IEA R&D WIND

STRATEGIC PLAN

1 November 2003 – 31 October 2008

FOREWORD

The purpose of this strategic plan is to provide direction for the activities of the International Energy Agency Implementing Agreement for Co-operation in the Research and Development of Wind Turbine Systems over the next five years. This new term of the Wind Implementing Agreement runs from the beginning of November 2003 through October 2008.

The Wind Implementing Agreement's Executive Committee (ExCo) generated the strategic plan through a consensus process. A dedicated task force comprising members of the ExCo was established to provide detailed guidance on structure and content. The full membership of the ExCo directed the document through an initial questionnaire and subsequent consultation on the draft report.

The Strategic Plan considers the key issues, the current characteristics of the Wind Implementing Agreement, sets out objectives and an appropriate set of actions.

TASK FORCE

The task force consisted of the following Executive Committee members.

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Photo credit: Gunnar Briste, www.windpowerphotos.com
Cover photo: Offshore windpark under construction at Horns Rev, Denmark.

EXECUTIVE SUMMARY

The purpose of the strategic plan is to provide direction and focus for the activities of the Wind Implementing Agreement over the next five-year term. It was generated through a consensus process and represents the views of the ExCo.

Vision, Mission, and Benefits

The Wind Implementing Agreement aims to contribute to the vision of the IEA Committee on Energy Research and Technology (CERT) to become the pre-eminent player in clean energy technologies. It will do this by strengthening its current position as an authoritative organization, providing technology and policy support to its members' governments and to the wind energy sector.

The Wind Implementing Agreement's mission is to stimulate co-operation on wind energy research and development and to provide high quality information and analysis to member governments and commercial sector leaders by addressing technology development and deployment and its benefits, markets, and policy instruments.

Globally, in the short to medium term, wind energy will be exploited predominately in the generation of electricity, through onshore and, increasingly, offshore installations. In the longer term, there is also high potential for the integration of wind and other renewables in wider applications and within future energy supply systems. Wind Implementing Agreement activities will therefore also address the use of wind energy in non-electricity generating applications (e.g. desalination) and within energy systems such as those exploiting hydrogen and forms of energy storage. Several of the issues will be handled through co-operation with other Implementing Agreements.

Key Issues

Technology R&D

The core activity of the Wind Implementing Agreement continues to be collaboration on technology R&D to achieve cost and performance improvements and to enable the increased deployment of wind energy systems. In the preceding terms, a successful formula, which will remain the cornerstone of future activities, has been developed to achieve this. Offshore wind development and system issues were identified by the ExCo as of great importance for the next term and will be increasingly built into the technology R&D activities.

Offshore wind energy

Offshore wind energy is currently an important element of development and R&D for Denmark, Germany, the Netherlands, the United Kingdom, and the United States and, to a lesser extent, Ireland, Italy, Japan and Spain. Developing offshore wind energy presents challenges including loads from the combined forces of wind, waves and ice; support structures for shallow and deep waters (>30 m); floating support structures; transportation, installation, and maintenance of turbines; and development of larger machines. In addition to these new challenges, the sector has high expectations but relatively little experience with offshore wind energy. The combination of the lack of experience, the high expectations, and the need for cost reductions makes R&D for offshore wind a high priority.

System issues

The integration of wind energy into national and international electricity supply systems is a priority area, having high relevance to all the member countries over the short to longer term. The development of validated models that enable network operators to reliably predict and regulate system behavior will greatly reduce resistance to the continued expansion of both onshore and offshore wind energy. Advances in system integration will have a strong influence on policy decisions over the next ten years and will be a key factor in accelerating deployment.

The future use of hydrogen within an integrated energy system has been identified by the IEA secretariat as of high importance and is seeing increased support from national government programmes. The Wind Implementing Agreement's role will be expanded to include the issues that arise in the exploitation of wind technology for hydrogen production and within other important energy supply systems. As renewable energy contributes an increasing proportion of the electricity and energy supply, there is also an increased need to optimise the way in which different technologies interact. Hybrid systems can exploit complimentary renewables technologies; for instance by combining wind and hydro to maximise the value of the electricity and to manage water flows. This can be applied at a local level to control generation at the source, but also at a system level to address the geographic distribution and connection of plant across an entire distribution network.

Environmental and societal issues

Sometimes referred to as 'soft issues' to differentiate them from technology aspects, environmental and societal issues have become pivotal to the deployment of wind energy in many countries. 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 visual and environmental effects. The evaluation of this balance is often complicated by its subjective nature and by the circulation of misinformation.

The Wind Implementing Agreement will take steps to assess the value of ongoing collaborative activities against strong national variations in policies and processes.

Support mechanisms and markets

Market development addresses both established and prospective markets to increase the prospects for wind energy. This in turn can generate increased prosperity for the commercial sector and greater exploitation of the established benefits of wind energy. Support mechanisms address the policy frameworks needed to enable the development of wind energy. As well as the direct financial support of capital outlay and energy output, support mechanisms can include obligations or renewables portfolio standards, planning and access legislation, green certificate accreditation, and national and international trading mechanisms.

The Wind Implementing Agreement has a role to collect, analyse, and present objective information on the leading global markets and support mechanisms, particularly those within the member countries. Such an appraisal is an essential part of providing an informed view of the technology and deployment issues.

Strategic Objectives and Plan

The strategic plan sets an agenda for the next five years, stemming from a set of objectives. Eight objectives have been developed to reflect the specific needs of the wind sector, whilst underpinning the four CERT strategic objectives.

In generating this plan, in addition to the key issues covered above, the ExCo identified the following generic issues to be addressed over the course of this term:

- To encourage the increased participation of the commercial sector and its associations in activities and planning,
- To actively pursue interaction with other international organisations,
- To increase the visibility and exploitation of activities and outputs.

Table 1 below summarises the approach that the Wind Implementing Agreement will take over the next term, by setting out the issues, plans, and example actions for each new strategic objective. Since the strategic plan provides direction in general terms rather than in specific actions, the table below provides examples of actions to illustrate the approach.

Strategy Review

This latest Strategic Plan is for use as a guiding reference document and not as a rigid commitment to a course of action. Therefore there will be periodic reviews to take proper account of changes in circumstance in light of the thinking behind the existing strategy.

The annual review of this Strategic Plan should involve an appraisal of objectives and should take account of any movement on key issues. The review should result in the generation of an annual action plan. The annual strategy review and associated action plan will fulfil the IEA requirement for an annual work programme.

Table 1 – Approach for the Next Term

Strategic Objective	Key Issues	Forward Plan	Action Path
To actively promote effective **co-operation on wind energy R&D,** through workshops, seminars, and collaborative work programmes	• Basic R&D: increased value and reduced uncertainties, cost reduction • Offshore wind: modelling loads, support structures, deep water (>30 m), floating structures, transportation, installation, and maintenance • Environmental and societal issues: effects on flora and fauna, visual influence	• Continue core technology R&D activities • Place increased emphasis on offshore technology and environmental issues • Increase engagement with the commercial sector • Evaluate collaboration on societal issues	• Exploit existing mechanisms to continue to identify and advance the state-of-the-art across R&D topics • Convene expert meetings and new annexes on offshore issues • Develop initiative to address societal issues and to determine the level of commonality and value of a collaborative programme

