30 Years of Policies for Wind Energy

Lessons from 12 Wind Energy Markets

GWEC
GLOBAL WIND ENERGY COUNCIL

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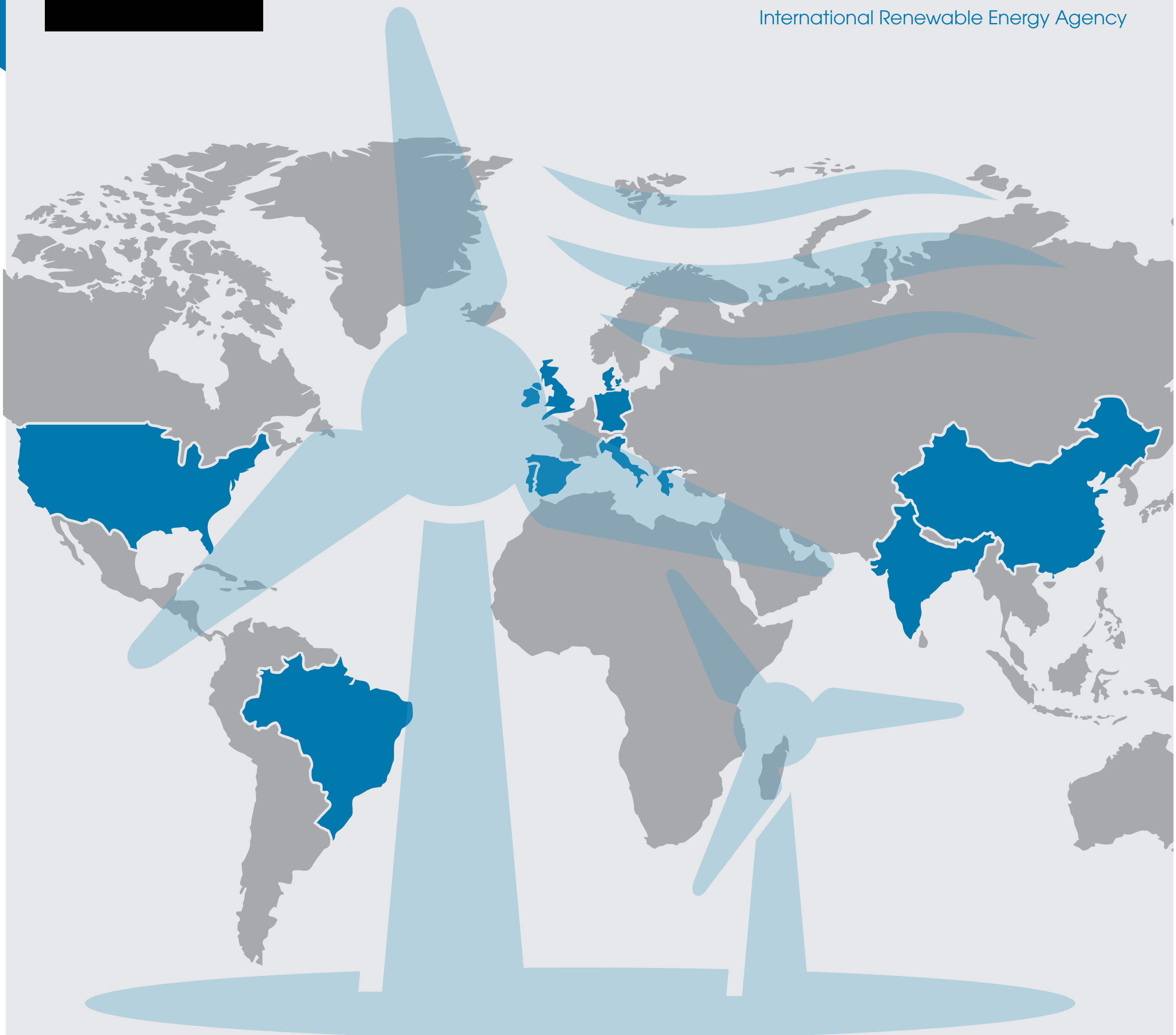
International Renewable Energy Agency



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ABOUT IRENA

The International Renewable Energy Agency (IRENA) promotes the accelerated adoption and sustainable use of all forms of renewable energy. IRENA's founding members were inspired by the opportunities offered by renewable energy to enable sustainable development while addressing issues of energy access, security and volatility.

Established in 2009, the intergovernmental organisation provides a global networking hub, advisory resource and unified voice for renewable energy.

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REPORT CONCEPT AND EDITORIAL VIEW

This report was commissioned by IRENA and produced in collaboration with the Global Wind Energy Council (GWEC). The lead authors were Shruti Shukla and Steve Sawyer of GWEC, with additional coordination and editing by Nicolas Fichaux, Gauri Singh, Won-Jung Lee and Salvatore Vinci of IRENA.

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For further information or for provision of feedback, please contact:

IRENA, C67 Office Building, Khalidiyah Street, P.O. Box 236, Abu Dhabi, United Arab Emirates;

Email: Secretariat@irena.org.

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Acronyms

• All Chapters

BNDES	Brazilian National Development Bank
CAGR	Compound Annual Growth Rate
DTI	Department of Trade and Industry
EC	European Commission
EEG	Renewable Energy Sources Act
EREC	European Renewable Energy Council
GHG	Greenhouse gas
GWEC	Global Wind Energy Council
IEA	International Energy Agency
IMF	International Monetary Fund
IPPs	Independent Power Producers
NREAP	National Renewable Energy Action Plan
PPA	Power Purchase Agreement
PSO	Public Service Obligation
REC	Renewable Energy Certificates
REFIT	Renewable Energy Feed-In Tariff
RPO	Renewable Purchase Obligation
RPS	Renewables Portfolio Standards
TSO	Transmission System Operator
UNEP	United Nations Environment Programme

• Brazil

ANEEL	National Electric Energy Agency
DUP	Declaration of Public Utility
MME	Brazilian Ministry of Mines and Energy
PROINFA	Programme of Incentives for Alternative Electricity Sources

• China

NDRC	National Development & Reform Commission
NEA	National Energy Administration
REN21	Renewable Energy Policy Network for the 21st Century
WPM	Windpower Monthly Magazine

• Denmark

DEA	Danish Energy Agency
DWIA	Danish Wind Industry Association
OECD	Organisation for Economic Co-Operation and Development

• Germany

BMU	Federal Ministry for Environment, Nature Conservation and Nuclear Safety
EFL	Electricity Feed-In Act
HVDC	High-Voltage Direct Current
IWES	Fraunhofer Institute for Wind Energy and Energy System Technology
RAVE	Research at Alpha Ventus
WWF	World Wildlife Fund

• Greece

DSO	Distribution System Operator
EIA	Environmental Impact Assessment
HTSO	Hellenic Transmission System Operator
HWEA	Hellenic Wind Industry Association
IPTO	Independent Power Transmission Operation
MEECC	Ministry for the Environment, Energy and Climate Change
PPC	Public Power Corporation
RAE	Regulatory Authority for Energy

• India

CASE	Commission for Additional Sources of Energy
CERC	Central Electricity Regulatory Commission
C-WET	Centre for Wind Energy Technology
DANIDA	Danish aid agency
DNES	Department of Non Conventional Energy Sources
ESMAP	Energy Sector Management Assistance Programme
GBI	Generation-Based Incentive
GEDA	Gujarat Energy Development Agency
GERC	Gujarat Electricity Regulatory Commission
IDBI	Industrial Development Bank of India
IEP	Integrated Energy Policy
IREDA	Indian Renewable Energy Development Agency
MERC	Maharashtra Electricity Regulatory Commission
MNES	Ministry of Non-conventional Energy Sources
MNRE	Ministry of New and Renewable Energy
NAPCC	National Action Plan on Climate Change
RE	Renewable Energy
REP	Rural Electrification Policy
RPS	Renewable Purchase Specification
RRD	World Bank's Renewable Resources Development
SDC	Swiss Development Corporation
SERC	State Electricity Regulatory Commissions
TEDA	Tamil Nadu Energy Development Agency
TNEB	Tamil Nadu Electricity Board
TUFS	Ministry of Textile's Technology Upgradation Fund Scheme

• Ireland

AER	Alternative Energy Requirement
CER	Commission for Energy Regulation

DCENR	Department of Communications, Energy and Natural Resources
ERA 1999	The Electricity Regulation Act 1999
ESB	Electricity Supply Board
SEAI	Sustainable Energy Authority of Ireland
SEM	Single Electricity Market

• Italy

AEEG	Regulatory Authority for Electricity and Gas
ANEV	Associazione Nazionale Energia del Vento
EEG	Energy Economics Group
ENEA	Energy and Sustainable Economic Development
EWEA	European Wind Energy Association
GME	Gestore del Mercato Elettrico
GSE	Gestore Servizi Elettrici
LEI	Lithuanian Energy Institute
MO	Market Operator
RES	Renewable Energy Sources
SB	Single Buyer

• Portugal

APREN	Portuguese Renewable Energy Association
CEB	Central European Bank
DGE	General-Directorate for Energy
E2P	Energias Endogenas de Portugal
EDP	Electricidade de Portugal
EDPD	EDP Distribuicao
ENEOP	Eolicas de Portugal
INETI	Institute for Industrial Engineering and Technology
MIBEL	Iberian Electricity Market or "Mercado Ibérico de Electricidade"
MoU	Memorandum of Understanding

OMI	Iberian Market Operator
OMIE	Spanish market operator
OMIP	Portuguese market operator
REN	Redes Energeticas Nacionais S.A.

• Spain

AEE	Asociacion Empresarial Eolica
CNE	National Commission of Energy
IDEA	Instituto Para la Diversificacion y Ahorro de la Energia

• United Kingdom

BP	British Petroleum
CEGB	Central Electricity Generation Board
DECC	Department of Energy and Climate Change
DNC	Declared Net Capacity
FFL	Fossil Fuel Levy
LPAs	Local Planning Authorities
NETA	New Electricity Trading Arrangements
NFFO	Non-Fossil Fuel Obligation
NIRO	the Northern Ireland Renewables Obligation
Ofgem	Office of Gas and Electricity Markets
RECs	Regional Electricity Companies
RO	Renewables Obligation
ROCs	Renewable Obligation Certificates
ROO	Renewables Obligation Order
ROS	Renewables Obligation Scotland
SEA	Strategic Environmental Assessment
SRO	Scottish Renewables Orders
UK	United Kingdom
WTGs	Wind Turbine Generators
ZAP	Zonal Appraisal and Planning

• United States

ACORE	American Council On Renewable Energy
ARRA	American Recovery and Reinvestment Act
AWEA	American Wind Energy Association
Berkeley Lab	Lawrence Berkeley National Laboratory
BNEF	Bloomberg New Energy Finance
CREZ	Competitive Renewable Energy Zones
DSIRE	Database of Incentives for Renewables & Efficiency
EPACT	Energy Policy Act
ERCOT	Electric Reliability Council of Texas
FERC	Federal Energy Regulatory Commission
GAO	U.S. Government Accountability Office
ITC	Investment Tax Credit
NREL	National Renewable Energy Lab
PTC	Production Tax Credit
PUCT	Public Utility Commission of Texas
PURPA	Public Utility Regulatory Policies Act
QF	Qualifying Facilities
REAP	Rural Energy for America Program
REP	Renewable Energy Program
REPI	Renewable Energy Production Incentive
RRTF	Renewable Resource Trust Fund
USDA	U.S. Department of Agriculture

Foreword

The Sustainable Energy for All initiative, launched by the Secretary-General of the United Nations in 2012, has set the ambitious target of doubling the share of renewable energy in the global energy mix by 2030. The scale of this challenge is daunting, but the renewable energy sector is extremely dynamic, with over USD 257 billion worth of investment globally in 2011 – nearly double the level seven years earlier.

Wind power, in particular, has long historical roots. Yet it is also one of the fastest growing and rapidly evolving modern energy technology options. The International Renewable Energy Agency (IRENA) is therefore pleased to put forward this review of the different policy options for wind energy investigated and tested by 12 different countries over the last 30 years. This wide-ranging historical overview of a key sector, written in partnership with the industry, is the first report of its kind for IRENA.

Renewable energy development remains strongly policy driven, requiring governments to develop adequate policy frameworks to attract investments for any large-scale transition. Policy choices shape each country's ability to diversify its energy mix, control its energy bill, and secure its energy supply. Costs to the state budget can vary widely, and the creation of local value may differ significantly. A documented decision-making process is of critical importance to foresee the consequences of each policy option.

However, many countries are unfamiliar with the policy measures available to create new market opportunities, or to accelerate the deployment of wind power or other renewables in existing markets. Policies tried in the past, in diverse parts of the world, performed differently in varying market environments.

This report highlights the main success factors in wind energy deployment for each market studied. While common elements are evident, there is clearly no single silver bullet for widespread wind deployment without a hitch. Policy development entails a continuous learning process, requiring continual adaptation to market dynamics. Thus, rather than seeking to simply transplant successful policies from other markets, each country needs to plan for the progressive development of its national legislation to develop effective policies.

Experiences from the past may help to accelerate market growth, but the learning process remains an important factor in long-term success. Each country is unique and needs to find its own way.

Adnan Z. Amin
Director-General, IRENA

The Global Wind Energy Council (GWEC) is pleased to present the results of our first major collaboration with IRENA, "30 Years of Policies for Wind Energy: Lessons from 12 Wind Energy Markets". Although wind energy is now firmly established as a mainstream source of clean, reliable and affordable utility scale power, it is still at a relatively early stage in its development. With an increasing number of countries generating 10, 15, 20 per cent or more of their electricity demand from wind, many lessons have been learned about how to most successfully harness its power. The objective of this report is to highlight what has worked and what hasn't, and to the extent possible answer why, from an industry perspective.

Every country has a different set of natural resources, a different power system, different economic, regulatory and planning norms, and different development requirements; and it is clear that there is no "one size fits all" method for maximizing wind's contribution in the most efficient and cost effective manner. However, from the industry's perspective, there is a set of conditions that must be fulfilled in order to attract investment, although they can be met in a variety of ways.

The two most important of these are a clear signal from government of the intention to develop wind power; and clarity and stability of the policy and regulatory framework within which manufacturers, project developers, system operators, utilities and investors must operate. If these conditions are sufficient, then most of the rest can fall into place; without them, it will be a difficult road.

We hope that this report will be useful to IRENA member governments and energy system planners in developing their own plans for wind power, attracting domestic and international investment, creating good jobs and economic opportunities as well as moving towards the clean and sustainable energy future upon which all of our futures depend.

Steve Sawyer
Secretary General
Global Wind Energy Council

Preface:

History of Wind Policy Development

BACKGROUND

Wind energy is a mature and rapidly growing renewable energy technology. It provides a cost-effective and scalable alternative to conventional energies, both in developing and developed countries. By the end of 2012 the cumulative global installed capacity stood at 282.5 GW.

The global capacity will grow to 322 GW by the end of 2013 and may reach 536 GW by 2017, according to industry projections.

A range of support mechanisms have been developed and implemented to promote the use of wind energy since the late 1970s. These include tax incentives (tax credits, production incentives, accelerated depreciation etc.), preferential tariff regimes, quota requirements and trading systems, among others.

Even though most countries share similar energy policy objectives – reducing reliance on (imported) fossil fuels, improving energy supply security, reducing the environmental impacts of their energy sector and encouraging new industrial development – the policy

Germany ©Martin Goltermann/GWEC

framework that a country implements to pursue these objectives varies. The preferred policy instruments depend on national circumstances, political cultures and histories, and stages of economic development.

The aim of this report is to provide an insight into the strengths of diverse policy design decisions across important existing markets. This report identifies and reviews significant policy and regulatory measures that have contributed to the successful development of wind energy across major markets in Asia, Europe, North and South America over the last three decades.

This report does not provide a detailed overview of the renewable energy legislation in each of the countries it describes. It does not aim to benchmark individual national legislations against each other, or to evaluate their achievements, but rather to highlight the major steps in the development of national policies that led to the creation of a large and successful wind power market.

