End-of-Term Report
2009–2013

and

Strategic Plan
2014–2019

International Energy Agency Implementing Agreement for Co-operation in the
Research, Development, and Deployment of Wind Energy Systems

Approved by the IEA Renewable Energy Working Party (REWPA) and the Committee for Energy Research in Technology (CERT) and the Executive Committee of IEA Wind

2013
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1. Preface


This report was reviewed and approved by the IEA Wind Executive Committee (ExCo). It was approved by email ballot on July 23, 2013 and forwarded to the REWP with recommendations for continuation of the IEA Wind Agreement for an additional 5 years on July 25, 2013. It includes an updated 5-year Strategic Plan consistent with the IEA Technology Roadmap: Wind Energy updated in 2013. In February 2014, the CERT approved the extension of the IEA Wind Agreement through February 2019.
2. Executive Summary

Based on the CERT criteria for extension of implementing agreements, the activities described in this End-of-Term Report, and the activities proposed in the Strategic Plan, the following can be concluded:

1. Technology and information development by IEA Wind has been useful to the participants and is consistent with IEA goals as expressed in the CERT review process.
2. A clear vision and role for continuing the work has been developed for IEA Wind that meets CERT review criteria.
3. Collaborative networks serve mainly the IEA/ the Organisation for Economic Co-operation and Development (OECD) governments, but outreach efforts are under way to all interested governments and industry from any country. The Chinese Wind Energy Association joined as a Sponsor member during the completed term and brings the benefits of IEA Wind to the People’s Republic of China.
4. Activities of IEA Wind have been well managed and responsive to the changing needs of the expanding global market for wind energy systems.

Consequently, the ExCo proposed a 5-year extension of the IEA Wind Agreement to February 28, 2019. The IEA REWP and the CERT approved this extension in February 2014.

(a) End-of-Term Report

As described in this End-of-Term Report, the participants of the IEA Wind Agreement have worked productively toward the objectives set out in the IEA Wind 2009 Strategic Plan¹ and its 2011 update². Participants report at meetings how their national programs are addressing key issues of improving wind turbine reliability and performance, wind power integration into the electricity system, offshore wind development, and social acceptance of wind energy projects. Results of the co-operative research tasks are having significant impact on expanded wind energy development in the member countries. The research tasks are rewarding participants with benefits many times the monetary and in-kind efforts they contribute. Industrial and utility participation is contributing to the research tasks, and the information sharing and distribution of the ExCo is being well managed to achieve maximum impact for modest participation fees. The work of IEA Wind is contributing to policy development in the member countries and at IEA.

(b) Strategic Plan

The IEA Wind ExCo developed a Strategic Plan for 2014–2019 through a consensus process. The work is based on recommendations from a Topical Expert Meeting (#67) on Long-Term Research and Development (R&D) Needs for Wind Power.³ The objective of the document was to identify future wind power research needs through 2030. A formal document, Long-Term Research and Development Needs for Wind Energy for the Time Frame 2012 to 2030, will be published in October 2013 (2). The IEA Wind ExCo grouped priority R&D projects into four strategic categories for the next 5 years. The coming work will address issues for wind turbines on land and offshore using the relevant experience from the industrial and national projects of participants. To ensure the dissemination and availability of important research results, the four R&D categories are supported by a communications activity to develop materials for publication and distribution.

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¹ ieawind.org/strategic_plans/EOT.SP%2010.31.v2.pdf
² ieawind.org/index_page_postings/strategic_plan_update_2009%20_%202014.pdf
The IEA Wind Agreement will focus on the work underway in the 13 active research tasks and initiate new tasks in the five categories of the Strategic Plan (Figure 1). Many of these new tasks will be initiated as a result of Task 11 Base Technology Information Exchange Topical Expert Meetings. At these meetings, participants make recommendations for collaborative R&D projects. Topical Experts Meetings help advance the state of knowledge by gathering experts who exchange the latest information. Even if a collaborative research task is not started, some important topics (e.g. forecasting) are addressed every two or three years at these meetings to foster regular interaction within the research community. The work of the research tasks will also contribute to the development of Recommended Practices to facilitate wind technology development and deployment. Recommended Practices serve as pre-normative guidelines in advance of formal standards to promote best practices available for wind technology and deployment.

Figure 1. IEA Wind Research Tasks

Most tasks contribute to more than one of the five Priority Areas and will be continued beyond their terms indicated in response to research needs.
The following five areas are drawn from the IEA Wind Strategic plan for the coming term 2014–2019.

1. Wind Characteristics
R&D activities identified in this area include wind characterisation to improve accuracy of resource assessment for optimal siting and operation of wind power plants and turbines, reduce wake array losses, and produce more accurate forecasting of performance and output.


2. Wind Power Technology
R&D activities in this area will focus on system design and analysis to improve performance and reduce costs. They will explore advanced controls for wind turbines and wind farms to reduce maintenance costs and increase production. They will conduct research on new materials, and activities will assess advanced components including rotors, drivetrains, power electronics, support structures, manufacturing, installation, reliability, and testing.

Active IEA Wind tasks that will contribute to this key area include: Task 19 Wind Energy in Cold Climates; Task 27 Small Wind Turbines at Turbulent Sites; Task 29 Mexnext Aerodynamic Models and Wind Tunnel Data; Task 30 Offshore Code Comparison Collaborative Continuation; Task 33 Reliability Data: Standardising Data Collection for Wind Turbine Reliability, Operation, and Maintenance Analyses; Task 35 Full-Size, Ground Testing for Wind Turbines and Their Components.

3. Wind Integration
R&D activities in this area will enable smooth integration of large amounts of wind power into the electrical grid. Topics are related to power system operation with wind to improve grid support from turbines; improve power system operation; improve the internal electrical grid within wind plants; and increase power system flexibility through transmission, generation, demand management, and storage.

The active IEA Wind Task 25 Design and Operation of Power Systems with Large Amounts of Wind Power will continue to contribute to this key area.

4. Social, Environmental, and Educational Issues
R&D activities will focus on increasing the understanding of barriers to wind development, developing tools to effectively manage the impacts of wind development, and helping prioritise research investments.

Active IEA Wind tasks that will contribute to this topic include: Task 26 Cost of Wind Energy, Task 27: Consumer Labelling of Small Wind Turbines, Task 28 Social Acceptance of Wind Energy Projects, and Task 34 Environmental Assessment and Monitoring of Wind Energy

5. Communication
The IEA Wind communication strategy will continue the work described in this End-of-Term Report and will add production of an e-newsletter, increase outreach to new members, and expand work with operating agents to produce reports, website content, and IEA Wind Recommended Practices.

(c) Development and Approval of Extension Materials
At the 70th ExCo meeting in Tokyo, Japan, the ExCo designated a working group to prepare the Self-Evaluation, End-of-Term Report, and Strategic Plan needed to support extension of the IEA Wind Agreement for another 5 years. In Vienna, Austria (ExCo 71), the ExCo voted to request extension from the CERT and agreed to review and approve the extension documents by July 31, 2013. The self-evaluation form was sent to ExCo members along with the draft End-of-Term Report and Strategic Plan. After commenting on those documents, the ExCo submitted the Self-Evaluation forms to the Secretary. The summarised evaluation form, End-of-Term Report, and Strategic Plan were approved by email ballot on July 23, 2013.
3. End-of-Term Report
Before developing the new Strategic Plan, IEA Wind participants designated the Secretary to draft a report explaining how activities and results of the term just completed relate to the CERT evaluation criteria and the goals set out in the previous IEA Wind Strategic Plan. The results of the Secretary’s report were used by the Long-Term R&D Working Group to develop the Strategic Plan for the next term included in Section 4 of this document. This End-of-Term Report section reviews the activities of the term just completed and is organised according to the Guidelines for End-of-Term Reports [from IEA/CERT (2010) 3/REV1].

(a) Strategic Direction
The programme of work of the IEA Wind agreement (meetings, tasks, and publications) has been planned over the last two terms (10 years) to coincide with the strategies of the CERT and the REWP. The success of the planned efforts has contributed directly to the REWP goal of “sharing and exchanging analysis and best practices on renewable technologies and policies, including renewable energy technology roadmaps and medium term market reports, in IEA Member countries…”

History
Since its establishment in 1978, participants in the IEA Wind Agreement have advanced deployment of wind energy generation capacity by meeting regularly (two times per year) to exchange experience and manage and plan co-operative research actions. IEA Wind publishes the results of its co-operative research tasks (35 numbered tasks through 2013) and Recommended Practices (15 through 2013) both on wind energy technology and on issues relevant to deployment of wind energy systems. Annual progress in the participating countries and in the research tasks are published in Annual Reports (35 to date), and each year more than 150 technical reports, presentations, and journal articles are issued. All of these documents are available on the IEAWind.org website and are announced in the IEA Secretariat’s electronic OPEN Bulletin.

CERT and REWP Strategies Supported
Strategic plans guide the development of research tasks to carry out the IEA Wind objectives. At the time of the mid-term report to the REWP and the CERT in 2010, the ExCo added the following key targets to its Strategic Plan (2009–2013) from the IEA Technology Roadmap: Wind Energy6, published in 2009, by the IEA Secretariat:

- Reduce the cost of wind energy use
- Increase the flexibility of transmission and power systems
- Increase social acceptance of wind energy projects
- Increase the exchange of best practices

The ExCo also clarified through the IEA Wind Strategic Plan update (2011) that these key CERT and REWP targets are being served within each of the following five research, development, and

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deployment (R,D&D) themes contained in the plan:

1. Wind technology research to improve performance and reliability at competitive costs
2. Research on power system operation and grid integration of high amounts of wind generation, including development of fully controllable, grid-friendly wind power plants
3. Wind resource and performance assessment for large wind integration
4. Research on offshore wind in shallow-to-deep waters
5. Research on social, educational, and environmental issues that affect wind siting

The 2011 Strategic Plan update also added the following vision and mission statements compatible with CERT/REWP strategy and IEA Wind’s continuing activities:

- **VISION:** The IEA Wind Agreement aims to contribute to the vision of the IEA CERT to become the pre-eminent player in clean energy technologies. It will do this by strengthening its current position as an authoritative organisation, and by providing technology and policy support to its members’ governments and to the wind energy sector.
- **MISSION:** IEA Wind’s mission is to stimulate co-operation on wind energy R,D&D. It will provide high-quality information and analysis to member governments and commercial sector leaders by addressing technology development and deployment. It will identify the benefits, markets, and policy options for wind energy. At the same time, IEA Wind’s activities are an important instrument to implement the *IEA Technology Roadmap: Wind Energy.*

The Strategic Objectives in Table 1 guided the work described in this End-of-Term Report. The Action Path set out in the 2009–2013 Strategic Plan was followed for the term. The Strategic Plan submitted at the last end of term coincides with the strategies of the CERT and the REWP. In addition to addressing its vision and mission, the work of IEA Wind during the reporting term has directly contributed to the strategies of the CERT and the REWP in the following ways:

- IEA Wind supported CERT activities by publishing results of the research tasks and Implementing Agreement (IA) work: annual reports, task technical reports and final reports, recommended practices, state-of-the-art reports, and archives of reports dating from 1978 on its website, [www.ieawind.org](http://www.ieawind.org).
- The members of IEA Wind contributed to CERT strategies by reviewing draft policy documents to ensure technical accuracy and currency (e.g., *IEA Technology Roadmap: Wind Energy*, the *Mid-term Renewables Market Report*), participating in workshops to develop IEA documents (e.g., GIVAR—Grid Integration of Variable Renewables), and publishing reports that are referenced in IEA documents directed at policymakers (e.g., environmental benefits reported by countries and summarised in the Executive Summaries of the IEA Wind Annual Reports executive summaries).
- Members of IEA Wind contribute to IEA meetings, including REWP meetings, Ministerials, Energy Technology Network meetings (on Communications, Integration, and Storage), and in IEA-sponsored workshops to approach non-IEA countries.

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7 The new IEA Wind Strategic Plan (2014–2019) employs a slightly different organisation of research themes. See Section 5 Strategic Plan.
Table 1. IEA Wind Strategic Objectives for the Completed Term (2009–2013)\(^8\)

<table>
<thead>
<tr>
<th>Strategic Objective</th>
<th>Key Issues</th>
<th>Action Path</th>
</tr>
</thead>
</table>
| 1. Wind technology research to improve performance and reliability at competitive costs | ➢ Improve basic R&D performance, reliability, and innovation  
➢ Optimise manufacturing and supply chains  
➢ Bring the test site to the lab (test facilities and methods) | ➢ Exploit existing mechanisms to identify and advance the state-of-the-art across R&D topics  
➢ Convene experts meetings and new tasks on offshore issues |
| 2. Power system operation and grid integration of high amounts of wind generation | ➢ Develop methods to assess the impact of wind generation on power system design and regulation  
➢ Make wind turbines grid-friendly to increase acceptance by grid operators | ➢ Advance the state-of-the-art in the area of power system operation with large wind penetration  
➢ Convene experts meetings and new tasks on grid integration  
➢ Increase engagement with power system operators  
➢ Co-operate with other IAs (e.g., IEA Storage) |
| 3. Wind resource and performance assessment for large wind integration             | ➢ Create dynamic models, performance assessment methods, and improved methods to estimate production in complex terrain and under offshore conditions  
➢ Improve forecasting | ➢ Consider additional experts meetings  
➢ Consider new tasks on performance assessment |
| 4. Offshore wind development                                                       | ➢ Model loads and design support structures for deep water (>30 m) and floating structures  
➢ Improve transport, installation, and maintenance  
➢ Develop new and optimised support structures as integrated concepts concerning production, installation, operation, and environmental impact | ➢ Extend foundation design work of Task 30  
➢ Develop new task proposals on offshore aspects based on final reports of Task 23, work of Task 30 and findings of experts meetings,  
➢ Hold experts meeting on long-term R&D needs toward the end of this term  
➢ Review strategy document and generate annual work plan  
➢ Support the exchange of operation experiences of wind farms taking into account commercial sensitivities |
| 5. Social, educational, and environmental issues                                   | ➢ Increase relevance of IEA activities for member countries  
➢ Explore wind within future energy supply systems  
➢ Conduct energy systems modelling  
➢ Assess support mechanisms and markets for wind in the context of all renewables  
➢ Increase the quality and visibility of information generated  
➢ Assess environmental and social issues such as the effects on flora and fauna, visual influence, and noise emission | ➢ Continue Task 28 work to address societal issues  
➢ National representatives continue to liaise with relevant commercial-sector organisations  
➢ Hold dedicated events with the commercial sector  
➢ Collaborate with other implementing agreements  
➢ Continue presentations at targeted events  
➢ Exploit appropriate IEA dissemination channels  
➢ Continue to produce and distribute the annual report  
➢ Update the strategy annually |
| 6. Communication strategy                                                         | ➢ Increase the influence of results from IEA-Wind-sponsored research  
➢ Increase quality participation in IEA-Wind-sponsored activities | ➢ Continue refinements to web site to serve the members, the research tasks, and publication of research reports  
➢ Continue improvements to the Annual Report to increase visibility of IEA Wind accomplishments within member countries  
➢ Increase use of newsletters such as the IEA OPEN Bulletin to announce IEA Wind accomplishments  
➢ Devise publicity strategy based on target audiences for each IEA Wind publication  
➢ Develop new brochures and Web content to publicise the work of IEA Wind |

\(^8\) Strategic Objectives for the coming term are presented in the Strategic Plan 2014–2019, Chapter 5 of this document.
(b) Scope

Overview

The IEA Wind Agreement encompasses a comprehensive programme of R,D&D through substantive research projects called tasks (Annexes to the IA) that operate for a minimum of three years (Table 2). Many tasks have been extended by the participants for more than three years to build upon the results of earlier terms. Both technology research and deployment issues are addressed by IEA Wind research tasks. At the close of 2013, 13 research tasks were active, 5 more than at the close of 2008.

