



# Benefits of the IEA Wind Co-operation

Name  
IEA Wind  
Workshop  
Place  
Date



# Wind energy is changing the generation mix

1. Wind energy development brings national benefits
2. IEA Wind activities support national programs by sharing information and joint research results



# Wind energy is part of the global economy

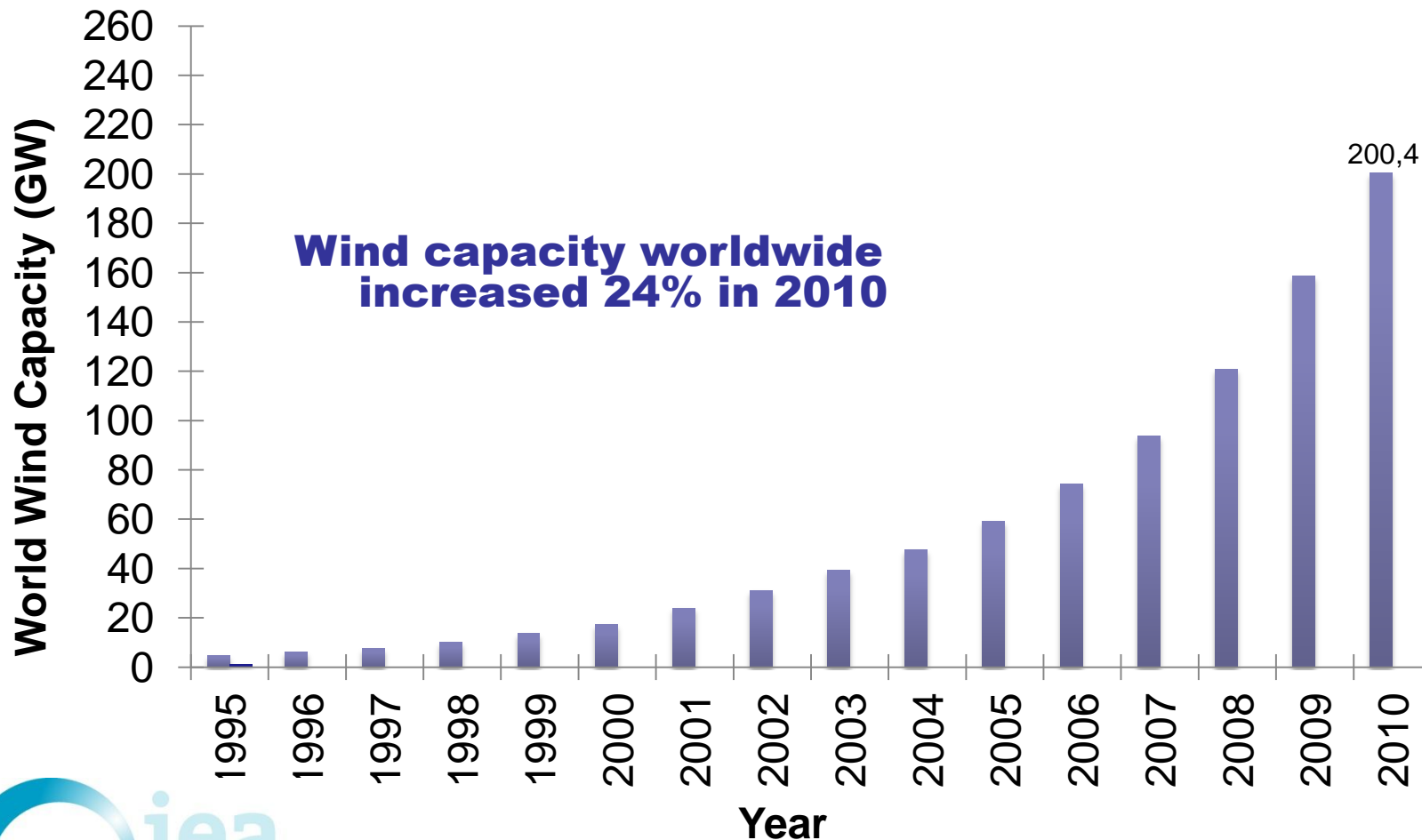
1. Worldwide, new wind energy installations in 2010 represented an investment of 47.3 billion € (65 billion USD)
2. More than 500,000 people are currently employed in the wind industry