The twelve markets studied here are of various sizes, display various policy options and diverse market dynamics. All have shown high market dynamism and represent interesting case studies. These markets are

Brazil, China, Denmark, Germany, Greece, India, Ireland, Italy, Portugal, Spain, the United Kingdom and the United States. In the case of India and the United States, particular state legislations complement federal legislation and these were studied in more detail.

The perspective of the industry was important for this exercise. The report was developed in partnership with the Global Wind Energy Council (GWEC), the international trade association for the wind power industry. The members of GWEC represent over 1 500 companies, organisations and institutions in more than 70 countries, including manufacturers, developers, component suppliers, research institutes, national wind and renewables associations, as well as finance and insurance companies. The report therefore indicates the important policy elements which drove the deployment of wind power in the twelve markets over several decades from the perspective of the wind sector. This approach is innovative and represents a pilot study for IRENA.

For IRENA, the added value of this report is to present a ground-based approach, crystalising the perspective of the investors, manufacturers and project developers directly influenced by policy decisions, and continuously adapting to the policy landscape.

STRUCTURE OF THE ANALYSIS

A policy and regulatory framework seeks a balance between a country's need for (i) energy security, (ii) prospects for economic growth and (iii) the environmental impacts and costs of all choices made. In addition, for some countries, there are international legal obligations for mitigating greenhouse gas emissions, or – in Europe – internationally agreed renewable energy penetration targets. The analysis in this report seeks to provide a clearer understanding of the pros and cons of various policy tools and mechanisms for supporting wind energy. It is especially aimed at policy-makers and other relevant stakeholders wishing to improve their understanding of the pre-conditions, influences and incentives that allowed wind energy to develop in the countries surveyed.

A) Policy-driven growth

Given that policy is the single most important driver for energy investments, one objective of this report was to come up with an exhaustive list of policy and regulatory options used over the last 30 years for promoting wind and other renewable energy sources in the twelve national markets, including, but not limited to, the list below.

Among the twelve national markets, historically a wide variety of measures as well as various unique combinations of policy and practice have been used for promoting wind energy. These measures have performed well in some contexts and not so well in others. There has however been a convergence towards two main mechanisms: the feed-in tariff (FIT); and the renewable portfolio standards (RPS), also referred to as renewable purchase obligations (RPOs). Overall the analysis remains focused on studying the relevance and effectiveness of various support mechanisms with a view towards supporting new and emerging markets.

B) Enabling conditions

Price support for renewable energy sources, through an incentive or subsidy, is often a necessary, but never a sufficient condition on its own. Price is only a part of

Feed-in tariffs	Grid codes
Premium systems	Permitting processes
Auction/tendering system	Investment tax credits
Renewable Portfolio Standards	Siting regulations
National targets (binding or indicative)	Import and tax deferral incentives
Generation/production-based incentives	Priority access regulations
Spot market trading	Other tax benefits

the long-term commitment for ensuring cost-effective transition to a cleaner and sustainable energy matrix. The analysis section of this report discusses some of the common elements needed for a successful support system. It identifies seven particular criteria (listed in Table 1) as critical for the development of wind energy.

Table 1: Framework conditions for assessing policy and regulatory performance

Some expression of political commitment from the government	National targets, such as the 2020 Renewable Energy Targets adopted by the European Union, are clearly defined and implemented in the legislation. These targets give clarity and confidence to the industry and investors for making long-term investments.
Effective rule of law and transparency; and effective administrative and permitting process	The overall energy legislation is perceived as well defined, well understood by the public authorities, and fairly implemented. This element influences investor confidence, and determines country risk premiums for financiers.
Provisions for a clear and effective pricing structure	Wind energy projects are characterized by large upfront costs and low operation costs. Project developers need to assess the financial viability of their projects over the whole project lifetime (e.g. 20 years), and their financiers require clarity on the level and stability of the remuneration scheme. This information is used to assess the project's bankability. The stability of the pricing mechanism also influences the cost of capital.
Grid Access: Provisions for priority access to the grid; connection availability and ease of grid access for wind farms.	Early experiences in several markets have shown that early guidance for the integration of renewable energy within the electricity system is a critical element for the development of projects. There are several aspects to this issue: the capacity of the grid operator to handle grid connection requests and allocate a grid connection point; the authorisation to effectively connect to the grid; and, during the project operation, the capacity to inject the power generation into the system. Each of those aspects potentially translates into a possible loss of revenue for the project, through delays to enter into production or through curtailments. They therefore represent a risk to the financial viability of the project.

A government and/or industry-led strategy for raising public awareness and community buy-in	Over the last three decades of wind power development, there have been ample documented cases of delays to wind projects due to a combination of lack of community support, lack of public consultation, and low awareness levels about the technology. It was often found to be essential to promote "win-win" ideas for all stakeholders (local industry, local residents etc.) in conjunction with wind farm development.
An industrial development and employment strategy	The development of the wind sector is also seen as an element for promoting local industrial development and competitiveness. The development of the sector can be stimulated by support to public or private sector R&D, support to SMEs, and excise and custom duty exemption. Governments can facilitate an employment strategy by developing specific training to attract workers to the field of wind energy.
A functioning finance sector	The easiness of access and the cost of capital are important elements of project economics. Governments can mobilise funding instruments to support the wind sector. Those financial instruments may partly or fully cover some of the investment risks, thus increasing the attractiveness of projects to investors, who may not be familiar with the technology. Those instruments are of particular interest for new markets, where the risks are not well understood.

C) Structure of analysis

Each of the country chapters contains three major sections:

A brief introduction presents the evolution of the installed wind power capacity over time. In this section, the annual installed capacity is based on data provided by GWEC. These numbers may differ slightly from the official numbers published by each country. The reason for choosing GWEC's figures is to illustrate the market growth using a consistent database based on a standardised methodology for all countries, over the last 10 years, and present data up to 2011.

Detailed sequential text highlights the salient elements of the development of the wind energy legislation over time. The aim here is not to provide a detailed overview of the renewable energy legislation in each country, but to identify the major policy instruments developed over time to stimulate the market, and analyse the impact they had on market growth. During the analysis, several major periods, or phases, have been highlighted in most markets. Most of the time, these phases do not result from a conscious choice of the government's plans, but from post facto analysis of the market dynamics. These phases characterise important stages in the evolution of each country's national legislation,as perceived by the authors.

Lastly, the chapters discuss challenges present in the market today and conclude by summarising the major findings of the analysis, based on the seven major criteria established in partnership with the industry. The perception of the policy situation for each of those criteria is dealt with in some detail in the chapter.

Three important aspects should be highlighted:

• The seven criteria are not intended to be exhaustive. It is not intended to cover all aspects of the impacts of policy development, but only to list the important aspects from the point of view of the industry. These elements cannot be used to provide an absolute estimate of the performance of policies, but they can help policy-makers understand what private sector investors see as important elements of policies, when they are evaluating opportunities in new markets.

• These criteria are not indicators. In no manner can they be used to benchmark countries. The information is not based on measurements of the individual parameters or analytical methods, but reflects a perception from the industry, based on three decades of policy development and project development, and thousands of successful and unsuccessful project development experiences.

• The assessments provided here are not measures of policy performance. This information is intended to help interested countries to replicate specific policy measures, to understand the challenges linked to their implementation, and realise how those measures are perceived by the private sector.

The important lessons drawn from the twelve markets are highlighted in the next chapter. By keeping these lessons in mind it is hoped that future policy-makers, especially those from new and emerging regions, and all other relevant stakeholders, will be able to make informed policy and investment decisions a deeper understanding of recent history.

All monetary values in this report were converted into USD values for 2011. The actualisation is done using the average consumer prices as of 2011, determined by the International Monetary Fund (IMF, 2012) and 2011 reference exchange rate (European Central Bank, 2012 and Banco de Portugal, 2012). For further research purposes please use the local currency value to make any calculations and comparisons.

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Analysis:

History of wind policy development across key national markets

This report investigates the history of policy and regulatory framework for wind energy. Wind energy technologies are growing strongly and are proving to be both cost-effective and scalable in developing and developed countries.

In 2011, the global investment in renewable energy increased by 17% to reach a record level at USD 257 billion. Developing countries represented 35% of the total investment made, with developed countries accounting for the other 65% of the investments (United Nations Environment Programme (UNEP), 2012).

By the end of 2012, the total installed capacity of wind energy had reached 282.5 GW. According to industry projections the total installed capacity is likely to surpass 322 GW by the end of 2013, and 536 GW by 2017. By 2011, 118 countries, more than half of which are developing countries, had put either renewable energy targets or policy frameworks in place.

Historically the development of renewable energy technologies is strongly driven by policy initiatives and the role of governments has been critical in developing adequate policy frameworks for attracting large investments to this sector. Decision makers in new and emerging markets may not be familiar with the long-term impact of policy choices. This includes the possible policy and regulatory solutions capable of creating new market opportunities, and accelerating the deployment of renewable energy technologies.

The choice of a policy framework is specific to a country. The design of the policy framework will drive a country's ability to successfully diversify its energy mix, to control its energy balance and to secure its energy supply. It follows therefore that the support mechanisms cost may be different depending on the country in question. In addition, the extent of local value creation (health benefits, improved energy access, employment and development) may differ significantly.

A summary analysis for each of the twelve national markets is presented in this chapter.

Canada ©Johan sullivan/GWEC

COMMON ELEMENTS ACROSS THE TWELVE MARKETS:

Support schemes differ noticeably between different markets, and most of the countries studied in this report have experimented with several different support schemes over time. However, there are common elements across almost all the different markets, which may be replicated by other countries to develop their respective indigenous wind resource.

The elements of success from the studied markets were clarity in the design of their support scheme; an expression of long-term political commitment; and a sufficient level of remuneration to allow an acceptable level of profit for investors. The expected profit depends on the project risks, and is therefore linked to the stage of the technology and market development.

In all of the twelve markets, the governments identified either national or state-level targets and developed specific plans for renewable energy. These targets were an important aspect of raising public awareness, and sent a strong long-term and clear signal to investors.

It should be noted that support for renewable energy sources through an incentive or subsidy is often a necessary, but never a sufficient condition. The feed-in tariff in Greece was among the highest in Europe, but other external elements eventually slowed the pace of development in the country.

In some countries like India and the US, the legal frameworks looked to create a balance between the federal legislation and the state legislation. The main success factor here is the complementarity of the policy schemes over time.

In India, the State Electricity Regulatory Commissions define purchase obligations for renewable energy and tariffs, which are complemented by federal incentives such as the generation-based incentive (GBI) . This arrangement has proved to be effective. However fluctuations in federal legislation have a direct influence on the domestic wind industry as demonstrated especially in the US market.

In some instances a dedicated ministry for renewable energy was created (in Germany the BMU, in India the MNRE) and was responsible for streamlining the legislation and undertaking the role of an interlocutor on relevant renewable energy issues with other related ministries and departments. Alternatively, the creation of an energy agency or a single access point generally facilitates interactions with the market players.

The awareness and involvement of local communities in the development of a new technology is a factor of success in the deployment phase. For example, in the cases of Denmark, Germany, Greece and Scotland, local communities received tangible benefits from their local wind projects. This helped to transform the nature of the local communities' engagement from one of non-participation to a more proactive shareholder base, in some cases they even became direct project investors.

The early technology development in Denmark (cooperatives) and Germany started with the engagement of local farmers who were encouraged to produce their own electricity. This scheme significantly facilitated the creation of a basic industry prior to 1980, from which the modern wind industry grew. It also facilitated the adoption of the technology at a later stage, as long as the local communities were kept strongly involved.

Dedicated permitting and siting procedures for wind energy could be identified in eight of the twelve markets. Well-designed permitting and siting procedures for the installation of projects keeps costs down, allows for better returns on investment, and drastically reduces the likelihood of conflicts with local authorities and communities.

Different strategies are observed regarding the creation of local value. Tax incentives (Denmark), state-funded R&D programmes (Germany, India in partnership with the Danish Development Agency) stimulated the development and demand for renewable energy technology, especially during the early stages. In later periods, with a more mature technology, a mix of market incentives and local content requirements were used across markets as varied as China, Brazil, Portugal and Spain.

The main purpose of developing local manufacturing capacity is to maximise local benefits, but should ensure reasonable prices, which require a level of competition. To be successful in creating a local supply chain, the domestic demand and growth opportunities should be large and steady enough to ensure a sustained uptake of locally produced parts and machines. Long-term targets signaling significant market volumes may then be a contributing

Table 2: Range of major policy mechanisms and support schemes used over time in the 12 studied markets. The chart illustrates the large number of policy instruments available (rows), while the constant adaptations of the policy regimes in a single country (columns) correspond to a learning process in developing a policy framework for wind energy.

INDICATIVE SUMMARY OF THE RANGE OF SUPPORT MECHANISMS USED HISTORICALLY

	COUNTRY	BRAZIL	CHINA	DENMARK	GERMANY	GREECE	INDIA	IRELAND	ITALY	PORTUGAL	SPAIN	UNITED KINGDOM	UNITED STATES
Remuneration	Feed-in tariff	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	
	Premium or Adder system			✓	✓						✓		
	Auction or tendering system	✓	✓					✓			✓	✓	
	Tax based (electricity) production incentives												✓
	Spot market trading			✓	✓			✓	✓		✓	✓	
	Investment subsidy or tax credit			✓		✓	✓						✓
	Tradable Green Certificate [e.g. REC / ROC]						✓		✓			✓	✓
	Concessionary finance through government supported agencies	✓	✓		✓		✓				✓		✓
	Concession on import duty	✓	✓				✓						
Target or Standard	Renewables Purchase Obligation or Renewables Portfolio Standard						✓						✓
	Federal or statewise targets (binding or indicative)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Permitting	Project siting guidelines	✓		✓	✓	✓					✓	✓	✓
	Project permitting process		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Grid Integration	Priority access to the grid	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
	Grid code			✓	✓	✓	✓				✓		

success factor (e.g., in the recent auctions in Brazil). Local content requirements need specific conditions to add value including a firm long-term target for wind, access to Power Purchase Agreements, grid access priority, and a good wind resource base.

Ease of access to the electricity grid is another important aspect of a successful framework for the growth of wind energy. Today, across ten of the twelve surveyed markets, wind energy has priority access to the grid. This guarantees that the projects will effectively be connected and investors will be able to recover their investments.

Even at the early stages of development, the authorisation procedures to connect to the grid can be overwhelmed by large number of project applications, as in the case of China. Hence a strategy is needed to allocate the connection points to all projects. At an early stage of policy development, the planning exercise must consider the consequences of any national targets or forecasts of market growth. Inadequate planning can lead to costly delays and losses for both the project developers and utilities.

In Germany, a 2011 study conducted for the German Wind Energy Association by the consultancy company Ecofys found that 150 GWh of wind energy was lost in 2010, due to overproduction and grid operators having to disconnect turbines. This represents an increase of 69% compared to 2009 (Sewohl, A. 2012). Likewise in China in 2011, more than 10 billion kWh of wind energy could not be absorbed by the grid (Global Wind Energy Council (GWEC), 2012)

EVOLUTION OF MARKET DRIVERS

The development of wind energy has been motivated by diverse drivers, which have evolved over time. The early demonstration programmes initiated in the 1970s were mostly motivated by the oil crisis. At that time, countries realised that their economies were inordinately dependent on imported sources of energy with unpredictable costs. The vulnerability of countries to external energy supply constraints and the willingness to harness indigenous resources have remained a constant driver of renewable energy development.

After the oil market stabilised, wind policy development entered the next phase driven largely by environmental concerns, the desire for energy diversification, and energy security. The Chernobyl accident (1986) amplified public questioning of the role of nuclear energy, especially in some European countries, leading to alternative energy solutions being researched and developed.

Environmental concerns added to the public support for renewables during the 1980s and 1990s. The Kyoto Protocol (1997), which was driven by concerns over climate change, became an important instrument for the promotion of renewable energy projects globally. Its Clean Development Mechanism was particularly important in further development of wind energy in China and India.