IEA Wind participants include countries and organisations from Asia, Europe, North America, and the Pacific (Table 4). Participation in Asia was increased this term with the addition of the Chinese Wind Energy Association as a Sponsor Member. Despite extensive efforts, outreach to South America, Africa, and Eastern Europe have not yet resulted in participation from those areas. (See Section (i)). Every IEA Wind country participates in at least one research task and some take part in all 13 active tasks (Table 5).

The benefits from participation in the research tasks justify the modest costs of joining (Table 3 and Table 9). The value to each participating country of labour applied to research tasks over a two or three-year period ranges from a low of 21 times the monetary cost of participation to a high of 1680 times the cost of participation. These numbers, while impressive, are only a small part of the value gained during participation in research tasks (See Section (j) Added Value). These numbers (collected by the Operating Agents as part of their work plans) indicate that investment in co-operative research yields major savings in R&D costs and leverages funding provided from independent sources. Published research results from the tasks, along with attendance and support of IEA-sponsored events contribute directly to the energy technology collaboration program (Table 6 and Table 9).

To provide high-quality, relevant information that is substantive and comprehensive, the IEA Wind Agreement conducts three kinds of activities: Strategic Technology Research, Strategic Deployment Research, and Communication Activities. The achievements and activities of IEA Wind research tasks are described below.

Achievements

As a direct result of the work of the research tasks and information dissemination, between 2009 and 2013, IEA Wind released more than 30 important technical reports; more than 100 journal articles and conference presentations; and four approved Recommended Practices (see www.ieawind.org). Nearly every research task has contributed to at least one doctoral dissertation, and sometimes as many as six dissertations have applied work performed in a single IEA Wind research task.

During the term, two research tasks (Task 23 Offshore Technology and Deployment and Task 24 Integration of Wind and Hydropower Systems) completed their work plans and issued final reports, along with published journal articles and conference papers. Another seven tasks completed their terms, issued final technical reports on the term, and were extended at least once since 2009. Four tasks issued Recommended Practices, resuming a very useful IEA Wind activity after nearly a decade of no new recommended practices. Five new research tasks were
approved during the term (see Figure 1) to address the evolving needs of the wind community. New reports, Recommended Practices, and new research tasks are described in the IEA OPEN Energy Technology Bulletin (email circulation 20,000), which includes links to relevant information posted on the ieawind.org website.

**Activities**

IEA Wind will begin the next term with 13 active research tasks, which is five more than at the beginning of the previous term. These new tasks have broadened the RD&D portfolio of IEA Wind and are well-aligned with the Strategic Plan for 2009-2013. And more countries and organisations are participating on average in each task (Table 2 and Table 3).

1. Strategic Technology Research tasks help improve wind technology and reduce the cost of energy from wind plants:
   - Base Technology Information Exchange (Task 11)
   - Wind Energy in Cold Climates (Task 19)
   - Small Wind Turbines in Turbulent Sites (Task 27 extension of labelling task)
   - Mexnext Aerodynamic Models and Wind Tunnel Measurements (Task 29)
   - Offshore Code Comparison Collaborative (OC3) was begun and completed during the term under Task 23 Offshore Technology and Deployment. Then, Offshore Code Comparison Collaborative Continuation (OC4) was authorised as Task 30 to continue the work on an expanded list of codes.
   - WAKEBENCH: Benchmarking Wind Farm Flow Models (Task 31)
   - LIDAR: Wind Lidar Systems for Wind Energy Deployment (Task 32)
   - Full-Scale Ground Testing for Wind Turbines and Their Components (Task 35)

2. Strategic Deployment tasks conduct applied research, system analysis, and design work to provide information and analysis on issues affecting technology deployment. At the close of 2013, they included the following tasks:
   - Base Technology Information Exchange (Task 11)
   - Design and Operation of Power Systems with Large Amounts of Wind Power (Task 25)
   - Cost of Wind Energy (Task 26)
   - Consumer Labelling of Small Wind Turbines (Task 27 completed and extended with research work plan—see above)
   - Social Acceptance of Wind Energy Projects (Task 28)
   - Reliability Data: Standardising Wind Data Collection for Wind Turbine Reliability and Operation and Maintenance (O&M) Analysis (Task 33)
   - Environmental Assessment and Monitoring for Wind Energy Systems (Task 34)

3. Communication Activities help the research task operating agents and participants to publicise the results of their work. The Secretariat provides editorial support for documents, co-ordinates the review and approval process, and maintains and expands the ieawind.org website as a global window for IEA Wind work. Each research task has dedicated web pages
to serve its needs. Public portions explain their work. Members-only portions, protected behind passwords, serve the task participants while work is underway. Public research results are featured in the IEA Wind Annual Reports (five this term), which are edited and published by the IEA Wind Secretariat.

Table 2. Active Research Tasks at the Close of 2013 (see also Figure 1)

<table>
<thead>
<tr>
<th>Task No.</th>
<th>Task Name, Operating Agent (OA), and Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>WAKEBENCH: Benchmarking of Wind Farm Flow Models OA: CENER, Spain, and NREL, United States (2011–2013)</td>
</tr>
<tr>
<td>33</td>
<td>Reliability Data: Standardising Data Collection for Wind Turbine Reliability and Operation and Maintenance Analyses OA: Fraunhofer IWES, Germany (2012–2014)</td>
</tr>
<tr>
<td>34</td>
<td>Environmental Assessment and Monitoring for Wind Energy Systems OA: NREL, United States (2013–2016)</td>
</tr>
<tr>
<td>35</td>
<td>Full-Size Ground Testing of Wind Turbines and Components OA: Rheinisch Westfälische Technische Hochschule (RWTH) Aachen University, Germany (2013–2016)</td>
</tr>
</tbody>
</table>

**Funding: Responsibilities and Benefits**

The cost to participate in IEA Wind consists of the modest annual member contribution to the Common Fund and annual fees to participate in at least one research task. During this term, one increase to the annual fee for the Common Fund was approved. The 20% increase was approved...
in 2009, effective beginning in 2010. At that time the IEA Wind agreement had the lowest fee for a Common Fund among the renewable energy implementing agreements.

The participating countries pay a fee to the Common Fund in one of three categories (3,552; 7,104; and 14,208 USD), depending on per capita gross domestic product. In 2013, total revenues for the Common Fund were 149,184 USD collected from 23 members. The budget of the Common Fund supports communication activities, including annual report production, printing, and shipping; website development and maintenance; the work of the Secretary; and travel by the Chair and Vice Chairs to meetings for IEA Paris and conferences on behalf of the ExCo.

The ExCo set an objective of maintaining a budget reserve equal to one-half of the annual revenue. This budget reserve covers expenses while fees for the coming year are being received into the Common Fund account. The Common Fund account is held by NREL in the United States as an in-kind service to the IEA Wind Agreement. An independent audit of the financial records is conducted annually. Costs to participants have been kept low by adding new members (one during this term) and careful budgeting. At the close of the approved 2013 budget year, the operating reserve is projected to be 69,204 USD (less than one-half of the annual budget). This amount argues for consideration of a fee increase for 2014 if new members do not join the IEA Wind Agreement and contribute to the Common Fund. France and Israel have been invited to join during this term, and may become active in 2013.

The research tasks completed and underway during this term are all cost-shared and task-shared, where the work is shared among the countries, and the participants share the cost of the OA. The OA acts as the manager and coordinator of the research task. To cover the expenses of the OA, participants contribute funds as a task fee, which varies with the complexity of the task and the number of participants sharing the expenses (see Table 3).

In addition to arranging the payment of fees, members are expected to attend (and report to) at least one of the two ExCo meetings per year; write their country chapter for the IEA Wind Annual Report; represent their country/sponsor by putting forth motions and voting as a member of the ExCo (when attending meetings and through email ballots); and share leadership over time (chair the ExCo, host meetings, participate on committees, host operating agent of research task).

In return for participation in IEA Wind, members receive benefits that they transfer to researchers and policy makers in their countries and organisations. They hear the latest progress in member countries through country reports at ExCo meetings and through reports on the work in the cooperative research tasks. Members receive printed copies of the IEA Wind Annual Report for distribution within their country. The annual report contains an overview chapter and country reports of progress in wind energy R,D&D. Members gain visibility by having content about their country on the IEA Wind public website (www.ieawind.org), and they gain access to password-protected web pages of internal ExCo documents and presentations. Members also have the opportunity to join research tasks and share results, and they can request and organise joint research tasks of interest. Members may have IEA-Wind-sponsored informative seminars presented in their country, and they gain representation through IEA Wind activities at
international conferences. In addition, members gain a voice in decisions and influence IEA policy and publications.

Table 3. Funding for Active Research Tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Cost Euro/yr</th>
<th>Cost USD/yr</th>
<th>No. of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td></td>
<td>4,750 (2013)</td>
<td>17</td>
</tr>
<tr>
<td>19</td>
<td>4,658 (2013)</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>25</td>
<td>3,300 (2013)</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>26</td>
<td>8,380 (2013)</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>27</td>
<td>3,400 (2013)</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>28</td>
<td>5,000 (2013)</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>29</td>
<td>10,000 (2013)</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>30</td>
<td>5,000 (2013)</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>31</td>
<td>8,500 (2013)</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>32</td>
<td>5,700 (2013)</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>33</td>
<td>5,350 (2012) est.</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>34</td>
<td>Pending</td>
<td></td>
<td>Pending</td>
</tr>
<tr>
<td>35</td>
<td>Pending</td>
<td></td>
<td>Pending</td>
</tr>
</tbody>
</table>

Membership

At the close of 2013, 25 contracting parties participated in the IEA Wind Agreement representing 21 countries (Table 4) in Europe, North America, Asia, and the Pacific. Most countries are represented by one contracting party, usually a government department or agency. Some countries have more than one contracting party within the country (Italy and Norway). The European Commission is also a member. Two organisations, the European Wind Energy Association and the Chinese Wind Energy Association participate as a Sponsor Members. As seen in Table 5, members are active both in participation and leadership of the research tasks.

This term, the IEA Wind Agreement welcomed an important new member, the Chinese Wind Energy Association (CWEA), as a sponsor member (alternative to Government member for key organisations). Founded in 1981, CWEA is a non-profit social entity registered through the Ministry of Civil Affairs of the People’s Republic of China. Its members include more than 800 institutes, companies, and universities as well as several thousand individual experts. Its goal is to improve wind energy technology and the industry in China to provide green energy for the

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9 A Sponsor Member, according to the IEA Framework Document, may be “entities of OECD member countries or OECD non-member countries who are not designated by the governments of their respective countries to participate in a particular Implementing Agreement…”
world. Through CWEA, Chinese research institutes and industry actively contributed to and benefited from participation in 9 of the cooperative research tasks.

An active Membership Committee has solicited participation by observers in ExCo meetings to increase membership. Representatives from the following countries were invited at least once to attend ExCo meetings: Argentina, Belgium, Brazil, Bulgaria, Chile, People’s Republic of China, Colombia, Costa Rica, Cyprus, France, Honduras, India, Israel, Malaysia, New Zealand (formerly a member), Panama, Poland, the Russian Federation, South Africa, Turkey, and Uruguay. The following organisations were also invited as observers between 2009 and 2013: American Wind Energy Association (AWEA), the IEA Renewable Energy Technology Deployment (RETD) IA, the Technology Platform for Wind Energy (TPWind), and the International Renewable Energy Agency (IRENA).

The following four countries and organisations attended ExCo meetings during the current term and were invited to join the IEA Wind Implementing Agreement: the Chinese Wind Energy Association (joined IEA Wind in 2010), France (in 2010 and in 2013), Israel (2013), and the Russian Federation (2009).

It has been difficult to recruit new member countries inside or outside of OECD. Non-member country participation is a topic that is being addressed in the strategic planning process. Many countries could benefit from membership in IEA Wind, but participation has been limited and there are obstacles to overcome, including funding for membership fees, administrative complexities, and travel cost to attend meetings. More help from the IEA Secretariat is needed to address this problem at the governmental level. (See Section (i) Outreach to IEA non-Member Countries.)
Table 4. Participation in IEA Wind in 2013

<table>
<thead>
<tr>
<th>Member</th>
<th>Contracting Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Australia</td>
<td>Clean Energy Council</td>
</tr>
<tr>
<td>2 Austria</td>
<td>Government of Austria</td>
</tr>
<tr>
<td>3 Canada</td>
<td>Natural Resources Canada</td>
</tr>
<tr>
<td>4 China (People’s Republic)</td>
<td>Chinese Wind Energy Association (Sponsor)</td>
</tr>
<tr>
<td>5 Denmark</td>
<td>Danish Energy Authority</td>
</tr>
<tr>
<td>6 European Union</td>
<td>European Commission</td>
</tr>
<tr>
<td>7 European Wind Energy Association</td>
<td>European Wind Energy Association (Sponsor)</td>
</tr>
<tr>
<td>8 Finland</td>
<td>The Finnish Funding Agency for Technology and Innovation (TEKES)</td>
</tr>
<tr>
<td>9 Germany</td>
<td>Federal Ministry for the Environment, Nature Conservation and Nuclear Safety</td>
</tr>
<tr>
<td>10 Greece</td>
<td>Ministry of Industry/Energy and Technology (CRES)</td>
</tr>
<tr>
<td>11 Ireland</td>
<td>Sustainable Energy Ireland</td>
</tr>
<tr>
<td>12 Italy</td>
<td>RSE S.p.A</td>
</tr>
<tr>
<td>13 2nd CP from Italy</td>
<td>Italian National Agency for New Technologies, Energy and the Environment (ENEA)</td>
</tr>
<tr>
<td>14 Japan</td>
<td>National Institute of Advanced Industrial Science and Technology (AIST)</td>
</tr>
<tr>
<td>15 Korea</td>
<td>Government of Korea</td>
</tr>
<tr>
<td>16 México</td>
<td>Instituto de Investigaciones Eléctricas (IIE)</td>
</tr>
<tr>
<td>17 The Netherlands</td>
<td>The Netherlands Agency</td>
</tr>
<tr>
<td>18 Norway</td>
<td>Norwegian Water Resources and Energy Directorate (NVE)</td>
</tr>
<tr>
<td>19 2nd CP from Norway</td>
<td>Research Council of Norway</td>
</tr>
<tr>
<td>20 Portugal</td>
<td>National Laboratory of Energy and Geology (LNEG)</td>
</tr>
<tr>
<td>21 Spain</td>
<td>Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT)</td>
</tr>
<tr>
<td>22 Sweden</td>
<td>Swedish Energy Agency</td>
</tr>
<tr>
<td>23 Switzerland</td>
<td>Swiss Federal Office of Energy</td>
</tr>
<tr>
<td>24 United Kingdom</td>
<td>National Renewable Energy Centre (Narec)</td>
</tr>
<tr>
<td>25 United States</td>
<td>U.S. Department of Energy</td>
</tr>
</tbody>
</table>
### Table 5. Broad Participation in Active Research Tasks