Source: GWEC 2011



# Wind generation is significant and growing

In Europe, wind power is 9.6% of total installed electrical generation capacity. (Source: EWEA, 2011)



iea wind



# Wind generation is significant

In 2010 alone, new global wind power installations equaled the capacity of 66 large conventional power plants

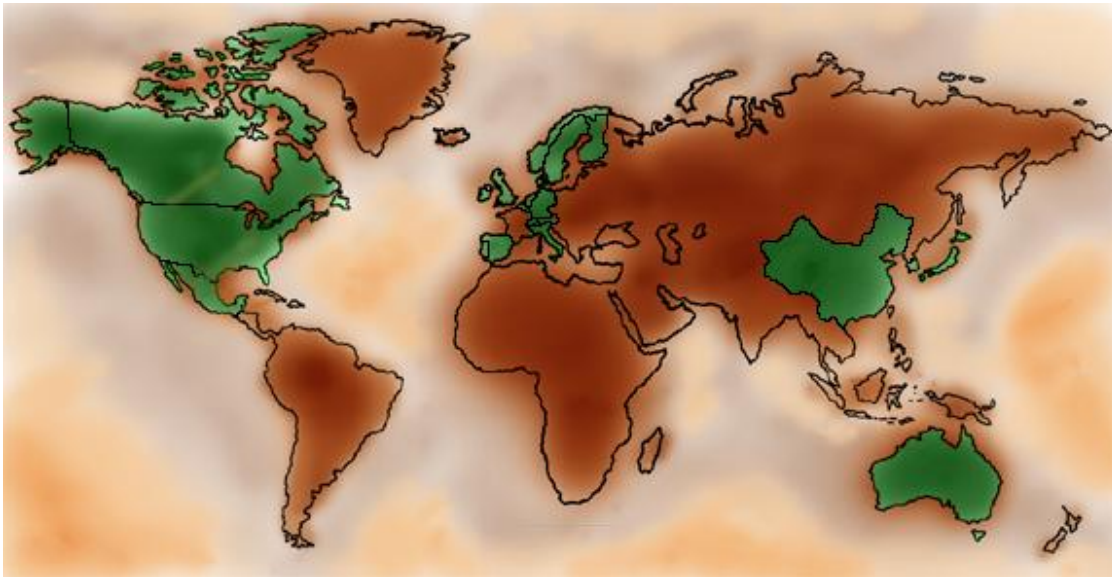


2010 New Global Wind Power Installations

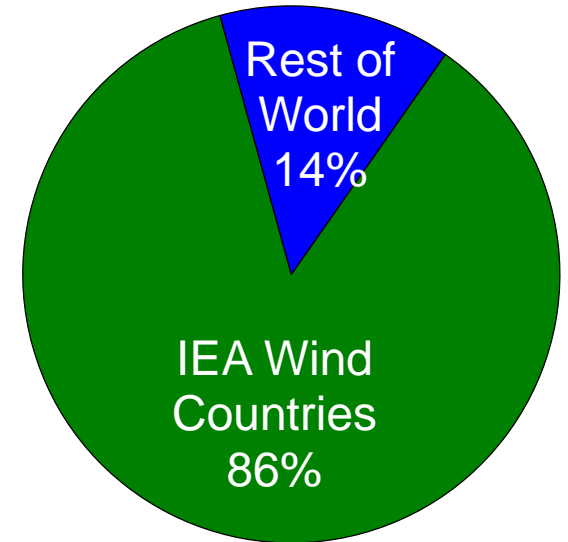
66 Large Conventional Power Plants



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



IEA Wind Countries



World Wind Capacity



# 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:

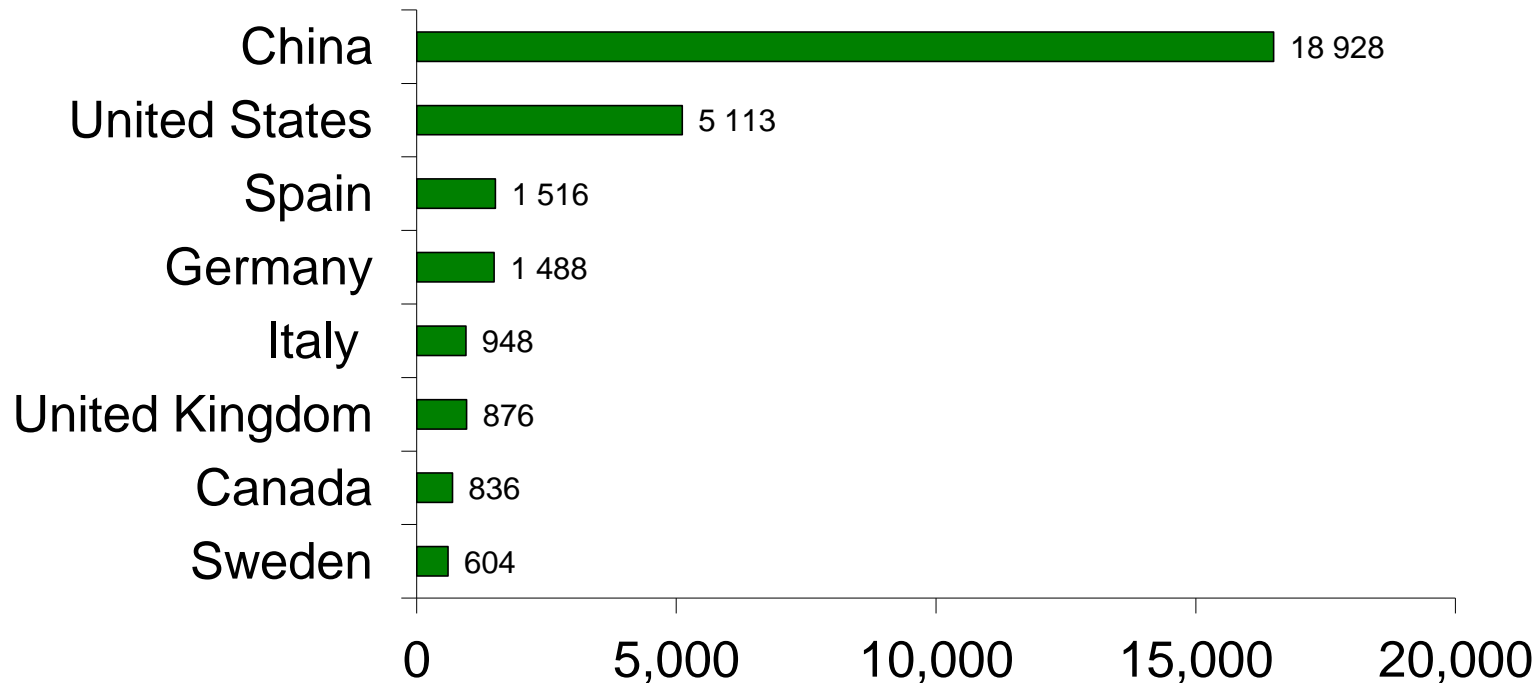
Australia, Chinese Wind Energy Association, Japan, and South Korea

## International Organizations (sponsors):

Chinese Wind Energy Association and the European Wind Energy Association



# IEA Wind participants added about 32 GW of wind generation in 2010



Capacity added in 2010 (MW)

Source: IEA Wind 2010 Annual Report

# Wind contributes to national electrical demand

| IEA Wind Country | Electricity demand (TWh/yr) | Electricity from wind* |
|------------------|-----------------------------|------------------------|
| Denmark          | 35,6                        | 21,9%                  |
| Portugal         | 52,2                        | 17,0%                  |
| Spain            | 259,9                       | 16,4%                  |
| Ireland          | 27,5                        | 10,5%                  |
| Germany          | 604,0                       | 6,0%                   |
| Greece           | 57,0                        | 4,0%                   |
| Netherlands      | 115,0                       | 4,0%                   |
| Austria          | 70,7                        | 3,0%                   |
| Italy            | 326,2                       | 2,6%                   |
| United Kingdom   | 381,2                       | 2,6%                   |
| Sweden           | 132,2                       | 2,6%                   |
| United States    | 4 120,0                     | 2,3%                   |
| Australia        | 261                         | 2,0%                   |
| Canada           | 549,9                       | 1,8%                   |
| China            | 4 192,0                     | 1,2%                   |

\* % of national electricity demand from wind = (wind generated electricity/ national electricity demand)  
 Source: IEA Wind 2010 Annual Report