Table 1 – Continued

Strategic Objective	Key Issues	Forward Plan	Action Path
To improve the quality and breadth of wind energy **policy information** and analyses applied in the member countries	• Market issues and support mechanisms: markets, policies, and policy instruments	• Collect and analyse information on the member countries and leading global markets	• Continue to produce and distribute the annual report • Actively pursue interaction with other international organisations (e.g. UN, World Bank)
To encourage the **development of analytical tools** addressing the integration of wind energy into future energy supply systems	• Grid-integration: turbine, wind farm and system modelling for large-scale wind farms and distributed generation	• Expand on existing grid-integration work	• Consider additional expert meetings or establishing a Joint Action that complements the work under Annex XXI [Dynamic Models of Wind Farms for Power Systems]
To assess future needs in wind technology R&D, the integration of wind into the energy supply system and other deployment issues and, opportunities	• Long-term R&D needs • Strategy review	• Conduct periodic review of long-term R&D needs • Gain increased input from industry • Update the strategy annually	• Expert meeting on long-term R&D needs towards the end of this term • Actively pursue exchange of topics for long-term R&D needs with industry, e.g. EWEA and AWEA • Review strategy document and generate annual work plan
To encourage the increased participation of the commercial sector in activities and planning	• Relevance of IEA activities in addressing issues faced by those exploiting wind energy	• Increased efforts to gain the more active involvement of the commercial sector	• National representatives continue to liaise with relevant commercial sector organisations • Hold dedicated events with the commercial sector
To increase collaboration across appropriate implementing agreements	• Wind within future energy supply systems	• Engage in collaborative activities associated with the exploitation of wind energy	• Define areas and seek to collaborate with other implementing agreements
To widen the influence of the Wind Implementing Agreement through **collaboration with additional international bodies**	• Energy systems modelling • Support mechanisms and markets for wind in the context of all renewables	• Influence the wider analysis of wind energy and the validity of perceptions, information and policy advice	• Make approaches to international organisations such as the UN, World Bank, World Energy Council, and trade associations, review activities and opportunities for ongoing collaboration
To raise the profile of the Wind Implementing Agreement and increase the circulation of information about its activities and outputs	• Increasing the visibility and quality of information generated	• Improve effectiveness through wider collaboration and further development of dissemination activities	• Consider presentations at targeted events • Exploit appropriate IEA dissemination channels • Exploit opportunities to develop productive interaction with non-OECD countries

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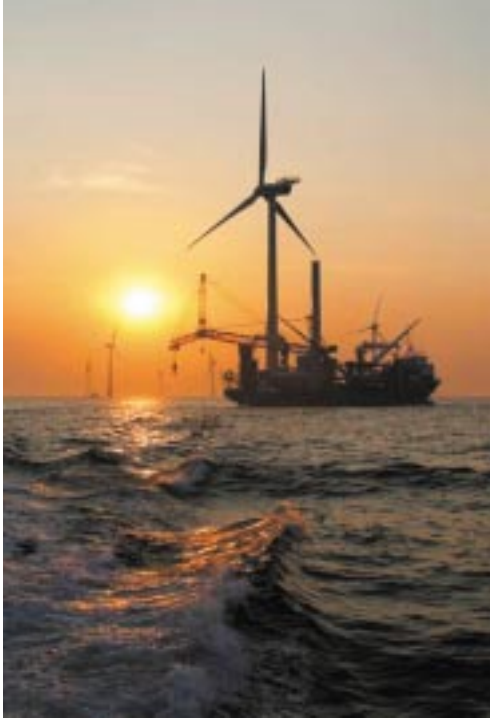

1 The Current Status

1.1 Wind Turbine Systems Technology

Implementation

At the end of 2002, the global wind capacity reached 31 Gigawatts (GW), 90% of which is in the member countries of the IEA Implementing Agreement for Co-operation in the Research and Development of Wind Turbine Systems. The IEA Wind Implementing Agreement countries generated 47 Terawatt hours (TWhrs) of electricity, up 27% from last year and provided electricity nearly equivalent to the entire needs of Greece. Globally, it is estimated that around 53 TWhrs of electricity were generated from wind.

Status of industry

The global strength of the wind energy sector has built continuously over the last decade, achieving annual growth of the order of 30% (28% in 2002). By October 2003, the value of this market globally was estimated at over 7 billion U.S. Dollars (USD). Increasingly, national policies are in favour of renewables, with wind energy able to take a leading role as an established and economic option. Wind energy is increasingly being viewed as mainstream, providing the following benefits to new and existing markets.

- Very low lifetime emissions of harmful gasses (especially CO_2)
- Large resource at costs approaching that of current thermal plant
- Increased diversity and security of electricity supply
- Removal of cost uncertainties caused by fuel supply price fluctuations
- Employment, rural income and an opportunity for industry.

Wind technology has become very reliable, operating with availabilities over 98% and having a design life of 20 years or more. Capacity factors, the fraction of continuous full production, are typically between 0.20 and 0.35, depending on the wind speeds at the sites and degree of plant optimisation. Turbines continue to grow in size and generating capacity. The average new turbine deployed in 2002 had an installed capacity of approximately 1,170 kilowatts (kW). The most recent offshore installation in Denmark used 2,000,000-kW turbines, with several larger machines now available. The cost of wind-generated electricity continues to fall steadily. For complete wind farms, estimates of average cost vary according to country, from about 900 to 1100 USD (Euro 940-1150) per kW of installed capacity. The cost of the turbine and tower alone varies between about 600 to 850 USD (Euro 630-890) per kW.

The market

Within most Wind Implementing Agreement member countries expectations are high for the coming years. Most countries have very positive policies towards renewables and plan to reduce their dependence upon conventional thermal generation plant and in some cases on nuclear generation. Additionally, international green certificate trading may expand the market for those countries with an especially good wind resource.

Interest in and expectations from offshore wind energy development continue to grow. The 160-MW Danish Horns Rev project was commissioned in 2002, and a number of other large projects across Europe are also gaining permits to build in the next few years. In the United States, there is growing interest in the large proposed project off Cape Cod, Massachusetts. The next few planned offshore wind farms are mostly of the order of 100 MW capacity, but looking further ahead, new projects are likely to be even larger. Those countries with solid plans to build in the near term are the United Kingdom, Denmark, the United States, Sweden, Germany, the Netherlands, and Ireland.

Support mechanisms

By the close of 2003, most grid-connected wind generation received government or state led incentives. The main market stimulation instruments used in the IEA countries are a combination of capital subsidy and the payment of premium prices for the energy produced. Increasingly, premium prices are preferred to capital investment subsidies. Premium prices come in several different forms ranging from a pre-determined fixed pricing regime (e.g. Germany and Spain) to a separate free market for green certificates to increase the value over the selling price of the electricity alone (e.g. the United Kingdom, the Netherlands, Australia, and Italy). Tax incentives in the United States and generation subsidies in Canada have been the principal drivers of wind energy development.

1.2 Wind Implementing Agreement Activities

The work under this agreement is managed by the ExCo in response to the needs of the member counties and their industry. Most technical work is carried out through Annexes to the Agreement. Results from the work take many forms: shared databases, numerous technical papers and reports, Recommended Practice reports, proceedings from meetings, a new interactive Web site, regular annual reports, brochures, and other publications. Countries choose to participate in tasks that are relevant to their current national research and development programs. By October 2003, 13 tasks had been successfully completed. The projects are either cost-shared and carried out in a lead-country, or task-shared, when the participants contribute in-kind, to a joint program coordinated by an Operating Agent.

Ongoing and recently completed annexes

Annex XI - Base Technology Information Exchange
The objective of the ongoing task XI is to promote wind turbine technology through information exchange between experts on R&D topics of common interest. Table 2 shows the range of Topical Expert Meetings and Joint Actions conducted during the last term starting in 1998.

Annex XV - Annual Review of Progress in the Implementation of Wind Energy
This task generated an annual report targeted at key decision makers, based on the set of IEA member national reports. This annex was completed in 2000, but the activity now continues as an overview chapter in the Annual Report.

Annex XVI - Wind Turbine Round Robin Test Program
The objectives of this task were to validate wind turbine testing procedures, analyse and resolve sources of discrepancies, and improve the testing methods and procedures. A series of field tests were conducted at participating national laboratories and test centres, using a standardized 50-kW wind turbine. Comparison test results are used as a means of validating test procedures and establishing reciprocity between different certification testing laboratories. The task will be completed in 2003.