In Europe, following a white paper on "Strategy and Action Plan for Renewable Energy" in 1997, the European Union defined EU-wide targets in both 2001[1] and 2009[2] which were divided into individual national renewable energy action plans. These targets were major drivers for the development of wind energy in the individual EU Member States. This development happened in parallel with the liberalisation of the energy market, which facilitated the emergence of independent power producers and private developers.

The need for energy supply diversification along with a desire for attaining energy security remained strong drivers across all markets, with some nuances. In the case of Brazil, the early developments came after a major energy supply crisis between 2000 and 2002, which initiated a reform of the energy sector including efforts to diversify the energy mix after a series of droughts affected hydropower generation.

Over the past few years, the cost of wind energy has declined significantly and in some locations, wind is now competitive with conventional sources including gas.

Under specific conditions, the drivers for wind energy development are increasingly becoming purely economical. The reasons for this include a technically advanced and mature supply chain at a global scale, which has reconciled the supply and the demand aspects, as well as reduced delivery delays, and more recently, the

[1] Directive 2001/77/EC: A target of 12% of overall energy consumption being produced from renewable energy in the EU in 2010. A share of electricity generated by renewable energy of 22% in 2010 for EU15 (compared with 14% in 2000); and a share of biofuels in diesel and petrol used for transport of 5.75% in 2010 (compared with 0.6% in 2002).

financial crisis, which has reduced the pace of growth, creating oversupply. In parallel, the price of fossil fuels grew significantly, with crude oil increasing from some USD 20 (USD_{2011} 26) per barrel in 2000, to often over USD 100 (USD_{2011} 104) per barrel post-December 2008. Gas prices increased in parallel, although the recent development of shale gas has significantly changed the energy landscape, especially in the North American markets.

An additional motivation for countries is the desire to create local economic value, in terms of jobs, additional income, health benefits and manufacturing. Those benefits vary significantly from market to market, and include localised installation and maintenance capacity, component supply or large-scale wind turbine manufacturing, local manpower development, and local investment opportunities.

For prospective wind markets, the main drivers are likely to be environmental and climate legislation, cost-competitiveness, energy independence, diversification of the energy supply, and creation of local value.

As determined in this report, policy and regulatory conditions are fundamental drivers across all major wind energy markets. They are further reinforced by the broader economic and financial conditions prevalent at any given point in time. They also determine the scale of investment – both public and private – over the long term.

However, there can be no "one size fits all" approach to designing a successful policy and regulatory framework for any country or market. Each country has its unique set of macro-economic conditions, historical and political constraints, all of which are key considerations for policy design and development.

HIGHLIGHTS: EVOLUTION OF POLICY AND REGULATORY SUPPORT FOR WIND ENERGY IN TWELVE IMPORTANT MARKETS

BRAZIL	The Programme of Incentives for Alternative Electricity Sources (PROINFA) was the major instrument which initiated the development of a wind market in Brazil. However, the Brazilian market only grew significantly in the last 5-6 years. The country has had a shorter experience curve in comparison to other important markets like Denmark, Germany and the USA. The use of a local content requirement for projects financed by the Brazilian Development Bank (BNDES) was instrumental in creating a supply chain. The main framework conditions favoring this development are (a) the availability of domestic concessionary finance (b) political support for grid access (c) a legal framework that is being continuously improved at the national and the state level. Brazil benefits from unique climatic circumstances, with a good complementarity between hydropower and wind, which eases the integration of wind energy to the grid. High-wind seasons are drier and low-wind seasons are humid, while average wind speeds are higher and lead to high wind capacity factors. Although the economic crisis of 2008-09 created a lack of liquidity in the global markets, the support from BNDES allowed the wind industry to develop in Brazil. The success of the auctioning system was made possible inter alia due to the availability of cheaper and accessible domestic finance, and oversupply in the wind industry globally. For detailed discussion see page 40

[2] Directive 2009/28/EC: A 20% share of energy from renewable sources and a 10% share of energy from renewable sources in transport in community energy consumption by 2020.

CHINA	China's wind industry has seen one of the steepest learning and shortest experience curves in the wind industry. The growth of the wind industry started with the adoption of the comprehensive Renewable Energy Law passed in 2005. Thereafter, the policy frameworks were updated through the Five-Year Plans, allowing any deficiencies in the policy or incentives to be addressed on a regular basis. A series of auctions enabled to gain experience on the price of the electricity generated from wind power, and to define the level of feed-in tariffs (FIT). The government stimulated the strong existing industrial base, and enabled the creation of a strong domestic manufacturing capacity. China is today the market leader both in terms of cumulative installation and manufacturing capacity. For detailed discussion see page 48
DENMARK	Denmark is "the cradle" of modern wind energy technology and has had a historical role in the growth of this sector. The main driver for developing wind energy has been long-term commitment from the government to address climate change and achieve energy independence. The major framework conditions that helped in the expansion of the wind industry are the following: (a) Denmark is the earliest market to implement an industrial and export-driven strategy for commercial scale wind; (b) it has one of the most developed permitting and siting procedures, which were consistently improved over time; (c) wind energy has priority access to the grid; (d) long-term targets for wind development out to 2020 are in place. On average Denmark had one of the best policy regimes for wind energy between 1980 and 2012. The availability of large hydro resources in Norway and interconnectors with Germany helped greatly in increasing the share of wind power in the country's energy mix. For detailed discussion see page 58
GERMANY	Germany is among the early pioneers of wind energy in Europe, with one of the most consistent renewable energy policy frameworks since the late 1980s. The desire for energy independence combined with prominent public support for addressing climate change, led to a high level of commitment to developing renewable energy. The main conditions supporting the uptake of wind energy were (a) a clear and long-term price stability through the feed-in tariff mechanism; (b) priority grid access; (c) local and regional banks made financing available; (d) early and strong political commitment to renewable energy. Germany could be a reference case for similar markets, although the country had unique characteristics (a) a skilled workforce available to manufacture a complex technology; (b) the ability to finance R&D; (c) a high entrepreneurial drive from small stakeholders and farmers, who provided the initial investment for wind turbine installations. For detailed discussion see page 68
GREECE	Since Greece announced its National Renewable Energy Action Plan (2020 targets) the political establishment has been strongly supportive of its renewable energy targets. However, a difficult economic climate has led to a slowdown in reaching its expected annual targets. For detailed discussion see page 76

INDIA	Among the three developing country markets discussed in this report, India was the first to deploy commercial wind projects. The market is growing strongly, especially since 2003. Over the last two decades, India had a varied and complex policy and regulatory framework supporting wind energy, and has shown great flexibility in terms of the range of support mechanisms available over time. India developed wind energy in response to chronic electricity shortages and a desire for energy independence. The drivers differ from most western European markets, which were often motivated by anti-nuclear, environmental sustainability or climate change concerns. India has access to skilled manpower; and mechanical and engineering support was available to (a) undertake resource assessment; (b) create local jobs and a manufacturing capacity; (c) rapidly replicate the experience gained from pilot projects. One unique feature of the Indian market was that private sector investors and industry entrepreneurs, helped by the dedicated Ministry for New and Renewable Energy since the late 1990s, primarily drove the market growth. For detailed discussion see page 86
IRELAND	Ireland showed early political commitment to wind energy, driven by a desire to achieve energy independence. The strong political support helped to raise interest in using the large wind resources, and favoured a higher level of public acceptance than in neighboring England and Wales, for example. The European Commission supported the early developments of wind energy, and helped the Irish government to develop a long-term (2020) target for wind energy. The Irish wind market benefited significantly from increased exchanges with northern Ireland through an all-island grid, and increased interconnectors to the UK. For detailed discussion see page 98
ITALY	Until 2010, Italy had one of the most generous support schemes for wind and solar. Unlike in Germany, Italy's feed-in tariff does not reduce over time to reflect the technology learning rate. Therefore, the cost of renewables has remained high in comparison to similar European markets. Despite a generous support scheme, long permitting processes and imprecise guidance at regional level led to delays in project construction. The Italian government, like the UK, favored market-based mechanisms (tradable green certificates) for supporting renewables. The political support for addressing climate change, an anti-nuclear position, and a desire to achieve energy independence also helped develop strong support for developing renewable energy. For detailed discussion see page 105
PORTUGAL	Today Portugal has one of the highest penetration rates of wind energy as a percentage of its total electricity generation. Portugal, like Brazil, illustrates the complementarity between hydropower and wind energy. The country is also an excellent example of the benefits of the feed-in tariff system. Early political support for wind energy in Portugal was influenced by the high dependency on imported fossil fuels until the 1980s. Similarly to Spain, Portugal made use of local content requirements, which initiated the creation of a supply chain. However, the economic reforms and global financial crisis post-2008 have severely impacted the market. For detailed discussion see page 111

SPAIN	Spain's policy and regulatory support for wind energy is comparable to the successful support schemes in Denmark and Germany. From the early stages of development, the federal government and the provincial governments treated the development of policies and support as an "industrial and economic development" strategy, which was supported by local content requirements. The early introduction of a feed-in tariff allowed for a stable support, which places Spain among the markets with the highest wind penetration in the world. The ongoing economic crisis has, however, impacted on the short-term market outlook. For detailed discussion see page 118
UNITED KINGDOM	The UK has one of the richest offshore wind regimes in Europe. The support to wind energy has been supplemented by efforts to address climate change and to achieve energy independence. The UK has used market-based mechanisms to promote wind energy, unlike the German or Spanish support schemes. The initial support for wind energy under the National Fossil Fuel Obligation was related to the support provided to nuclear energy under the same scheme. Under the National Fossil Fuel Obligation, the development of wind projects remained low in comparison to that in Germany, Italy, Spain or Denmark during the same period. Due to disparities in the policy regimes across the UK, Northern Ireland and Scotland are exploiting their intense wind resources and creating local manufacturing capacity, while planning permissions in England and Wales are still difficult to obtain. For detailed discussion see page 125
UNITED STATES	In responding to the oil-shock of the 1970s, the United States became one of the earliest countries to promote wind energy, along with Denmark. This development was driven by a desire to achieve energy independence, and was initiated by the introduction of the Public Utility Regulatory Policies Act (PURPA) of 1978. However, this support was reduced drastically by the mid-1980s and the wind sector did not regain momentum until the early 1990s. Wind power generation has grown exponentially since the turn of the century. Since 2010 the individual states have implemented their respective plans for wind energy through Renewable Purchase Specifications, and states like California, Iowa and Texas are at the forefront of wind energy development. Today the US is the second-largest market globally, although a lack of long-term federal targets and short-term renewals of the federal production tax credit support continue to have a detrimental impact on investment plans for the sector. For detailed discussion see page 138

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Global Status of Wind Power in 2012

In 2012, the global wind power market increased by 10% compared to 2011, and the 45 GW of new wind power capacity represented USD 78 billion (EUR 60 billion) of investments.

The total cumulative capacity increased by 19% in 2012, reaching 282.5 GW. Slightly lower than the average capacity increase of 22% over the last 10 years.

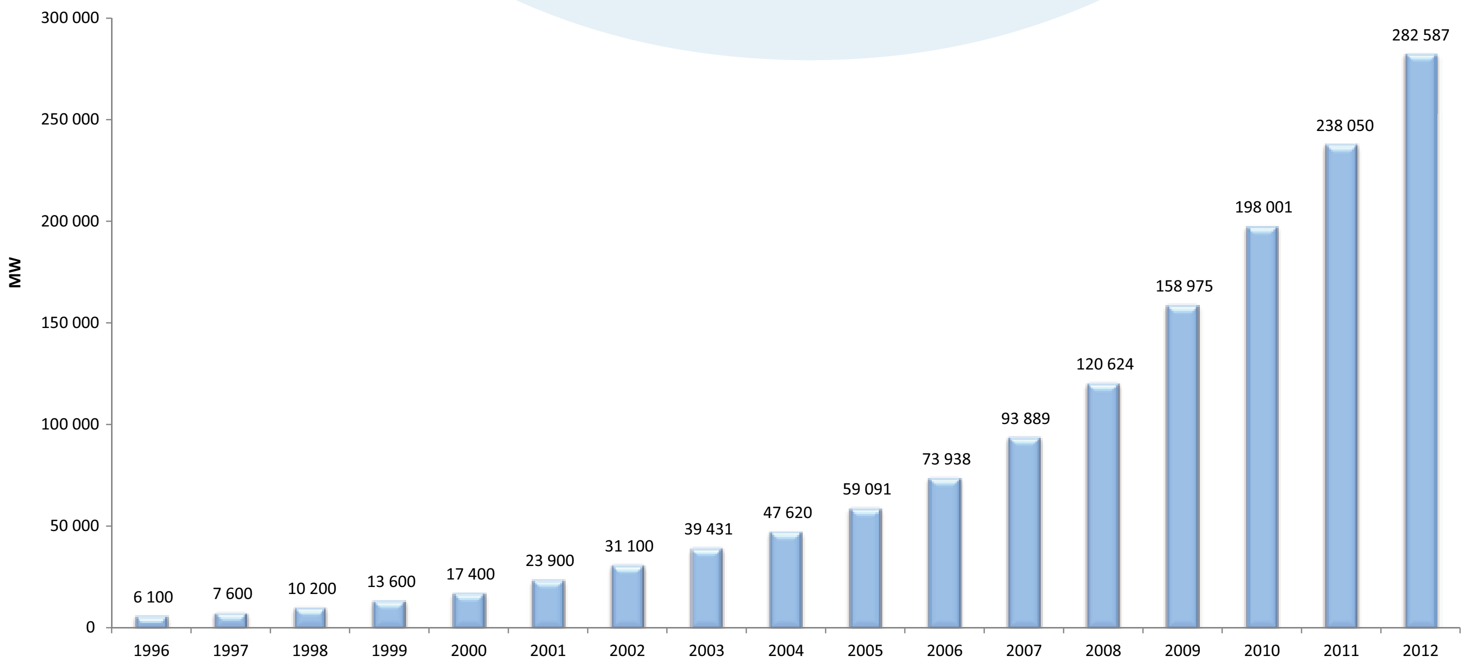


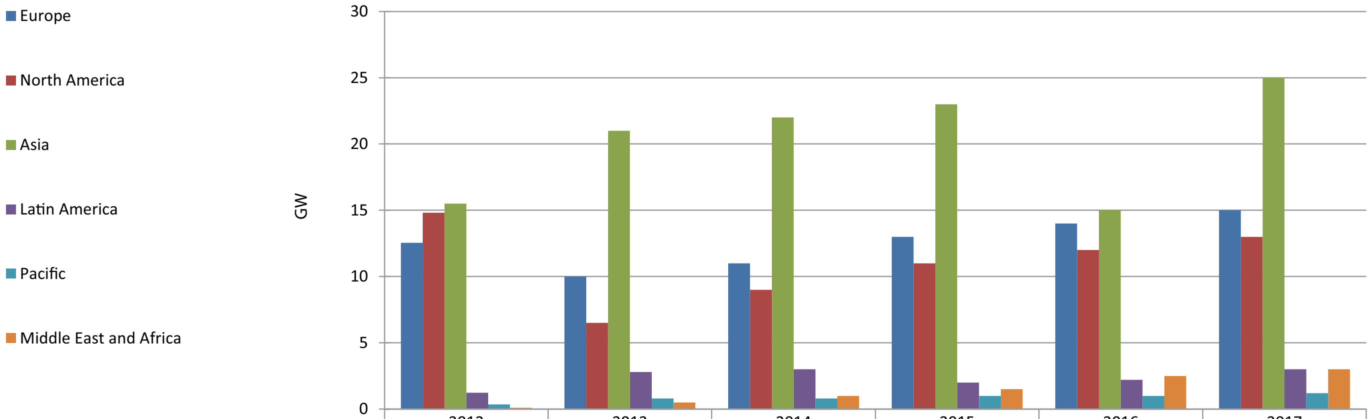
Figure 1: Global Cumulative Installed Wind Capacity (1996-2012) (GWEC, 2013)

At the end of 2011, the market growth projections for 2012 were mixed, due to the economic slowdown in Europe and uncertainty on the future of the US Production Tax Credit (PTC). On the contrary, North America and Europe saw a record year of installations in 2012. In the US, 8.4 GW were installed in the fourth quarter of 2012 in anticipation of the expiration of the PTC.

