



Benefits of the IEA Wind Co-operation

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Wind energy makes sense today

1. Wind energy is a significant source for new electrical generation capacity
2. Wind energy development brings national benefits
3. IEA Wind activities support national programs by sharing information and joint research results

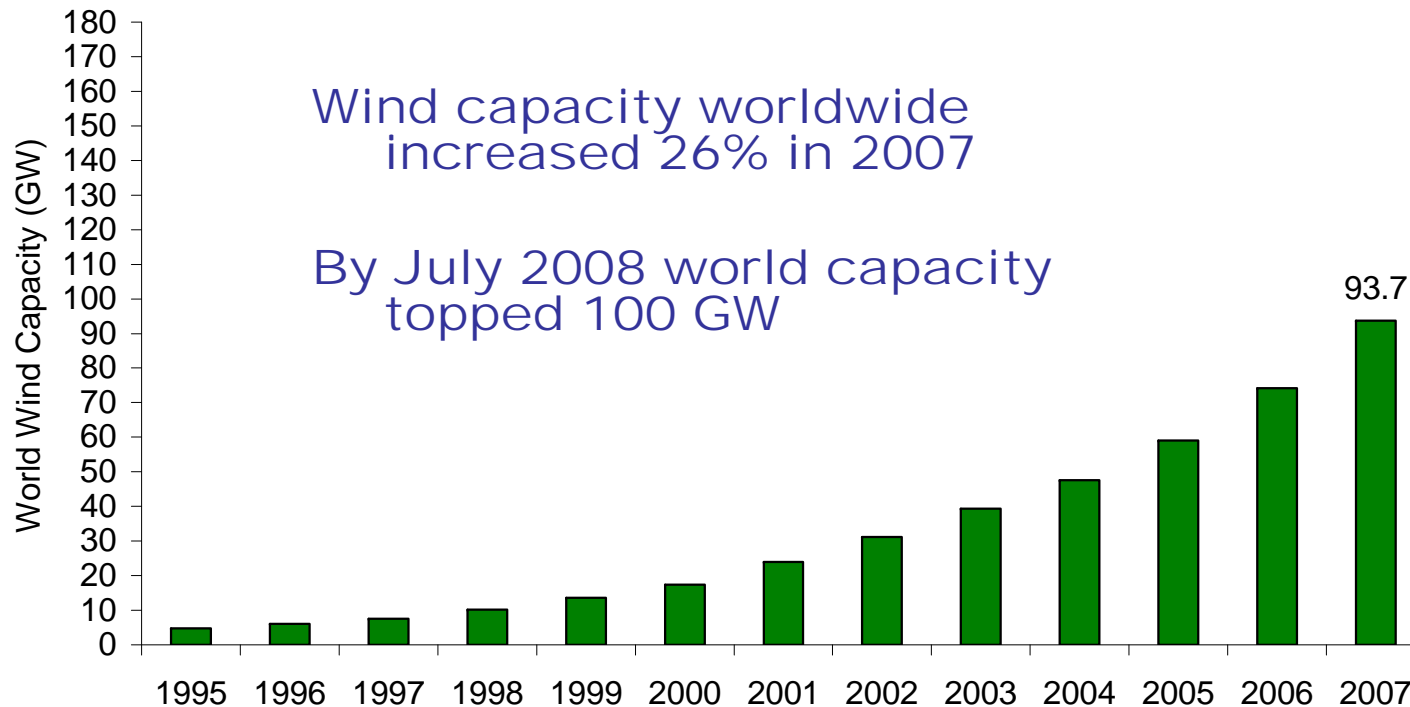


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1. Wind generation is significant and growing

- In Europe, 40% of new power installations were wind power projects (Source: EWEA, 2007)
- In the U.S. 36% (Source: IEA Wind Annual Report 2007)



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Wind generation is significant

In 2007 alone, new global wind power installations equaled the capacity of 20 large conventional power plants