Annex XVII - Database on Wind Characteristics
The objective of this task is to provide wind energy planners and designers, as well as the international wind engineering sector, with easy access to quality-controlled, time domain wind field measurement data collected in a wide range of environments (wind climates, terrain types, wind turbine wakes). By October 2003, the database included more than 161,000 hours of wind field time series data from more than 62 sites.

Annex XVIII - Enhanced Field Rotor Aerodynamics Database
This task was completed in 2002. The objective was to enhance the database resulting from the IEA Wind Agreement Annex XIV, Field Rotor Aerodynamics, completed in 1997. In these projects, a cooperative agreement was established among six institutes in five countries, which were taking detailed aerodynamic measurements on full-scale wind turbines. The projects resulted in a database of measurements, available for outside parties and through the web at http://www.ecn.nl/unit_de/wind/annexxiv/index.html.

Table 2 – Topics of Information Exchange

Topical Expert Meeting Subjects	Joint Action Subjects
State-of-the-art on Wind Resource Estimation	Aerodynamics of Wind Turbines
Wind Energy Under Cold Climate Conditions	Fatigue of Wind Turbine Blades
Noise Immission	Wind Forecasting Techniques
Long-Term R&D Needs of Wind Energy for the Time Frame 2000 to 2020	
Large Scale Integration into the Grid	
Structural Reliability of Wind Turbines	
Material Recycling and Life Cycle Analysis	
Power Performance of Small Wind Turbines Not Connected to the Grid	
Environmental Issues of Offshore Wind Farms	

Annex XIX - Wind Energy in Cold Climates
The overall objective is to develop guidelines for applying wind energy in cold climates, through the gathering and sharing of information. Participants are working to establish site classification formulae for wind turbine designers, manufacturers, project developers, and wind energy producers. The task participants also collect data on the reliability and availability of standard and adapted wind turbine technology operating in cold climates.

Annex XX - Horizontal Axis Wind Turbine (HAWT) Aerodynamics and Models from Wind Tunnel Measurements
This is a new task with eight participating countries. The objective is to compare theoretical aerodynamic model predictions of wind turbine blade and structural performance and loads with actual measurements taken in carefully controlled wind tunnel tests on actual turbines.

Annex XXI - Dynamic Models of Wind Farms for Power Systems
This task was approved by the ExCo in 2002 and will run until the end of 2005. Seven countries have committed to the Annex. The work facilitates a coordinated effort to develop wind farm models for use in combination with software packages for simulation and analysis of power system operation.

Dissemination activities

The Wind Energy Agreement is expanding both internal and external information exchange. ExCo meetings now generally include a representative from IEA headquarters. They are organised to include cross-membership updates every year on wind energy R&D activities, deployment, and incentives.

A new public site has been established (http://www.ieawind.org) linked to both IEA and to the national sites of member countries. This partially replaces the web site at the Danish Technical University that has been available since 1997 (http://www.afm.dtu.dk/wind/iea/index.html). Some public information on the Wind Energy Agreement has also been available on the IEA Web site. During this term, a password-protected Web site for ExCo Members was created for more efficient information exchange, providing archival information as well as current postings of meeting information and documents available for review. Four newsletters were published and distributed during the term. This activity was discontinued late in the term. Results from IEA Wind Energy task work, joint actions, recommended practices, analysis of implementation progress and policies are published and described in some public conferences and forums. The ExCo Ad Hoc Group report Long-Term R&D Needs for Wind Energy for the Time Frame 2000-2020 was published in Wind Energy in 2003.

1.3 Overview of Related IEA Activities

The Wind Implementing Agreement reports to the IEA Working Party on Renewable Energy Technologies (REWP), which in turn reports to the Committee on Energy Research and Technology (CERT). The CERT reports to the Governing Board of the IEA. The IEA Secretariat supports the activities of CERT and its working parties.

There are a number of other implementing agreements and wider IEA activities that have the potential to be drawn into future Wind Implementing Agreement activities. These are detailed in Appendix A. The IEA implementing agreements concerned with renewable energy and related topics are candidates for collaboration in crosscutting activities addressing complete energy supply systems in terms of physical integration, policies, and support mechanisms.

Established dissemination routes may be of value to the Wind Implementing Agreement to increase awareness of activities and improve the circulation of results, articles, or publications. One such dissemination route is the IEA Centre for the Analysis and Dissemination of Demonstrated Energy Technologies (CADDET) program, which produces newsletters, has a comprehensive web site, publishes the OPEN Energy Technology Bulletin, and provides a free on-line newsletter from IEA and CERT.

There are also standing committees within the IEA that may be of benefit in establishing connections with non-member countries and in widening the influence of the Wind Implementing Agreement.

2 Vision, Mission, and Benefits

Vision Statement

For the Wind Implementing Agreement to become recognised as a unique authority in providing technology research and policy support to its members' governments and the wind energy sector.

Mission Statement

To stimulate co-operation on wind energy research and development and to provide high quality information and analysis to member governments and commercial sector leaders by addressing technology development and deployment and its benefits, markets, and policy instruments.

The Wind Implementing Agreement vision and mission aim to directly contribute to the vision and mission of the CERT by enabling deployment of wind energy through reducing costs and overcoming barriers to encourage a diverse, secure, and sustainable energy supply. Globally, in the short to medium term, wind energy will be exploited predominately in the generation of electricity through onshore and, increasingly, through offshore installations. In the longer term there, is also high potential for the integration of wind and other renewables in the complete energy supply system. Wind Implementing Agreement activities will therefore also address the use of wind energy in non-electricity generating applications (e.g. desalination) and within energy systems such as those exploiting hydrogen and other forms of energy storage. Several of the issues will be handled through co-operation with other Implementing Agreements.

The Wind Implementing Agreement aims to produce objective information and analysis that will inform government policy rather than directly generating policy advice. The active promotion of wind energy is considered to be outside of its area of authority.

The benefits of the Wind Implementing Agreement principally accrue to the governmental, academic, and commercial sectors within the participating countries. However, there are also societal benefits in ensuring that wind energy is developed in the most acceptable way, minimising effects on other activities and especially effects on the environment. Benefits to the commercial sector can be listed separately from the benefits to wider society as below.

Commercial sector benefits

- Developing the skills and knowledge needed to meet future challenges
- Providing wider access to research results
- Improving R&D cost effectiveness
- Providing an international overview on R&D, deployment, and markets

Societal and governmental benefits

- Minimising environmental effects
- Providing objective information and analysis to guide national programmes and policy frameworks
- Guiding the most appropriate focus for R&D
- Improving R&D cost effectiveness
- Providing benchmarks to evaluate the positioning and performance of national R&D programmes (R&D budgets, industry funding and participation, wind energy performance and costs, commercial activity).

Some of the key benefits are described in more detail below.

Improved R&D cost effectiveness

The Wind Implementing Agreement enables highly informed exchanges on national government supported programmes and findings. The Agreement is ideally placed to establish effective collaboration on basic research.

As well as government sponsored R&D, considerable effort and resources are spent within the commercial sector that includes manufacturing industry, developers, consultancy services and organizations that provide the physical infrastructure for wind development. The activities of the Wind Implementing Agreement provide a means for international co-operation that can only accelerate cost reduction and enable more rapid deployment.

Developing skills and knowledge

The Wind Implementing Agreement has a clear role in developing the skills and knowledge that will help the commercial sector meet future technical challenges. This will be achieved through continuing the very successful collaboration between national programmes and among experts. It remains very important to have the involvement of the commercial sector through participation and ideally co-funding of activities. It is also important to guide work that will address their medium to long-term technology needs.

Guiding national programmes and policies

There is a need for the provision of high-level information and analysis to governments, with a view to contributing to the development of effective policy. The Wind Implementing Agreement makes a positive contribution to this need by providing material that is neutral, objective, and truly international in its perspective, drawing on experience from across the major wind energy markets.