The annual installed capacity in the US reached 13 124 MW, surpassing that of China, which had its lowest level of installations since 2008 (at 12 960 MW). Combined with an exceptionally strong year in Europe, the market was more reasonably balanced between the three major regions (Asia, North America and Europe) than at any point in the last decade. While Asia was still the leading region, it did not enjoy the strong dominance that characterized the 2010 and 2011 markets.

The market is progressively diversifying. By the end of last year the number of countries with more than 1 000 megawatt (MW) installed capacity has risen to 24: including 16 in Europe (European Wind Energy Association, 2013); 4 in Asia-Pacific (China, India, Japan and Australia); 3 in North America (Canada, Mexico and US) and 1 in Latin America (Brazil).

Looking ahead, the picture is increasingly complex worldwide. From the industry point of view, although the US PTC has been renewed for almost two years in the US, the broader economic reforms may impact the level of support available to renewables in the short to medium term. The European legislation and 2020 targets ensure a degree of stability, but a recent wave of policy reforms creates uncertainty for 2013.



	2012	2013	2014	2015	2016	2017
Europe	12.54	10	11	13	14	15
North America	14.82	6.5	9	11	12	13
Asia	15.5	21	22	23	15	25
Latin America	1.23	2.8	3	2	2.2	3
Pacific	0.36	0.8	0.8	1	1	1.2
Middle East and Africa	0.1	0.5	1	1.5	2.5	3

Figure 2: Annual Market Forecast by Region 2012-2017 (GWEC, 2013).

Market consolidation and rationalization in China, and a lapse in policy in India were the main reasons for the significant slowdown in Asia in 2012, but these conditions are expected to be short-term and Asian dominance of global wind markets is expected to continue. Canada, Brazil and Mexico are expected to have large growth in 2013, and new installations are expected in sub-Saharan Africa: South Africa, Ethiopia and possibly Kenya. Additionally new projects will be soon operating in Mongolia, Pakistan, the Philippines and Thailand

Asia

For the fifth year in a row, Asia was the world's largest regional market for wind energy, with capacity additions totalling just over 15 GW.

In terms of annual installations China ceded its leadership position to the US in 2012, with less than 200 MW difference between them. China added 12.96 GW of new capacity in 2012, a significant decrease compared to the exceptional annual installation figures in the three years prior to 2012.

By the end of 2012, the cumulative installed capacity in China was over 75 GW, and generated 100.4 billion kilowatt-hour (kWh), accounting for 2% of the country's total electricity output, up from 1.5% in 2011 (People's Daily, 2013).

The astonishing growth of China's wind sector since 2006 has managed to surprise even many optimists in the industry, although it may now enter a more steady development phase. Curtailment of electricity generation became a new challenge for wind power projects. In 2011 alone, more than 10 billion kWh of wind power was lost because the grid had no capacity to absorb it. According to a recent announcement, China's National Energy Administration (NEA) expects installations of about 18 GW of new wind power capacity in 2013. In the meantime, however, the NEA and State Grid are working to solve the transmission bottlenecks and other grid issues. The NEA is also actively encouraging wind farm development in lower wind zones that are closer to load centres.

India today is also a key market for the wind industry, presenting substantial opportunities for both international and domestic players. Although in 2011, the Indian wind sector experienced its strongest annual growth ever, with over 3 GW of new installations, 2012 was a slower year due to a lapse in policy. Nonetheless, India saw new wind energy installations reach 2 336 MW by the end of 2012, providing overall a total of 18 421 MW in-country. This pace of growth kept the Indian wind power market firmly in the top five rankings globally. As of January 2013, total wind installations had risen to 18 552 MW bringing total renewable energy installations in the country to 26 920 MW (Ministry of New and Renewable Energy, 2013). By the end of 2012, renewable energy accounted for over 12% of total installed capacity and about 6% of electricity generation, up from 2% in 1995. Wind power accounted for about 69% of total renewable energy capacity or about 8% of the total installed capacity (Central Electricity Authority, 2012)[1] in India. With the acute need for electrification and rising power consumption in the country, wind energy is going to provide an increasingly significant share of the renewables based capacity.

While the rest of Asia did not make much progress in 2012, there are some favourable signs on the horizon. The Japanese market saw new installations of 88 MW in 2012 to reach a cumulative capacity of 2 614 MW. This represents around 0.5% of the total power supply in Japan. After the Fukushima accident of March 2011, Japan is slowly moving towards a transformation of its energy system to allow for a more diverse energy mix including more wind power and other renewables. However, removing existing barriers will still take time. Offshore wind development, in particular floating turbines, is a promising prospect for the future.

The Government of South Korea has made "green growth" one of its national development priorities. Although wind power is still a relatively young energy generation technology in South Korea, 2012 saw 76 MW of new onshore installations, which brought the total installed capacity to 483 MW. The introduction of a Renewable Portfolio Standard in 2012 is likely to expedite the development of new wind projects in the future. The Korean government had already put forward a strategy for offshore wind development with a target of 2.5 GW by 2019.

Finally, 2012 saw Pakistan commission its first large-scale commercial wind farm of 50 MW in the province of Sindh. The total installed capacity reached 56 MW by the end of 2012. Almost 150 MW of new capacity is currently under construction and projects totalling 700 MW are likely to achieve financial closure by the end of 2013.

The first commercial wind farm of 50 MW will get commissioned this summer in Mongolia. As for the rest of Asia, new projects are expected to begin operations in Thailand and the Philippines during 2013.

Brazil ©Carlos Pereira/GWEC

[1] The month of January in 2013 saw total wind installations of 131 MW.

North America

Uncertain federal policies in the US have caused a 'boom-bust' cycle in wind energy development for over a decade. Nonetheless the US wind energy industry had its strongest year ever in 2012, making it the market leader in terms of new wind installations globally. The US connected over 13.1 GW of new wind power capacity from 190 projects, which leveraged USD 25 billion (EUR 19 billion) in private investment. The country is now home to 60 GW of total wind power capacity, up from 46.9 GW in 2011.

In 2012, wind energy was the largest source of new US electricity generating capacity, providing some 42% of all new generating capacity. In fact, 2012 was a robust year for all renewables, as together they provided over 55% of all new generating capacity in the country. An unprecedented 8.3 GW of wind power was installed in the fourth quarter alone, making it the strongest quarter in the country's long wind power history. This was due in a large part to impending expiration of the federal Production Tax Credit (PTC). It was slated to end on 31st December 2012, but was extended by Congress on 1st January 2013 as part of the 'fiscal cliff package,' or the American Taxpayer Relief Act of 2012. The '13th hour' extension of the tax credit means that although the US market will slow substantially in 2013, it is unlikely to be as much of a slowdown as was expected and the nature of the extension bodes well for the 2014 market.

In terms of new capacity added in 2012, Texas again led the Top-five rankings (1 826 MW), followed by California (1 656 MW), Kansas (1 440 MW), Oklahoma (1 127 MW) and Illinois (823 MW). As of February 2013, 29 of the 50 states have firm RPSs, and 7 states have renewable energy goals. Additionally a total of 66 utilities in the US bought or owned wind power in 2012, a significant increase from 42 in 2011.New wind power purchasers last year included at least 18 industrial buyers, 11 schools and universities, and 8 towns or cities, showing a significant trend toward non-traditional power purchasers from the industrial sector.

Canada saw 935 MW of new wind capacity come online, making it the ninth largest market in 2012; but when compared to 1 267 MW new wind capacity in 2011, Canada's wind power market saw a slight slowdown in 2012, despite this it was still the second best year ever. Ontario leads in wind energy installed capacity with more than 2 000 MW now supplying over 3% of the province's electricity demand. The Canadian industry expects to see a record year in 2013 for new installations with the addition of almost 1 500 MW of new capacity that will drive over USD 3 billion (EUR 2.3 billion) in new investments. Ontario and Quebec are expected to lead in new wind energy installations. New contracts were also awarded in 2012 for projects in Saskatchewan, Nova Scotia and Prince Edward Island.

Mexico has an outstanding wind resource, especially in the Oaxaca region. Mexico more than doubled its installed capacity, installing 801 MW for a total of 1 370 MW and joining the list of countries (now 24) with more than 1 000 MW of wind power capacity. At the end of 2010, Mexico had a total of 519 MW of installed wind capacity connected to the grid, with only 10 MW installed outside of the State of Oaxaca (in Baja California). The year 2012 was exceptional for Mexico and 2013 is expected to be another good year.

Europe

During 2012, 12 744 MW of wind power was installed across Europe, with European Union countries accounting for 11 895 MW of the total. The 2012 figures reflect orders made before the wave of political uncertainty that has swept across Europe since 2011. Wind energy represented 26% of all new EU power capacity installed last year, and investments of between EUR 12.8 billion and EUR 17.2 billion (resp. USD 16.6 and 22.4 billion). Wind is now meeting 7% of Europe's electricity demand, up from 6.3% at end 2011 and 4.8% in 2009.

New wind energy installations in 2012 were led by Germany (21% of all new wind power capacity), the UK (16%), Italy (11%), Romania (8%) and Poland (8%). In terms of total installed capacity, Germany is leading again (30% of total wind power capacity), followed by Spain (22%), the UK (8%), Italy (8%) and France (7%).

Currently, the wind industry is being hit by the economic crisis and austerity measures being implemented across Europe.

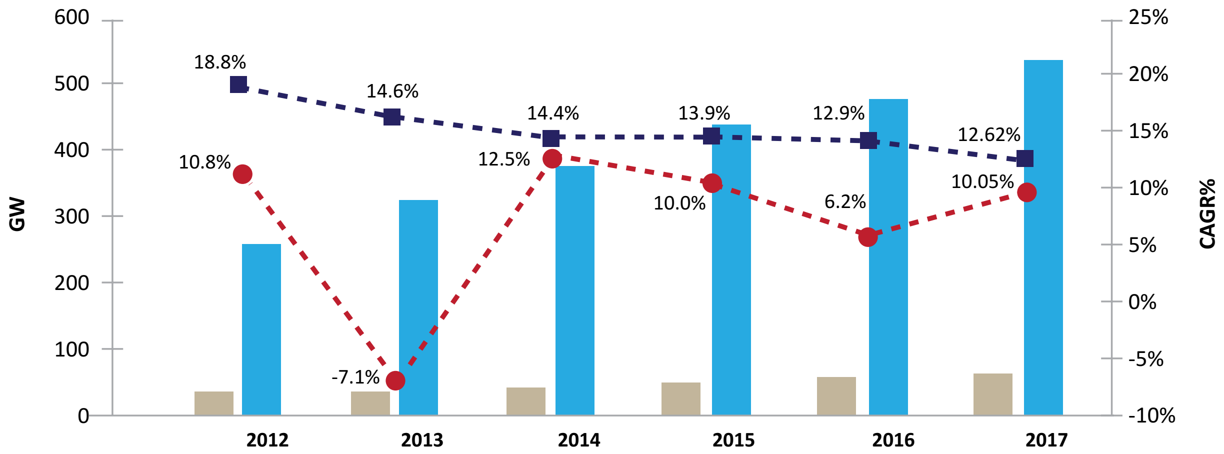
Despite the current difficulties, the European wind industry is optimistic. The industry is advocating for the formalisation of 2030 Renewable Energy Targets. Overall, the EU is almost 2 GW (1.7%) under its National Renewable Energy Action Plan forecasts for 2012. Eighteen Member States are falling behind, including Czech Republic, France, Hungary, Greece, Portugal and Slovakia.

The German wind energy market continued to provide stable growth in 2012. The German wind industry expects this to continue during 2013 as well. However, the latest plans for reforming the feed-in tariffs for renewable energy could negatively impact investor confidence in future wind projects in Germany (REcharge, 2013).

German offshore wind projects saw 16 new wind turbines with a capacity of 80 MW connect to the grid in 2012, bringing the total number of wind turbines in the German part of the North and Baltic Seas to 68, with a combined capacity of 280 MW. Last year, approximately 109 foundation structures were installed in the sea, while 6 offshore wind farms with a total capacity of 1 700 MW are currently under construction. In the coming months the industry would know whether the difficulties surrounding grid connection for offshore wind farms have been satisfactorily resolved.

Despite facing strong austerity measures, Spain continued to be the second largest market in the EU and the seventh largest global market for wind energy in 2012. However, a dramatic drop in installations in 2013 is expected and the future is very uncertain. On 1 February 2013, the government introduced a new decree, which removes the option for renewables producers to sell energy at the market price plus a premium, and obliges them to choose between a fixed tariff and the prevailing market price. The majority of Spanish wind farms (over 80%) until last year were using the market price plus a premium option, one of the incentives under the Royal Decree 661/2007 Under the new decree, renewable energy producers are opting for a fixed tariff, since the current market price is not sufficient to support projects, according to the Spanish Wind Energy Association. Further, this decree would be retroactive, which would require project owners to undertake a complete overhaul of the original conditions under which long-term investments were made. (Spanish Wind Energy Association, 2013).

The United Kingdom is the windiest country in Europe and could power itself several times over using wind. The UK installed 1 897 MW in 2012 - 1 043 MW onshore and 854 MW offshore, which represents 16% of the new wind capacity in Europe. Overall wind power generated 5.5% of the UK's electricity needs in 2012, up from 4% in 2011 (Department of Energy & Climate Change, 2013).



	2012	2013	2014	2015	2016	2017
Annual installed capacity [GW]	44.8	41.6	46.8	51.5	54.7	60.2
Cumulative capacity [GW]	282.8	324.2	371.0	422.5	477.2	537.39
Annual installed capacity growth rate [%]	18.8%	14.6%	14.4%	13.9%	12.9%	12.62%
Cumulative capacity growth rate [%]	10.8%	-7.1%	12.5%	10.0%	6.2%	10.05%

Figure 3: Expected growth trajectory 2012-2017

Recently, the UK government tabled an amendment to the Energy Bill, which would require the Government to set a decarbonisation target for the power sector in April 2014. If the amendment were to be introduced, it would limit the maximum amount of carbon emitted from 2030 onwards. The currently recommended limit is of 50 grams (g)/kWh or 90% lower than current levels[2]. Renewable UK, the UK's renewable energy trade association stated that this would secure more than 76 000 jobs in the wind industry by 2021, and have a transformative impact on the UK manufacturing sector.

Another regional development that will have long-term positive outcomes for the wind industry was the signing of the memorandum of understanding (MoU) between the Irish and UK government in January 2013. The MoU will initiate detailed analysis of how Irish renewable energy resources, onshore and offshore, might be developed to the mutual benefit of Ireland and the UK (Gov.UK, 2013). Based on this analysis, the parties will develop an inter-governmental agreement to be signed by 2014.

Early 2013, Italy had installed a total wind capacity of 8 144 MW, an increase from 6 737 MW in 2011. It is the seventh largest wind market globally. France's wind capacity is also growing steadily and has now reached 7 564 MW. The French government set a target of 25 GW by 2020, which would require a strong effort until the end of the period.

Latin America

Wind power is reaching critical mass in a number of Latin American markets, and the region has begun developing a substantial wind power industry to complement its rich hydro and biomass (and potentially solar) resources. In the medium to long-term, the demand for energy security and diversity of supply is expected to foster the growth wind power in Latin America. For the first time Latin American markets installed over 1 GW of new capacity. During 2012 six markets in the region installed 1 225 MW of new wind capacity to reach a total installed capacity of just over 3.5 GW.

The cumulative wind capacity in Brazil is 1 077 MW. Brazil is one of the few wind energy markets with annual installations of over 1 GW. Brazil has a strong pipeline of projects, with almost 7 GW to be completed by 2016. Subsequently it is a very promising onshore market for wind energy, for at least the next five years. The country's support framework and the sector's experience have been adapted to meet local conditions.