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2007 New Global Wind Power Installations

20 Large Conventional Power Plants

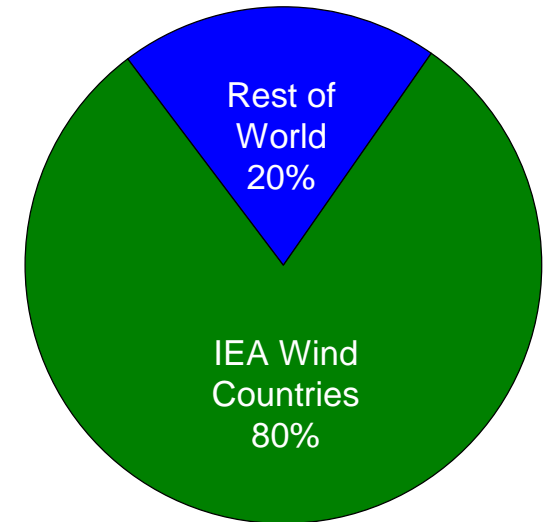


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80% of the world wind capacity is in IEA Wind member countries



IEA Wind Countries



World Wind Capacity



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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

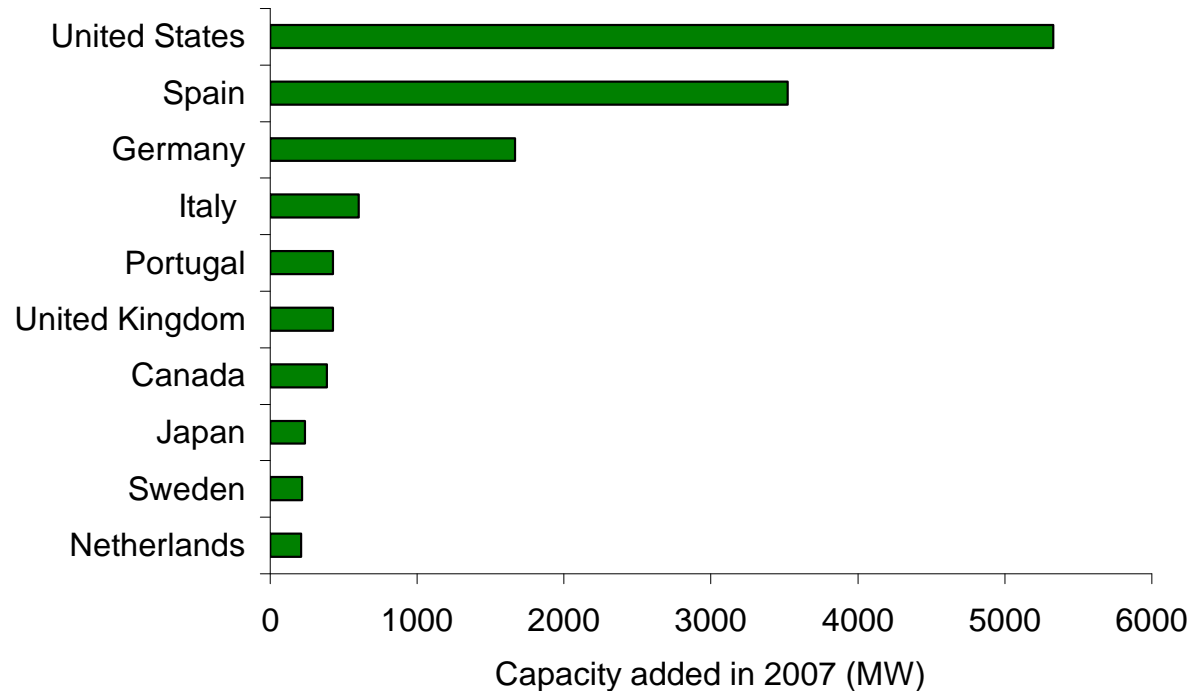
International Organizations (sponsors):