<table>
<thead>
<tr>
<th>Member</th>
<th>Research Task Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country</td>
<td>11 19 25 26 27 28 29 30 31 32 33 34 35</td>
</tr>
<tr>
<td>Australia</td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>•</td>
</tr>
<tr>
<td>Canada</td>
<td>• • •</td>
</tr>
<tr>
<td>China (CWEA)</td>
<td>• • • • • • •</td>
</tr>
<tr>
<td>Denmark</td>
<td>• • • • • • • •</td>
</tr>
<tr>
<td>EC</td>
<td></td>
</tr>
<tr>
<td>EWEA</td>
<td>• •</td>
</tr>
<tr>
<td>Finland</td>
<td>• OA OA •</td>
</tr>
<tr>
<td>Germany</td>
<td>• • • • • OA OA • OA</td>
</tr>
<tr>
<td>Greece</td>
<td>• • •</td>
</tr>
<tr>
<td>Ireland</td>
<td>• • •</td>
</tr>
<tr>
<td>Italy</td>
<td>• • •</td>
</tr>
<tr>
<td>Japan</td>
<td>• • • • • • • • •</td>
</tr>
<tr>
<td>Korea</td>
<td>• • •</td>
</tr>
<tr>
<td>México</td>
<td>•</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>• • • • • OA • • • •</td>
</tr>
<tr>
<td>Norway</td>
<td>• • • • • • • • •</td>
</tr>
<tr>
<td>Portugal</td>
<td>• • •</td>
</tr>
<tr>
<td>Spain</td>
<td>OA • • OA • • OA •</td>
</tr>
<tr>
<td>Sweden</td>
<td>• • • • • • • • •</td>
</tr>
<tr>
<td>Switzerland</td>
<td>• • • OA •</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>• • • • •</td>
</tr>
<tr>
<td>United States</td>
<td>• • • OA • • • OA • OA •</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>16 10 16 9 7 11 10 12 14 12 6</td>
</tr>
</tbody>
</table>

For the latest participant data, check the task websites at [www.ieawind.org](http://www.ieawind.org)

### Contribution to Technology Network

The Wind IA has contributed significantly during the term to IEA’s goals and objectives through the IEA Technology Network\(^{10}\), including the following: attending REWP meetings (by the Chair, including a presentation of the Mid-Term Report); filling out the Energy Technology...

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\(^{10}\) The IEA Technology Network operates from the Secretariat in Paris to coordinate publication of results of the Implementing Agreements.
questionnaire; attending an Electricity Coordination Group meeting; attending two IEA Energy Technology Network Communication seminar/workshops; presenting at the renewable energy workshop at the 17th Conference of the Parties (COP17) to the United Nations Framework Convention on Climate Change South Africa; reviewing the Medium-Term Renewable Energy Market Report; providing input to Energy Technology Initiatives; consulting with RETD about its renewable energy cost study; attending a workshop on the Energy Storage Technology Roadmap; attending the co-sponsored workshop at EWEA 2013 on updating the IEA Technology Roadmap: Wind Energy; Web presentation at the IEA Roadmapping workshop in South Africa.

As further evidence of cooperation, the IEA Wind Agreement also has incorporated the IEA Technology Network Logo into its website and PowerPoint presentations.

**Table 6. IEA Wind Activities Support IEA CERT and REWP (2009–2013)**

<table>
<thead>
<tr>
<th>Type of Activity</th>
<th>No.</th>
<th>No. of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>ExCo Industry Encounter Workshops</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>R&amp;D Task Meetings</td>
<td>&gt;65</td>
<td>12–78 people; 6–15 countries</td>
</tr>
<tr>
<td>R&amp;D Task Net Meetings</td>
<td>&gt;16</td>
<td></td>
</tr>
<tr>
<td>Completed Task Terms</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Extended Research Tasks</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Conference Presentations on IEA Wind</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>ExCo Meetings</td>
<td>10</td>
<td>Average 76% of contracting parties</td>
</tr>
</tbody>
</table>

(c) **Contractual and Management Requirements**

**Overview**

The Wind Implementing Agreement, one of the oldest, has a long tradition of meeting all of the management requirements of the IEA.

- Reporting regularly (Annual Report published in July, approved minutes delivered for two meetings per year, commitment letters for task participation submitted, changes in membership forwarded, etc.)
- A midterm report was presented by the Chair at the REWP meeting in 2011. At that time IEA Wind updated the Strategic Plan to better align with the IEA Technology Roadmap: Wind Energy
- Following the Implementing Agreement text (definition of membership categories, etc.)
- Referring to IEA Secretariat procedures (model letters, etc.)
- Maintaining standard operating procedures. The IA text has been augmented by written Procedures for Research Tasks. The ExCo approved this document for developing, conducting, and closing an IEA Wind research task, and the Chair and Secretary update it as necessary. Additional written procedures (electronic voting, determining charging structure, etc.) are also posted on the members’ web pages\(^\text{11}\) and used regularly.
- Audit reports of the completed Common Fund budget cycle are presented at the first meeting of the calendar year.

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\(^\text{11}\) The members’ portion of the IEAWind.org website is accessed with a password and is reserved for the use of ExCo members, including task Operating Agents.
IEA Wind activities are guided by its strategic plan and annual programme of work.

- The Strategic Plan 2009–2013 and the update completed in 2011 are posted on the home page of IEA Wind. They present the objectives of the agreement to the public and are referred to when selecting Topical Expert Meetings or discussing new research tasks.
- The annual work programme for IEA Wind includes the work plans of the research tasks and the activities budgeted in the Common Fund: the Secretariat, Annual Report production, website development, and special miscellaneous projects for the year. The task work plans and the Common Fund budget are approved at ExCo meetings for the coming calendar year and are posted on the members’ web pages with the ExCo meeting minutes.

The IEA Wind Annual Report, published in July for the preceding year, is a major activity of the Agreement. Each country writes a chapter about the year just completed following an outline determined by the information needs of the group. Each Operating Agent writes a chapter about progress for the year and plans for the coming term. The Secretary (editor) writes an Executive Summary compiling the country statistics and highlighting significant trends. The numbers presented in the IEA Wind Annual Report are used by many other organisations and by the member countries as the most reliable information on trends.

To meet the contractual requirements of the IEA Framework, the Executive Committee (ExCo) manages the IEA Wind Agreement. The ExCo consists of a member and alternate member or members from each contracting party. The ExCo meets twice each year to exchange information on the R&D programs of the members, discuss work progress on the various tasks, and plan future activities. The Chair and two Vice Chairs preside over the meeting. Decisions are reached by majority vote or by unanimity when financial matters are decided. The Planning Committee that manages work between ExCo meetings consists of the Chair, Past Chair, Vice Chairs, Secretary, and OA of Task 11. Members share the cost of administration for the ExCo through annual contributions to the Common Fund (See Funding). Contributions are based on the size of the economy, as determined by the OECD and IEA.

**Meetings**

Since the first meeting in March 1978 through 2013, 72 **IEA Wind ExCo meetings** have been held. During the term just ended, 10 ExCo meetings were held (see Table 7). Member participation varies from 75% to 90% at these meetings. **Industry Encounter workshops** have been held to showcase IEA Wind R&D activities and raise awareness of IEA Wind within the host country. These took place prior to the ExCo meetings in Ireland, Japan, the Netherlands, and Norway. Beginning in 2009, the Chair hosts **meetings of Operating Agents** prior to ExCo meetings. These meetings give the OAs a chance to share information about initiating tasks, reporting, collecting funds, etc. They also have the chance to ask the Chair and Planning Committee for support with any issues arising from their management of IEA Wind tasks.

The IEA Wind Agreement has grown during the term just completed (one additional member organisation and 5 additional research tasks). In order to keep to a 2-day meeting format, ExCo meetings now have either a technology or deployment emphasis and tasks relating to the topic have more time on the agenda. Country reports also emphasise the deployment or technology topic of the meeting.
To exchange information, all participating countries are encouraged to attend at least one of the two ExCo meetings held each year. These 2-day meetings are hosted by one of the member countries or sponsors. An additional day is usually planned for a technical tour of a new wind project, manufacturing plant, or research test facility that includes exchange of valuable technical information. The host organisation is encouraged to organise an industry encounter prior to the ExCo meeting to raise the visibility of IEA Wind in its country. Operating Agents present the plans and accomplishments of their tasks at these industry encounters.

**Table 7. Regular ExCo Meetings were Held during the Term Completed**

<table>
<thead>
<tr>
<th>Meeting No.</th>
<th>Date</th>
<th>Year</th>
<th>Location</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>63</td>
<td>April 21–23</td>
<td>2009</td>
<td>Bremerhaven, Germany</td>
<td>Brian Smith, US</td>
</tr>
<tr>
<td>64</td>
<td>Nov 3–6</td>
<td>2009</td>
<td>Huatulco, México</td>
<td>Brian Smith, US</td>
</tr>
<tr>
<td>65</td>
<td>April 27–29</td>
<td>2010</td>
<td>Malmö, Sweden</td>
<td>Brian Smith, US</td>
</tr>
<tr>
<td>66</td>
<td>Oct 26–28</td>
<td>2010</td>
<td>Palermo, Sicily, Italy</td>
<td>Brian Smith, US</td>
</tr>
<tr>
<td>67</td>
<td>April 12–14</td>
<td>2011</td>
<td>Amsterdam, the Netherlands</td>
<td>Hannele Holttinen, Finland</td>
</tr>
<tr>
<td>68</td>
<td>Oct 18–20</td>
<td>2011</td>
<td>Dublin, Ireland</td>
<td>Hannele Holttinen, Finland</td>
</tr>
<tr>
<td>69</td>
<td>May 22–24</td>
<td>2012</td>
<td>Rorvik, Norway</td>
<td>Hannele Holttinen, Finland</td>
</tr>
<tr>
<td>70</td>
<td>Oct 23–25</td>
<td>2012</td>
<td>Tokyo, Japan</td>
<td>Hannele Holttinen, Finland</td>
</tr>
<tr>
<td>71</td>
<td>Feb 6–7</td>
<td>2013</td>
<td>Vienna, Austria</td>
<td>Jim Ahlgrimm, US</td>
</tr>
<tr>
<td>72</td>
<td>Oct 14–17</td>
<td>2013</td>
<td>Beijing, China</td>
<td>Jim Ahlgrimm, US</td>
</tr>
</tbody>
</table>

**Annual Reports**

During the past 5-year term, IEA Wind published five issues of the IEA Wind Annual Report and distributed 2,500 printed copies each year. The IEA Wind Annual Report (published continuously since 1977) includes an Executive Summary with statistics about wind energy in the member countries, including wind generation’s contribution to national electrical demand, environmental impacts, research priorities and budgets, and wind sector economic turnover. In 2009, the IEA Wind Annual Report moved to a larger, full-colour format that has been very well received by the members. The 180-page annual reports are sent to IEA Paris and to the ExCo members for distribution within their countries to key target audiences. A sample press release and distribution suggestions are also forwarded to each ExCo member. Although moving to solely electronic distribution has been discussed, the majority of members find the printed version well worth the expense when explaining to policy makers the activities of the IEA Wind Agreement.

The annual reports are available for free download on the IEA Wind public website and have been assigned International Standard Book Numbers (ISBNs) to improve visibility to non-member countries. In response to requests of policy analysts studying the global history of wind development, all IEA Wind annual reports (beginning with 1978) have been scanned and posted to the archives section of the ieawind.org website.
IEA Framework
The IEA Wind Agreement operates within the IEA Framework. The Framework document is posted on the members’ pages at ieawind.org under Official Documents. New participants are made aware of this important resource.

IA Legal Text
On November 4, 2009, an updated Implementing Agreement text was unanimously adopted that incorporated acceptance of the IEA Framework for International Energy Technology Co-operation (2003). The IEA Wind IA text is posted on the members’ pages under Official Documents. New participants are made aware of this important resource, and it is sent to potential new participants as part of the information about the IEA Wind Agreement.

(d) Contribution to Technology Evolution and Progress
Overview
The IEA Wind agreement contributes to technology evolution through its research tasks. As mentioned under Section (b) Scope, the IEA Wind Agreement conducts three kinds of activities: strategic technology research, strategic deployment research, and communication activities.

Every IEA Wind research task publishes extensively. For example, the Operating Agent and participants in Task 24 Integration of Wind and Hydropower Systems worked with the editor of Wind Engineering to publish a complete 2012 issue featuring the results of the task. For details about publications, please refer to the separate document listing selected articles in peer-reviewed journals that are a direct result of IEA Wind collaborations during the term completed in 2013.

In addition to task results, participants in the tasks gain knowledge and experience from their international colleagues that they apply to their other work on wind energy. IEA Wind tasks are set up to encourage broad participation within countries and Sponsor Member organisations that contribute to the work plan. For one participation fee, many institutions within the country may contribute to and benefit from the work. For example, Task 31 WAKEBENCH on benchmarking wind farm flow models has 13 participating countries, 10 working groups, 80 interested organisations and 200 people on the email list. A LinkedIn group for the task has more than 130 members.

IEA Wind, through its procedures and reporting requirements for Operating Agents, encourages cooperation with other international organisations and with related technology areas. This approach ensures spill over effects to and from other technologies. For example, Task 24 Integration of Wind and Hydropower Systems had active participation from the IEA Hydropower IA. Task 25 Design and Operation of Power Systems with Large Amounts of Wind Power has drafted Recommended Practices for conducting integration studies that are applicable to conducting studies of any variable power generation technology (e.g., solar and hydropower).

IEA Wind research tasks that contribute mostly to technology evolution are discussed here. Tasks that contribute mostly to deployment and market facilitation are discussed in Section (e).

12 ieawind.org/index_page_postings/June%207%20posts/task%2024%20wind%20engineering%202012.pdf
Contribution to Technology Deployment / Market Facilitation. Communication activities are discussed in Section (h) Contribution to Information Dissemination.

**Success Story: Topical Experts Meetings**

Task 11 Base Technology Information Exchange promotes wind turbine technology and deployment through Topical Expert Meetings for information exchange on R&D topics selected by the ExCo. When invited experts attend, they learn that they are not working alone on the topic at hand and broaden their network of peers in the international community. In addition, the resulting networks among researchers improve the design and implementation of similar research efforts, avoid duplication of effort, and increase collaborations. During the term completed, 17 Topical Expert Meetings were held (Table 8). Five new research tasks were approved based on proposals that resulted from Topical Experts Meetings.