Minimising environmental effects

Finding locations where wind energy receives general acceptance and where it is economic has become increasingly complicated and bound up with the development process. R&D will help countries to make the best use of their resources and develop wind energy appropriately with a knowledge and appreciation of its effects on plants, animals, and the conflicting goals for the use of landscape by different human interest groups.

3 Strength, Limitations, and Opportunities for Development

This section considers the current characteristics of the Wind Implementing Agreement. It serves to clarify its capabilities and role in order to assess the need for any changes in the scope of its authority
or activities.

3.1 Strengths

Many of the strengths of the Wind Implementing Agreement are derived from its current membership, which is characterised by government departments or agents responsible for national R&D programmes. The key strengths are as follows.

- A wide membership covering a high proportion of the global wind market
- Objectivity and neutrality
- An understanding of government issues, policies and processes
- Direct access to and influence on national R&D programmes
- A knowledge of and access to key decision makers in the commercial sector
- Ready access to other implementing agreements and the IEA secretariat
- Direct access to leading research institutions.

The Wind Implementing Agreement is uniquely placed to provide information and analysis on wind energy markets and policies, because of its international resources, government affiliations, and objectivity.

It has consistently helped individuals and companies with guidance and development of skills and knowledge, through the interaction of experts with their peers from around the world.

As a part of the wider IEA family, the Wind Implementing Agreement is also ideally placed to access information across the spectrum of technologies, through the other implementing agreements. This is already achieved to some

extent when individuals and organisations hold membership in several implementing agreements. Information can also be provided by the IEA secretariat, a coordinating and facilitating body with established links to governments and global organisations.

3.2 Limitations

The current structure and resources of the Wind Implementing Agreement have been developed around delivery of the benefits acknowledged in Section 2. These are what provides the Wind Implementing Agreement with its strengths. However, shaping it in this specific way can also place natural limitations on its effectiveness in other areas. Whilst these limitations may well not compromise core activities, it is wise to understand them, in order that changes can be made to adjust to an expanded scope or changes in the area of authority.

The principal limitations are currently as follows.

- Limited diversity of expertise in the membership of the ExCo
- Limited staff and financial resources
- Limited commercial sector participation in planning and activities
- Occasional lengthy time scales to establish and complete new work streams, potentially reducing their value to the commercial sector
- Limited direct access and engagement with decision makers at higher political levels.

3.3 Opportunities for Development

Executive Committee membership

Representation in the ExCo could be broadened because of new IEA rules approved in April 2003. IEA Implementing Agreements may now include Sponsors, which have representation at the ExCo level and participation in the annexes. Sponsors can be any company or organisation from within or outside of the OECD member countries. Unlike current Implementing Agreement member organisations, Sponsors do not require nomination from their national governments, but do require the approval of the Implementing Agreement and CERT. The conditions of their participation are determined by the ExCo of the Implementing Agreement.

The current resources and role of the Wind Implementing Agreement limit the scope of market related activities appropriate for it to address. This scope may be expanded through the greater involvement of the commercial sector and the introduction of more relevant expertise. It should also be noted that many of the activities of the IEA rely on its objectivity and independence from commercial organisations. Balance is therefore needed between the influence of the commercial sector and an independence from it. The Wind Implementing Agreement can maintain its independence through the make up of the ExCo. Increased commercial sector involvement could come from the interaction of ExCo members with their national industry leaders and from the participation of the commercial sector in future ExCo activities.

The Wind Implementing Agreement should actively pursue interaction with other international organisations such as the United Nations and industry associations. This will facilitate the exchange of information and bring increased experience and expertise to the implementing agreement. This has the potential to change the views of the ExCo over the course of the coming term. This does not preclude member countries from establishing new annexes through common goals at any time.

Resources

The principal resources available to the Wind Implementing Agreement are the time (supported by home organisation) of the individuals making up the ExCo and government funding through membership fees and annex participation fees. It is difficult to determine the limits of government support, because it varies with the perceived value of the implementing agreement's activities to each member country. Accessing government resources is complex and time-consuming, requiring commitment from both national funding agencies and the ExCo.

The staff resources within the ExCo are more clearly limited and have a strong influence on the level of ongoing activity possible during the course of the year. This probably has the most significant effect because many decisions and actions must be generated and authorised through the ExCo.

Increasing the profile of the Wind Implementing Agreement will require significant additional resources. In addition to the effort of attending additional events, funding will be needed to generate appropriate materials for dissemination.

The involvement of the commercial sector

By virtue of its independence from commerce, the ExCo is also less able to fully represent the commercial wind sector and so directly respond to its R&D needs. There is also a clear requirement for all European Community Government funded R&D to avoid supporting projects that influence the competitive position of individual companies.

It is increasingly apparent that, as R&D activities approach the near-term market, collaboration becomes increasingly bound up with intellectual property and competitiveness. This places practical limits on the extent of information

exchange and the nature of collaborative work that can be conducted between competing organisations. In particular, turbine manufacturers are unwilling to share extensive information on the design, loading, performance, and reliability of contemporary wind turbines.

However, the importance of the participation of the commercial sector is recognised by the ExCo. Its influence is currently realised through interaction with the ExCo members and participation in collaborative activities. There is a perception within the ExCo, that greater participation is needed. The future participation of the commercial sector will be strongly influenced by the nature of activities and their immediate relevance to commercial goals.

The level of influence

The Wind Implementing Agreement has limited engagement with high-level policy decision makers. Access to external international bodies is also limited at present and sustained efforts would be needed to build a useful exchange.

4 Key Issues

The rapid development and uptake of wind energy has led to new issues and new technical challenges. Some new issues are of particular importance to the future development and deployment of wind energy and to the role of the Wind Implementing Agreement. Alongside these new issues, basic R&D remains of fundamental importance in reducing engineering uncertainties and so reducing cost and improving performance. This section considers the ongoing need for technology R&D, the other issues of particular prominence, and the potential response of the Wind Implementing Agreement to them.

The focus of long-term R&D

The Wind Implementing Agreement produced a paper in 2001 titled, "Long-Term Research and Development Needs for Wind Energy for the Time Frame 2000 to 2020." That paper resulted from a topical experts meeting on the subject, which identified an ongoing need for long-term R&D in a number of specific areas. Drawing upon these ideas, as part of the process for developing this five-year strategic plan, each member country was asked to prioritise these topics for importance to their particular situation and to identify any additional topics. There was strong support for continued activity in all the areas, with no issues taking precedence over others.

However two key additional topics were identified for R&D efforts—issues of offshore wind development and the role of wind energy within hydrogen-based energy supply systems. Offshore wind energy, although in its infancy, is increasingly seen as a key element of renewables development in several Wind Implementing Agreement member countries. Technology and environmental issues raised by offshore wind energy development are the subject of much research and are likely to form an important part of the Wind Implementing Agreement's future activities. In addition to using wind energy for electricity production, in the longer term, wind energy could be applied to other energy applications, in particular for the generation of hydrogen.

Priority research areas

The priority research areas determined by the members of the ExCo for this strategic plan can thus be summarised as follows.

1. Increase value and reduce uncertainties
   - Forecasting power performance, reducing engineering uncertainties especially in large machines, and improving standards
2. Continue cost reduction
   - Improved site assessment, better models for aerodynamics/aeroelasticity, new concepts, more efficient components, stand alone systems
3. Enable large-scale use
   - Electric load flow control and adaptive loads, improvement of power quality
   - Integration of large (500 MW +) wind farms
4. Minimise environmental impacts
   - Compatible use of land, quieter turbines, effects of turbines on flora and fauna onshore and offshore, recycling
5. Wind within future energy supply systems
   - Wind energy in combination with long and short-term energy storage
   - Wind energy in combination with hydrogen generation
   - Wind energy in combination with other renewables

4.1 Technology R&D

The nature of technology research and development has changed as the industry has matured and become more commercial. Wind energy is now in a state of rapid development and implementation. It is increasingly being considered as a mainstream technology, reflected in the changing attitudes and involvement of the large utilities and oil and gas companies.