European Wind Energy Association



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IEA Wind participants added 13,300 MW of wind in 2007



Electrical output from wind in IEA Wind countries increased 31% in 2007 (while capacity increased 21%) due to better hardware and better development strategies (Source: IEA Wind 2007 Annual Report)

Wind contributes to national electrical demand

IEA Wind Country	National electricity demand (TWh/yr)	Percent of national electricity demand from wind*
Denmark	36.0	19.9%
Spain	276.8	9.8%
Portugal	50.0	8.1%
Ireland	26.0	6.9%
Germany	617.2	6.4%
Greece	51.0	4.6%
Netherlands	115.6	2.9%
United Kingdom	406.0	1.3%
Italy	340.0	1.2%
Australia	220.0	1.1%

* % of national electricity demand from wind = (wind generated electricity/ national electricity demand)

Source: IEA Wind 2007 Annual Report

- The EU overall has moved from .09% wind contribution in 2000 to 3.7% in 2007
- In Spain on certain days, wind has covered 30% of hourly demand and up to 20% of daily electrical demand.



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2. Wind energy development brings national benefits

IEA Wind Country	Total Capacity (MW)	Estimated jobs	Economic impact (Million euro)
Germany	22,247	84,300*	11,729*
United States	16,904	17,000	6,165
Spain	15,145	45,000	5,000
Denmark	3,124	28,000	4,690
Italy	2,726	10,600	1,000
Canada	1,845	3,340*	1,490*
Australia	824	978	180

* Numbers from 2006

Source: IEA Wind 2007 Annual Report

- Avoided CO₂ emissions:
Spain 18 million tons
U.S. 30 million tons



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3. IEA Wind supports national programs with information exchange and joint R&D

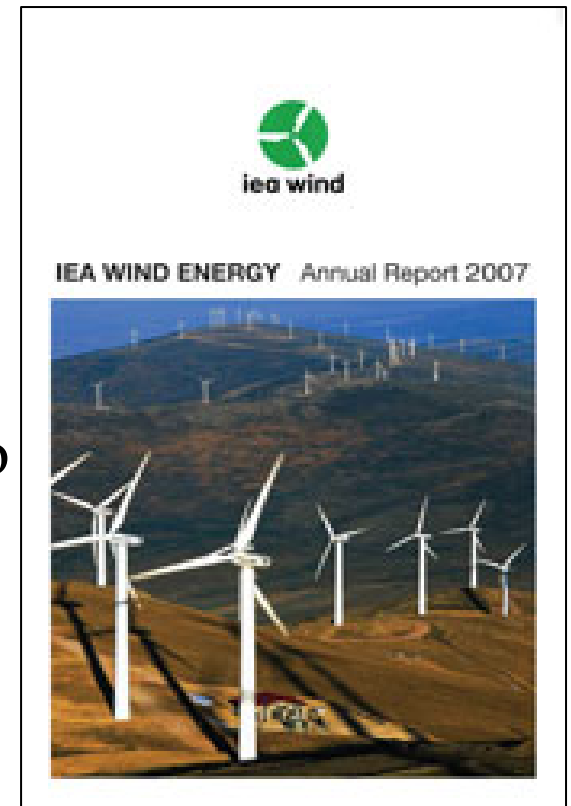
- Information Exchange: Sharing experience
 - the planning and execution of large-scale wind energy deployment
 - tariffs, permits, credits, certificates, mandates, and other incentive and regulatory environments
 - experiences with national technology research projects



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Information Exchange:

- Country and Task reports at meetings of the IEA Wind Executive Committee (2 times per year, 20 countries, the European Commission, and the European Wind Energy Association)
- IEA Wind Annual Report (280 pages) containing country and Task chapters and Executive Summary is distributed to all participating organisations
- Public Web site: www.ieawind.org
- Members-only Web pages



Information Exchange: Experts address challenges



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Topical Experts Meetings:

- Smart structures for blades (22 people from 7 countries)
- Gear boxes and drive train dynamics (47 people from 9 countries) Proposal for joint research task being prepared
- Forecasting remote wind speed sensing techniques using sodar, lidar, and satellites (24 people from 10 countries)
- Wind and wave measurements at offshore locations
- Radar, radio, and wind turbines
- Social acceptance of wind energy projects
- Long-term research needs for wind energy
- Periodic symposia on aerodynamics, fatigue, wind characteristics, and forecasting



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IEA Wind Joint R&D Tasks:

- Task 20 HAWT aerodynamics and models from wind tunnel measurements.
 - Contribution per participant: \$9,375 plus in-kind effort
 - **Total value of shared labor: \$2,036,300 USD**
 - Access to the NASA wind tunnel data
- Task 21 Dynamic models of wind farms for power system studies
 - Contribution per participant: 15,500 Euro plus in-kind effort
 - **Total value of shared labor: 4,760,000 Euro**
- Task 24 Integration of wind and hydropower systems
 - Contribution per participant: \$16,430 USD plus in-kind effort
 - **Total value of shared labor: \$6,237,000 USD**



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IEA Wind R&D continues to reduce costs

- Grid integration tools
- Designs to increase performance/value
 - Forecasting
 - Aerodynamics
 - Structural dynamics
 - Electrical systems
- Designs for specific locations
 - Cold climate
 - Offshore
 - High wind/turbulence
- Impact assessment
 - Cost assessment tools
 - Social impacts
 - Environmental impacts



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Task 19 addresses cold climate issues for wind energy

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



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Task 23 explores issues of offshore wind development

- Workshops on regulation, grid connection, and ecological issues
- Technical research for deeper water
 - Benchmarks structural dynamics models for estimating offshore dynamic loads
 - Identifies and verifies model capabilities and limitations



The Lilgrund Wind Power Farm 2007-11-02

Photo: Hans Blumberg +46 70 550 0121

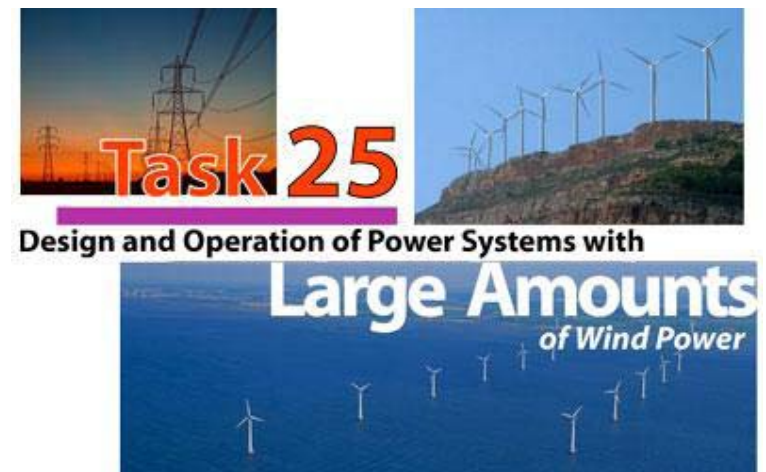
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Transmission system operators and wind developers benefit from IEA Wind Tasks