IEA Wind research tasks are paramount among international research collaborations. Topical Expert Meetings lay the foundation with technical information and the necessary network of researchers to begin new cooperative research tasks. During this term, the following tasks were proposed as a result of Topical Expert Meetings:

- Task 30 Offshore Codes and Models Comparison (OC4)
- Task 31 WAKEBENCH: Benchmarking Wind Farm Flow Models
- Task 32 LIDAR: Wind Lidar Systems for Wind Energy Deployment
- Task 33 Reliability: Standardising Reliability Databases
- Task 35 Full-Scale Ground Testing of Wind Turbines and Components
Table 8. Topical Expert Meetings Held during the Term 2009–2013

<table>
<thead>
<tr>
<th>Date</th>
<th>Topical Expert Meeting Topic, Number</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>Wind Energy in Complex Terrain, 75</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>Operation and Maintenance Challenges, 74</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>Noise Reduction Technologies, 73</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>Forecasting, 72</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>Wind Farm Control Methods, 71</td>
<td>18 people; 6 countries</td>
</tr>
<tr>
<td>2012</td>
<td>Social Acceptance of Wind Energy, 70</td>
<td>26 people; 11 countries</td>
</tr>
<tr>
<td>2012</td>
<td>Operations and Maintenance Issues of Wind Farms, 69</td>
<td>cancelled</td>
</tr>
<tr>
<td>2012</td>
<td>Advances in Wind Turbine and Component Testing, 68</td>
<td>28 people; 7 countries</td>
</tr>
<tr>
<td>2011</td>
<td>Long-Term R&amp;D Needs for Wind Power, 67</td>
<td>21 people; 8 countries</td>
</tr>
<tr>
<td>2011</td>
<td>Offshore Foundation Technology and Knowledge for Shallow, Middle, and Deep Water, 66</td>
<td>20 people; 9 countries</td>
</tr>
<tr>
<td>2011</td>
<td>International Statistical Analysis on Wind Turbine Failures, 65</td>
<td>22 people; 7 countries</td>
</tr>
<tr>
<td>2010</td>
<td>Wind Conditions for Wind Turbine Design, 64</td>
<td>24 people; 4 countries</td>
</tr>
<tr>
<td>2010</td>
<td>High Reliability Solutions and Innovative concepts for Offshore Wind Turbines, 63</td>
<td>30 people, 10 countries</td>
</tr>
<tr>
<td>2010</td>
<td>Micrometeorology Inside Wind Farms and Wakes Between Wind Farms, 62</td>
<td>15 people; 9 countries</td>
</tr>
<tr>
<td>2010</td>
<td>Wind Farms in Complex Terrain, 61</td>
<td>12 people; 6 countries</td>
</tr>
<tr>
<td>2009</td>
<td>Radar, Radio Links, and Wind Turbines, 60</td>
<td>27 people; 8 countries</td>
</tr>
<tr>
<td>2009</td>
<td>Remote Wind Speed Sensing Techniques Using Sodar\textsuperscript{13} and Lidar\textsuperscript{14}, 59</td>
<td>31 people; 11 countries</td>
</tr>
<tr>
<td>2009</td>
<td>Sound Propagation Models and Validation, 58</td>
<td>17 people; 9 countries</td>
</tr>
</tbody>
</table>

Wind Turbine Design Tools and Validation

Task 19 Wind Energy in Cold Climates participants wrote a state-of-the-art report that formed the basis for an IEA Wind Recommended Practice. RP 13 Wind Energy Projects in Cold Climates (2011) formed the basis for the fourth revision of IEC 61400-1 Design Requirements, which included the effect of ice loads and low temperatures in design load cases. Having a dedicated design load case for wind turbines with ice accretion on blades gives manufacturers a tool to design turbines for these adverse conditions. This, in turn, leads to better technologies, reduction of O&M costs, and lower cost of energy from cold climate wind plants.

Task 29 Mexnext Aerodynamic Models and Wind Tunnel Measurements participants are evaluating detailed aerodynamic measurements (from the European Union Model Rotor Experiments under Controlled Conditions or “MEXICO” project) to validate and improve aerodynamic models, including: free vortex wake models, computational fluid dynamics blade flow and near wake flow, yawed flow models, dynamic inflow models, instationary airfoil aerodynamics, general inflow modelling (non-uniformity between blades), and 3-dimentional...

\textsuperscript{13} SOnic Detection And Ranging (sodar)
\textsuperscript{14} LIght Detection And Ranging (lidar)
models (including tip effects). In the first phase of Mexnext, most of the attention was paid to measurements from the European Union Project MEXICO. In the second phase of the project, measurements from a large variety of sources are used, including new measurements from MEXICO project wind tunnel set-up).

Task 30 Offshore Code Comparison Collaboration Continuation (OC4) compares and verifies computer codes (more than 22) for coupled dynamic analysis of offshore wind turbine support structures (monopile, tripod, floating spar buoy, jacket, and semisubmersible). It continues the work of Task 23 Offshore Wind Technology and Deployment, Subtask B Offshore Code Comparison Collaboration (OC3), with new and continuing participants. It is expected to improve the design of offshore wind turbines, including support structures thanks to verified and improved codes for jacket and semi-submersible substructures. A key goal of Task 30 is to identify ways to improve codes that will allow the design of better, lower-cost offshore wind structures.

Task 31 Benchmarking of Wind Farm Flow Models (WAKEBENCH) will improve atmospheric boundary layer and wind turbine wake models for use in wind energy by benchmarking different wind and wake modelling techniques. The large number of participants (12 countries and 80 organisations) will ensure comprehensive work to identify and quantify best practices for using these models under a range of conditions, both land-based and offshore, from flat to very complex terrain.

New Tasks for Technology Evolution
Task 27 Small Wind Turbines at Turbulent Sites (continuation of Task 27 Consumer Labelling with a new R&D focus) will develop a Small Wind Turbine Association of Testers and conduct research to evaluate the wind resource in areas of high turbulence (rooftops, complex terrain, etc.) and effects on small turbine performance.

Task 32 Wind Lidar Systems for Wind Energy Deployment (LIDAR) provides a forum for experts to exchange experience and progress on the performance of lidar devices, associated measurement techniques, and the effect of operational and site conditions for wind energy applications. Subtask 1 addresses calibration and classification of lidar devices. Subtask 2 addresses procedures for site assessment. Subtask 3 addresses procedures for turbine assessment. Expected results include differentiation of technical aspects of lidar systems compared to conventional anemometry; performance evaluation of lidar systems for resource assessment and prediction of the annual energy production, namely, wind speed, turbulence, stability, and boundary-layer characteristics in flat as well as complex terrain, and offshore; evaluation of lidar-based power curve measurement methods during simple and complex inflow conditions through benchmark studies with new lidar-based measurement techniques and conventional procedures; definition of approaches to estimate the inflow conditions related to mechanical loads of wind turbines by means of lidar systems.

Task 35 Full-Size Ground Testing of Wind Turbines and Components, approved in 2013, will address the lack of uniform procedures for ground testing wind turbines and their full-size components. The first two subtasks will document and develop recommendations for test procedures of wind turbine blades and drive trains. The output of this task should increase the
comparability of ground test results and improve confidence in tests of wind turbine durability, and develop technical requirements that will be recognised internationally by standards and certification organisations.

(e) Contribution to Technology Deployment and Market Facilitation

Overview

In addition to the benefits of the tasks directed at reducing the cost of wind energy through technology evolution, several IEA Wind research tasks contribute to deployment and market facilitation. Technology improvements have hastened the adoption of wind energy, and IEA Wind’s intense focus on information exchange has increased the understanding of wind technology and impacts, thereby smoothing its general acceptance in the marketplace, policy arena, and public mind-set.

Industry participation is important to designing and carrying out work to advance deployment and expand markets. Industry perspective and relevance is enhanced with the joining of the two Sponsor Member organisations. The Sponsor Member, European Wind Energy Association, has brought a much appreciated industry perspective to IEA Wind since 2006. Since 2010, the Chinese Wind Energy Association also brings the perspective of their wind industry to IEA Wind. Industry relevance is also ensured by the strategy of forming tasks based on proposals from Topical Experts Meetings. Industry experts are invited to these meetings so that their perspective is represented. Recommended Practices are also developed with input from industry and are circulated for review within the industry as well.

Results of IEA Wind activities have accelerated deployment of wind energy. The Recommended Practice 12 on labelling small wind turbines is being used in Japan and other countries to facilitate the small wind market and ensure quality products are deployed. Recommended Practice 14 Social Acceptance of Wind Energy Projects was developed with case studies and is being used to promote actions that increase social acceptance and therefore accelerate technology deployment.

Success Story: Recommended Practices

IEA Wind set the goal at the start of this term to resume developing and approving Recommended Practices. With the help of the OA of Task 11 and the Secretary, all research tasks are encouraged to develop Recommended Practices. Recommended Practices were identified in the IEA Wind 2009 Strategic Plan as contributing both to technology development and deployment. IEA Wind Recommended Practices serve as pre-normative guidelines in advance of formal standards to promote best practices available for wind technology and deployment. They are often used as input to the more lengthy full standards process.

Four Recommended Practices have been approved this term and are described below: Recommended Practice (RP) 12 Consumer Label for Small Wind Turbines; RP13 Wind Energy in Cold Climates; RP 14 Social Acceptance of Wind Energy Projects; and RP 15 Ground-Based, Vertically-Profiling Remote Sensing for Wind Resource Assessment. Additional Recommended Practices on Integration Studies (Task 25) and Cost of Energy Analyses (Task 26) are under development.
RP 12 Consumer Label for Small Wind Turbines (2011), developed within IEA Wind Task 27, has been included as an appendix to the International Electrotechnical Commission (IEC) TC 88 standard on wind system testing. In 2012, the IEC compliance group began work to implement the labelling of small wind turbines applying the IEA Wind RP 12.

RP 13 Wind Energy Projects in Cold Climates (2011), developed within IEA Wind Task 19, formed the basis for the fourth revision of IEC 61400-1 Design Requirements, which included the effect of ice loads and low temperatures in design load cases. Having a dedicated design load case for wind turbines with ice accretion on blades gives manufacturers a tool to design turbines for these adverse conditions. This, in turn, leads to better technologies, reduction of O&M costs, and lower cost of energy from cold climate wind plants.

RP 14 Social Acceptance of Wind Energy Projects (2013), developed within IEA Wind Task 28, is expected to guide good practices by developers and local authorities. The wide input collected during the development of this RP has already increased the knowledge base on this topic area. A database of studies is available on the Task 28 web pages at ieawind.org as ready reference in addition to the Recommended Practices document.

RP 15 Ground-Based, Vertically-Profiling Remote Sensing for Wind Resource Assessment (2013) is expected to promote use of this new, potentially powerful method for measuring the wind resource with remote sensing devices—Sodar and Lidar—by consolidating descriptions of current theory and industry practices. The IEA Wind Task 32 Wind Lidar Systems for Wind Energy Deployment will refine this document based on results of the task work into a second edition and provide input to IEC standards development.

State-of-the-Art Reports for Deployment

Assembling the state-of-the-art into a public report is a key first step for many IEA Wind research tasks. Participants learn to work together and contribute experience from their countries and organisations. State-of-the-art reports also serve as starting points for Recommended Practices and prioritising R&D needs.

Task 25 Design and Operation of Power Systems with Large Amounts of Wind Power issued its first state-of-the-art report in 2007 sharing the experiences of 11 countries and the European Wind Energy Association. This report has been updated and extended to include summaries of results and experience on wind integration from new participating countries. The national case studies address different aspects of power system operation and design: balancing, grid impacts, and capacity credit of wind power. The Recommendations for Integration Studies paper built on these case studies and will evolve into RP 16 Integration Studies in the coming term. This paper describes and recommends methodologies to assess the impact of wind energy on power systems with an emphasis on technical operation. The task has involved the transmission system operators in the task work to ensure seamless application of the results.

Task 26, Cost of Wind Energy issued The Past and Future Cost of Wind Energy report (2012) that reviews historical costs, evaluates near-term market trends, reviews the methods used to
estimate long-term cost trajectories, and summarises the range of costs projected for land-based wind energy across an array of forward-looking studies and scenarios. It also highlights high-level market variables that have influenced wind energy costs in the past and are expected to do so in the future. This report followed the *Multi-National Case Study of the Financial Cost of Wind Energy* (2011) report. Continuing work will identify the primary cost drivers of offshore wind energy and explore the variation of these costs among participating countries. The objective of the task is to provide information on cost of wind energy in order to understand past and present trends and anticipate future trends using consistent transparent methodologies, as well as to understand how wind technology compares to other generation options within the broader electric sector.

Task 28 Social Acceptance of Wind Energy Projects is set up as an interdisciplinary and trans-national working group of practitioners and researchers to share their knowledge and experience. Participants benefit from learning about successful strategies and innovative ideas. The development of wind energy—more specifically, the debates surrounding projects in the field — have also shown that social acceptance is a topic that must be better understood if policy targets for renewable energy production are to be accomplished. Individual projects require public approvals to be realised, and proponents and opponents need to work together to improve projects. Such trends appear to be increasingly recognised by industry, government, and research institutions. To achieve long-term acceptance of wind power, the topic requires further attention and examination, i.e., in terms of “quantification” or “monitoring”, by efforts such as Task 28 with its interdisciplinary and trans-national approach. In the next term, updated reports and more focused publications will be developed and the website database on publications and projects will be expanded for use by all stakeholders.

**Completed Tasks for Deployment**

Two tasks, Task 23 and Task 24, were completed and their work will be continued in other tasks.

Task 23 Offshore Wind Technology and Deployment (final reports in 2010) completed two subtasks at the beginning of this term and issued final technical reports that are posted on the ieawind.org website. Subtask 1 Experience with Critical Deployment Issues explored ecological issues and regulations, electrical system integration, and external conditions, layouts, and design of offshore wind farms by holding meetings of interested parties. Subtask 2 Wind Turbine Technologies explored modelling for applications in water deeper than 30 m. Researchers compared and tried to validate existing computer models for analysing and evaluating offshore wind turbines on various types of foundations. Subtask 2 had participation from industrial organisations including Vestas, Siemens, Eslam, DNV, Garrad Hassan and GL Windenergie, CarlBro, Ramboll, RePower, Norske Hydro, and Acciona Energia. This subtask provided the foundation for IEA Wind Task 30 to continue work in this fast-moving area of offshore wind research.

Task 24 Integration of Wind and Hydropower Systems (final report in 2011) was completed at the beginning of this term and issued the following two volumes of its final report:

- *Volume 1: Issues, Impacts, and Economics of Wind and Hydropower Integration: Results of IEA Wind Task 24 on the Integration of Wind and Hydropower Systems*
- *Volume 2: Participant Case Studies.*

This task included significant cooperation with the IEA Hydropower agreement. The final report volumes are posted on the ieawind.org website. Continuing issues of integrating wind and hydropower are being addressed in Task 25 Design and Operation of Power Systems with Large Amounts of Wind Power.

**New Tasks for Deployment**

Late in the term, Task 33 and Task 34 were approved based on information and networks established through Topical Expert Meetings.

Task 33 Reliability Data: Standardising Data Collection for Wind Turbine Reliability and Maintenance Analyses will provide an open forum on wind turbine failure and maintenance statistics. Participants will exchange experience from individual research projects; develop an IEA Wind Recommended Practice for collecting and reporting reliability data; and identify research, development, and standardisation needs for collecting and reporting reliability data. The expected results include state-of-the-art reports on the following topics: (1) initiatives concerning reliability, (2) flow of maintenance information, and (3) tools for O&M planning and overview of data needs.