# Wind energy development brings national benefits

| IEA Wind Country | Total Wind Capacity (MW) | Estimated jobs | Economic impact (Million euro) |
|------------------|--------------------------|----------------|--------------------------------|
| China            | 44 733                   | 279 000        | ---                            |
| U. S.            | 40 180                   | 75 000         | 14 450                         |
| Germany          | 27 204                   | 96 100         | 5 650                          |
| Spain            | 20 676                   | 16 970         | ---                            |
| Italy            | 5 797                    | 28 000         | 1 700                          |
| Canada           | 4 124                    | 4 124          | 1 500                          |
| Portugal         | 3 987                    | 3 000          | 1 296                          |
| Denmark          | 3 802                    | 24 700         | 12 260                         |

Source: IEA Wind 2010 Annual Report

- Thanks to wind generation, the U.S. avoided 62 million tons of CO<sub>2</sub> emissions, the same as taking 10,5 million cars off the road



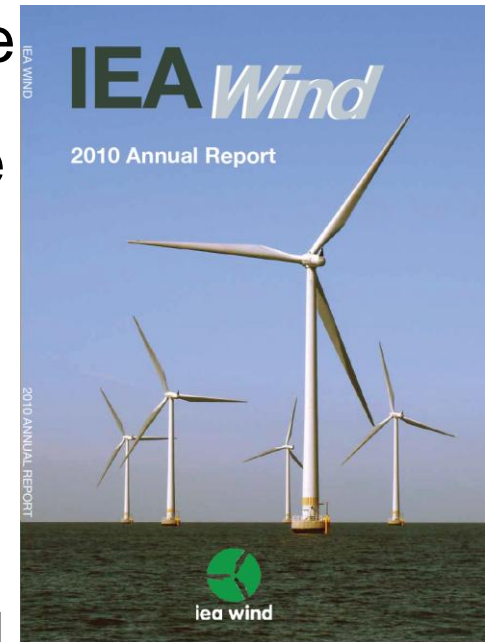
# IEA Wind supports national programs with information exchange and joint R&D

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



# Information Exchange:

- Country and Task reports at meetings of the IEA Wind Executive Committee (two per year, 21 countries, the European Union, the Chinese Wind Energy Association, and the European Wind Energy Association)
- IEA Wind Annual Report (176 pages) contains chapters on research tasks, country activities, and an Executive Summary. It is distributed to all participating organisations.
- Public Web site: [www.ieawind.org](http://www.ieawind.org)
- Members-only Web pages





# Active Research Tasks of IEA Wind

- Lidar: Wind lidar systems for wind energy deployment (Task 32)
- WAKEBENCH: Benchmarking of wind farm flow models (Task 31)
- Dynamic Codes and Models for Offshore Wind Energy (Task 30)
- Aerodynamic Data Analysis of the EU MEXICO Project (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 Power (Task 25)
- Wind Energy in Cold Climates (Task 19)
- Base Technology Information Exchange (Task 11)



# Task 11 Topical Experts Meetings:

**exclusively for experts from participating member 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)



# IEA Wind Joint R&D Tasks: multiplying national research efforts

- Task 25 Power Systems With Large Amounts of Wind Power (First term)
  - Contribution per participant: 7 002 Euro plus in-kind effort over 3 years
  - **Total value of shared labor: 9 528 000 Euro**
- Task 24 Integration of Wind and Hydropower Systems
  - Contribution per participant: 16 430 USD plus in-kind effort over 3 years
  - **Total value of shared labor: 6 237 000 USD**
- Task 23 Offshore Wind Technology and Deployment
  - Contribution per participant: 18 675 USD plus in-kind effort over 5 years
  - **Total value of shared labor: 4 630 000 USD (Subtask 2)**



# 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



# Task 19 addresses cold climate issues for wind energy

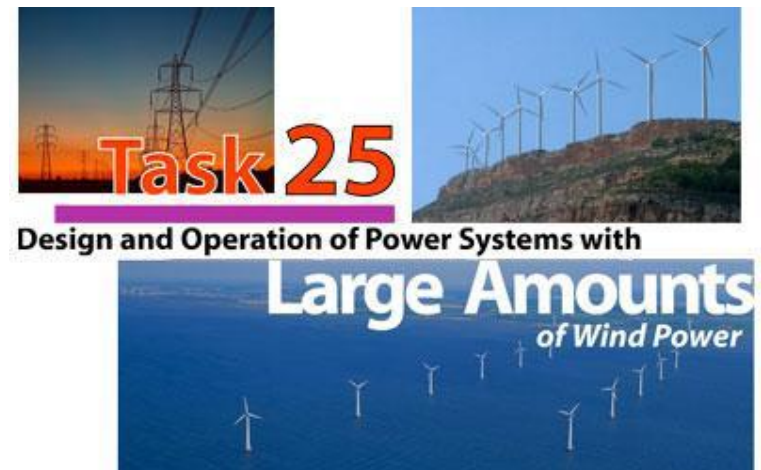
- Establishes a site classification scheme
- Explores technologies to increase productivity
- Develops tools to predict performance