According to the industry, achieving sustained development requires a new regulatory framework, which would then provide certainty in terms of development volumes in the medium- and long-term; legal security in the processing of projects; and a support system, which would further enhance competitiveness. Current government projections foresee 16 000 MW of wind power installed in the country by the end of 2021.

Argentina added 54 MW of new capacity, bringing its total installed capacity up to 167 MW last year. Argentina is a promising market, which has massive wind resources. A number of wind power projects are under development, which could help alleviate chronic electricity shortages in the country. Some analysts claim that the winds in Argentina are sufficient to supply Latin America's entire electrical demand seven times over.

Venezuela commissioned its first commercial wind farm in 2012 (30 MW). Uruguay commissioned 9 MW of new capacity, bringing its total to 52 MW. In Central America, Nicaragua installed 40 MW, bringing its total to 102 MW and 15 MW was installed in Costa Rica, which brought its total installed capacity up to 147 MW.

Pacific

The region's installed capacity exceeded 3 GW in 2012. Australia added 358 MW in 2012 (compared to 234 MW in 2011), bringing the total installed capacity to 2 584 MW. According to recent research conducted by the Clean Energy Council, wind farms have generated more than AUD 4 billion (USD 3.8 billion) in investment in Australia since their introduction (ABC Rural, 2013). The Australian Government's Renewable Energy Target Scheme is designed to deliver 20% of Australia's electricity supply from renewable sources by 2020. The Largescale Renewable Energy Target

[2] The exact amount would be set based on advice from the independent body that is set up to advise the Government and Committee on Climate Change.


Ilocos Norte, Philippines ©Greenpeace / Rap Rios

and the Smallscale Renewable Energy Scheme provide incentives designed to bridge the gap between the price of electricity from conventional sources and renewable energy, and are expected to produce more than 45 000 gigawatt-hour (GWh) in 2020. As an additional measure, Australia last year started charging its biggest polluters a price of AUD 23 (USD 22) a metric tonne for their carbon emissions . In August 2012, the Australian government and the European Commission agreed to link their carbon trading platforms in a shared marketplace[3].

Most importantly, wind electricity is now competitive with fossil fuels in Australia. According to a recent Bloomberg New Energy Finance report by (BNEF, 2013b), a new wind farm in Australia can supply electricity at a cost of AUD 80 (USD 77) per megawatt-hour (MWh), compared with AUD 143 (USD 110) a MWh from a new coal-fired power plant or AUD 116 (USD 111) from a new station powered by natural gas when the cost of carbon emissions are factored in.

Africa and the Middle East

Africa and the Middle East seem to be waking up to the opportunity of their enormous wind power potential. Growth in 2012 was still small in absolute terms, with just over 1.1 GW installed across the region. However, several countries have announced long-term plans for installing commercial scale wind power; this includes South Africa, Ethiopia, Morocco, Kenya and Saudi Arabia, among others.

At the end of 2012, over 98% of the region's total wind installations of just over 1 135 MW were to be found across six countries; Egypt (550 MW), Morocco (291 MW), Tunisia (104 MW), Ethiopia (52 MW), Iran (91 MW) and Cape Verde (24 MW).

EXPECTED GROWTH TRAJECTORY FOR WIND ENERGY (2013-2017)

According to the GWEC, the industry is expected to continue growing during the coming five years. The wind industry continued to diversify geographically, with significant new activity in Latin America, Africa and Asia outside of China and India; but the major markets are still the key determinants of global market growth.

In an increasingly tight market, with tremendous downward pressure on prices through oversupply in the turbine market; fierce competition with 'cheap' gas; and a wave of downward revisions to support mechanisms in an austerity driven economic landscape; the industry continues to be challenged to compete on a price basis directly with fossil fuel and nuclear energy plants. The fundamental drivers for wind power development however remain, and there is a need around the world for new power generation, which is clean, affordable, indigenous, reliable and quick to install. The continued uncertainty over the short-term development of the global economy with all its regional and national variations, and its effect on electricity demand growth are other factors to consider when projecting the wind industry's development over the next five years.

GWEC forecasted that annual installations for 2013 would drop by more than 11% to just under 40 GW; and then recover sharply in 2014 to slightly exceed the 2012 market; and average just over 11% annual market growth from 2014 to 2017. The average annual market growth rate for the entire 2013-2017 period is forecast to be almost 7%, ending up with an annual market in 2017 of 61 GW. In cumulative terms, this means an average growth rate over the period of about 13.7%, well below the previous ten-year. GWEC projected that by the end of 2017; total cumulative installed capacity would pass 500 GW to reach approximately 536 GW.

[3] Beginning 1 July 2015, Australia's carbon pricing scheme will be linked to the EU's Emissions Trading System (ETS) under an interim link that will synchronise carbon prices in the two markets and allow for global permit trading. A full linkage is scheduled to take place no later than January of 2018.

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BRAZIL

MARKET OVERVIEW

Brazil installed 1077 MW of wind power in 2012 to reach a total installed capacity of 2 508 MW. The country has excellent wind resources in its north-east[4] and southern parts. Today Brazil has a project pipeline for more than 7 GW of wind power by 2016, with a market forecast to grow at over 2 GW annually. The Brazilian government's Decennial Energy Plan (PDE 2021) sets a goal of 16 GW of installed wind capacity to be reached by 2021, accounting for 9 % of national electricity consumption. This makes Brazil the fastest-growing market on the South American continent (Global Wind Energy Council (GWEC), 2013).

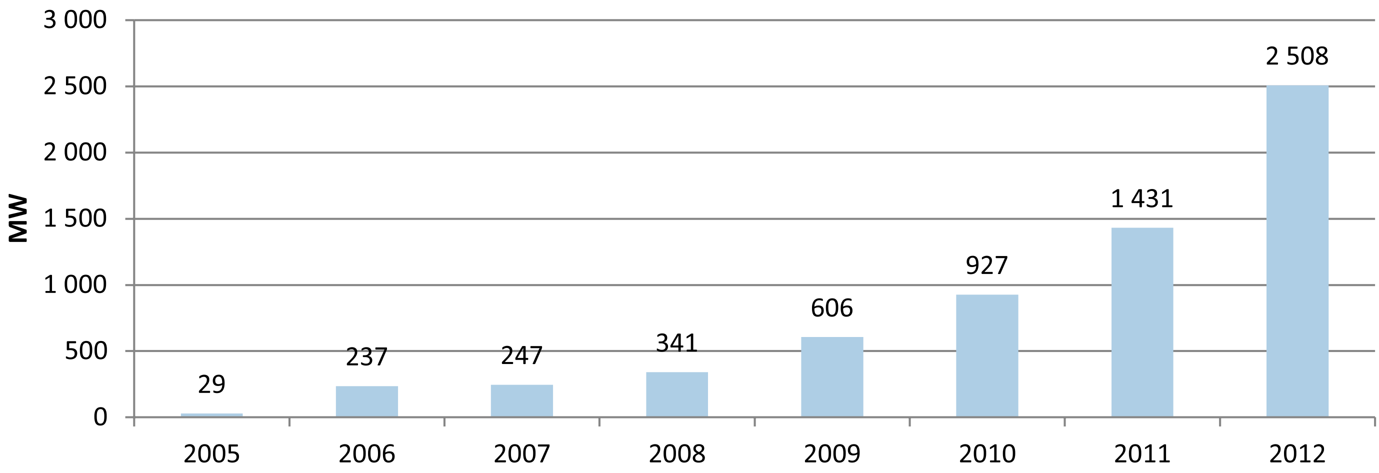

Figure 4: Cumulative Wind Installation (MW) of Brazil (GWEC, 2013)

HISTORY AND EVOLUTION OF POLICY AND REGULATORY FRAMEWORK FOR WIND ENERGY

Brazil has one of the cleanest energy matrices in the world with hydropower providing 67% of the total installed capacity (Aneel, 2011). In the 1990s, Brazil faced a period of rapid economic growth which led to a rapid increase in energy demand, particularly in the north-east of the country. Brazil faced a very serious energy crisis between 2000 and 2002[6], due to three key factors.

Firstly, in a country with over 80% historical dependency on hydroelectric generation capacity several years of below average rainfall forced over-tapping of its very large reservoirs. Secondly, even during this shortage the

[4] Especially across the states of Bahia, Rio Grande do Norte and Ceara. Furthermore, the high wind seasons coincide with low rainfall seasons, thereby providing a natural complementarity between the country's hydropower and wind resources.

[5] In 2001 when Brazil's first wind atlas was published, the country's wind power potential was estimated to be 143 GW at 50 meters.

[6] The Brazilian energy crisis prompted the former government of President Fernando Henrique Cardoso (1994-2002) to embark on a USD 5 billion countrywide "crash" construction programme that called for 55 gas-fired power plants totalling 22 GW (Ellsworth and Gibbs, 2004).

[7] In 1953, the energy sector was a monopoly operated by Petrobras. In 1975, the market was opened up to permit risk contracts with private sector operators. In 1997, Petrobras was partially privatised, and joint ventures with other companies were permitted (Mares, 2010).

[8] United Kingdom and Argentina.

[9] Brazil's electricity sector went through two major reforms. The first reform took place between 1995 and 2003. The second reform started in 2004 with the introduction of a long-term market (Oliveira, *et al.*, 2005).

grid operators' preference to dispatch hydro-electricity led to the reservoirs shrinking to dangerously low levels (Oliveira, *et al.*, 2005).

Lastly, although substantial hydropower potential remains, it is difficult to develop, as much of it is located in the eastern part of the country far away from load centres. In addition to this difficult situation, the national privatisation process had delayed investments in new generation plants and transmission.

This crisis highlighted the urgent need to diversify Brazil's energy mix to ensure security[7] of domestic energy supplies, and created opportunities and incentives for renewable energy sources.

Phase 1:

PROINFA programme – learning by doing (2002-2009)

Until the mid-nineties the Brazilian electricity sector was predominantly run as a public sector monopoly. In 1996, inspired by concurrent reforms in other countries[8], the Brazilian government implemented reforms to the electricity sector[9] and transformed it from a monopoly into a competitive market (Wanderley, Cullen and Tsamenyi, 2011).

Power sector reform started with the privatisation of distribution, followed by generation and transmission. In 2002, the provisions for diversifying the electricity generation matrix were the first step towards opening up the Brazilian market for the global wind industry.

The Programme of Incentives for Alternative Electricity Sources (PROINFA[10]) was passed in April 2002[11]. It was divided into two phases, and its scope extended to small hydropower plants, biomass and wind power.

For the first phase, a total capacity of 3 300 MW was assigned under a feed-in tariff scheme, distributed equally between wind power, biomass and small hydropower. The programme was seen to be especially important for wind energy, given the long history of support for both biomass and hydropower in Brazil.

This first phase, which had to be implemented before December 2008, included provisions for a fixed tariff, guaranteed grid access for all electricity produced over a period of 20 years, and distributed equally across all participating sources.

The first phase of the programme was based on a guaranteed 20-year power purchase agreement with Eletrobras[12] (utility) at a price set by the government[13]. The target for wind was revised upwards to 1 429 MW (Fiestas, 2011).

For the second phase[14], the programme set a target for new renewable energy sources to provide 10% of the country's annual power consumption within 20 years. This phase was due to come into force after the target capacity of 3 300 MW of the first phase had been met, which is yet to be implemented.

During the implementation of the first phase of PROINFA, several practical issues undermined the development of some of the alternative energy projects, which led to a slower than expected start of operations. These problems included:

- Complex and highly bureaucratic permitting process and procedures to obtain or renew environmental licences.
- Problems and delays in obtaining the Declaration of Public Utility (DUP) for projects[15].
- Difficulty in connecting to the grid, particularly in the

[10] Law 10,438 of 2002 of 26April 2002, as amended by Laws 10,762/03, and Law 11,943 of 28March, 2009 authorised the creation of PROINFA.

[11] Law No. 10,438 of 26 April 2002 set out the targets and timescales for PROINFA, as well as the mechanisms for assigning projects and determining the prices at which electricity will be sold.

[12] As of 2010 Eletrobrás owned and operated 38% of Brazil's installed capacity as well as the majority of the country's high-voltage transmission system (Schwieger, *et al.* (eds.), 2009).

[13] With floors or minimum purchase prices of 50%, 70% and 90% (for small hydro, biomass and wind farms respectively), of the average retail power price in the final 12 months, and where participation in the programme is via an Independent Power Producer, and provided that the nationalisation index for equipment and services is at least 60% in the first stage (GWEC, 2011).

[14] The price for electricity in the second phase will be equal to the weighted average cost of the generation from new hydropower plants with capacities greater than 30 MW and natural gas power stations (GWEC, 2011). The acquisition will be again made under a 20-year Power Purchase Agreement (PPA) with ELECTROBRAS, through annually scheduled purchases from each producer. New renewable energy sources would achieve a minimum annual increase in power output of 15% to be supplied to the consumer market.

central-west region.

- For the first phase of PROINFA, local content requirements (also known as "nationalisation índices") were set to 60% for equipment (calculated by weight) (Backwell, 2011). For example, the high local content requirement created a high demand for locally produced wind turbine towers, thereby creating an upward price pressure on Brazilian steel. The steel industry was dominated by a single supplier[16] which led to significantly higher costs in comparison to the option of using imported steel (Azau, Rose and Aubrey, 2011).

These early experiences led to repeated postponements of the deadlines set out in the original programme of action. In late 2008 the administrative barriers and lack of a clear long-term policy signal to support further wind power generation were strongly undermining the investments.

The global and local industry took coordinated action to identify bottlenecks and barriers to wind power development. The wind industry worked closely with the regulators to raise awareness about the technology during that time. In late 2009 the government launched the first specific electricity auction for wind power generation which resulted in over 1 800 MW being allocated.

This was the first in a series of auctions in which wind power was awarded large capacity allocations. These auctions spurred the development of the projects granted under the first phase. The rate of installations increased during the last two year of the PROINFA programme and led to the creation of a local supply chain.

Phase 2:

Introduction of auction systems (2009-2012)

Under this phase a reverse price auction (competitive bidding system) was introduced which constituted a marked change from the PROINFA programme. While PROINFA was implemented with the aim of diversifying the electricity mix, the auction model was aimed at efficiently and cost-effectively increasing energy security.

The first "wind only" auction was organised by the Brazilian Ministry of Mines and Energy (MME) in December 2009 (LER-2009[17]). The auction had a very positive impact on the development of wind power. Wind installations saw their fastest growth that year, attracting more than three times the investment they did in 2008[18]. The auction commercialised 1.8 GW of new projects[19] which are due to come online by the end of 2012 (UNEP, 2010).

In August 2010, the MME held further sets of auctions (LER-2010 and LFA 2010) in which wind power developers were allowed to participate and compete with a variety of energy sources, including conventional sources. The pressure to compete on costs with conventional sources might explain the high concentration of projects in the north-western region of Brazil where almost 80% of the awarded projects are located.

Under these auctions, specific measures were introduced for all power generation technologies. For wind, the 2009 auction prohibited the import of wind turbines with nominal capacity below 1.5 MW. The tenders held in 2010 (LFA-2010 and LER-2010) did not include such provisions, and no local content requirement was necessary to take part in the tender process.

The nationalisation index remains a stipulation to access funding from the Brazilian National Development Bank (BNDES), which comes at a lower cost. This funding requires additional conditions to be fulfilled, including meeting deadlines for implementation, and has resulted in a rapid expansion of the local supply chain. However, not all wind power projects in Brazil are financed by BNDES.

According to UNEP, investment in the wind sector took off in 2009, more than trebling to USD 2.2 billion. Brazil is increasingly financing projects in other developing

[15] This is a qualification that facilitates negotiations to use the assets and rights affected by the projects, in particular the land, which in many cases is affected by complicated terms of use and occupation, and disputes between owners and landholders that make it difficult to identify the property for the wind farm developer (GWEC, 2011).