Task 34 Environmental Assessment and Monitoring Efforts for Wind Energy Projects Offshore and on Land will share information from completed and on-going environmental assessment and monitoring efforts on land and offshore, both pre- and post-construction, to: (1) improve monitoring approaches; (2) make data easily accessible to all interested parties; (3) aggregate information on biological species affected; (4) aggregate information on effects of mitigation strategies; and (5) identify successful approaches to monitoring impacts, analysis techniques, and assessment methodologies. The expected results include a publicly accessible database with documents on monitoring, assessing, and mitigating environmental impacts of land-based and offshore wind energy projects; a State-of-the-Science report on accepted methodologies for environmental assessments for land-based and offshore wind projects, and, potentially, distributed technologies; and a research compendium of publicly available data on impacts.

**(f) Policy Relevance**

The most policy relevant activity during the term has been the Task 27 RP 12 Consumer Label for Small Wind Turbines. Participants in the task have stated at ExCo meetings that without this Recommended Practice, small wind installations would be less likely in their countries and they support the work as an input to their policy-making processes.

An additional policy relevant activity has been Task 28 Social Acceptance of Wind Energy Projects. Participants have used the database of case studies, the state-of-the-art report, and the IEA Wind RP 14 to inform policy makers about the human effects of wind power and successful mitigation strategies. The task provides visibility for successful activities to encourage social acceptance of wind energy. Issues such as policy strategies, planning, or incentive schemes, have been incorporated in the Task 28 discussions.
Identifying cost drivers for wind energy has helped shape research investment policy. The most recent Task 26 report provided cost driver data that is incorporated into the IEA Wind Long-Term R&D strategy document and will inform the updated *IEA Technology Roadmap: Wind Energy*.

Understanding the intricacies of integration studies has allowed the participants in Task 25 Design and Operation of Power Systems with Large Amounts of Wind Power to be effective reviewers of many policy analyses. They have been able to provide fair and unbiased wind integration research to electric grid planners and operators.

The IEA Wind agreement is in close cooperation with the Renewable Energy analysts at IEA. Participants provided extensive reviews of IEA analysis documents (See Section (b) Scope).

**(g) Contribution to Environmental Protection**

The work of IEA Wind to expand deployment of this clean technology helps reduce carbon dioxide emissions and particulates by displacing electric generation from other sources. The environmental benefits of wind generation are highlighted in the country chapters of the annual report, and emphasised in its executive summary. This information can be used by policymakers in all countries to demonstrate the potential contribution of wind deployment to reduction of emissions.

Late in the term, the ExCo approved a new task to assess the state-of-the-art in assessment and monitoring techniques used for the environmental impacts of wind development on land and offshore. Sharing experiences and improving knowledge should improve assessments prior to development and enhance monitoring efforts after wind farms are in place.

**(h) Contribution to Information Dissemination**

IEA Wind has expanded both internal and external information exchange within the budget constraints of the Common Fund supplied by member fees. To keep the costs of participation low, much of the information dissemination burden is placed on the ExCo members and on the Planning Committee, who contribute in-kind effort to the IEA Wind Agreement. The Secretary supports the ExCo, Planning Committee, and Operating Agents to help with information dissemination.

*ExCo meetings*, a key vehicle for information exchange, now generally include a representative from IEA headquarters and invited observers from key organisations. They are organised so that one meeting each year addresses wind energy R&D activities and the other meeting addresses deployment and policy. This format allows more in-depth discussion of each of these important aspects. The *ExCo meeting minutes* contain decisions of the ExCo and action items to be addressed at the next meeting. All meeting reports are posted on the members’ web pages within 24 hours of the meeting.

*The IEA Wind Annual Report* includes a chapter from each participating country and from each task Operating Agent describing activities for the calendar year just completed. Each year, ExCo members distribute 2,500 printed colour books within their countries and at selected IEA events. In 2009, the ExCo decided to move to a larger format with fewer pages and to print in full color.
The savings in shipping weight due to the more efficient format compensated for the small additional cost of printing in colour. These 180-page reports are substantive and comprehensive, providing an accurate historical record of the research, development, deployment, and maturation issues associated with this renewable energy technology in much of the world.

The Executive Summary of the Annual Report contains trend data from the history of IEA Wind and extracts important information from the individual country chapters. It is designed as an overview for policy makers and the wind community. Key headings include: national objectives and progress, national incentive programs, issues affecting growth, economic impact, industry status, operational details.

The Secretary provides a model press release about the IEA Wind Annual Report to the ExCo members with the shipment of their printed reports. ExCo members publicise and distribute the report to key target audiences within their countries. A model presentation, The Benefits of Participating in IEA Wind, was developed by the Secretary and is updated every year with statistics from the Annual Report. Members can use this to explain the activities of IEA Wind at workshops and meetings in their own countries or abroad.

The IEA Wind public website (www.ieawind.org) hosts or has links to IEA Wind task websites, the national sites of member countries, and IEA. Some public information on IEA Wind has also been available on the IEA website. A password-protected website for ExCo Members only is used to post pre-meeting materials, official documents, materials presented at ExCo meetings, and documents available for review by all ExCo members.

A logo lapel pin was purchased to raise awareness among ExCo member organisations and meeting observers.

The Secretary sends news from IEA Wind to the editor of IEA’s OPEN Bulletin, and members appreciate the visibility gained from this e-newsletter. IEA Wind has added links to ieawind.org on IEA’s Wikipedia page and has coordinated (through the ExCo and through the research tasks) with the following IEA IAs and activities: Demand-Side Management; Electricity Networks Analysis, Research & Development; Hydrogen; Hydropower; Ocean Energy Systems; RETD; IEA Electricity Coordination Group (ECG), and Energy Storage. The Secretary has participated in the IEA Energy Technology Network Communication Workshops. In addition, as required by the topic of the research tasks, cooperation takes place with the relevant international bodies such as IEEE, the Council on Large Electric Systems (or CIGRE), IEC, TPWind, and various industrial and utility groups.

**(i) Outreach to Non-Member Countries**

The IEA Wind Agreement actively recruits for new member countries and organisations, inside and outside OECD. México and CWEA are active members of IEA Wind that are not in OECD.

The membership committee has several ways to recruit participants. It responds to requests for information with invitations to attend an ExCo meeting. In addition, when ExCo members identify a contact in a new country, information and invitations are sent. As reported in the Membership section above, many observers have been invited to IEA Wind ExCo meetings.
during the term. The Chinese Wind Energy Association joined as a sponsor member after several years of correspondence and attending meetings. CWEA is now a very active participant in IEA Wind and its research tasks (see Table 5).

Researchers from potential member countries or organisations are allowed to attend one research task meeting before officially joining IEA Wind. Beyond the one meeting, attendance is discouraged until the country or organisation joins IEA Wind. All formal task participants must reside in an IEA Wind member country or belong to a Sponsor Member organisation. The public information generated by IEA Wind is freely available to citizens of all countries.

Between 2009 and 2013, invitations to ExCo meetings were extended to the following 21 countries. Argentina, Belgium, Brazil, Bulgaria, Chile, People’s Republic of China, Colombia, Costa Rica, Cyprus, France, Honduras, India, Israel, Malaysia, New Zealand (formerly a member), Panama, Poland, the Russian Federation, South Africa, Turkey, and Uruguay.

The following organisations were also invited as observers between 2009 and 2013: American Wind Energy Association (AWEA), the IEA Renewable Energy Technology Deployment (RETD) IA, the Technology Platform for Wind Energy (TPWind), and the International Renewable Energy Agency IRENA.

The following four countries and organisations were invited to join the IEA Wind Implementing Agreement after attending ExCo meetings during the current term: Chinese Wind Energy Association (joined IEA Wind in 2010), France (invited 2010 and in 2013), Israel (invited in 2013), and the Russian Federation (invited in 2009).

It has been difficult to recruit new member countries inside or outside of OECD for several reasons.

- It is difficult to find the appropriate individuals and governmental bodies to inform about the benefits of IEA Wind.
- It can be hard for representatives of new countries or organisation to gain support for travel to an IEA Wind ExCo meeting.
- It is difficult for the representative to gain the necessary approvals and signatures within the new member country. France, Israel, and the Russian Federation, have not managed to complete the internal approval and commitment process to join.
- More help from the IEA Secretariat is needed to address these problems at the governmental level.

(j) Added Value

Overview

Task reports presented to ExCo meetings show enormous value received for a modest contribution by each participant (see Table 9). The value to each participating country of labor applied to research tasks over a two or three-year period ranges from a low of 21 times the monetary cost of participation to 1 680 times the cost of participation for each country. These numbers indicate that investment in this kind of cooperative research effort yields major savings in R&D costs and leverages funding provided from independent sources.
Value of Participation

Participants in a research task contribute to the expenses incurred by the OA for managing the effort and agree to a budget for these expenses in advance. Participants also conduct portions of the work designated in the program of work as their in-kind contribution to the effort. This in-kind effort has often been planned as part of a national research program. The value of those efforts is shared by all participants and equals many times the modest cost to join the task and travel to meetings (Table 9).

Table 9. Value is High for IEA Wind Research Tasks (2011–2012)

<table>
<thead>
<tr>
<th>Task Number and Topic</th>
<th>Annual Fee per Country (EUR)</th>
<th>Total Labour Months from all Countries*</th>
<th>Value of Labour (EUR)**</th>
<th>Value/Cost per Country (EUR/EUR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Experts Meetings</td>
<td>3 600</td>
<td>2yrs: 14</td>
<td>151 200</td>
<td>21</td>
</tr>
<tr>
<td>25 Integration</td>
<td>3 333</td>
<td>2yrs: 1 037</td>
<td>11 199 600</td>
<td>1 680</td>
</tr>
<tr>
<td>26 Cost</td>
<td>5 810</td>
<td>3yrs: 537</td>
<td>5 799 600</td>
<td>499</td>
</tr>
<tr>
<td>27 Small Wind</td>
<td>3 400</td>
<td>2yrs: 38</td>
<td>410 000</td>
<td>120</td>
</tr>
<tr>
<td>28 Social Acceptance</td>
<td>4 500</td>
<td>2yrs: 54</td>
<td>583 200</td>
<td>65</td>
</tr>
<tr>
<td>29 Aerodynamics</td>
<td>10 000</td>
<td>3yrs: 257</td>
<td>2 775 600</td>
<td>93</td>
</tr>
<tr>
<td>30 Offshore models</td>
<td>3 790</td>
<td>2yrs: 36</td>
<td>388 800</td>
<td>51</td>
</tr>
</tbody>
</table>

*Labour contributions equal in-kind effort designated in work plan, plus estimated contributing effort from related national projects including PhD work that is shared with the task for making reports and analysis for the effort.

** One labour month (140hr) valued at 10 800 Euro

Educating the Next Generation

In addition to advancing the technology, leveraging national research dollars, and lowering the cost of wind energy, the work of IEA Wind is contributing significantly to training the next generation of researchers. The shortage of trained wind energy experts has been identified as a constraining factor by several key studies. Cooperative research efforts of IEA Wind that include universities are contributing to the work of doctoral students who are working on their dissertations. Through participation in these tasks, students are introduced to international research and to the latest in technical progress in the field.

Networking

The main advantage of the IEA Wind approach to information flow among researchers is the multinational nature of the task meetings. All meetings have included no fewer than 4 represented countries and often include 10 to 17. These researchers typically come from several of the major geographic areas (North America, Europe, Asia, or the Pacific Region). This broad representation expands the effect of experiences in any one country and reduces the likelihood of repeated mistakes or duplicated efforts. Exposure to this broader perspective is especially important for new researchers who may have a narrow view of the issues surrounding their interest in wind energy research. Another advantage of IEA Wind meetings is the focused nature of the topics and the diverse group of discussants invited to address them. In summary, benefits from networking include the following:
• Reduced research costs by eliminating duplication of efforts
• Improved quality of research through peer review
• The international scope broadens the view of participants
• IEA structure does not impose a large administrative burden
• Project strategy is determined by participating task members
• All participants are chosen as recognised experts in their field doing significant research
• IEA Wind work is widely used by the international research and policy communities.

4. Publications of IEA Wind
See separate document posted at IEAWind.org.
5. **Strategic Plan for 2014–2019**


The IEA Wind Executive Committee (ExCo) generated this new Strategic Plan through a consensus process drawing from the recommendations of participants in the Task 11 Topical Expert Meeting on wind research needs held in 2011 in Brussels, Belgium. At this Topical Expert Meeting, the experts discussed the emerging issues related to wind technology development, which will need to be addressed through research activities that will produce results in the short-, mid-, and long-term. The results from this Topical Expert Meeting and a survey of experts (nearly 100 research recommendations received) will be published by the end of 2013 as *Long-Term Research and Development Needs for Wind Energy for the Time Frame 2012 to 2030* (4). This document was used by the Strategic Plan Working Group to guide the development of this Plan for the coming five years. It will also serve as a resource for the IEA Secretariat’s update of the Wind Technology Roadmap.

As specified in the CERT Guidelines for supporting documents for extension requests, this Strategic Plan text flows from the research needs analysis of the *Long-Term Research and Development Needs for Wind Energy for the Time Frame 2012 to 2030* and is organised according to the CERT Criteria: strategic direction, scope, contractual and management requirements, contribution to technology evolution and progress, contribution to technology deployment and market facilitation, policy relevance, contribution to environmental protection, contribution to information dissemination, outreach to IEA non-member countries, and added value.

**(a) Future Strategic Direction**

This strategic plan coincides with the strategies of the CERT and the Renewable Energy Working Party (REWP). The objectives also correspond to those in the *IEA Technology Roadmap: Wind Energy*, published in 2009, by the IEA Secretariat.

The four strategic objectives are:

- Reduce the cost of wind energy use, for both land-based and offshore wind
- Increase the flexibility of transmission and power systems
- Increase social acceptance and environmental compatibility of wind energy projects
- Increase the exchange of best practices

These objectives will be addressed by IEA Wind activities for the next five years. The successful formula of the preceding terms (regular meetings, active research tasks, and targeted communications) will remain the cornerstone of future activities. Many of the tasks begun in the

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The prior five-year term will continue into the new term. Table 10 shows approved and active tasks for IEA Wind.