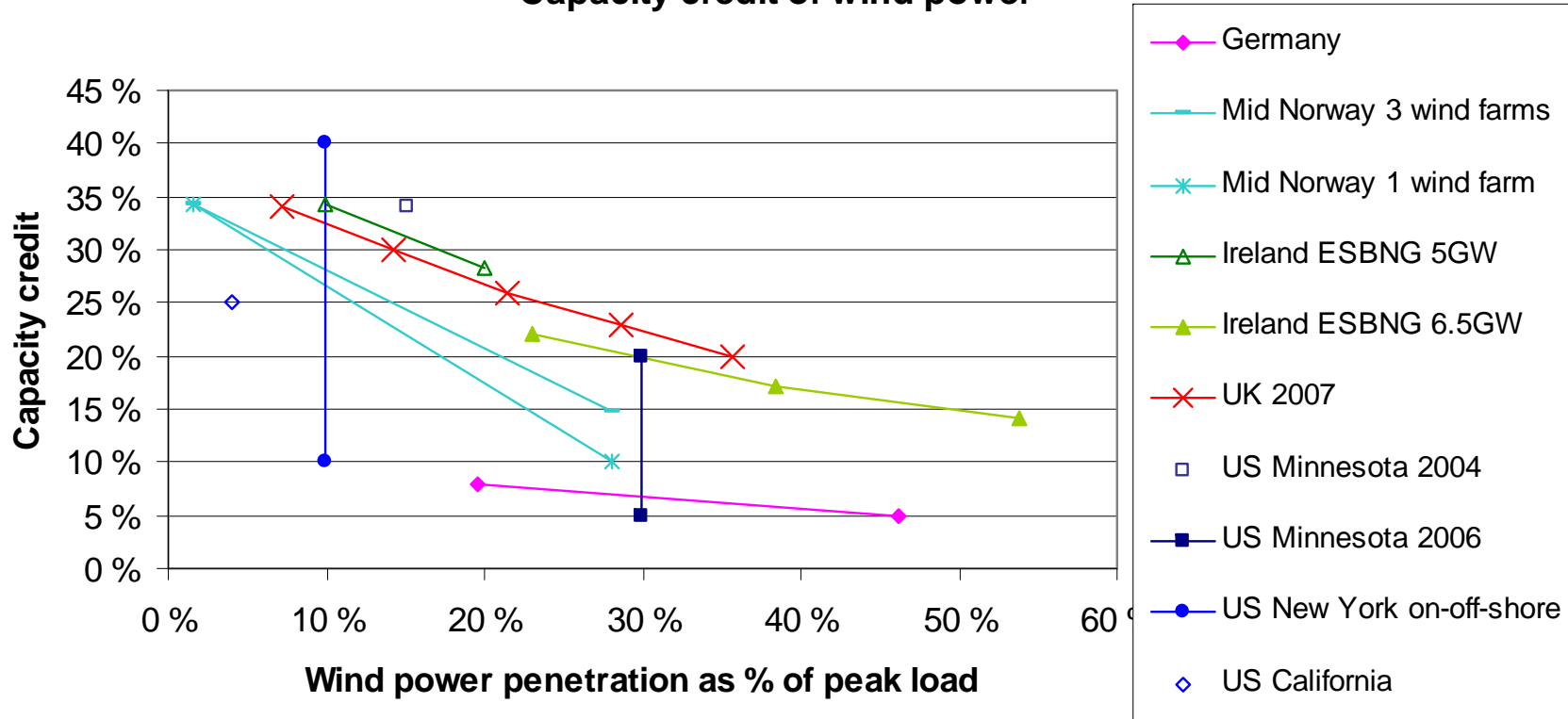
- Dynamic models of wind farms for power system studies (Task 21)
- Integration of wind and hydropower systems (Task 24)
- Design and operation of power systems with large amounts of wind power (Task 25)



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State-of-the-art report on integration

Capacity credit of wind power



Aerodynamic research

- Task 29 will analyse wind tunnel measurements and improve aerodynamic models
 - Using measurements of a wind turbine in the large German Dutch Wind Tunnel, DNW
 - Measurements are available from EU-funded project *Measurements and Experiments in Controlled Conditions, MEXICO*



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Three new tasks will address key issues

- Cost of wind energy (Task 26)
 - Bring economists and engineers together on the issue
- Quality labeling of small wind turbines (Task 27)
 - Bring standards and test practices together
 - Produce a recommended practice for quality labeling of small wind systems
- Social impacts of wind power projects (Task 28)
 - Bring social scientists, planners, and project developers together





Russia could benefit from IEA Wind information exchange and joint R&D tasks

1. Wind energy could add significant electrical generation capacity now, not in 20 or 30 years.
2. Wind energy development could bring economic (often rural) development, exports, and reduced carbon emissions in the near term.
3. To support national development, IEA Wind would provide technical and policy support including
 - strategies for extreme environments
 - integrating large amounts of wind power into the electricity grid, and
 - perfecting incentive programs.