Research and development has been an essential activity in achieving the cost and performance improvements that have brought wind energy this far, but there remains a need for further cost reductions. The rapid development and uptake of wind energy has led to different technologies for distinct applications, broadly categorised in Table 3.

4.1.1 Wind turbine technology

Basic R&D continues to be of high importance and will contribute to further cost reductions and improved effectiveness in all technology development lines. The re-emergence of large turbines of 2 MW and larger requires a greater understanding of machine loads and the response of the structure. For instance, there are uncertainties in the incident wind field, which have increased spatial variation for larger swept areas. Currently the largest turbines are used both onshore and offshore, but these technologies may diverge in future. Basic R&D on loads and structure will contribute equally to both these development tracks.

The sharing of information and the cross-fertilisation of national R&D programmes and projects has always been a very successful core activity of the Wind Implementing Agreement. The structure of the ExCo and the current spectrum of tasks being carried out as annexes to the Agreement reflect that origin. There is an ongoing need for the continuation of this co-operation between technology R&D programmes and people. The existing mechanisms are ideal for addressing future wind turbine technology needs.

Table 3 Technologies for Different Applications

Application	Wind turbine size
Onshore, grid-connected wind farms	> 0.85 MW
Offshore, grid-connected wind farms	> 2.00 MW
Onshore single or small clusters of grid-connected turbines	0.50 – 2.00 MW
Onshore turbines for decentralised applications, weak grid/hybrid systems/stand alone	10 W – 500 kW
Onshore turbines for hydrogen and other energy applications	>100 kW

4.1.2 Offshore turbine technology

Offshore wind energy is currently an important element of R&D for Denmark, Germany, the Netherlands, Sweden, the United Kingdom, the United States, and, to a lesser extent, Ireland, Italy, Japan, and Spain. Whilst offshore wind energy substantially exploits existing knowledge and research work from onshore wind development, a number of important new areas require R&D to improve the level of understanding and optimise solutions. There are also a variety of different issues for development of offshore wind turbines such as sea state, seabed characteristics, sea depth, and the possibility of floating structures. The challenges specific to offshore wind energy development include the loads from the combined forces of wind, waves, and ice; support structures for shallow and deep waters (≥30 m); floating support structures; and methods for the transportation, installation, and maintenance of turbines. Machine sizes will also continue to grow until the combination of turbine size and installation costs is optimised.

As well as presenting new challenges, there is relatively little experience with offshore wind energy implementation. For those countries with interest in exploiting offshore wind energy, the combination of lack of experience, high expectations, and need for cost reductions make research to advance the development of offshore wind turbines a high priority. So issues of offshore wind energy development will be an important focus area and will be incorporated into many existing and new Wind Implementing Agreement activities over the course of this next term.

The basic mechanisms are in place to meet the specific needs of offshore wind energy technology. The need to cover additional topics may require more activities and funding; initially through Annex XI – Base Technology Information Exchange and subsequently through new annexes. The ExCo will address the need for specific activities as it arises, and no fundamental structural changes to the Agreement are required. However, as with other research areas discussed here, there is a need for engagement with the commercial sector. In this case, the commercial sector encompasses the traditional offshore sector (engineering, cable installation, geophysics, marine expertise, and so on) in addition to the established wind energy development sector. Developing offshore wind technology will require additional effort to identify and encourage appropriate organisations to participate.

4.1.3 System issues

This section addresses issues related to the integration of wind power plant within the spectrum of electricity supply and energy supply options. There are three main categories of wind system integration considered here: grid-connected electricity generation, off-gird (including mini-grid) electricity generation, and energy supply applications. As well as the direct generation of electricity feeding both large transmission systems and mini-grids, wind energy can be exploited to power other plant. In particular it can be used to generate hydrogen as an energy transfer medium.

Grid-connected system integration

Because of the expected growth in the contribution from wind energy, the integration of wind generation into national and international electricity supply systems is an immediate priority area. It has high relevance to all the member countries over the short and long term. For several member countries, grid integration issues will present the primary challenge to the expansion of wind power in the medium term.

Because of the different characteristics of wind generation and its connection into utility networks, operators are concerned about effects on system stability, the operation of existing plant, and the effect on costs. For example, offshore wind farm economics favour very large installations, typically requiring high voltage transmission systems. Wind energy power plant of this nature is new to transmission system operators, who need to evaluate the effects of such wind plant on their overall operations. The development of validated models that enable network operators to reliably predict and regulate system behaviour will greatly reduce resistance to the continued expansion of both onshore and offshore wind energy. This will have a strong influence on policy decisions over the next ten years and will be a key factor in accelerating deployment.

The Wind Implementing Agreement has identified the following topics as most important in addressing the future grid-integration of wind energy; encompassing short to long time scales.

1. Large scale grid integration: modelling and management of load flows within national and international high voltage transmission networks
2. Distributed generation: modelling the system response to wind energy embedded in the low voltage distribution networks
3. The development of detailed models describing wind turbine and large wind farm electrical behaviour
4. Energy storage, regeneration, and active demand side management
5. The value and benefits of combining wind energy with other technologies such as hydropower and photovoltaics
6. The organisational and legal framework for transmission and distribution system operators to provide a safe and reliable electricity supply.

This is a technical area in which improvements will benefit all member countries. Because the technology is generic rather than bound up with individual manufacturers, commercial sensitivities are less of an issue. High gains can be expected from effective collaborative work and information exchange. The IEA Wind Implementing Agreement is an appropriate vehicle to foster this collaboration and to disseminate findings for the benefit of all member countries. Increased input from the commercial sector is needed through the electricity companies, grid operators, and the developers and operators of large onshore and offshore wind farms.

Hydrogen and other energy supply applications

The future use of hydrogen within an integrated energy system has been identified by the IEA secretariat as of importance. It is also seeing increased interest and support from within the governments of IEA Wind Implementing Agreement member countries. In response, the Wind Implementing Agreement's role will expand to include issues that arise in the exploitation of wind technology for hydrogen production. This also applies to the combination of wind with other energy supply applications as they become of high interest. This work cannot be conducted in isolation, but must involve other implementing agreements, such as those on hydrogen and energy storage, and must also account for the views of international organisations such as the World Energy Council, the United Nations, and the World Bank.

Hybrid systems

As renewable energy contributes an increasing proportion of the electricity and energy supply, there is also an increased need to optimise the way in which different technologies interact. This need is driven by economics, but also by the importance of maintaining a stable and secure energy supply. The security of the electricity supply system has been identified as fundamental to overall energy security by the CERT group of experts on Electric Power Technologies (meeting of May 12th 2000).

Hybrid systems can exploit complimentary renewable energy technologies; for instance by combining wind generation and hydro power to maximise the value of the electricity and manage water flows. This can be applied at a local level to control generation at source. It can also address the geographic distribution and connection of plant across an entire distribution system. It is equally possible to consider how to optimise the combination of wind with conventional thermal generation at a local rather than system level. It will be a very long time before thermal plant is removed from the system and the increasing involvement of traditional oil and gas companies and utilities means that this will be of very high relevance for the short to medium term at least.

This is an area that cannot be developed by the Wind Implementing Agreement in isolation. As for the supply applications listed above, opportunities for effective collaboration with other implementing agreements should be evaluated (e.g. Hydropower, Biomass, Photovoltaics, SolarPaces, Hydrogen, Energy Storage).