Table 10. Research Tasks Continuing into the Next Term (2014–2019)

<table>
<thead>
<tr>
<th>Task No.</th>
<th>Task Name and Operating Agent (OA)</th>
<th>Duration 17</th>
</tr>
</thead>
</table>
| 11       | Base Technology Information Exchange  
| 19       | Wind Energy In Cold Climates  
OA: Technical Research Centre of Finland (VTT), Finland | 2001–2011; 2012–2015 |
| 25       | Design and Operation of Power Systems With Large Amounts of Wind Power  
| 26       | Cost of Wind Energy  
| 27       | Small Wind Turbine Labels for Consumers/ Small Wind Turbines in Turbulent Environments  
OA: Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT), Spain | 2008–2011; 2012–2015 |
| 28       | Social Acceptance of Wind Energy Projects  
| 29       | Mexnext: Analysis of Wind Tunnel Measurements and Improvement of Aerodynamic Models/ Mexnext II  
OA: ECN, the Netherlands | 2008–2011; 2012–2014 |
| 30       | OC3/OC4: Offshore Code Comparison Collaborative (Continuation); OA: NREL, the United States and Fraunhofer Institute for Wind Energy and Energy System Technology (IWES), Germany | 2010–2013 |
| 31       | WAKEBENCH: Benchmarking of Wind Farm Flow Models  
OA: CENER, Spain, and NREL, United States | 2011–2013 |
| 32       | LIDAR: Wind Lidar Systems for Wind Energy Deployment  
OA: ForWind Centre for Wind Energy Research, Germany | 2011–2014 |
| 33       | Reliability Data: Standardising Data Collection for Wind Turbine Reliability and Operation and Maintenance Analyses  
OA: Fraunhofer Institute for Wind Energy and Energy System Technology (IWES), Germany | 2012–2014 |
| 34       | Environmental Assessment and Monitoring for Wind Energy Systems  
OA: NREL, United States | 2013–2016 |
| 35       | Full-Size Ground Testing of Wind Turbines and Components  
OA: Rheinisch Westfälische Technische Hochschule (RWTH) Aachen University, Germany | 2013–2016 |

17 Extension of these tasks beyond the listed terms is very likely. The task participants will evaluate the benefits of continued co-operation to address the priority areas of the Strategic Plan.
To help determine future collaborative research, IEA Wind conducts periodic assessments by experts to determine long-term R,D&D needs for wind energy. The resulting documents have helped the wind community in general, and IEA Wind in particular, to direct efforts on important research topics. The Long-Term Research and Development Needs for Wind Energy for the Time Frame 2012 to 2030 divided the periods for obtaining research results into three time frames: short-term (0–5 years; by 2017), mid-term (5–10 years; by 2022), and long-term (10–20 years; by 2030). The IEA Wind work on the following topics over the upcoming term will lay the groundwork for continued advancements in each of the time frames.

IEA Wind will achieve its strategic objectives through collaborative activities in five priority areas during the upcoming five-year term. These priority areas contribute to IEA Wind member country energy technology and policy goals. Additionally, progress in these activities during the upcoming term align with and will help to satisfy the wider range of R&D needs as identified by in the Long-Term Research and Development Needs for Wind Energy for the Time Frame 2012 to 2030. To compile these lists of research topics, the Strategic Plan working group considered the potential benefits of international collaboration, the feasibility of progress on a topic within the research tasks structure, R&D work well underway in IEA Wind (Table 10), and issues expressed at ExCo meetings in the present term. They selected the following five priority areas and detailed research topics for the new term.

Priority Area 1: Wind Characteristics - Research will be conducted to assess and characterize the wind resource to improve siting and performance.

Priority Area 2: Next Generation Technology - Technology research will be conducted to improve wind turbine performance and reliability at competitive costs.

Priority Area 3: Wind Integration - Research will be conducted on power system operation and grid integration of high amounts of wind generation.

Priority Area 4: Social, Educational, and Environmental Issues - Research will be conducted on non-technology issues that affect wind siting, acceptance, and maximization of social benefit.

Priority Area 5: Communications – Dual function of 1) coordinating and sharing information internally within IEA Wind, and 2) disseminating the results of R&D work performed in the other Priority Areas.

**Priority Area 1: Wind Characteristics**

R&D activities will address wind characterisation to improve accuracy of resource assessment for optimal siting and operation of wind power plants and turbines, reduce wake array losses, and produce more accurate forecasting of performance and output. Wind characterisation has an impact on both wind cost of energy and transmission/power system flexibility. Better understanding of the wind resource will improve the cost of energy through optimisation of wind plant performance. Better wind resource characterisation also leads to improved wind forecasting. For example, allowing for improved integration into the electrical grid. See Table 11 for more detail on the research planned.
IEA Wind currently has three research tasks that address issues of wind characteristics.
• Task 19 – Wind Energy in Cold Climates
• Task 27 – Small wind Turbines in Turbulent Environments
• Task 29 – Analysis of Wind Tunnel Measurements and Improvement of Aerodynamic Models
• Task 31 – Benchmarking of Wind Farm Flow Models
• Task 32 – Wind Lidar Systems for Wind Energy Deployment

These active tasks are the beginning of what is expected to be a long-term, sustained collaborative effort to characterise wind at the atmospheric, wind plant, and wind turbine level. Results from these active tasks will be evaluated and used to shape the direction of future collaborative research. Future research is expected to follow the R&D needs identified by the IEA Wind experts.
### Table 1: Detailed Priority Area 1: Wind Characteristics

<table>
<thead>
<tr>
<th>Research Topics</th>
<th>Time Frame</th>
<th>IEA Wind Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Utility-Scale Market</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Remote Sensing Techniques</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assess high spatial resolution sensing technology and techniques for use in high-fidelity experiments, both in the laboratory and in the field (e.g. LIDAR/SODAR/RADAR development).</td>
<td>2017 Short-term</td>
<td>Task 32</td>
</tr>
<tr>
<td><strong>Icing Conditions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consistent method(s) for characterisation of icing conditions during resource assessment</td>
<td>2017 Short-term</td>
<td>Task 19</td>
</tr>
<tr>
<td><strong>Wind Plant Complex Flow Modelling and Experimentation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop integrated, fully coupled models linking all relevant temporal and spatial scales of wind plant aerodynamics: inflow conditions, wake creation and ingestion, blade aerodynamics, blade tip compressibility, and other intra-plant flows. Extensive experimentation is required to validate these models, including laboratory-scale tests, wind tunnel tests, full-scale multi-MW wind turbine tests, and operational wind plant tests. Experiments must include multiple terrain types, both on-land and off-shore.</td>
<td>2022 Mid-term</td>
<td>Task 29, Task 31, TEM(^{18})</td>
</tr>
<tr>
<td><strong>Short-Term Forecasting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop standard methods for meteorological wind forecasts, with a feedback loop from wind power plant on-line data to weather forecasting. Assess methods for accurate power forecasts for use in power system operation, with consideration of storm and icing forecasts.</td>
<td>2022 Mid-term</td>
<td>TEM</td>
</tr>
<tr>
<td><strong>Offshore Market</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Marine Environment Design Conditions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop measurement, modelling, characterisation and design cases for the complex interactions among wind, waves, turbulence and current. This includes handling of extreme conditions such as typhoons and icing.</td>
<td>2030 Long-term</td>
<td></td>
</tr>
<tr>
<td><strong>Small-Scale Market</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Built Environment Resource Assessment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improve siting tools and methodologies for building-integrated small wind turbines.</td>
<td>2022 Mid-term</td>
<td>Task 27</td>
</tr>
</tbody>
</table>

### Priority Area 2: Wind Power Technology

Technology R&D activities will explore system design and advanced controls at the turbine and wind power plant levels, for both land-based and offshore wind, to reduce maintenance costs and increase production. Activities will assess advanced components including rotors, drivetrains, power electronics, support structures, manufacturing and installation, and reliability and testing. Wind Power technology research activities reduce wind cost of energy through innovations in components and structures that result in reduced cost or improved energy capture. Technology research can also impact social acceptance. For example, innovations that reduce turbine noise, or floating offshore wind turbines that are out of the view from shorelines are technology developments that improve wind deployment acceptance.

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\(^{18}\) Topical Expert Meetings (TEM) of Task 11 begin the discussion of research topics and often lead to the formation of an IEA Wind Research Task. This column indicates TEMs held recently or planned for the coming year.
IEA Wind currently has six research tasks active in this priority area.

- Task 19 – Wind Energy in Cold Climates
- Task 26 – Cost of Wind Energy\textsuperscript{19}
- Task 27 – Small Wind Turbines in Turbulent Environments
- Task 29 – Analysis of Wind Tunnel Measurements and Improvements of Aerodynamic Models
- Task 30 – Offshore Wind Code Comparison Collaborative
- Task 33 – Standardising Data Collection for Wind Turbine Reliability and Operation and Maintenance Analysis
- Task 35 – Full-Size Ground Testing of Wind Turbines and Components

IEA Wind will continue to inspire constructive dialogue to reveal emerging R&D needs and promising solutions to address them. Wherever current tasks do not or cannot address such R&D priorities, IEA Wind will consider and proceed through its established decision process with expert consultation to initiate new tasks with explicit missions to tackle those topics. See Table 12 for more detail on the research planned.

\textsuperscript{19} Task 26 Cost of Wind Energy identifies cost drivers to inform research investment decisions. This work will also contribute to goals of the social acceptance priority area.
<table>
<thead>
<tr>
<th>Research Topics</th>
<th>Time Frame</th>
<th>IEA Wind Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Utility-Scale Market</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wind Turbine Scaling</strong></td>
<td>2017</td>
<td>TEM</td>
</tr>
<tr>
<td>Improve understanding of design requirements for turbines up to 10 to 20 MW; develop offshore reference designs.</td>
<td>Short-term</td>
<td></td>
</tr>
<tr>
<td><strong>Systems Engineering to Optimise Turbine and Plant Design</strong></td>
<td>2017</td>
<td>TEM</td>
</tr>
<tr>
<td>Apply systems engineering to evaluate technology innovations and impact on cost and performance. Collaborate on the structure, types and numbers of subsystems, and level of detail in each subsystem for each modelling effort.</td>
<td>Short-term</td>
<td></td>
</tr>
<tr>
<td><strong>Wind Turbine Design Tools</strong></td>
<td>2022</td>
<td>Task 29, Task 30</td>
</tr>
<tr>
<td>Analyse data from aerodynamic experiments to improve full CFD-structure interaction tools, aerodynamic engineering methods, hydrodynamic linking capabilities, and overall model accuracy and performance of land-based and offshore wind turbines and their components. Include integrated numerical design tools system dynamics models for offshore wind plants in deep water.</td>
<td>Mid-term</td>
<td></td>
</tr>
<tr>
<td><strong>Wind Turbines in Diverse Operating Conditions</strong></td>
<td>2022</td>
<td>Task 19</td>
</tr>
<tr>
<td>Improve system designs for diverse environments such as cold climates, tropical cyclones, earthquakes, and low wind conditions.</td>
<td>Mid-term</td>
<td></td>
</tr>
<tr>
<td><strong>Operational Data Management</strong></td>
<td>2022</td>
<td>Task 33</td>
</tr>
<tr>
<td>Develop standardised and automated wind plant economic and technical data management processes and data collection best practices. Include reliability characteristics such as failure rates and repair times in the data bases.</td>
<td>Mid-term</td>
<td></td>
</tr>
<tr>
<td><strong>O&amp;M and Diagnostic Methods</strong></td>
<td>2022</td>
<td>Task 26, TEM</td>
</tr>
<tr>
<td>Improve diagnostic methods for the whole turbine, generators, converters, bearings and mechanical components, and develop predictive maintenance tools and advanced condition monitoring techniques considering also logistical and personnel costs for O&amp;M activities. Analyse life-time consumption, failure mode analysis, model growth of damage on cracks. Improve repair techniques especially offshore.</td>
<td>Mid-term</td>
<td></td>
</tr>
<tr>
<td><strong>Testing Methods</strong></td>
<td>2022</td>
<td>Task 35</td>
</tr>
<tr>
<td>Develop advanced methods for testing large components in the lab by simulation of the most relevant physical environmental conditions and using hardware in the loop principles.</td>
<td>Mid-term</td>
<td></td>
</tr>
<tr>
<td><strong>Advanced Wind Turbine and Wind Plant Controls</strong></td>
<td>2030</td>
<td>TEM</td>
</tr>
<tr>
<td>Apply understanding of aerodynamics, wake effects, and resource assessment to develop load-reducing turbine and wind plant control strategies.</td>
<td>Long-term</td>
<td></td>
</tr>
<tr>
<td><strong>Offshore Market</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Advanced Offshore Support Structures</strong></td>
<td>2030</td>
<td>Task 30</td>
</tr>
<tr>
<td>Develop next generation concepts including floating structures, alternative bottom fixed foundation types for use in water depths up to 50m.</td>
<td>Long-term</td>
<td></td>
</tr>
<tr>
<td><strong>Floating Offshore Wind Plants</strong></td>
<td>2030</td>
<td></td>
</tr>
<tr>
<td>Examine diverse system architectures and novel designs that may result in cost effective deployment of floating offshore wind plants in deep waters; studies should include industrialisation analysis and standardised load analyses.</td>
<td>Long-term</td>
<td></td>
</tr>
<tr>
<td><strong>Small-Scale Market</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Improve Design of Small Wind Turbines</strong></td>
<td>2017</td>
<td>Task 27</td>
</tr>
<tr>
<td>Establish testing procedures for building-integrated small wind turbines and facilitate the creation of testing facilities capable of serving the small wind turbine market.</td>
<td>Short-term</td>
<td></td>
</tr>
<tr>
<td><strong>Distributed Wind Systems</strong></td>
<td>2022</td>
<td>Task 27</td>
</tr>
<tr>
<td>Optimise system designs for community scale projects such as wind-diesel systems and the built-environment. Develop procedures and design tools for building integrated small wind turbines with improved performance and reliability.</td>
<td>Mid-term</td>
<td></td>
</tr>
</tbody>
</table>
Priority Area 3: Wind Integration

Research will be conducted on power system operation and grid integration of high amounts of wind generation. R&D activities will publish information on power system operation with wind to enhance transmission planning and development; improve power system operation; and improve the internal grid within wind plants. As grid operations and wind integration processes and procedures become more defined, the costs associated with wind integration are expected to be reduced.

IEA Wind currently has one research task active in this area:

- Task 25 – Power Systems with Large Amounts of Wind Power

Task 25 is currently in its third phase, having twice been approved for three-year extensions of the original task. As wind and other renewable energy sources continue to become a larger part of the world’s energy mix, issues of cost effective integration into the electrical power system continue to gain in importance. IEA Wind will continue to collaborate in this area and will look for collaboration with other IEA research agreements for sharing of knowledge and lessons learned. The Table 13 outlines specific activities needed to make progress on wind integration research, and will be used to guide future collaboration opportunities.

**Table 13. Detailed Priority Area 3: Wind Integration**

<table>
<thead>
<tr>
<th>Research Topics</th>
<th>Time Frame</th>
<th>Active Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electricity Market</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advance strategies for high-penetration levels of wind; improve operational methods and electricity market rules; accelerate development of larger-scale, faster and deeper trading of electricity through evolved power markets; and enable wind power plants bidding for ancillary services.</td>
<td>2017 Short-term</td>
<td></td>
</tr>
<tr>
<td><strong>Tools to Advance Electric System Design</strong></td>
<td></td>
<td>Task 25</td>
</tr>
<tr>
<td>Conduct power system studies for scenarios involving high penetration of wind and other variable renewables, both in larger footprints and in smaller systems. Include studies addressing electric vehicle integration, demand side flexibility, enhanced flexibility from conventional generation units, and storage. Incentivise timely development of additional flexible reserves, innovative demand-side response and storage integration.</td>
<td>2022 Mid-term</td>
<td></td>
</tr>
<tr>
<td><strong>Offshore Transmission Planning</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Progress and implement plans for offshore grids, linking offshore wind resources and bordering power markets. Develop tools for offshore electric design, transnational offshore grid design, and offshore wind plant power management.</td>
<td>2022 Long-term</td>
<td></td>
</tr>
<tr>
<td><strong>Smart Grid Architecture</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research smart grid architectures for application to distributed wind generation, transmission, and distribution. Explore design and use of virtual wind power plants.</td>
<td>2030 Long-term</td>
<td></td>
</tr>
</tbody>
</table>
Priority Area 4: Social, Educational, and Environmental Issues
Research will be conducted on issues that affect wind siting, acceptance, and maximisation of social benefit. R&D will explore social acceptance, cost of wind energy, environmental impacts, and tools to effectively communicate and manage the impacts of wind development and help direct research investments. Research related to social, educational, and environmental issues directly informs the regulatory and permitting process, enabling authorities to make well informed decisions regarding wind deployment. As knowledge is shared with regard to these issues, the regulatory and permitting process has the potential to become more streamlined and timely, reducing the pre-construction licensing costs to wind developers. Also understanding social issues and the elements of wind energy costs will help guide investments in all research categories. Table 14 outlines activities for the coming term to make progress on social, educational, and environmental issues.