[16] Belo Horizonte-based Usiminas, a former state-owned company privatised in the 1990s.

[17] With the exception of the first wind-only auction in 2009, the framework of regulated contractual arrangements for power generation capacity addresses a variety of technologies without distinction.

[18] Asset finance provided the majority of financial investment in Brazil at USD 7 billion (89% of the total), followed by venture capital and private equity. There was only a very small role for public market finance in 2009.

[19] First-time wind developers in Brazil under-priced natural gas-fired power projects. The average price for wind was USD 62/MWh while it was USD 65/MWhfor natural gas. These are the lowest tariffs being offered to wind generators on a market-wide basis globally, and below wholesale electricity prices in Latin American markets. However, the wind developers are required to supply energy at

countries, with USD 5 billion of government-subsidised debt pledged by BNDES to renewable energy projects in developing countries (UNEP, 2010).

The wind power industry and its supply chain have been firmly established, and offered a varied additional production capacity of over 1 000 MW per annum by 2010. Rising industrial investment will significantly increase this capacity, and the sector aims to implement a manufacturing base capable of producing between 2 GW and 2.5 GW of wind power equipment per year. As a result of its local content requirement Brazil saw an increasing number of manufacturers entering the wind power equipment supply chain. The Brazilian market also has excellent potential to become a manufacturing base for most of Latin America (GWEC, 2011).

The downward pressure on wind prices was maintained at the last A-5 auction[20] held in December 2011. The National Electric Energy Agency (ANEEL) contracted 42 new power plants worth 1 211 MW, including 39 wind projects totalling more than 976 MW or 80% of the total sales. In contrast to previous auctions, including those that took place in August 2011, this auction permitted project developers five years before they must connect to the grid. In this auction wind projects competed with hydroelectric and even large-scale thermoelectric projects (Spatuzza, 2012).

Brazil met the first phase target of the PROINFA programme of 1 429 MW of wind power in 2011. Over 94% of the current installed wind generation capacity was achieved through PROINFA projects, although the balance of the remaining 7 GW pipeline came from the auction process.

Unlike the PROINFA programme, the structure of the auction system set the eligibility criteria at such a level, that only serious players were able to compete for the tenders. The rigorousness of this system has given the industry confidence to move ahead, even with the very low prices of the winning bids.

CURRENT CHALLENGES

Some of the main challenges facing the wind industry in Brazil in the short term are directly related to the projected growth of the market. This growth phase will involve:

- Mobilising and securing greater financial resources for the project pipeline.
- Increasing the production capacity of the wind turbine industry, and adapting the technology to local wind regimes.
- Improving the energy infrastructure through technological innovation.
- Adapting certification standards to Brazilian conditions.
- Training more local manpower for wind farm development, operations and project management.

Currently, the potential for wind power development is limited to the wind capacity allocated through the auctions. The low prices accepted in recent tenders[21] and the lack of specific long-term policy support (e.g., through 2020 or 2030 targets for wind) could potentially slow down the pace of development.

Even though Brazil has dispensed with the local content requirement it still has a high import tariff on foreign wind turbines. This has encouraged companies to open local manufacturing operations in the country, which has to some extent helped to reduce the project development costs.

However, the taxes and procedures for environmental impact assessments are causing delays for new projects. While the latest projects reflect significant downward price pressure, they remain to be financed and built. There is uncertainty about the ability of bid-winners to operate wind farms under such low-priced contracts.

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lower costs that would allow their investors to earn the necessary returns. To achieve those returns, nearly half of these new projects will have to operate at considerably higher efficiencies or lower cost than has been seen in other parts of the world. For most of these projects to become viable by current standards, turbine costs would have to fall by 15% in Brazil to USD 1.2/W, or 10% below the 2011 global average (Oliveira, 2011).

[20] This auction was significant as it was the first time the government allowed wind projects to participate in a tender – known as the A-5 – which was previously designed for bigger projects that need longer construction periods, compared to the 18-month-average for wind farms. Wind projects competed with hydroelectric and even large-scale thermoelectric projects. This A-5 energy auction saw average wind prices of BRL 105/MWh (approximately USD 62.9/MWh) up 5.5% from the record lows of the previous auction (in August 2011).

[21] Wind power was the largest contributor of new power capacity contracted at Brazil's two power auctions in mid-August 2011. Out of a total of 3.9 GW of contracted projects, 1 928.8 MW were allocated to wind energy projects in the A-3 and Reserve auctions. The overall prices achieved at the auctions were considerably lower than in previous processes in 2009 and 2010, at BRL 99.8/MWh (approx USD 59.8/MWh). The new contracts increased the pipeline of wind energy projects under construction to 5 175 MW in addition to the 1 120 MW in operation in 55 wind farms (Fiestas, 2011).

Grid access is a challenge for wind power in Brazil. Additional investments in the transmission grid would allow wind farms to be effectively connected to the power grid and to transport the electricity generated to the demand centres[22].

Under price pressure, the developments focus on the most economically feasible sites. The average capacity factor seen from the reserve energy tender (LER 2010) is as high as 50%, which is twice the average capacity factor for wind projects in Europe. This has led to a high concentration of the projects in a limited number of locations, increasing challenges for both the technology and grid integration.

Since wind energy is a relatively recent technology in the country, there is limited awareness about the industry. According to industry representatives, the project developers need to play an educational role towards ensuring buy-in from local communities[23].

Today, Brazil has a robust pipeline of wind energy projects, which is attracting large investments to the sector. The annual wind market could reach 2 000 MW per year. In addition there is an oversupply of wind turbines on the international wind market, which has contributed to lower costs for the projects.

CONCLUSION

Brazil has a long history of promoting indigenous sources of energy (initially bio-ethanol and hydropower). When a prolonged drought brought on the country's energy crisis of 2002, the government looked towards diversifying Brazil's predominantly hydropower-based generation capacity by promoting more bio-energy, small hydro and wind, through the PROINFA model.

The PROINFA programme was the first attempt to diversify the energy mix. The programme was developed in 2002, and implemented in 2004. PROINFA was a well-designed support mechanism. The programme provided a limited overall outlook for wind power development (1 429 MW by 2008), and encountered significant administrative barriers during its implementation phase. The lack of long-term targets for wind energy was seen as a major obstacle for faster development and attracting large renewable energy investors. The wind energy target for 2008 was only reached in 2011, which indicates that the eligibility criteria were not sufficient to attract local industry and major market players early on.

From 2007 through 2009 the reform of PROINFA was debated, due to its limited outcomes for wind power, and a number of legislative proposals were made at both state and federal level. The successful outcome of the first wind-only auction in December 2009 increased the opportunities for wind power in Brazil. While auctions were not an ideal solution from the industry's point of view, a number of factors contributed to their success:

- Improvements in wind energy technology and strong competition from new Asian manufacturers had driven down costs. The last decade saw an oversupply of wind turbines on the global markets.
- Due to the financial crisis, a manufacturing surplus was available on the global market, which made manufacturers and developers explore new markets, including Brazil which was seen as having a large potential.
- The national economy was growing, contributing to rising electricity demand.
- Brazil was seen as a potential manufacturing "centre" to supply other South American markets.
- The country's wind resources are extremely large, with capacity factors twice as high as the European average.

Six more auctions have been organised. A large number of major international players have established manufacturing and assembly facilities in Brazil, and the country now has a project pipeline of 7 000 MW up to 2016, and may reach 15 000 MW by 2020.

The regulated auctions for wind projects have to some extent helped in providing a solution for securing a continued investment stream for new projects. The conditions of the auction system, which included financial penalties for

[22] The Brazilian wind power sector advocates for the reinforcement of the grid infrastructure in the north-east region, via a transmission line running parallel to the coast. The line would connect São Luís and Recife, and would also benefit Ceará, Rio Grande do Norte and Paraíba.

[23] Recent projects have provided schools with computer lessons, built roads, refurbished a church and provided a doctor two days a week to communities – tangible improvements to the social welfare of isolated settlements. Companies such as Suzlon are increasingly running education programmes in the municipal schools close to the wind farms, providing information on the farms and wind technology (Azau, Rose and Aubrey, 2011).

avoiding speculators and unviable projects, have improved the attractiveness of the wind energy market.

However, the electricity prices awarded to wind projects reduced dramatically in the last five years due to the direct competition with conventional energy sources. The commercial margins are low across the entire value chain, and the tariffs are half their value under PROINFA.

Overall the current auction system is not ideal from the industry's point of view. The industry lacks market stability and long-term visibility on market volumes. However, Brazil is one of the fastest-growing economies in the world today with the potential for large growth for in the wind energy market. International manufacturers such as Enercon (Wobben) have been established in the country for a long period, but the market has recently attracted other large manufacturing companies such as IMPSA, Vestas, Gamesa, GE, Suzlon, Siemens, Alstom, LM and Sinovel.

Brazil's unique geography and wind resource represent an excellent opportunity for wind energy. The latest energy auction showed that wind projects can compete successfully with hydropower. An increasing number of large domestic and foreign players are committed to developing the Brazilian market, which increases the confidence of investors, and increases trust in the successful development of proposed projects. However, several policy elements could be improved, in order to sustain the growth of the industry over the long term:

» Clear and long-term targets for wind energy.

» Clear and long-term regulatory framework for wind.

» Planning permissions provided within a given timeframe.

» Permitting and siting procedures may be streamlined further.

» Despite Brazil's extensive national grid, adequate provision would be required to meet the auction requirements and enable large injections of wind power in several locations (especially Ceara, Rio Grande do Norte, Bahia, and Rio Grande do Sul).


Norway ©Joachim Beinlich/GWEC

ANALYSIS OF ENABLING CONDITIONS FOR WIND ENERGY

Effective rule of law and transparency in administrative and permitting processes	The processes are clear and well defined. However there is a critical need for a common framework for wind farm approvals across the Brazilian states.
A clear and effective pricing structure	Power purchase agreements for 39 projects were awarded for 20 years during the latest 2011 A-5 auction, at BRL 105/MWh (approximately USD 62.9/MWh).
Provisions for access to the grid (incentives & penalties for grid operators)	EPE is responsible for ensuring the connection of the wind projects selected through the auctioning process.
An industrial development strategy	Not Applicable
A functioning finance sector	The Brazilian Development Bank is one of the largest lenders for renewable energy projects worldwide.
Expression of political commitment from government (e.g. targets)	A national long-term target for wind energy is desirable for ensuring robust growth of Brazil's emerging wind sector.
A government and/or industry-led strategy for public and community buy-in.	Not Applicable
An employment development strategy	Not Applicable
NOTE	**Brazil has some of the best wind resource worldwide. The current auction system is not ideal from the industry's point of view. The industry lacks market stability and long-term visibility on market volumes. However, Brazil is a large market with a potential for growth for wind energy. It is also one of the fastest-growing economies in the world today. A large number of major international players have established manufacturing and assembly facilities in Brazil, and the country has a project pipeline of 7 000 MW until 2016, which may reach 15 000 MW by 2020.**

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CHINA

MARKET OVERVIEW

China's wind energy sector has grown at an exceptional pace since 2005. In 2010, China became the world's leading market for wind energy, both in terms of annual and cumulative market size.

China installed 28.9% of new global capacity in 2012. By the end of 2012, China had installed 75 324 MW of wind power. The Chinese market represented about 27% of the global market in 2012, down from 49.5% in 2010, and 43% in 2011. By the end of 2012, non-fossil fuel energy sources already accounted for 29.5% of China's electricity generation capacity (Global Wind Energy Council (GWEC), 2013).

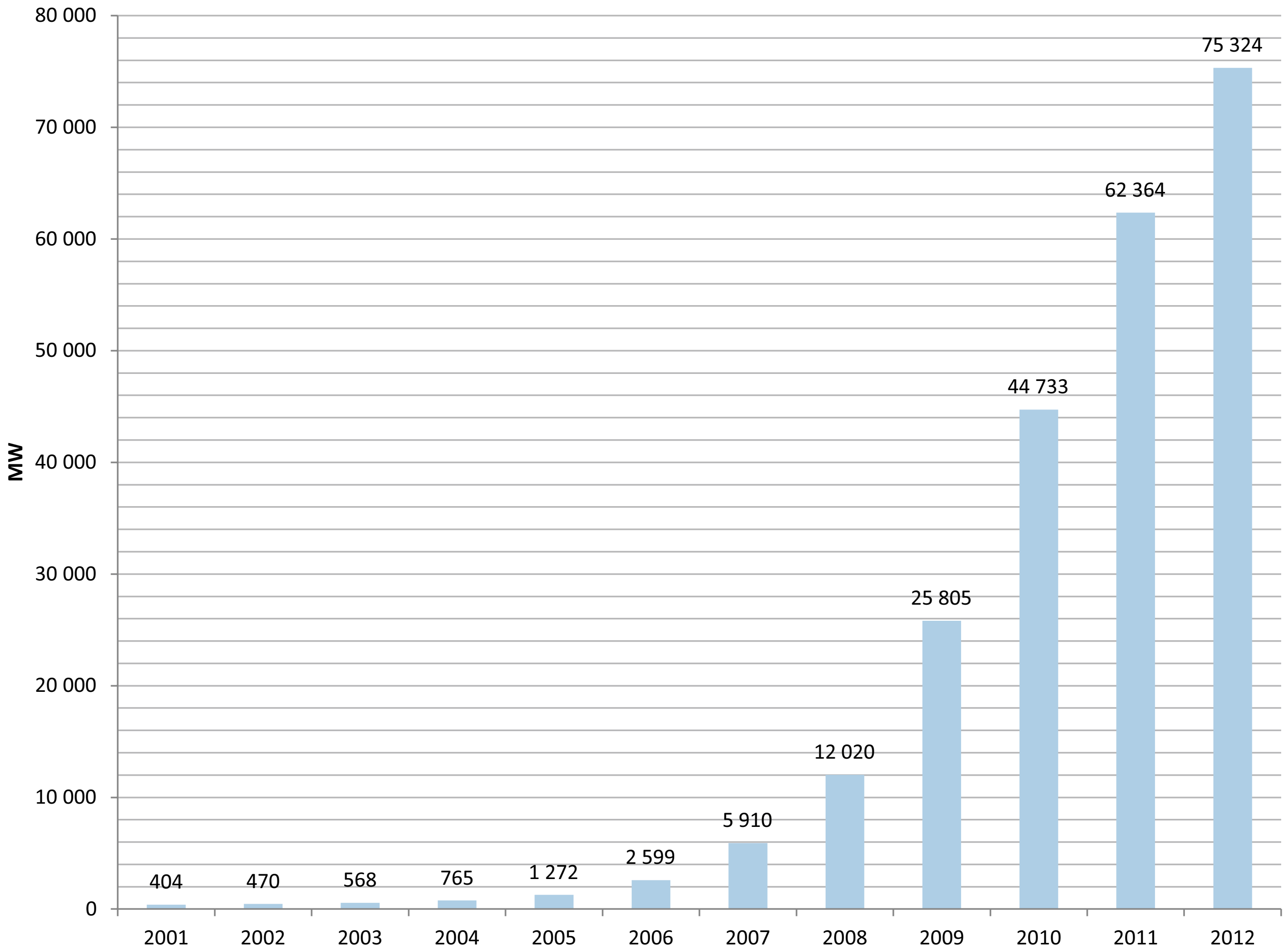

Figure 5: Cumulative Wind Installation (MW) of China (GWEC, 2013)

HISTORY AND EVOLUTION OF POLICY AND REGULATORY FRAMEWORK FOR WIND ENERGY

According to the third National Wind Energy Resources Census, China's total exploitable capacity for both onshore and offshore wind energy is between 700 and 1 200 GW (Junfeng, *et al.*, 2010). Compared to the other leading global wind power markets, China's wind resources are similar to those in the United States (US), and greatly exceed currently estimated resources in Brazil, Germany, India or Spain. China has installed more wind capacity in five years (2007-2011) than either the US or Germany[24] installed in over 30 years of wind power development.