Off-grid generation

Stand-alone or off-grid systems have the capability to bring a reliable and cost-effective electricity supply to many remote locations. Whilst the total installed capacity will remain low in comparison to grid-connected wind generation, the value of such systems can be very high. In particular, this is true where the alternative is no electricity supply, or a supply wholly dependent upon expensive and uncertain imported fuel supplies. Off-grid electricity supply systems usually combine wind with complimentary technologies such as diesel and photovoltaics. They benefit from energy storage, often using batteries, and require a control system.

The present small size of this market has discouraged technology investment, and research is needed to improve both the turbine technology and the rest of the system. Experience to date has shown reliability and availability to be well below that of larger turbines. This, compounded by difficulties in servicing and supplying spares, has led many small systems to fall into disuse. The size of the market is sensitive to perceptions about reliability and cost. Improved

technology will expand the market, which includes remote areas and islands within the OECD countries and large rural areas within many developing countries.

The rate of development of off-grid technology can be improved by establishing consistent and ongoing collaboration between experts and key organisations. The interest and viability of initiating a joint action or new annex on this subject will be assessed at the next off-grid Topical Expert Meeting conducted under Annex XI – Base Technology Information Exchange.

4.2 Environmental and Societal Issues

Sometimes referred to as 'soft issues' to differentiate them from technology aspects, environmental and societal issues have become pivotal to the deployment of wind energy in many countries. Even where the economics of wind energy are favourable, deployment can only occur when the public and, in turn, the planning authorities, accept the technology. This requires an appreciation of how the benefits can outweigh the visual and environmental effects for any given set of circumstances. The subjective nature of evaluating this balance is often complicated by strong local opposition arising from communities or individuals very close to proposed turbines and by the circulation of misinformation. The Wind Implementing Agreement has a potential role in providing accurate and objective information to combat misinformation. The planning or building permit process generally tries to take some account of these issues, and technology can also have some influence.

Environmental and societal issues have much in common and to some extent are interwoven. Both require a judgment that the wider benefits to the environment and society are balanced against the local effects on people, flora, and fauna.

Environmental issues

Environmental issues are considered in every wind project proposal, whether onshore or offshore. Avian issues have been particularly prominent in consideration of onshore applications. There is concern about birds striking turbines. In addition, bird flight paths may be influenced by wind turbines and thereby change the feeding and breeding patterns of some bird species. Whilst much research has been conducted in this area, the sensitivities of species are not fully understood and the pooling of expertise and knowledge can only improve the current position. So far, this has been done at a national level, but much less so at an international level.

The lack of data on the environmental effects of offshore wind turbine installations has caused much concern and is the subject of many projects across Europe in particular. Concern, perceptions, and the lack of data on environmental effects have a large influence on deployment, constraining available sites and causing delays and increased costs. There have been some international efforts to pool knowledge in this area, such as the Concerted action on Offshore Development (COD project) supported by the European Commission. Any further activities should exploit and build on these.

Societal issues

Societal issues cover the effects wind energy has on local communities and the whole of society. The visual effects in particular cause concern and objections to planned projects. As a part of the development of this strategic plan, the level of interest in the various societal issues across the member organisations was surveyed. Without exception, societal issues are considered a relevant topic for this planning period. The issues considered most and least important in terms of their influence on the deployment of wind energy are listed in Table 4.

Societal issues are considered of high importance by the membership of the Wind Implementing Agreement, and there is a desire to increase the prominence of activities in this area. However the variability of the position and approach across differing member countries is felt by many to limit the potential for constructive collaboration; so it is first necessary to evaluate the value and benefits of collaboration in this area. A useful first step could review the

Table 4 - Relative Importance of Societal Issues

Importance	Issue
High	Awareness and acceptance of wind technology Planning issues (legislation and visual effects on landscape character) Community involvement and the local economy
Low	Effects on tourism

commonality and potential benefits of collaborative activities, addressing awareness and acceptance of the technology, visual impacts, and other planning issues.

4.3 Developing Markets

This issue is concerned with the development of markets, both established and prospective. It is centered on increasing the prospects for wind energy, through presenting and disseminating targeted information on best practices, policies, and measures. This in turn can generate increased prosperity from the commercial sector and greater exploitation of the established benefits of wind energy.

Developing markets is of greatest interest to those member countries having a strong indigenous manufacturing industry that may benefit from increased export activities as the global market for wind energy expands. This limits the number of countries that have a strong interest in establishing collaborative market related activities. It should also be noted that there are many national and international organisations that are already involved in the appraisal and development of the role of renewables. Many of these have greater resources and expertise than the Wind Implementing Agreement, but they may also have interests that influence their perspective.

The members of the ExCo agree that the scope of the Wind Implementing Agreement should extend to the collection and analysis of information on the leading global markets and, in particular, those within the member countries. An appraisal of these markets is an essential part of providing an informed view of the technology and deployment issues.

Whilst this strategic plan does not set a market related objective to initiate unilateral activities, it remains completely acceptable for two or more member countries to establish an Annex in this area. This topic has been the subject of much discussion, initiated by the IEA Secretariat's interest in a market acceleration initiative. Support has been provided to the IEA Secretariat for the generation of the learning curve analysis and market acceleration initiative, and some member countries of the Wind Implementing Agreement maintain an interest in taking this further in some form.

Where clear opportunities arise to develop productive interaction with non-OECD countries, the ExCo should consider these on a case-by-case basis. The 1999 International Seminar in Mexico developed a model that can be repeated successfully in other developing markets.

4.4 Support Mechanisms

This area addresses policy frameworks to support the development of wind energy. As well as the direct financial support of capital outlay and energy output, support mechanisms can include the setting of obligations or renewables portfolio standards, planning and access legislation, green certificate accreditation, and national and international trading mechanisms.

Most grid-connected wind energy markets operate with a supporting policy framework. Consequently markets and the mechanisms used to establish them are of great interest and relevance to all member countries and further activities are considered valuable. Support mechanisms have been evolving over the last two decades and there is now a wealth of experience. The picture is complicated by the liberalisation of the electricity markets, wide variations in overall energy and environmental policy, and the historic investments and support for conventional generation industries. There is a drive to a level of harmonization in Europe to enable international trading of energy and environmental credits. Such trading mechanisms aim to help meet overall pollution and emission reduction commitments.

Whilst all the members of the Wind Implementing Agreement identify support mechanisms as relevant to their national situations, the Agreement itself is thought to be only partially appropriate as a means to address them. This may stem from the strong R&D role of the Agreement and the bias of the group. In spite of this, there remains a majority in favor of some activity in the area of support mechanisms.

The members of the Wind Implementing Agreement do recognise the importance of understanding and evaluating markets, policies, and policy instruments to enable the continued success of wind energy. This is reflected in the production of an annual report, which includes a level of such analysis. There is scope for improving the annual report through greater standardization of data collection, reporting, and terminology accompanied by more rigorous analysis.

Support mechanisms cut across the technologies and must work within a wider framework. The expertise and knowledge of the Wind Implementing Agreement should be improved through active engagement with international organisations and industry associations. Established mechanisms should also be exploited to set up expert meetings and workshops. There has been insufficient groundwork in this area to be able to consider the development of recommended practices in the short term, but this may be appropriate in the future.

5 Strategic Objectives and Plan

The strategic objectives set an agenda for the next five years in general terms rather than in specific actions. They specify the scope of activities, highlighting those areas that should continue unchanged, and they identify areas where some change is considered desirable. Working towards these objectives is beneficial to the overall purpose as set out in the mission statement. The IEA CERT produced a strategic plan in April 2002 that set out a vision, mission, and four strategic objectives. The plan outlined the overall direction required from the various working parties, including the REWP, and the implementing agreements reporting to them. In order to put the activities of the Wind Implementing Agreement in their correct context, the strategic objectives are structured around these four CERT strategic objectives as shown in Table 5.

The following text considers each of the Wind Implementing Agreement's strategic objectives in turn. It draws on the discussion of the key issues to describe the strategic position and planned approach over the course of the term, which runs from November 2003 through October 2008.