IEA Wind currently has four research tasks that contribute to this area:
• Task 26 – Cost of Wind Energy
• Task 27 – Consumer Labelling of Small Wind Turbines
• Task 28 – Social Acceptance of Wind Energy Projects
• Task 34 – Environmental Assessment and Monitoring for Wind Energy Systems

IEA Wind will continue to provide a forum for social scientists, natural scientists, engineers, and planning professionals to reveal emerging public acceptance needs and develop promising solutions to address them.
Table 14. Detailed Priority Area 4: Social, Educational, and Environmental Issues

<table>
<thead>
<tr>
<th>Research Topics</th>
<th>Time Frame</th>
<th>IEA Wind Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Acceptance</td>
<td>2017 Short-term</td>
<td>Task 28</td>
</tr>
<tr>
<td>Spatial Planning Methods and Tools</td>
<td>2017 Short-term</td>
<td>Task 26</td>
</tr>
<tr>
<td>Develop methods and tools for spatial planning to meet economic, social and environmental objectives, all with the objective of ensuring social acceptance and environmental compatibility of wind energy use.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools to Identify Cost Drivers of Wind Energy</td>
<td>2022 Mid-term</td>
<td>Task 28</td>
</tr>
<tr>
<td>Develop internationally comparable and accepted methods to calculate the cost of wind energy and identify the cost driving components for research investments.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human Use Effects and Mitigation</td>
<td>2017 Short-term</td>
<td>TEM</td>
</tr>
<tr>
<td>Generate insight into human-use conflicts (e.g., radar, view shed, noise, property values) that will allow decision-makers and communities to site projects in such a way as to maximise socioeconomic benefit and minimise conflicts with other users.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Impacts</td>
<td>2022 Mid-term</td>
<td>Task 34</td>
</tr>
<tr>
<td>Recycling of Wind Turbines</td>
<td>2017 Short-term</td>
<td>TEM</td>
</tr>
<tr>
<td>Conduct policy studies and develop strategies for wind turbine end of life and recycling procedures and best practices.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Strategies and Planning</td>
<td>2022 Mid-term</td>
<td>Task 34</td>
</tr>
<tr>
<td>Institute a coordinated strategy to gather, analyse, and publicly disseminate environmental data, modelling tools, and related technologies. This will allow the industry to better understand and mitigate potential environmental impacts of land-based and offshore wind power development.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mitigation for Marine Environments</td>
<td>2030 Long-term</td>
<td></td>
</tr>
<tr>
<td>Assess impacts of offshore project installation and operation, validate models that can be used to predict the impact of future projects, and develop a suite of instrumentation and techniques that can be used by future projects to measure and mitigate, where necessary, environmental impacts.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Educational Issues</td>
<td>2022 Mid-term</td>
<td>All tasks and TEMs</td>
</tr>
<tr>
<td>Workforce Education</td>
<td>2022 Mid-term</td>
<td>All tasks and TEMs</td>
</tr>
<tr>
<td>Increase the supply of educated personnel, considering all levels of education, targeting specific actions to increase opportunities for education, and exploring the potential of long distance education solutions.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
performance, and deployment of wind energy systems. These audiences are reached both with external public communications and with internal communications among IEA Wind participants to facilitate the conduct of the work. For more detail see Section 5 (h) Future Contribution to Information Dissemination.

Table 11. Detailed Priority Area 5: Communication

<table>
<thead>
<tr>
<th>Communication Activities</th>
<th>IEA Wind Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External Communications</strong></td>
<td></td>
</tr>
<tr>
<td>Annual Report</td>
<td>Continuing</td>
</tr>
<tr>
<td>Include information not available in other publications such as research plans and results from tasks and member countries.</td>
<td></td>
</tr>
<tr>
<td>e-newsletter</td>
<td>Planned</td>
</tr>
<tr>
<td>Report quickly on interesting decisions and accomplishments discussed at ExCo meetings.</td>
<td></td>
</tr>
<tr>
<td><strong>Task Final Reports</strong></td>
<td>All tasks</td>
</tr>
<tr>
<td>Increase impact by including Executive Summaries for non-experts. Expand distribution to target audiences.</td>
<td></td>
</tr>
<tr>
<td><strong>Task State-of-the-Art Reports</strong></td>
<td>All tasks</td>
</tr>
<tr>
<td>Increase impact by including Executive Summaries for non-experts. Expand distribution to target audiences.</td>
<td></td>
</tr>
<tr>
<td><strong>Recommended Practices</strong></td>
<td>Potentially all tasks</td>
</tr>
<tr>
<td>Increase visibility to target audiences. Contribute to policy development.</td>
<td></td>
</tr>
<tr>
<td><strong>Public Website</strong></td>
<td>Continuing</td>
</tr>
<tr>
<td>Enhance in response to members’ and OA needs.</td>
<td></td>
</tr>
<tr>
<td><strong>Internal Communications</strong></td>
<td></td>
</tr>
<tr>
<td>Presentation template on IEA Wind</td>
<td>Continuing</td>
</tr>
<tr>
<td>Update presentation should be available for members to adapt for their target audiences.</td>
<td></td>
</tr>
<tr>
<td><strong>Procedures for Research Tasks</strong></td>
<td>Continuing</td>
</tr>
<tr>
<td>Update as needed and maintain awareness among OAs.</td>
<td></td>
</tr>
<tr>
<td><strong>Members’ Website</strong></td>
<td>Continuing</td>
</tr>
<tr>
<td>Enhance in response to members’ needs.</td>
<td></td>
</tr>
<tr>
<td><strong>Outreach to Potential Members</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Invitations</strong></td>
<td>Continuing</td>
</tr>
<tr>
<td>Maintain current list of tasks and costs, benefits and responsibilities of participation; request contacts from IEA.</td>
<td></td>
</tr>
</tbody>
</table>

The Coming Term

The members of IEA Wind will use this list of selected high-priority topics to identify areas for additional cooperation to mutual advantage. In addition, it is hoped that other research organisations will find the longer lists of priorities of the Long-Term Research and Development Needs for Wind Energy for the Time Frame 2012 to 2030 useful in setting their own research agendas to advance wind energy technology.

Collaboration in each of the five priority areas supports the four IEA Wind strategic objectives (Table 16). All of the priority activity areas facilitate the exchange of best practices through the sharing of knowledge and research and especially through the continued development of IEA Wind Recommended Practices within the research tasks. Recommended Practices as pre
normative recommendations are an important tool of IEA Wind to influence and foster the technological development of wind energy use.

Table 16. Priority Areas Address Strategic Objectives

<table>
<thead>
<tr>
<th>Priority Areas</th>
<th>Strategic Objectives</th>
<th>Active Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reduce cost of wind energy use</td>
<td></td>
</tr>
<tr>
<td>1: Wind Characteristics</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>2: Wind Power Technology</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>3: Wind Integration</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>4: Social, Educational, and Environmental Issues</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5: Communications</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

(b) Future Scope

Overview
The IEA Wind substantive work programme for the next five years is comprehensive because it contains on-going tasks that address the five priority areas identified through the long-term R&D needs assessment activity. Participation in these tasks is broad, with a minimum of seven participating contracting parties and a maximum of 16 in established tasks. In addition, as many as 200 additional organisations monitor the progress and contribute to some tasks. Additional tasks to fill gaps in needed research will be proposed by ExCo members over the term.

Participation in IEA Wind more than justifies the transaction cost of membership. As demonstrated in the End-of-Term Report, the value of labour shared by participants in research tasks varied from 21 times their participation fee to as much as 1680 times their contributions in the last term. In addition, no participants withdrew from IEA Wind in the previous term and one new participant was added. France and Israel have been invited to join and have not yet completed formal arrangements with IEA. Work to increase membership is planned for the new term as part of the communication priority area.

IEA Wind technical reports and Recommended Practices undergo rigorous peer review and revisions prior to publication. This high quality and the careful selection of research topics enhance the IEA energy technology collaboration programme. IEA Wind experts also attend meetings called by the Secretariat and by relevant implementing agreements to share
information. The IEA Wind agreement will continue to contribute to the Technology Network by reviewing and contributing in a timely manner to IEA documents, meetings, and workshops.

IEA Wind Activities for the New Term

IEA Wind will begin the next term with 13 active research tasks, which is five more than at the beginning of the previous term. These tasks represent a broad scope of research and have good participation (between 7 and 16 contracting parties). They address issues in each of the priority areas identified for this term’s strategic plan. In addition, the tasks can be viewed according to how they contribute to improving wind technology or enhancing deployment of wind energy systems. Some tasks have elements of both but are divided according to the major impact of their work. Detailed plans are provided in Section 5 (d) and Section 5 (e).

Collaboration in the new term will continue to address both technology development and deployment needs. The objective to reduce wind cost of energy will drive research toward larger wind turbines, optimised and more reliable wind plants, and reduced operations and maintenance costs. Offshore wind will have both technology and deployment research needs, and work in this area could expand to include longer term environmental effects studies as well as innovative turbine designs such as wind turbines mounted on floating platforms. Large-scale deployment of land-based and offshore wind will continue to drive wind integration research and the need to better manage existing transmission and distribution systems. Sharing of wind integration knowledge and lessons learned with other renewable energy sources will benefit deployment of other renewable energy technologies.

Communications activities will assist and encourage the research task operating agents and participants in publicising the results of their work. The IEA Wind Secretariat provides editorial support for some documents, co-ordinates the review and approval process, and maintains and expands the ieawind.org website as a global window on IEA Wind work. Each research task has dedicated web pages to serve its needs. Public portions explain their work. Members-only portions, protected behind passwords, serve the task participants while work is underway. Public research results are featured in the IEA Wind Annual Reports, which are edited and published by the IEA Wind Secretariat.

(c) Future Contractual and Management Requirements

Overview

The Wind Implementing Agreement will continue its long tradition of meeting all of the management requirements of the IEA.

- Executive Committee meets two times per year to exchange information, monitor and control the progress of the tasks, and manage the work of the agreement
- Reporting regularly (Annual Report published in July, approved minutes delivered for two meetings per year, commitment letters for task participation submitted, changes in membership forwarded, etc.)
- Preparing and presenting a midterm report or others as requested by the IEA Secretariat
- Following the Implementing Agreement text (definition of membership categories, etc.)
- Referring to IEA Secretariat procedures (using model letters, etc.)
- Maintaining standard operating procedures
• Preparing audit reports of the completed Common Fund budget cycle.

The ExCo will continue to meet two times per year in alternating host countries. The meetings will take place on two days and will be associated with a third day devoted to a technical tour. The technical tour is an important measure to learn about the host countries state of wind development, latest technological developments, and challenges that have to be tackled in practise. Continuing the successful strategy of responding to host countries, the ExCo meetings will be associated with local industry encounters. At these workshops, presentations by ExCo members raises awareness of IEA Wind activities in host countries and interaction with industry representatives provides valuable input to task operating agents. It is also part of the overall strategy of IEA Wind to solicit and encourage participation from all stakeholder groups, especially industry, utility, and regulatory bodies.

IEA Wind activities will be guided by its approved Strategic Plan and by the annual program of work determined by the approved Common Fund budget and the work plans of the research tasks.

The planned activities do not indicate a need to revise the IA Legal Text.

Membership Issues

Even though IEA Wind has established a broad membership over the years, it has been difficult in this term just completed to recruit new member countries to the Implementing Agreement from inside or outside of OECD. Many more countries could benefit from membership in IEA Wind and the current participants would benefit from broader membership. Participation has been limited by obstacles such as funding for membership fees, administrative complexities, and travel cost to attend meetings. Difficult administrative processes within potential new member countries have also blocked participation.

The IEA Wind agreement needs more help from the IEA Secretariat to address this problem. Researchers and ExCo members do not have the contacts or authority to reach out to the governments of potential new countries. The IEA Secretariat is requested to provide active contacts at a higher governmental level and mediate the process of gaining support for participation by new countries. Support from the office of legal counsel is also needed to complete the involved administrative process.

Funding Issues

The End-of-Term Report demonstrated the benefits of participation in research tasks are many times greater than the participation fees. The benefits of participation do justify the transaction costs of international collaboration.

The ExCo set an objective of maintaining a budget reserve equal to one-half of the annual revenue. At the close of the approved 2013 budget year, the operating reserve is projected to be 69,204 USD (less than one-half of the annual budget).
Several other issues argue for increasing the IEA Wind participation fee slightly. The Communication portion of this plan calls for developing an e-newsletter. This would add 10,000 USD to the budget for two issues per year.

France and Israel have been invited to join during this term, and may become active in 2013. If they join, this would add 10,656 USD to the Common Fund in 2013.

The fee for the Common Fund was increased 20% in 2010 when the operating reserve dipped to 42% of gross revenues. The operating reserve for the 2013 budget was projected to be 46% of gross revenues. A 10% increase in fees would barely cover the budget increases resulting from activities in this strategic plan and rising costs. A 15% or 20% increase in fees would begin to restore the operating reserve fund to 50% of gross revenues.

(d) Future Contribution to Technology Evolution and Progress Overview

The IEA Wind agreement will contribute to technology evolution through its research tasks (and their resulting publications), industry encounter workshops, Topical Expert Meetings, and ExCo meetings.

Every IEA Wind research task publishes extensively. In addition to task results, participants in the tasks gain knowledge and experience from their international colleagues that they apply to their other work on wind energy. IEA Wind tasks are set up to encourage broad participation within countries and Sponsor Member organisations that contribute to the work plan. For one participation fee, many institutions within the country may contribute to and benefit from the work.

IEA Wind, through its procedures and reporting requirements for Operating Agents, encourages cooperation with other international organisations and with related technology areas. For example, Task 25 Design and Operation of Power Systems with Large Amounts of Wind Power will publish Recommended Practices for conducting integration studies that are applicable to conducting studies of any variable power generation technology (e.g., solar and hydropower).

The following IEA Wind research tasks will contribute to technology evolution topics identified for the next term.

Task 11 Base Technology Information Exchange

Task 11 Base Technology Information Exchange promotes wind turbine technology and deployment through Topical Expert Meetings for information exchange on R&D topics selected by the ExCo. During the upcoming term approximately four Topical Expert Meetings will be held each year (20 for the term). These meetings will address topics coming out of research tasks as well as research topics identified in this strategic plan that are not yet addressed in research tasks.