# Design and operation of power systems with large amounts of wind power – Task 25

- International forum for wind integration, actively following also parallel activities (CIGRE, UWIG, IEEE, other IEA IAs).
- Analysing and further developing the methodology to assess the impact of wind power → best practices to assess the impacts
- Summaries on the range of impacts, evolving experience as well as integration solutions



# Cost of Wind Energy

Task 26



- GOAL: understand cost of wind energy among participating countries
  - Identified cost elements from the perspective of a private investor, in a given project, in each country
  - Calculated levelized cost of energy (LCOE) - the sum of all costs over project lifetime, discounted to present, and levelized based on annual production
- Used two approaches: 1. high level scenario planning and 2. sophisticated financial cash flow analysis
- Results:
  - LCOE varies considerably between countries
  - Variation is attributed to energy production, investment cost, operations cost, and financing cost



# Labeling Small Wind Turbines, Task 27

- Develop approved test procedures and consumer label for small wind turbines
- Set up Small Wind Association of Testers (SWAT)
  - Encourage peer review of test protocols and data analysis
  - Promote dissemination of results

| INDEPENDENTLY TESTED SMALL WIND TURBINE  |  |
|--|--|
| MANUFACTURER   | AMPAIR   |
| MODEL  | 600/230 Mk2.5  |
| ANNUAL REFERENCE ENERGY<br>@ 5 m/s average wind speed<br>Actual production will vary<br>depending on site conditions | 481<br>kWh/yr  |
| DECLARED SOUND<br>POWER LEVEL  | 89<br>dBA  |
| TURBINE CLASS<br>(I-IV or S for special)   | II   |
| <b>SEPEN</b>   | Tested by: SEPEN : Site Expérimental pour<br>le Petit Eolien de Narbonne<br>Tested date: 15 October 2009 |



# Social Acceptance of Wind Energy Projects, Task 28

- State-of-the-Art Report compiled current knowledge about social acceptance of wind energy projects.
- Strategies to resolve social acceptance challenges, include:
  - Engage and seek public consultation early
  - Employ participatory development and investment models
  - Implement coordinated and efficient processes
  - Continue refining and communicating state-of-the-art knowledge





# Aerodynamic Research, Task 29

- MexNEXT analyses wind tunnel measurements and improves 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*





# Comparing Structural Models for Offshore Wind Development, OC4 Task 30

- Technical research for deeper water
  - Benchmarks structural dynamics models for estimating offshore dynamic loads
  - Identifies and verifies model capabilities and limitations