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For more information, visit www.ieawind.org
or email the Secretary ieawind@comcast.net.



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References

- *End-of-term Report for IEA Wind*, July 2008.
- *Windpower Monthly*, April 2008.
- *IEA Wind Energy, 2007 Annual Report*, July 2008.
- IEA Wind task reports posted to www.ieawind.org
- *The Difference Wind Makes*. American Wind Energy Association, 2008.
- *Clean Energy Trends 2008*. Clean Energy, 2008.



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Supplemental information about the IEA Wind co-operation

25 YEARS OF INTERNATIONAL CO-OPERATION

WWW.IEAWIND.ORG



1977

The 3-MW prototype at Hagaryn, Sweden provided electrical performance data to the participants in the Large-Scale WECS agreement during the 1980s.

One of the first activities reported to participants in IEA Wind was the testing performed by Denmark and the US on the reconstructed, 200-kW Gørdler turbine.



1978

The 750-kW tube prototype turbines installed in Denmark generated power curve data that was shared with the participants in IEA Wind.

From the beginning, participants in IEA Wind worked to improve understanding of wind turbine structural dynamics. This diagram of a simplified plane system with gravity effects was presented at the first Experts Meeting on structural dynamics.



1980

Government programs in Canada, New Zealand, and the US shared findings about their programs to develop vertical axis turbines based on the design of F.A. Sauerbuss.



1982

The Mast 1, the first megawatt scale government prototype in the US, provided information to participants about noise operation and television interference from large wind turbines.



1986

A landmark study published by the Expert Group on Recommended Practices presented the mechanisms identified that cause electromagnetic interference of wind turbines on radio services.



1987

Feathering - To change the blade pitch angle of each blade of a rotor to a zero or near zero lift condition. (Normally used as a method of shutdown.)

The Glossary of Terms published by the Expert Group on Recommended Practices standardized the technical vocabulary used by researchers and engineers worldwide.



1978

Lightning tests such as this one performed at CSES Spa, Italy were reported in an Expert Meeting on lightning protection for wind turbines.



1989

Task VII reviewed studies conducted in Denmark, the Netherlands, Sweden, the UK, and the US about the feasibility of offshore wind development. The world's first offshore windfarm went into operation in 1991 at Vindby, Denmark.



1992

Participants in Tasks V and IX measured energy losses and fatigue loads of turbines operating downwind of other turbines. This information helps guide the layout of wind parks like this one in Spain for improved energy production and increased turbine operating life.



1994

Under Task XII UNIWEX, researchers in Germany modified a computer controlled, two-bladed wind turbine 16 m in diameter and used a numerical code to simulate aerostatic behavior. The dynamic behavior and the stressing of rotor types were investigated experimentally and numerically to aid designers.



2000

Accurately predicting the electrical production of wind turbines will increase the value of their electricity to the grid. To advance the art and science of wind energy forecasting, Task XI sponsors regular meetings called Joint Action Symposia on this topic.



2002 and Beyond

The first Experts Meeting sponsored by IEA Wind in 1978 addressed aerodynamic modeling. Such meetings continue to address the latest issues in wind power development under Task XI. In 2002, an Experts Meeting explored what is known of the environmental impacts of offshore wind farm development.



To evaluate how wind farms affect the dynamic and transient stability of utility power systems, participants in Task XXI are developing and validating models of wind farm output.



The comprehensive database of wind characteristics using data assembled under the EU-DO XII (JOULE) project and by participants in IEA Wind Task XVII is available on the Web to wind energy planners, designers, engineers, and researchers.