Table 5 – Strategic Objectives

CERT objectives	Wind Implementing Agreement objectives
1. To better identify and promote effective and innovative policies that **stimulate energy technology R&D.**	To actively promote effective co-operation on wind energy R&D through workshops, seminars, and collaborative work programmes. To improve the quality and breadth of wind energy policy information and analyses applied in the member countries.
2. To more clearly define and analyse energy technology issues and opportunities, and to enhance **development of analytical tools** that inform and support policy and program development in member countries.	To encourage the development of analytical tools addressing the integration of wind energy into future energy supply systems. To review future needs in wind technology R&D, in integration of wind into the energy supply system, and in other deployment issues and opportunities.
3. To more vigorously foster **international networking and collaboration** in energy technology R&D.	To encourage the increased participation of the commercial sector in activities and planning. To increase collaboration across appropriate implementing agreements. To widen the influence of the Wind Implementing Agreement through collaboration with additional international bodies, exploiting appropriate IEA channels and initiatives.
4. To more effectively **communicate key lessons learned** through the CERT's activities to IEA member country governments and agencies, the research sector and other interested parties.	To raise the profile of the activities and outputs of the Wind Implementing Agreement and increase the circulation of information.

5.1 Stimulate Technology R&D

To actively promote effective co-operation on wind energy R&D through workshops, seminars, and collaborative work programmes.

The active encouragement of effective networking and collaboration on technology related R&D should continue to be a core activity of the Wind Implementing Agreement.

The recent activity to evaluate and publish the long-term wind energy R&D needs identified key future R&D topics. The consultation conducted in generating this strategy has consolidated those views with strong support for continued activity in all the areas highlighted and with no issues taking clear precedence (The focus of long-term R&D) Offshore wind technology, its integration into the grid, and the role of wind within hydrogen-based energy supply systems were identified as additional key technology topics for R&D efforts.

The existing Wind Implementing Agreement mechanisms are ideal to address future wind turbine technology needs. Topical Expert Meetings (TEMs) will continue to provide an effective means of evaluating new topics through information exchange on the state of the art and peer review. The need to cover additional topics highlighted under key issues, such as offshore and system integration, may require more activities and funding; initially through Annex XI – Base Technology Information Exchange and subsequently through new annexes. There is a need for greater engagement with the commercial sector and a streamlined process for initiating new collaboration efforts would assist in achieving this.

In addition to technology oriented topics, environmental and societal issues have become equally important in terms of the deployment of wind energy in many countries. It is clear that these soft issues should also be addressed by the Wind Implementing Agreement, although the nature and extent of useful collaboration must first be established. Such collaborations might be achieved through initiatives such as workshops addressing societal issues, to determine the level of commonality and the value of a collaborative programme. The Wind Implementing Agreement has a potential role in providing accurate and objective information to the public to combat a lack of understanding and the circulation of misinformation.

To improve the quality and breadth of wind energy policy information and analyses applied in the member countries.

Another essential role is the collection and collaborative analysis, publication, and dissemination of information on the technology, on the R&D needs, and on markets, policies, and support instruments. The key mechanism for disseminating this information is the annual report and overview, which should continue to be produced. There is scope for improving this document in terms of both the data and its analysis. To bring about these improvements would require increased resources either in terms of finance or increased effort from the contracting parties.

5.2 Develop Analytical Tools

To encourage the development of analytical tools addressing the integration of wind energy into future energy supply systems.

As wind energy becomes increasingly regarded as a mainstream technology its continued growth depends upon appropriate changes to the physical and regulatory structure within the whole generation and supply chain. Wind energy can no longer be viewed in isolation, operating within protected niche markets and managed by suppliers as a peripheral obligation.

The Wind Implementing Agreement is already active in developing improved turbine and system models for the large-scale integration of wind energy into electricity distribution networks. This important area warrants further activities, which could be initiated through additional Topical Expert Meetings or by establishing a Joint Action on the subject, either of which should complement the work under Annex XXI - Dynamic Models of Wind Farms for Power Systems Studies.

There is an issue of physical integration that goes beyond wind farm behaviour alone. This issue addresses the interactions and opportunities of a mixture of distributed energy resources. Hydrogen as an energy transfer medium is of particular importance. Although work on the wider energy picture is conducted in the member countries, this has not been brought into the annual report and no collaborative activities have been initiated. The Wind Implementing Agreement's role will expand to include issues that arise in the integration of wind into future energy supply systems, such as the combination of wind energy with hydrogen production and within hybrid systems.

To review future needs in wind technology R&D, in the integration of wind into the energy supply system, and in other deployment issues and opportunities.

Appraising the future needs of wind technology has been an ongoing theme within the Wind Implementing Agreement. It is important in informing and guiding both government research programmes and the research sector. General long-term R&D needs were reviewed by the Wind Implementing Agreement in 2001 and previously in 1995, with more specific areas being reviewed in Topical Expert Meetings across the spectrum of wind technology issues. A similar review, covering future R&D needs, will be considered

before the end of this term, perhaps additionally including input from industry associations such as the European Wind Energy Association and the American Wind Energy Association.

5.3 International Networking and Collaboration

To encourage the increased participation of the commercial sector in activities and planning.

The involvement of the commercial sector is clearly important in ensuring that IEA activities are relevant and address the problems and issues faced by those seeking to develop and exploit wind energy. Whilst the commercial sector is invited to attend activities, it is not always well represented. Increased efforts are needed to gain active involvement of the commercial sector. This may be realised through two mechanisms. Firstly, it remains important for national representatives of the ExCo to continue their efforts to directly engage the commercial sector and enable participation at Topical Expert Meetings, workshops, etc. Secondly, it may be beneficial to consider a new initiative dedicated to informing the commercial sector of the activities of the Wind Implementing Agreement and of opportunities for their involvement and influence. This might be achieved through the holding of dedicated workshops or seminars within conferences, either within a national or international forum.

To increase collaboration across appropriate implementing agreements.

To widen the influence of the Wind Implementing Agreement through collaboration with additional international bodies, exploiting appropriate IEA channels and initiatives.

It is increasingly important to engage in collaborative activities that span the technologies to put wind energy into the wider context of electricity and energy issues. As a member of the IEA family, the Wind Implementing Agreement through activities involving other implementing agreements and the IEA Secretariat can readily achieve this. Such exchange could influence the wider analysis of wind energy and ensure the validity of perceptions and information used in generating reports and policies. The first stage is a definition activity to identify the areas for collaboration, such as energy systems modelling (storage and combined renewables), hydrogen generation, and support mechanisms for renewables. Collaboration can then be sought with those IEA implementing agreements with a mutual benefit and interest.

The same model can be applied for widening the influence of the Wind Implementing Agreement still further to reach external organisations such as the United Nations, the World Bank, the World Energy Council, and trade associations. Initial approaches should address their activities and perceptions of wind energy (status, markets, support mechanisms) and consider the benefits of any ongoing collaboration.

5.4 Communicate Key Lessons Learned

To raise the profile of the activities and outputs of the Wind Implementing Agreement and increase the circulation of information.

There is a shortage of impartial information and analysis on wind technology and issues associated with its deployment. With an established reporting system and, as a member of the IEA family, the Wind Implementing Agreement has a strong platform to build on. The Agreement aims to improve its effectiveness through wider collaboration and further development of its dissemination activities. Increasing the profile, the quality of information generated, and ultimately the influence of the Wind Implementing Agreement can be addressed in part through the mechanisms and channels established by the IEA and CERT, such as the on-line newsletter, OPEN, and the CADDET newsletter. Other avenues should also be considered and reviewed, such as the presentation of papers at targeted events, the submission of articles in leading trade journals, and the greater exploitation of industry associations. Where clear opportunities arise to develop productive interaction with non-OECD countries, the ExCo should consider them on a case-by-case basis.

5.5 Action Plan – 2003 Through 2004

This plan sets out the priority actions for the year commencing November 2003.