Photo: Hans Blomberg +46 70 950 0121

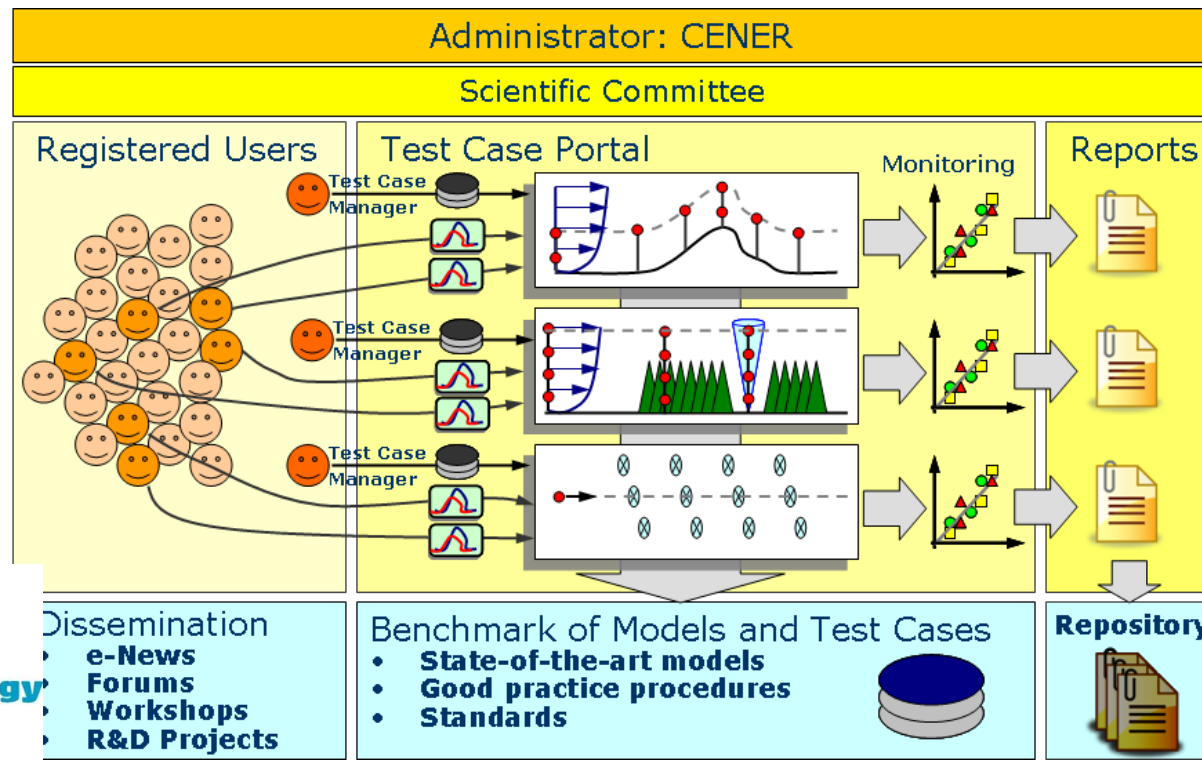
The Lillgrund Wind Power Farm 2007-11-02

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# Bench Wind Farm Flow Models, Task 31

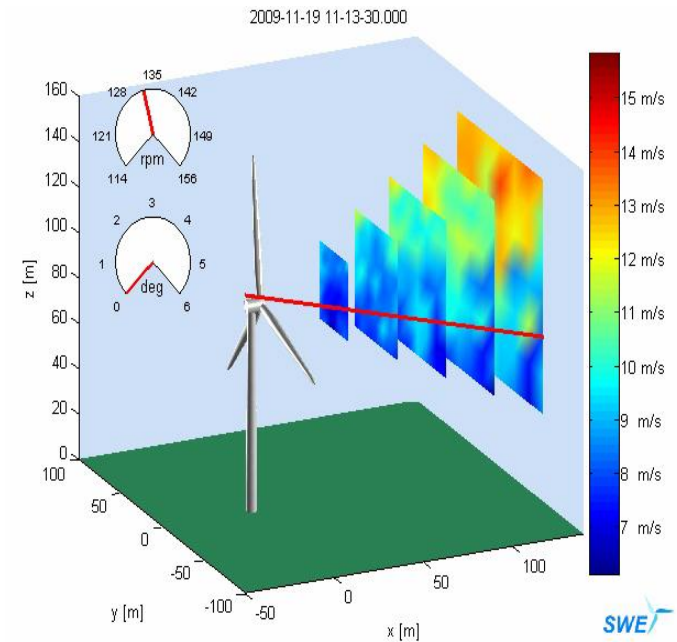
- Improves wind farm wake modeling techniques
- Provides a forum for industry, government, and academic partners
- Develops, evaluates, and improves atmospheric boundary layer and wind turbine wake models for use in wind energy.