Task 19 Wind Energy in Cold Climates

RP 13 Wind Energy Projects in Cold Climates (2011) formed the basis for the fourth revision of IEC 61400-1 Design Requirements, which included the effect of ice loads and low temperatures.
in design load cases. Having a dedicated design load case for wind turbines with ice accretion on blades gives manufacturers a tool to design turbines for these adverse conditions. This, in turn, leads to better technologies, reduction of O&M costs, and lower cost of energy from cold climate wind plants. In the coming term, participants in this task will support a market study for wind energy in cold climates. This work will demonstrate the demand for improved technology. The participants will update the Recommended Practices and State-of-the-Art report to include the latest research results. They will work to compare icing forecast and mapping methods, include cold climate issues as part of certification and design processes, develop ice sensor classification, improve knowledge of safety related issues (ice throw, ice-induced noise, etc.), and improve knowledge of ice loads on off-shore foundations.

**Task 27 Small Wind Turbines in Turbulent Sites**

Task 27 participants will develop a Small Wind Turbine Association of Testers and conduct research to evaluate wind characteristics in areas of high turbulence (rooftops, complex terrain, etc.) and effects on small turbine performance. The work will support development of a Recommended Practice on micro-siting and predicting energy production of small turbines in highly turbulent sites (urban or suburban, rooftop, forested, etc.). The work will provide data and results along with guidance for a new design classification with specific guidance on I15 or similar variables for IEC 61400-2 and new information on external conditions i.e. the normal turbulence model and extreme direction change found in Section 6 of 61400-2. In addition, the participants will compare existing power performance test results (typically from accredited power performance test organisations) to power performance results taken in highly turbulent sites. These results will contribute to design and deployment of small wind turbines in appropriate environments for durability and good energy production.

**Task 29 Mexnext II Validating Aerodynamic Models**

Task 29 participants (10 countries) have established an aerodynamic research consortium (including Suzlon Blade Technology, Vestas, Enercon, WindNovation, Garrad Hassan and Partners) that will evaluate detailed aerodynamic measurements (from wind tunnel experiments and field operations) to validate and improve aerodynamic models, including: free vortex wake models, computational fluid dynamics blade flow and near wake flow, yawed flow models, dynamic inflow models, instationary airfoil aerodynamics, general inflow modelling (non-uniformity between blades), and 3-dimentional models (including tip effects). “Lost data” from experiments or tests that have never been analysed will be explored in the next two years of the project for added insights to aerodynamic models. In addition, the “MEXICO” scale test turbine will be used by the European Strategic Wind tunnels Improved Research Potential project to provide data to Task 29 and others. These results will benefit wind turbine designers by improving or increasing confidence in aerodynamic models.

**Task 30 Offshore Code Comparison for Foundations**

Task 30 participants (18 countries and more than 47 organisations, including Alstom Wind, Germanischer Lloyd, Repower, ABS Consulting, Lloyds’s Register, 4subsea, GE Wind, Marintek, and China General Certification Centre) has been comparing and verifying computer codes (more than 22) for coupled dynamic analysis of offshore wind turbine support structures (monopile, tripod, floating spar buoy, jacket, and semisubmersible). The group is preparing an extension proposal to build on its completed work over the next three years. It is expected to
improve the design of offshore wind turbines, including support structures thanks to verified and improved codes for jacket and semi-submersible substructures.

**Task 31 Benchmarking Wind Farm Flow Models**

Task 31 participants (13 countries and 80 organisations) will improve atmospheric boundary layer and wind turbine wake models for use in wind energy by benchmarking different wind and wake modelling techniques. The large number of participants will ensure comprehensive work to identify and quantify best practices for using these models under a range of conditions, both land-based and offshore, from flat to very complex terrain. The work will define quality-checked procedures for the simulation of wind and wakes. This information will be useful to wind turbine designers as well as for applications in siting of wind power plants.

**Task 35 Full-Size, Ground-Testing of Wind Turbines and Components**

Task 35, approved in 2013, will address the lack of uniform procedures for ground testing. The first two subtasks will document and develop recommendations for test procedures of wind turbine blades and drive trains. The output of this task should increase the comparability of ground test results, improve confidence in tests of wind turbine durability, and develop technical requirements that will be recognised internationally by standards and certification organisations.

**(e) Future Contribution to Technology Deployment and Market Facilitation**

Results of IEA Wind activities have accelerated deployment of wind energy by increasing information exchange. A key element has been development of IEA Wind Recommended Practices. Four Recommended Practices were approved in the current term: *RP 12 Consumer Label for Small Wind Turbines (2011); RP 13 Wind Energy Projects in Cold Climates (2011); RP 14 Social Acceptance of Wind Energy Projects (2013); RP 15 Ground-Based, Vertically-Profiling Remote Sensing for Wind Resource Assessment (2013).*

IEA Wind tasks will formulate additional Recommended Practices in the coming term. Guidelines on Integration Studies (Task 25) and on Cost of Energy Analyses (Task 26) were being developed in 2013 and will continue in the upcoming term. All research tasks are encouraged to consider developing Recommended Practices as a result of their research.

The following suite of tasks helps advance technology deployment and market facilitation. While other tasks might indirectly impact this topic, and while the tasks below might also contribute to technology evolution and progress, these are the tasks that deal most directly with technology deployment and market facilitation.

**Task 11 Base Technology Information Exchange**

Task 11 gathers experts to present the latest results on narrow topics and discuss solutions in a small group setting. Invited experts from many countries and organisations share information and work to develop recommended practices for wind energy activities. As an important instrument of IEA Wind, the Task 11 Topical Expert Meetings begin conversations about new technical and scientific developments and information needs. Task 11 is also an important catalyst for starting new IEA Wind research tasks.
Task 25 Design and Operation of Power Systems with Large Amounts of Wind Power

Task 25 has been active since 2006 addressing issues of power systems and wind energy. The overall goal is to provide information to facilitate the highest economically feasible wind energy penetration within electricity power systems worldwide. The participants (16 countries and more than 24 organisations and transmission system operators) support this goal by analysing and further developing the methodology to assess the impact of wind power on power systems. IEA Wind Recommended Practice 16: Wind Integration Studies (in review) includes guidelines on the recommended methodologies for estimating the system impacts and the costs of wind power integration. The task also produces summary reports on integration impacts and experience. Participants will continue to publish in peer reviewed journals (50+ articles with an average of seven authors per article in the current term), publish fact sheets, make presentations, and organise workshops for specialised stakeholders.

Task 26 Cost of Wind Energy

Task 26 has been working since 2009 to provide understanding of the past, present, and future costs of wind energy using transparent methodology. The participants have established an international forum for exchange of knowledge and information related to the cost of wind energy. It will identify the major drivers of wind energy costs (e.g., capital investment, installation, operation and maintenance, replacement, insurance, finance, and development costs) and quantify the differences of these cost elements among participating countries. Additionally, the task will develop an IEA Wind Recommended Practice that includes an internationally accepted, transparent method for calculating the cost of wind energy. The next term will begin assessing the costs of offshore wind.

Task 27 Consumer Labelling of Small Wind Turbines

Consumer Labelling of Small Wind Turbines (Task 27 completed and extended with research work plan—see above)

RP 12 Consumer Label for Small Wind Turbines (2011) has been included as an appendix to the International Electrotechnical Commission (IEC) TC 88 standard on wind system testing. In 2012, the IEC compliance group began work to implement the labelling of small wind turbines applying the IEA Wind RP 12.

Task 28 Social Acceptance of Wind Energy Projects

Even where the economics of wind energy are favourable, deployment can only occur when the public and the planning authorities accept the technology. This requires an appreciation of the benefits of wind energy that weigh against any local negative impacts. The evaluation of this balance is often complicated by subjectivity and by the circulation of misinformation. This task will improve decision-makers’ ability to evaluate wind projects by continuing to provide high-quality information and analysis to member governments and commercial sector leaders by addressing wind’s benefits, markets, and policy instruments.

Task 32 Lidar for Wind Energy Deployment

Task 32 provides a forum for experts to exchange experience and progress on the performance of lidar devices, associated measurement techniques, and the effect of operational and site
conditions for wind energy applications. Subtask 1 addresses calibration and classification of lidar devices. Subtask 2 addresses procedures for site assessment. Subtask 3 addresses procedures for turbine assessment. Expected results include differentiation of technical aspects of lidar systems compared to conventional anemometry; performance evaluation of lidar systems for resource assessment and prediction of the annual energy production, namely, wind speed, turbulence, stability, and boundary-layer characteristics in flat as well as complex terrain, and offshore; evaluation of lidar-based power curve measurement methods during simple and complex inflow conditions through benchmark studies with new lidar-based measurement techniques and conventional procedures; definition of approaches to estimate the inflow conditions related to mechanical loads of wind turbines by means of lidar systems.

**Task 33 Standardising Wind Turbine Reliability Data**

Task 33 will provide an open forum on wind turbine failure and maintenance statistics. Participants will exchange experience from individual research projects; develop an IEA Wind Recommended Practice for collecting and reporting reliability data; and identify research, development, and standardisation needs for collecting and reporting reliability data. The expected results include state-of-the-art reports on the following topics: (1) initiatives concerning reliability, (2) flow of maintenance information, and (3) tools for O&M planning and overview of data needs.

**Task 34 Environmental Assessment and Monitoring**

Task 34 will share information from completed and on-going environmental assessment and monitoring efforts on land and offshore, both pre- and post-construction, to: (1) improve monitoring approaches; (2) make data easily accessible to all interested parties; (3) aggregate information on biological species affected; (4) aggregate information on effects of mitigation strategies; and (5) identify successful approaches to monitoring impacts, analysis techniques, and assessment methodologies. The expected results include a publicly accessible database with documents on monitoring, assessing, and mitigating environmental impacts of wind energy projects land-based and offshore; a State-of-the-Science report on accepted methodologies for environmental assessments for land-based projects, offshore, and, potentially, distributed technologies; and a research compendium of publicly available data on impacts.

**(f) Future Policy Relevance**

Several continuing tasks will publish Recommended Practices and technical reports to inform policy makers. The Recommended Practice for conducting integration studies will improve the overall quality of these analyses and identify poor quality studies that have previously influenced policy. The Recommended Practice for determining the cost of wind energy will have a similar impact by improving the overall quality of such studies. Identifying cost drivers for wind energy will continue to shape research investment policy.

**(g) Future Contribution to Environmental Protection**

The work of IEA Wind to expand deployment of wind technology helps reduce carbon dioxide emissions and particulates by displacing electric generation from other sources. The environmental benefits of wind generation will continue to be highlighted in the country chapters of the IEA Wind Annual Report and emphasised in its executive summary. This information can
be used by policymakers in all countries to demonstrate the potential contribution of wind deployment to reduction of emissions.

Task 34 Environmental Assessment and Monitoring Efforts for Wind Energy Projects Offshore and on Land will assess the state-of-the-art in assessment and monitoring techniques used for the environmental impacts of land-based and offshore wind development. Sharing experiences and improving knowledge should improve assessments prior to development and enhance monitoring efforts after wind farms are in place.

A Topical Expert Meeting on noise reduction technologies in 2013 has advanced the state of knowledge on that topic and may result in a new cooperative research effort. Noise has been an issue of social acceptance of wind energy, and greater understanding of how to reduce it will be most beneficial to deployment activities.

\textbf{(h) Future Contribution to Information Dissemination}

IEA Wind research tasks produce important results that can benefit individuals and institutions beyond the task participants. A major goal of the communication activity will be to \textit{increase the influence} of results from IEA Wind-sponsored research by effectively packaging and distributing it to key audiences.

Because IEA Wind competes for funds with other research activities of the member national governments, another goal of the communication activity is to ensure that participants (and their funding agencies) see the value of the collaborative research. \textit{Publicising the value of research} will also attract new participants to the agreement. A broad membership enhances the quality and effect of the work of the Implementing Agreement.

The overall goal of the communication effort is to affect the behaviour of the target audiences (researchers, developers, influencers and policymakers, and users) to enhance the quality of wind energy development. As each audience moves through the steps toward action (awareness, decision, and action), it becomes clear that different information products are appropriate for different audiences in the decision process. The communication strategy will help IEA Wind reach more audiences with balanced information appropriate to each audience’s role in deploying wind energy. A properly targeted information and distribution strategy will reach more people within each audience.

To increase the effect of IEA Wind results and to gain broader participation, the communication activity will support Operating Agents to develop and distribute the research results to appropriate audiences. The communication activity will also produce and distribute information on the benefits of collaboration in IEA Wind, facilitate communication among participants to enhance the research efforts, and enhance the credibility and visibility of IEA Wind as a reliable source of research and development information.

The communication activities of IEA Wind are directed by the ExCo and managed by the Planning Committee and the Communication Committee. Activities are carried out by the Secretary, operating agents, and ExCo members. New activities achievable within the approved
Secretary’s budget can be proposed by the Planning Committee. Major cost items will be included in the annual Common Fund budget proposal presented at the second meeting of the year.

External Communications
- Publish the IEA Wind Annual Reports and provide model press releases
- Maintain and expand the ieawind.org website as a global window on IEA Wind work
- Maintain and develop new web pages for research tasks
- Provide editorial and graphics support for official documents
- Co-ordinate the review and approval process of official documents
- Maintain generic presentation on IEA Wind for members to use

Internal Communications
- Produce official minutes of ExCo meetings
- Maintain Members’ web pages with meeting information and draft documents for review
- Maintain Procedures for Research Tasks document with updates approved by the ExCo
- Provide guidelines and templates for reporting to the ExCo

New Activities
E-newsletter after each ExCo meeting (external)
IEA Wind Award to publicise the activities of participants (external)

(i) Future Outreach to IEA Non-Member Countries
It has been difficult to bring new countries completely through the process of joining IEA Wind. Many countries could benefit from membership in IEA Wind and the current participants would benefit from broader membership.

Although we have had many researchers interested in getting their countries to join, participation has been limited by obstacles such as funding for membership fees, administrative complexities, and travel cost to attend meetings.

To address the administrative complexities, the IEA Wind agreement needs more help from the IEA Secretariat. Researchers and ExCo members do not have the contacts or authority to reach out to the governments of potential new countries. The IEA Secretariat needs to provide active contacts at a higher governmental level and mediate the process of gaining support for participation by new countries. For example, the ExCo voted to invite Israel and France to join at the first ExCo meeting of 2013. If the IEA Secretariat wrote to these governments, it could make a difference.

(j) Future Added Value
Task reports presented to ExCo meetings show enormous value received for a modest contribution by each participant (See Table 9). In some cases a country’s R&D investment is multiplied by hundreds of times when the contributions of all partners are considered. Investment
in this kind of cooperative research effort yields major savings in R&D costs and leverages funding provided from independent sources.

**Educating the Next Generation**
In addition to advancing the technology, leveraging national research dollars, and lowering the cost of wind energy, the work of IEA Wind will contribute significantly to training the next generation of researchers. The shortage of trained wind energy experts has been identified as a constraining factor by several key studies. Cooperative research efforts of IEA Wind that include universities are contributing to the work of doctoral students who are working on their dissertations. Through participation in these tasks, students are introduced to international research and to the latest in technical progress in the field.

**Networking**
The main advantage of the IEA Wind approach to information flow among researchers is the multinational nature of the task meetings. In the coming term, efforts to engage additional countries and organisations will continue. The benefits from networking include:
- Reduced research costs by eliminating duplication of efforts
- Improved quality of research through peer review
- The international scope broadens the view of participants
- IEA structure does not impose a large administrative burden
- Project strategy is determined by participating task members
- All participants are chosen as recognised experts in their field doing significant research
IEA Wind work is widely used by the international research and policy communities