Phase 1:

Demonstration phase (1986-2000)

The first demonstration wind farm was built in Rongcheng, Shandong province in 1986 (Pengfei, 2005). Domestic manufacturing was still at an early stage, with only a few Chinese companies, such as Goldwind, operating in the market. In the initial demonstration period (1986-1993), the main activity was building small-scale demonstration wind farms using grants from foreign donor countries and loans. Government support was predominantly provided through financial backing, such as investment in wind farm projects or in the development of wind turbines (Junfeng, *et al.*, 2007).

The wind industry started to develop slowly in the late 1990s. Many of the projects developed during this period were either highly subsided by the government or non-commercial, and were only using wind turbines with low power ratings (< 500 kW).

At a National Wind Power work meeting (1993), the former Ministry of Electric Power proposed a wind power industrialisation programme. The following year, it was decided that the national utility should facilitate the connection of wind farms to the nearest grid point, and all the electricity generated by wind farms should be purchased[25]. This measure guaranteed the security of investors and helped finance the development of wind farms through loans.

Later, the State Planning Commission decreed that the average electricity price for wind power should be calculated according to the operational period of the turbines, and the loan repayment period should be extended to over 15 years. In addition, Value Added Tax was reduced by half (to 8.5%) for wind power projects. However, the wind industry continued to develop slowly due to unclear policy support, high costs, and the need to operate within the limits imposed by the broader reform of the electricity supply system which was being undertaken to transform the electricity sector into a competitive market.

The first wind target set by China's State Planning Commission was for 1 000 MW to be developed by 2001 under the "Ride the Wind Programme", launched in January 1997. China's State Planning Commission selected a German company, Nordex Balcke-Durr GmbH, as the first foreign partner to develop these projects. Nordex Balcke-Durr and Xian Aero Engine Company[26] completed almost 50% of the Planning Commission's projects. The first 400 MW was financed through Chinese and foreign government loans.

This was the first joint venture set up to develop the planned wind projects. It was designed to initiate an ambitious localisation programme to gradually increase the local content to 80%. Furthermore, as part of China's "Double Increase" plan under the Ninth Five-Year Plan, contracts for over 70 MW of wind power were granted in 1997 to Danish companies Vestas and Micon (Windpower Monthly Magazine (WPM), 1997).

By the end of 2001, 404 MW of wind power had been installed in the country.

Phase 2:

Early commercialisation and tariff setting for wind (2001-2005)

Under its Tenth Five-Year Plan (2001-2005), the Chinese government introduced the concept of a Mandatory Market Share[27] of renewable energy in the national electricity supply (WPM, 2001).

As part of a broader electricity market reform, the government also introduced market-based mechanisms such as concession tendering for wind projects in 2002-2003.

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[24] By June of 2012, the USA had installed over 50 GW, and by the end of 2011 Germany had installed 29 060 MW of wind capacity. The USA is currently the second-largest and Germany the third-largest market for wind power.

[25] The grid tariff was to be calculated as the sum of power generation costs, loan payments and a reasonable profit. The difference between the wind electricity price and the average electricity price would be shared across the whole grid, with the power company responsible for purchase of the electricity.

[26] Xian Aero was the commercial arm of the Aviation Ministry. It was selected as a wind turbine manufacturing partner by the Chinese authorities in 1996 along with Luoyang First Tractor Factory, the commercial wing of the Chinese Machinery Ministry.

[27] The idea of Mandatory Market Share rose from an earlier proposal to place an obligation on provinces to meet a renewable energy quota of 5.5% of total electricity production from either their own generation or through the trade of green certificates. This system was based on a concept similar to the Renewables Portfolio Standard in the USA.

[28] The State Council and the National Development and Reform Commission (NDRC) are China's most powerful and influential clean energy regulators. Other government agencies play supporting roles and regulate more narrow parts of clean energy planning, programme management and implementation.

The objective of the National Development & Reform Commission (NDRC[28]) was to achieve commercialisation of the nascent wind industry by initiating a wind power "concession policy" programme (which went on to become an annual feature of China's wind development process). This programme promoted domestic projects through competitive bidding, requiring wind turbines to be manufactured with 70% domestically produced content (the so-called "localisation" provision).

Under this scheme the investors and developers of wind power projects were selected through a bidding process. The objectives were to expand the rate of development, improve domestic manufacturing capacity, lower power generation costs and reduce electricity prices. At the same time the concession projects were helping identify reasonable tariff levels for wind power in China.

During this period, the tariffs were either determined under these concessions or through government-approved tariffs, depending on the size of the projects. The government-approved tariffs were used for projects of less than 50 MW.

» Tariffs were proposed by the project developers as part of the wind concession tendering process. The government used the tariffs approved through the concession projects as guidance for determining tariffs often in similar sites.

» Up until 2006, the government-approved tariff scheme was still in a phase of trial and testing, and tariffs varied in locations with similar wind resources.

Another reason for undertaking the tendering process was to stimulate the development of large wind farms and create a scale effect to reduce the price of manufacturing and procuring a wind turbine. The "concession policy" created substantial developments post-2003, but a standard tariff structure was not yet in place across the country.

By the end of 2004, the market share of locally made wind turbines had reached 18% (Pengfei, 2005). By the end of 2005, the country had installed 2 559 MW of wind generation capacity.

Phase 3:

Renewable Energy Law and Targets (2005 -2007).

The rapid growth of the wind energy industry in China has been driven primarily by national renewable energy policies. The first Renewable Energy Law, which entered into force in 2006, significantly accelerated the growth of renewable energy. In 2007, the first implementation rules for the law were issued.

Up until this time renewable energy technologies had been marginal, but the Renewable Energy Law now provided a legal framework for their operation and development. The law stipulated that grid companies should prioritise renewable energy over other sources of power. Although it did not include targets and tariff bands for various technologies, the law did provide the basis for follow-up supporting regulations.

These supporting regulations can be divided between those setting targets, and those setting tariffs for different technologies. The former were successful, and the targets provided investors with indicators for gauging investment opportunities.

In addition, the 2007 Medium and Long-term Development Plan for Renewable Energy (NDRC, 2007) set out the government's commitment to renewable energy and put forward national targets and policy measures for implementation. It included a mandatory market share of 1% of renewable energy (not including hydro) in the country's total electricity mix by 2010.

To further encourage the nascent wind industry, the government maintained the 70% local content requirement[29], which encouraged international players to set up manufacturing facilities in China. Almost all

[29] The rule was abolished in 2010, when the domestic industry had been fully established with companies covering the whole supply chain and international players coming to set up their manufacturing facilities in China.

[30] In 2011, there were a total of 29 original equipment manufacturers active in China. In 2011, the top five manufacturers in the Chinese market were Goldwind 3 600 MW(20.4%), Sinovel 2 939 MW (16.7%), United Power 2 847 MW (16.1%), Mingyang 1 177.5 MW(6.7%) and Dongfang Turbine 946 MW (5.4%).

[31] Instead of the grid companies collecting the surcharge directly from the end user, the end user would pay the surcharge into the Renewable Energy Development Fund. Once the surcharges were pooled, the grid company then sought compensation from the fund for the additional cost of purchasing the renewable energy, including the costs associated with integration. This change was quite significant once all payments were pooled into one large fund. It allowed the government to use the fund (USD 689 million in 2009 (USD2011 751 million) and an estimated USD 1 billion in 2010 (USD2011 1.05 billion) not only to compensate grid companies, but also to invest in other renewable energy projects, including R&D (Xinhua, 2009).

[32] The bases are Gansu, East Inner-Mongolia, West Inner-Mongolia, Xinjiang, North Hebei, West Jilin, and Jiangsu Coastline.

of the world's major wind turbine manufacturers set up either an independent manufacturing business or a joint venture with a local company during this period.

After the introduction of the Renewable Energy Law, the Chinese wind turbine manufacturing industry took off rapidly and has since undergone extraordinary development. By the end of 2007, there were 40 domestic turbine manufacturers in China. By the end of 2008 this number had risen to 70, although only 30 of these had commercial products on the market[30] .

International wind turbine manufacturing firms such as Gamesa, General Electric, Nordex, Suzlon and Vestas established manufacturing facilities in China. They led the market until 2007, but by 2008 domestic manufacturers represented half of the total market share. Annual installations in 2008 reached 6 300 MW and the two largest domestic manufacturers, Goldwind and Sinovel, ranked among the world's ten largest wind turbine manufacturers.

In 2009, the Renewable Energy Law was amended to introduce a requirement for grid operators to purchase a fixed amount of renewable energy. The amendment law further reiterated that the grid companies should absorb the full amount of renewable energy produced, with the option to apply for subsidies from a new Renewable Energy Fund to cover the extra cost of of integration.

To finance renewable energy projects, the government put a surcharge per kWh on the electricity price. The surcharge started as CYN 0.002/kWh (USD 0.3/MWh), and was raised to CYN 0.004/kWh (USD 0.6/MWh) in 2008. This income[31] is pooled with other national funding sources into a national renewable energy fund to finance both special renewable energy projects and the feed-in tariff for solar and wind (Xinhua, 2009).

A provision for renewable portfolio standards (also called "mandated market share") was a key element of the 2006 Law. Other market-enhancing provisions included "government-guided" prices for wind power, the obligation for utilities to purchase all generated renewable power, and state guarantees.

Phase 4:

Wind Base Programme, introduction of FIT, offshore projects and amendment of the Renewable Energy Law (2008-2011)

The government started the Wind Base Programme in 2008, and selected seven areas, each to develop more than 10 GW wind capacity. The National Energy Administration selected locations in the provinces with the best wind resources and set targets to be reached by 2020.

According to the plan, the seven designated wind power bases[32] will add a combined total of 138 GW of wind power

Table 3: Annual installed capacity planned for Wind Power Bases in China (MW)

Wind Power Base	2010 (installed)	2015 (planned)	2020 (planned)
Heibei	4 160	8 980	14 130
Inner Mongolia East	4 211	13 211	30 811
Inner Mongolia West	3 460	17 970	38 320
Jilin	3 915	10 115	21 315
Jiangsu	1 800	5 800	10 000
Gansu Jiuquan	5 160	8 000	12 710
Xinjiang	0	5 000	10 800
Total	22 706	69 076	138 086

capacity by 2020, assuming that a supporting grid network is established. By early 2012 the Chinese government had confirmed seven GW-scale Wind Power Bases, with a total of 83 projects.

In terms of annual installed capacity, the provinces benefited significantly from this programme in 2010 (see table 3). The Wind Power Base in Gansu Jiuquan reported the greatest growth – more than 5 GW – while others followed with growths of between 1.8 GW and 4.2 GW.

Transmission bottlenecks have become a significant issue for the seven wind power bases. Many of the projects were reporting delays in obtaining final approval for the wind farms, due to the time required for interconnection, testing, certification, and final approvals. However, these delays were largely associated with personnel and administrative bottlenecks, rather than with infrastructure issues.

In 2009, China introduced a feed-in tariff for wind power generation, which applies for the entire operational period (usually 20 years) of a wind farm. There are four different tariff categories, ranging from CNY 0.51/kWh (USD 0.08/kWh) to CNY 0.61/kWh (USD 0.10/kWh), depending on the region's wind resources. The feed-in tariffs sent a strong signal of long-term financial price stability to the investors.

The Chinese government has continued to promote domestic manufacturing and technology development through a number of initiatives, including competitive bidding. For example, in 2009 seven domestic manufacturers were selected to supply over 5 GW of wind turbines to 25 projects in three sites in Inner Mongolia and Hebei provinces (Renewable Energy Policy Network for the 21st Century (REN21), 2010).

Driven by the global trend towards bigger wind turbines, Chinese firms, including Sinovel, Goldwind, XEMC, Shanghai Electric Group and Ming Yang, are now manufacturing wind turbines with rated capacities of 5 MW or more. Of these, Sinovel has already installed its 5 MW turbine in an offshore project and Goldwind expects to have its 5 MW machine ready for commercial use in 2012-13. This rapid cycle of technological, human and institutional learning has not been witnessed in any other market.

2011 was an important year for Chinese wind turbine manufacturers, as four companies, including Sinovel, Goldwind, United Power and Dongfang Electric, entered the list of the world's ten largest wind turbine manufacturers, and began to expand into overseas markets.

The national wind power generation market is mainly shared among the "Big Five" power producers and a few other major state-owned enterprises. These firms account for more than 80% of the total wind power market[33]. Most of the foreign-owned and private enterprises have only a limited presence in the market.

An update to the 2006 Renewable Energy Law was adopted by the National People's Congress in December 2009 and took effect on 1 April, 2010. Since this revision included detailed planning, a strong co-ordination was required between power sector and transmission planning, and also between the development plans drawn up at local/provincial level and those developed by national ministries. The revised law also clarified the roles and responsibilities of the power companies regarding the interconnection of renewable energy generation to the grid.

Energy storage and smart grids were also addressed in the revised law. The domestic wind energy sector had been growing at such high rates that the process of transmission planning and interconnection could not keep pace with annual wind turbine installations. Some completed wind projects, mostly those that were not coordinated with national planning, lacked transmission access, although this was not a widespread problem (Martinot and Junfeng, 2010).

The provisions guaranteeing the purchase of all renewable energy production by electric utilities were further strengthened. Previously, utilities were only obligated to purchase the electricity if there was sufficient electricity demand. Under the new version of the law, utilities were obligated to buy all renewable energy production. The utilities could then transfer the purchased power to the national grid company. The 2009 revisions to the law also added deadlines and economic penalties for utilities failing to comply with this guaranteed-purchase requirement.

As part of the 2005 law, the Ministry of Finance had established a Renewable Energy Fund and guidelines for the fund were improved and consolidated in 2010. Previously, the fund was meant to provide support to special projects developed solely as demonstration projects. The amended guidelines required the fund to utilise the surcharge to finance the tariffs payments for renewable energy projects. However, since the surcharge did not reflect the overall disbursements, the new revisions also allowed the Ministry to supplement this energy fund from general revenues.

China's first offshore wind power demonstration project, and the first offshore wind project outside Europe, is the Shanghai Donghai Bridge 102 MW offshore wind farm, which started generating power in June 2010.

During the period from May to November 2010, the government launched a public tender for the first round of offshore wind concession projects, adding 1 GW of planned capacity in four projects along the coastline of Jiangsu Province[34].

However these projects, although approved by the National Energy Administration (NEA), led to objections from other government departments seeking to protect fishing rights and other marine interests. In the meantime, the developers realised that the proposed prices were too low (Patton, 2012). Chinese power companies are now drawing up plans for a series of demonstration projects[35], as a way of gaining experience in offshore developments and preparing for the next tenders. By 2011, China had installed 242.5 MW through offshore demonstration plants, ranking third globally, after the UK (2093.7 MW) and Denmark (857.3 MW) (Junfeng, *et al.*, 2012).

In 2010, the National Energy Administration and the State Oceanic Administration jointly published "Interim Measures for the Administration of Development and Construction of Offshore Wind Power". These guidelines could help accelerate China's offshore wind power development as they set out provisions for project approval procedures, as well as criteria for project development and construction. Tender procedures will be the preferred method of selecting the offshore projects, and foreign investors can only hold a minority stake in offshore wind developments. China has set targets for offshore wind development of 5GW by 2015 and 30 GW by 2020.

Another significant change in 2010 was the removal of the requirement for 70% share of domestic content in terms of the value of incorporated materials and components. This requirement was no longer necessary, as all installed wind turbines were now nationally produced (Martinot and Junfeng, 2010).

By the end of 2010, most manufactured Chinese turbines had a capacity of 1.5-2.0 MW, in comparison with earlier years when models lower than 1 MW accounted for a major proportion of the turbine production. Four Chinese companies are among the world's top 10 wind turbine manufacturers.

CURRENT CHALLENGES

Despite its rapid expansion, the Chinese wind power sector continues to face significant challenges, including issues surrounding grid access and integration, reliability of turbines and the development of offshore wind projects. Due to varied wind resources and different technical and economic conditions across China, the developments focused on a few regions and provinces including: Inner Mongolia, the north-west, the north-east, Hebei Province, the south-east coast and offshore islands.

