact of wind energy
- Wind energy research in Germany
- Benefits from participation in the IEA Wind Energy Agreement







Wind Energy Changes our Surroundings and Electrical Energy Production.....





rothaargeb-almut -witzel

21 600 wind turbines at present







The German Electrical Energy Mix 2010



Total electrical energy production Wind energy production

621.0 TWh 36.5 TWh



Sorce: BdEW



Wind Energy 2010 and Targets

Total installed wind generation	27,204 M W
Offshore installation at present	appr. 250 M VV
New wind generation installed 2010	1,551 M W
Total electrical output from wind	36.5 TWh
Wind generation as % of national gross electrical consumption	6 %
New targets: Electricity from renewable energies	35% of electrical energy consumption by renewables and 10 GW offshore wind by 2020. 80% RE in 2050.







Wind Power Development in Germany





Renewable Energy Sources Act (EEG)

The Renewable Energy Sources Act (EEG, precursor since 1991) is the **main incentive** for Germany's wind energy development.

The produced energy is sold under a **fixed feed-in tariff**.

TSO are **obliged to connect the wind farms** to the grid and to take over the wind electricity.

A project built **onshore** in 2010 had a premium tariff of **€91 per MWh**. (Medium price at for conventional electricity at the electricity stock exchange market appr. €50 MWh).

Digression of 1 % based on the year of construction of the wind farm.

Extra payment (Boni) for improved grid compatibility and repowering of WT.

Offshore wind farms: €150 per MWh (after 2015 € 130 per MWh)



paid for 12 years. Boni regulation considering distance from coast and water depth.







North Sea: 10 m/s







Share of Potential Annual Wind Energy Yield of the Net Energy Consumption in the German States





Benefits of a Growing Wind Energy Market in the World



Turnover of German wind turbine and component manufacturers 2009: 6.4

6.4 Bill. Euro

Export share 2009: 75 %

Employees in the total wind industry: 102,000





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New Multi MW Turbine Technology - Examples

Enercon E 126

AREVA-Wind M 5000

REpower 6 M

BARD 6.5,

Nordex







BARD 5.0

Enercon



AREVA Wind M5000





Investment in R+D is the Basis to Excelerate the Development and to Keep the Position in the World Market

Budget 2010: 53 mill. Euro, 2011: 50 mill. Euro +

Responsibility: Federal Environmental Ministry (BMU)

General Objectives of financial support of R+D:

- To reduce costs of wind energy.
- To improve technical performance and availability of wind turbines.
- To develop offshore adopted wind technology.
- To improve grid compatibility.
- To develop wind energy in accordance with the environment.







Examples of R+D Activities I

New wind Energy Institute: FhG Institute for Wind Energy and Energy System Technologies (IWES, Bremerhaven and Kassel) was founded 2009.

Offshore Testsite alpha ventus (2010)

- 12 x 5 MW, 45 km from shore, 28 m water depth
- Accompanying Research Program RAVE (43 mill Euro)
- 1.200 sensor applications at rotor blades, turbine, tower and foundation
- Development of a general technical offshore monitoring program (OWMEP)
- RAVE-database
- Extensive environmental monitoring program
- 45 institutes and companies involved









Examples of R+D Activities II

- In house test facilities for rotor blades, drive trains and offshore foundations.
- Development of new drive train conceptions.
- Development of offshore foundations for wind turbines.
- Wind as a resource, investigation of wind meteorological and oceanographic conditions at sea with the three FINO offshore research platforms.
- Environmental research (birds, sound, etc.).
- Technologies for grid connection of offshore wind farms and energy storage.





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IEA Wind has broad membership

OECD Participating Countries:

Europe:

Austria, Denmark, Finland, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the European Commission

North America:

Canada, Mexico, and the United States

Asia and Pacific:

Australia, Japan, and South Korea

International Organizations (sponsors):

Chinese Wind Energy Association and the European Wind Energy Association







86% of the world wind capacity is in IEA Wind member countries



IEA Wind Countries



World Wind Capacity





Active Common Research Tasks of IEA Wind

- WAKEBENCH: Wind farm **flow models** (Task 31)
- Dynamic Models for **Offshore Wind Energy** (Task 30)
- **Aerodynamic** Rotor Data Analysis ...(Task 29)
- **Social Acceptance** of Wind Energy Projects (Task 28)
- Consumer Labeling of Small Wind Turbines (Task 27)
- **Cost** of Wind Energy (Task 26)
- **Power Systems** with Large Amounts of Wind...(Task 25)
- Wind Energy in **Cold Climates** (Task 19)
- Base Technology Information Exchange (Task 11)
- Lidar Wind Measuring Systems (Task 31)





Task 11 Topical Experts Meetings:

<u>exclusively</u> for experts from participating <u>member</u> countries (recent topics explored)

- High reliability solutions and innovative concepts for offshore wind technology (30 experts from 11 countries)
- Micrometeorology inside wind farms and wakes between wind farms (15 experts; 9 countries)
- Wind farms in **complex terrain** (12 experts; 6 countries)
- **Radar**, radio and links with wind turbines (27 experts; 8 countries)
- Remote wind speed sensing techniques using Sodar and Lidar (31 experts; 11 countries)
- Sound propagation models and validation (17 experts; 9 countries)

ied wind



Task 19 addresses cold climate issues for wind energy

- Establishes a site classification scheme
- Explores technologies to increase productivity
- Develops tools to predict performance









Transmission system operators and wind developers benefit from IEA Wind Tasks

- Dynamic models of wind farms for power system studies (Task 21 final report)
- Integration of wind and hydropower systems (Task 24 final report)
- Design and operation of power systems with large amounts of wind power (Task 25 Recommendation Reports)









Benefits for Germany from the participation in the IEA Wind Energy Agreement

Getting policy and technical information on the development in leading and up coming wind energy countries from first hand.

IEA Wind is a platform to make our wind technology known in the world.

Possibility for researchers to work in the IEA-Wind Tasks together with international experts on important issues of wind energy for low costs.

The German research community benefits from scientific exchange with leading experts of other countries.

At the technical tours of the Executive Committee Meetings one can see what otherwise is difficult to see (industry, institutes).







IEA Wind contacts

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