Table 7 Action Plan – 2003 Through 2004

	Action	Comment
To improve the quality and breadth of wind energy policy information and analyses, applied in the member countries.		
1	Produce the 2003 Annual Report	Publication by May 2004.
To actively promote effective co-operation on wind energy R&D, through workshops, seminars, and collaborative work programmes.		
2	Develop an initiative addressing societal issues to determine the level of commonality and value of a collaborative programme.	This might be realised through a Topical Expert Meeting or other form of workshop. A key deliverable would be a paper documenting the level of commonality and the prospects for successful collaborative actions.
3	Consider the need to streamline the process for initiating new collaboration efforts.	For example, through an ExCo paper and discussion.
To encourage the development of analytical tools addressing the integration of wind energy into future energy supply systems.		
4	Consider additional Topical Expert Meetings or establish a Joint Action that complements the work under Annex XXI- Dynamic Models of Wind Farms for Power Systems Studies.	The Annex XXI operating agent could consider additional work streams as a part of the report to the ExCo.
To encourage the increased participation of the commercial sector in activities and planning.		
5	Consider ways in which the interest and participation of the commercial sector can be further encouraged.	Options could include increased liaison with industry associations, commercial sector workshops, and new dissemination channels.
To increase collaboration across appropriate implementing agreements.		
6	Define areas and seek to collaborate with other implementing agreements on wind within combined renewables and hydrogen energy systems.	Initially, a limited activity and scope would enable interaction to become established and the likely benefits of collaboration evaluated.
To widen the influence of the Wind Implementing Agreement through collaboration with additional international bodies.		
7	Specify appropriate international organisations for future interaction; defining the possible scope of activities.	Organisations for consideration might include the World Bank, the United Nations, the World Energy Council and the IEA Secretariat.
To raise the profile of the activities and outputs of the wind Implementing Agreement and increase the circulation of information.		
8	Consider presentations at targeted events and opportunities to develop interactions with non-OECD countries.	Where clear opportunities arise to raise the profile of activities or develop productive interaction with non-OECD countries, the ExCo should consider them on a case-by-case basis.

6 Srategy and Performance Review

This strategic plan is a guiding reference document and not a rigid commitment to a course of action. The objective of an annual review is to take proper account of changes in circumstance against an appreciation of the thinking behind the existing strategy.

Annual review

The strategy will be reviewed annually and this review should involve an appraisal of objectives and related actions, taking account of any movement on key issues. The review can take the form of an addendum to this plan and include the following elements.

- A brief description of any new key issues that need to be taken into account
- A brief review of the strategic objectives, stating their continued relevance or explaining changes and updating priorities
- Generation of the forward annual action plan
- Conclusions noting the overall compliance with the strategy, highlighting success stories and commenting on the value of the strategy.

The annual strategy review and associated action plan will fulfil the requirement for an annual work programme. The following annual timing is suggested.

First ExCo meeting - Strategy review including progress towards strategic objectives and agreement of the forward annual action plan.

Second ExCo meeting - Interim review of progress against action plan.

The annual strategy review needs a level of consultation to be valid as a tool for directing the Wind Implementing Agreement. This should not be too involved as an annual exercise. It may be achieved through the inputs of the chair and vice chairs, followed by circulation for comment prior to final approval at the second meeting of the ExCo.

Monitoring the benefits of the wind implementing agreement

Historically, investment in research and development has been fundamental in establishing wind energy as a reliable and competitive option. International collaboration has undoubtedly sped up the development rate. With the commercial sector now reaching a size that enables inward investment in product development, it is more difficult to separate out the contribution made within the national programmes collaborating under the Wind Implementing Agreement. The development of performance measures (bench marking) and the monitoring of commercial sector progress against these measures could provide some indication of the future progress of the technology and the value and benefits of R&D.

APPENDIX A – Related IEA Activities

Renewables implementing agreements

Bioenergy – Collaborative R&D and information exchange on biomass based energy systems, including sustainable forestry, conversion, and utilisation.
http://www.ieabioenergy.com

Hydrogen – Collaborative R&D and information exchange on the production, storage, and utilisation of hydrogen.
http://www.eere.energy.gov/hydrogenandfuelcells/hydrogen/iea

Hydropower – Collaborative R&D on hydropower upgrading, education and training, small scale hydropower, and environmental and social issues. http://www.ieahydro.org/

Photovoltaic Power Systems – Collaborative R&D and information exchange on the application of photovoltaic systems, including cost reduction, awareness building, performance analysis, market deployment and enhancing technology co-operation with non-IEA countries.
http://www.iea-pvps.org/

Solar Power and Chemical Energy Systems (SolarPACES) – Collaborative R&D and demonstration of solar thermal power systems, solar chemistry, and analysis and simulation and coordinated experiments of an R&D nature.
http://www.solarpaces.org/

Ocean Energy Systems – International collaboration to make ocean energy technologies a significant energy option in the mid-term future, through the promotion of research, development, demonstration and information exchange and dissemination. http://www.iea-oceans.org/

Geothermal Energy – Collaborative R&D and information exchange on geothermal energy systems.

Other related implementing agreements

Demand Side Management – Collaborative activities and information exchange on development and demonstration of DSM programmes and technologies, demand-side bidding in competitive electricity markets, market transformation, Database: 'INDEEP'. http://dsm.iea.org/

Energy Storage – Collaborative R&D and information exchange, covering underground thermal energy storage systems, electrical storage technologies to optimise electricity supply and utilisation and phase change materials.
http://www.iea-eces.org/

Energy Technology Systems Analysis Programme (ETSAP) – Development and use of a family of computer models (MARKAL) to assist policy analysts and decision-makers to identify and explore energy technology scenarios.
http://www.ecn.nl/unit_bs/etsap/

Related IEA activities

The following dissemination routes may be of value to the Wind Implementing Agreement to increase awareness of activities and improve the circulation of results, articles or publications.

OPEN Energy Technology Bulletin – Free on-line newsletter from the International Energy Agency (IEA) and its Committee on Energy Research and Technology. It brings regular updates on activities within the IEA's energy technology and R&D sector.
http://www.iea.org/impagr/cip/about_open.htm

CADDET Renewable Energy – Analysis and dissemination of information on demonstrated renewable energy technologies. Technical brochures, newsletter, a database of demonstrated renewable energy projects and review reports are available online. http://www.caddet-re.org/

GREENTIE – Compilation and distribution of a database of suppliers of technologies to reduce emissions of greenhouse gases. Directory database containing clean energy technology suppliers, newsletters and technology descriptions are available online. The Website also provides an electronic news service and links to around 185 other relevant Websites dealing with greenhouse gas technology/information/funding. http://www.greentie.org/

Energy Technology Data Exchange (ETDE) – Produces an on-line bibliographic database of energy R&D results and other energy-related information from ETDE member countries. Users in ETDE member countries can register online to access the ETDEWEB Database. The annual report and quarterly newsletter are available online.
http://www.etde.org/

The following groups may be of benefit in establishing connections with non-member countries and in widening the influence of the Wind Implementing Agreement

The Committee on Non-Member Countries (CNMC) – Responsible for IEA relations outside the IEA. Many CNMC projects draw upon the specific expertise and are carried out jointly with other IEA divisions. The IEA has entered memoranda of policy understanding to strengthen cooperation with China, India and Russia - three countries, which are increasingly important in the world energy balance. The CNMC is focusing on areas such as security of supply, energy policy and regulatory reform, energy efficiency and technology. http://www.iea.org/about/cnmc.htm

Standing Group on Long-Term Co-operation (SLT) – Monitors energy developments in member countries and makes recommendations in regular country reviews. It undertakes analyses and recommends policies to promote the conservation and efficient use of energy and increased use of alternatives to oil. It meets 4 times a year.
http://www.iea.org/about/slt.htm