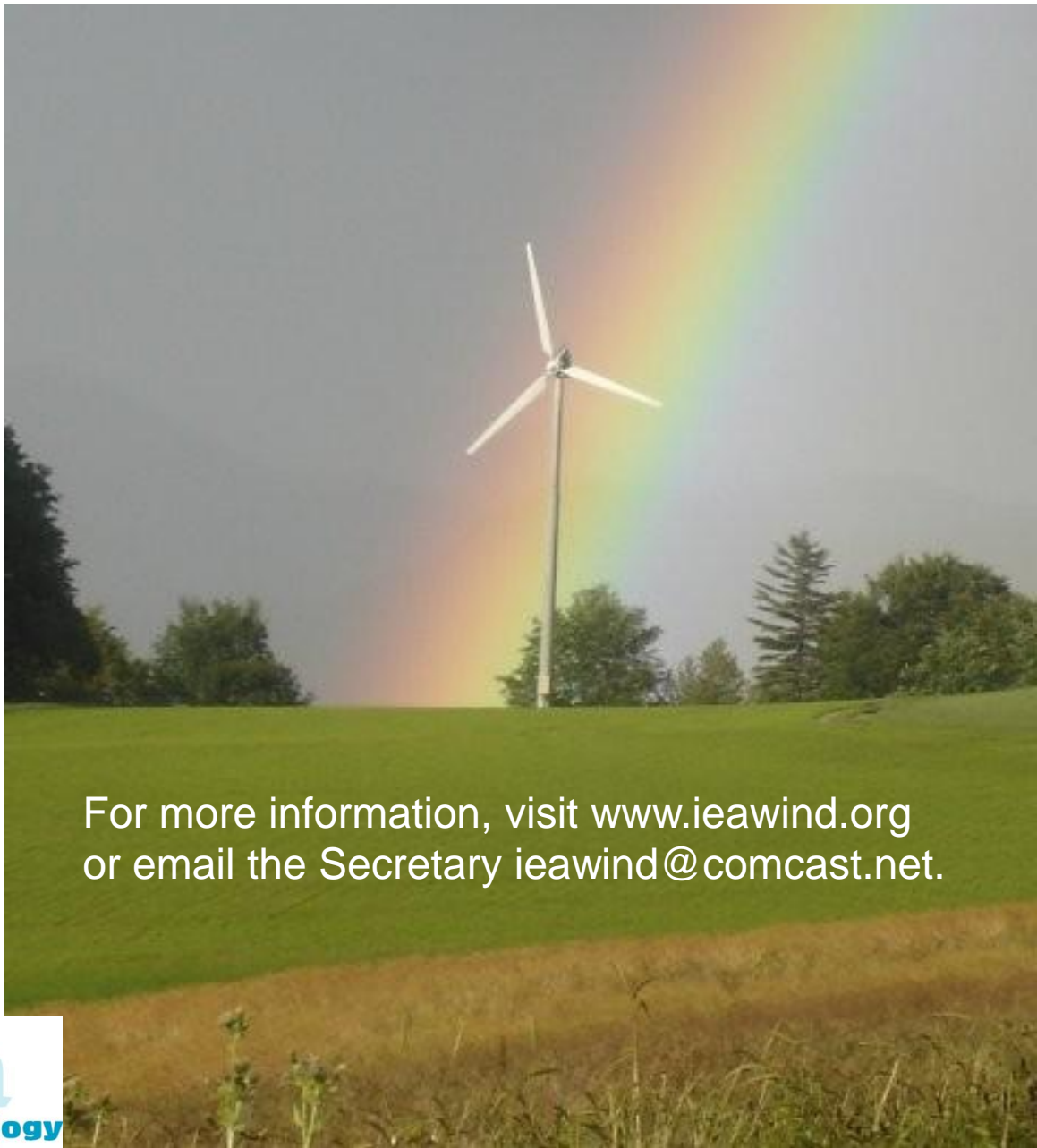




# Lidar: Wind Lidar Systems for Wind Energy Deployment, Task 32

- Exchange experience from research activities and measurement projects on the performance of lidar devices and associated measurement techniques
- Continue the development of an “IEA Recommended Practices for Remote Sensing Measurements” (Action 59th Topical Expert meeting) and refine it during the course of the task in the three areas:
  - a) measurement techniques
  - b) resource assessment
  - c) power curve measurements and load estimation
- Identify areas for further research and development as well as standardization needs.





For more information, visit [www.ieawind.org](http://www.ieawind.org)  
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# References

- *End-of-term Report for IEA Wind, July 2008.*
- *IEA Wind 2010 Annual Report, July 2011.*
- Global Wind Energy Council (GWEC), February 2011
- IEA Wind task reports posted to [www.ieawind.org](http://www.ieawind.org)

# 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.



# IEA Wind Strategic Plan for 2008-2013

## Key Research Needs

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



# 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



# 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



# 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



# IEA Wind active research tasks

Task 32 LIDAR: Wind Lidar Systems for Wind Energy Deployment

Task 31 WAKEBENCH: Benchmarking of Wind Farm Flow Models

Task 30 Comparison of Dynamic Codes and Models for Offshore Wind Energy

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