Using data from a full-scale turbine experiment conducted in 2000 at a NASA wind tunnel, participants in Task XX are developing and validating model components for aerodynamic research. This effort extends work performed in Tasks XIV and Task XVII.



Participants in Task XIX are collecting data to improve the design and operation of wind turbines in cold climates.



INTERNATIONAL ENERGY AGENCY • IMPLEMENTING AGREEMENT FOR CO-OPERATION IN THE RESEARCH AND DEVELOPMENT OF WIND TURBINE SYSTEMS





Mission of IEA Wind

“...to stimulate co-operation on wind energy research and development and to provide **high quality information and analysis to member governments** and commercial **sector leaders** by addressing **technology development** and deployment and its **benefits, markets, and policy instruments.**” – IEA Wind Strategic Plan



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IEA Wind organisational details

- IEA Wind is one of the more than 40 Implementing Agreements under International Energy Agency (IEA) Organization for Economic Co-operation and Development (OECD). It is attached to the Renewable Energy Working Party (REWP).
- The full, legal name of the activity is the IEA Implementing Agreement for Co-operation in the Research, Development, and Deployment of Wind Energy Systems.
- Benefits include: Guide national governmental programmes and policies through information exchange
- Develop skills, knowledge and improve wind R&D cost effectiveness and minimise environmental effects
- Provide information and technology to reduce costs and increase the value of wind energy
- Identify and publicise societal, economical and governmental benefits





IEA Wind operational details (1)

- The IEA Wind Executive Committee (ExCo) organises the overall information exchange and the R,D&D tasks
- The ExCo consists of a Member and an Alternate Member from each contracting party in the Implementing Agreement
- Most countries are represented by one contracting party such as a government department or agency
- The ExCo meets twice a year to discuss the R&D programs of the member countries, to report work progress on the various Tasks, and to plan future activities



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IEA Wind operational details (2)

- Most decisions are reached by majority vote with one vote per member country. Change to members rights and contractual obligations require unanimity
- Members share the cost of administration for the ExCo through annual contributions (based on the size of the nation's economy) to a Common Fund
- Each research task has its own budget and fees based on the work and number of participants
- Each member country must participate in at least one research task



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IEA Wind active research tasks

Task 29 Aerodynamic Analysis of the EU MEXICO Project

Task 28 Social Impacts of Wind Energy Projects

Task 27 Quality Labeling of Small Wind Turbines

Task 26 Cost of Wind Energy

Task 25 Design and Operation of Power Systems with Large Amounts of Wind Power

Task 23 Offshore Wind Technology Deployment

Task 19 Wind Energy in Cold Climates

Task 11 Base Technology Information Exchange



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Data for IEA Wind

Table 1 Key Statistics of IEA Wind Member Countries 2007		
	2006	2007
Total installed capacity	61.855 GW	74.844 GW
Total offshore wind capacity	891 MW	1,125 MW
Total new wind capacity installed	10,463 MW	13,315 MW
Annual increase in capacity from previous year	22%	21%
Total annual output from wind	118 TWh/yr	155 TWh/yr
Wind generation as % of national electric demand	1.42%	1.6%



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IEA Wind Strategic Plan for 2008-2013

1. Wind Technology Research to Improve Performance and Reliability at Competitive Costs
2. Power System Operation and Grid Integration of High Amounts of Wind Generation Including Development of Fully controllable, Grid-friendly “Wind Power Plants”
3. Planning and Performance Assessment Methods for Large Wind Integration
4. Offshore Wind in Shallow and Deep Waters
5. Social, Educational, and Environmental Issues



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IEA Disclaimer

The IEA Wind agreement, also known as the Implementing Agreement for Co-operation in the Research, Development, and Deployment of Wind Energy Systems, functions within a framework created by the International Energy Agency (IEA). Views, findings, and publications of IEA Wind do not necessarily represent the views or policies of the IEA Secretariat or of all its individual member countries.



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