The rapid development of wind power has put a strain on the electricity grid infrastructure, and some projects are delayed by several months before being connected to the national grid. Reports stating that a large share of China's wind power capacity is not grid-connected are based on a misunderstanding due to the methodology used for calculating the installed capacity[36].

Due to a lack of incentives, the Chinese grid operator State Grid was initially reluctant to absorb large amounts of wind energy. An agreement was reached in 2010 to connect 100 GW of wind power by 2015 and 150 GW by 2020. According to figures from State Grid, by the end of 2010, CNY 40 billion (USD 6.1 billion) had been invested to facilitate wind power integration into the national power grid.

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[33] The largest wind power operators, Guodian (Longyuan Electric Group), Datang and Huaneng, expanded their capacity by 1-2 GW each during the year, while Huadian, Guohua and China Guangdong Nuclear Power are following close behind.

[34] The winning bids for these projects ranged between CNY 0.62 and CNY 0.74/kWh (USD 0.10 and USD 0.12/kWh).

[35] These demonstration projects were initially of a smaller size, consisting of several turbines with a maximum capacity of 20-30 MW. However the Rudong project (150 MW) was approved and labeled as a "demonstration project" in 2011. Demonstration projects enjoy a favorable tariff, compared to the low tariff resulting from the bidding process. This mechanism could play a positive role in testing the offshore technology and offshore wind farm management in the country (GWEC, 2011).

[36] For example at the end of 2010 the China Electricity Council published a figure for operational capacity, which included wind farms that had been connected to the grid with a Power Purchase Agreement, having successfully undergone a testing procedure, and for which the national grid operator State Grid had started to pay for the electricity. The accounting method resulted in a time difference of several months, compared to the installed capacity counted by the wind power associations CREIA and CWEA. The associations accounted for turbines that were grid-connected and were delivering electricity, even before undergoing the commissioning and acceptance procedure. This difference in accounting methods explains the gap between installation and grid connection, often reported from China. In other countries with significant wind installations, the common practice is to count all turbines once they are grid-connected and producing electricity.

Expansion of the electricity grid has not kept pace with the development of wind projects, and coordination for grid planning is needed at both national and provincial levels. The areas with the best wind resources are sparsely populated regions where electricity demand is low. For example Inner Mongolia, a region with a very strong wind resource, suffers from severe transmission constraints. High voltage transmission lines could connect Inner Mongolia and similar areas to the rapidly developing eastern parts of China. In 2011, more than 10 billion kWh of wind power was not generated because of wind farm curtailments (Junfeng, *et al.*, 2012).

Locally produced wind turbines are not certified using international standards. The quality improvements of the domestically manufactured wind turbines has not kept pace with the installation rates, although the situation is improving with the emergence of domestic certification agencies. Certification will be a critical element for exporting to international markets.

CONCLUSION

Some of the key factors underlying the growth path for wind industry in China are:

» A strong long-term legislative background;

» A clear tariff structure; and

» A strong industrial base.

The 11th Five-Year Plan period (2006-2010) was instrumental in stimulating the renewable energy industry in China. Much of the regulatory structure was put into place during this period, starting from planning documents to related statutes and regulations. Another key milestone was the passage of the Renewable Energy Law, which stimulated renewable energy R&D and equipment manufacturing, and resulted in the creation of an exceptionally large number of domestic wind projects (the law was amended in 2009).

The development of the policy framework was continuous and it integrated the lessons learnt from ongoing developments, including developing a price curve for (new) renewable technologies versus conventional energy generation. Onshore wind power was supported first, then solar, followed by offshore wind.

The 2006 Renewable Energy Law, and complementary measures such as the pricing policy, obligation on the grid companies to purchase renewable electricity, and cost distribution through the Renewable Energy Fund has accelerated the development of renewable energy

A maintenance engineer inspects a wind turbine at the Nan'no Wind Farm, Guangdong, China. ©2005 Greenpeace/Xuan Canxiong

in China. The 2006 law was complemented by a wind power "concession" programme (2003–2007), which added 3.4 GW through annual competitive project bidding (Martinot and Junfeng, 2010).

The evolution of the Chinese market shows that the determination of differentiated tariffs for each region was a lengthy process and required a cautious and well-researched use of concession tenders. Although the concession tenders were designed to find a realistic tariff for wind farms, the initial criteria for selecting winning bids were primarily based on the tariff. This strategy pushed developers into proposing low prices, thereby endangering the financial viability of the projects. The "lowest tariff" approach ultimately translated into extremely low profit margins for investors.

The Wind Base Programme has become a major driving force for wind development over the last four years. The programme started implementation in 2009 with seven 10 GW-size development areas being selected in six provinces. This major programme provided a large market for the domestic industry and was a turning point for the wind industry development in China. Large-scale concession tenders also played a significant role in promoting the development of the wind power sector during its early stages.

China's wind projects are mostly developed by state-owned energy company/utilities. The government-owned utilities account for almost 80% of the total capacity. The remaining 20% are increasingly supplied by utilities owned by provincial governments. Private enterprise and foreign-owned developing businesses represent a limited share of the total wind capacity of the country.

The Chinese government report "Development Planning of New Energy Industry" calculated that the cumulative installed capacity of China's wind power would reach 200 GW by 2020 and generate 440 TWh of electricity annually, creating more than CNY 250 billion (USD 38 billion) in revenue (Junfeng, *et al.*, 2010).

From the industry's point of view, the country faces challenges in its efforts to expand its renewable energy base. These include the need for expanding R&D institutions dedicated to renewables; improving the operational performance of wind turbines; reducing transmission issues for wind power; addressing delays in testing and certifying new wind turbine installations; conducting more detailed resource assessments; integrating renewables into the overall power sector planning and design at both national and local levels; continued policy development and adjustment; and ensuring the availability of skilled manpower.

ANALYSIS OF ENABLING CONDITIONS FOR WIND ENERGY

Effective rule of law; and transparency in administrative and permitting processes	With the introduction of the Renewable Energy Law in 2006, the wind industry grew rapidly. This law, together with other measures such as a pricing policy, obligation on grid companies to purchase renewable electricity, and cost distribution, accelerated the development of renewable energy. Improved permitting processes are under development. Due to the large developments expected in the future, infrastructure planning also requires coordination at both regional and central levels.
A clear and effective pricing structure	In 2009, China introduced a feed-in tariff for wind power generation, which applies for the entire operational period (usually 20 years) of a wind farm.
Provisions for access to the grid (incentives and penalties for grid operators)	Renewable energy-based electricity generation from approved projects has priority access to the grid.
An industrial development strategy	The government encouraged early joint ventures with foreign manufacturers. It also implemented a local content requirement rule to encourage the local production of wind turbine generators. This rule was later abolished in 2010.
A functioning finance sector	The government, state-owned enterprises, the Chinese Development Bank, international lending institutions and donor agencies have all been instrumental in financing wind projects. Furthermore, China has been the largest beneficiary of support from the Clean Development Mechanism of the UNFCCC, including support for wind projects.
Expression of political commitment from government (e.g. targets)	The Chinese government has declared a target of connecting 100 GW of wind power to the grid by 2015 and 150 GW by 2020.
A government and/or industry-led strategy for public and community buy-in.	Not applicable
An employment development strategy	Not applicable
NOTE	**Long-term national renewable energy policies and targets drive the unparalleled rate of growth of the Chinese wind industry.**

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DENMARK

MARKET OVERVIEW

By the end of 2012, Denmark had installed 4 162 MW of wind capacity. According to the Danish Transmission System Operator (TSO) Energinet.dk, wind power represented a share of 28.3% of the country's total electricity demand in 2011, by far the largest share of any country in the world[37]. Wind power accounted for 9 765 GWh of electricity generation in 2011.

For Denmark, the 2009 European Renewable Energy Directive targets a share of renewable energy in the country's final energy demand rising from 17% in 2005 to 30% in 2020. The government has set a target of 50% wind energy in electricity consumption by 2020 as part of its long-term strategy to achieve a 100% renewable energy mix in the electricity and heat sector by 2035, and in all sectors by 2050 (Danish Energy Agency (DEA), 2012a)[38].

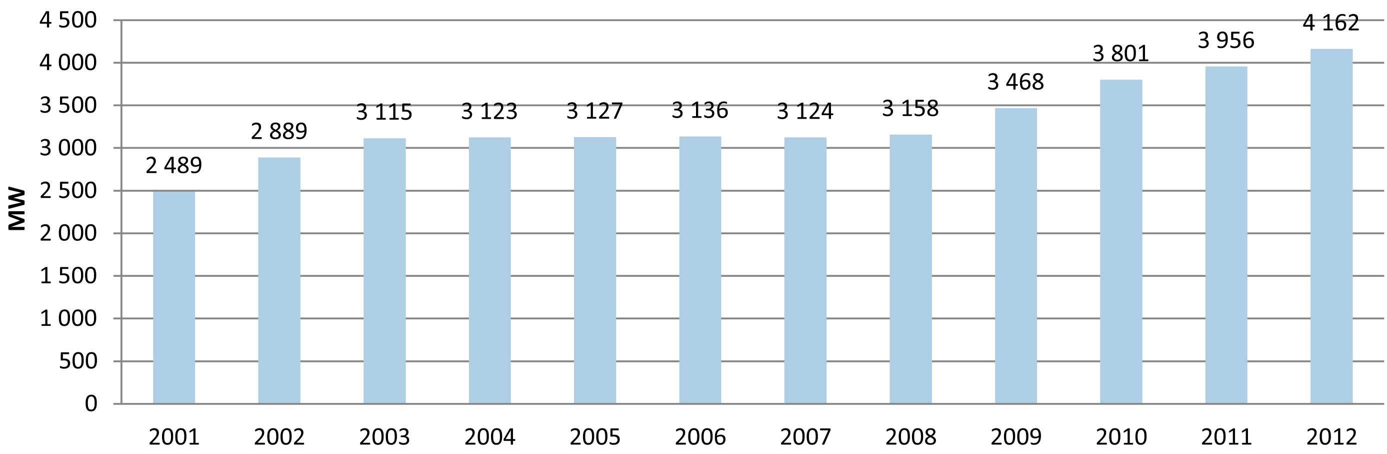

Figure 6: Cumulative Wind Installation (MW) of Denmark (GWEC, 2013)

HISTORY AND EVOLUTION OF THE POLICY AND REGULATORY FRAMEWORK FOR WIND ENERGY

The history of wind energy in Denmark goes back hundreds of years although real commercialisation of the technology started only after the oil crises of the 1970s. In 1973 Denmark had an exceptionally high dependency on oil in its energy mix with more than 90% of its energy supply based on imported oil. This situation led to significant economic difficulties triggered by the 1973 and 1979 oil crises. It stimulated Denmark to shift from oil to coal for electricity production and propose the use of nuclear power to ensure security of supply. These decisions became part of a proactive energy policy promoted through four energy plans over the following two decades (DEA, 2010).

Phase 1:

First Energy Plan, (Dansk Energipolitik): 1976

This plan was developed to safeguard the country against energy supply crises and reduce dependence on imported oil. Its focus was on energy savings and converting Danish power plants from oil to coal and nuclear power. At that time, renewable energy only had a marginal role in the country's energy supply.

Energy taxes on electricity prices were imposed in the mid-70s, and used to support R&D for renewable energy. This provided financial support for public research, while spreading the costs of that research among all electricity customers. In 1979, Denmark created its Ministry of Energy.

In 1973 the electricity companies announced their intention to build nuclear power plants and by the following year 16 possible locations had been identified. However an anti-nuclear movement (OOA) soon started in the country and over the next 11 years took the lead in a broad public campaign ending in March 1985, when a majority of the members of the Danish parliament decided to exclude nuclear power from future energy planning.

This development had major help from two alternative energy plans published by independent groups of energy experts: "Sketch for an energy plan in Denmark"[39] published in 1976 and "Energy for the future: alternative energy plan"[40] published in 1983 (Blegaa, *et al.*, 1976; Hvelplund, *et al.*, 1983).

Wind power was included in these plans as one of the key alternatives to nuclear power. Together with the anti-nuclear movement, the plans were significant drivers for the introduction of wind and other renewables which, together with energy efficiency and natural gas in decentralised cogeneration plants, offered an alternative to nuclear power (Greenpeace, Denmark 2012).

By the early 1980s several manufacturers were producing wind turbines with a capacity larger than 55 kW. However, since these turbines were too costly for most individual owners, the concept of local wind cooperatives – where groups of people invest jointly in shared wind turbines – developed (Grobbelaar, 2010). Many individual owners invested in wind turbines to meet their own energy consumption needs with the option of selling excess electricity generation to the grid.

Phase 2:

Second Energy Plan (Energiplan81): 1981

This plan laid the ground for rapidly growing indigenous energy production and nuclear power. It included oil and gas recovery in the North Sea, the development of a nationwide grid for natural gas, and the introduction of subsidies for the construction and operation of wind turbines and biomass plants.

The support brought by the Energy Plan helped establish a strong home market for renewable energy and a local industry associated to it, while taxes imposed on oil and coal helped increase the competitiveness of renewable energy plants. Furthermore, during the 1980s Danish families were offered tax incentives for generating power for their community. As a result, more and more wind turbine cooperatives started to invest in community-owned wind turbines.

Another important parallel development during the 1980s was the large renewable energy market in California, which created an export opportunity for Danish wind turbine manufacturers until the California wind market came to a halt in 1985 (see page 134 for further discussion).

In 1985, a parliamentary majority rejected nuclear power. An agreement between the Ministry of Energy and the utilities, "100 MW Agreement", was reached to develop 100 MW of wind power between 1986 and 1990 (Organisation for Economic Co-Operation and Development (OECD), 2000). This agreement supported the local wind industry's growth at a time when its overseas sales had fallen. The government set ambitious targets for utilities to install wind power, with two orders of 100 MW issued in 1985 and 1990, and a further order of 200 MW for completion in 2000.

The Danish government initially provided capital grants of up to 30% of the installation costs, progressively reduced to 20%, and then 10%. With sound growth in reliability and improved cost-effectiveness of the turbines, the subsidy for wind power was repealed in 1988[41].

Denmark reduced the capital subsidy and required utilities to interconnect and purchase power from wind projects. Utilities were also required to provide a fair price. The total installed wind power capacity increased to approximately 300 MW, mostly based on 100 kW wind turbines.

Some subsidies introduced under this plan continued to be available through research funds into the mid-2000s. Grants were also made available for replacing old wind turbines.

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[37] Interview with Sune Strom, Sr. Economist at Danish Wind Industry Association in 2012 (Danish Wind Industry Association (DWIA), 2012).

[38] This agreement was reached under a broad energy agreement (on 22 March, 2012) supported by all major political parties in Denmark (apart from one).

[39] "Skitse til alternativ energiplan for Danmark"

[40] "Energi for fremtiden: Alternativ energiplan"

[41] In 1988, the newly elected government cut the subsidy by half. However, thereturn on investment in wind energy was maintained between 15% and 25%, and community-owned wind energy was supported by three principles: 1.The right to connect to the electrical grid;2.A legal obligation for electrical utilities to purchase wind energy; and 3.A guaranteed fair price (Christianson, n.d.).

Phase 3:

Third Energy Plan (Energi 2000), Feed-in tariff: 1990

The third plan was one of the first energy plans in the world without nuclear power. It set a target of reducing Danish CO2 emissions by 20% between 1988 and 2005. Specific targets included providing 10% of electricity from wind turbines by 2005.

By 1992, the "fair price" for wind power was set at 85% of the retail electricity rate. The rules provided guaranteed interconnection and power purchase of wind-based electricity. Noticeably, the price was set relative to retail rates, and not relative to the cost of production for wind generators (Farrell, 2009).

By 1992 systematic planning procedures, which included directives for local planners, were developed and implemented at the national level. At the same time an executive order from the Minister of Environment and Energy ordered municipalities to find suitable sites for wind turbines throughout the country. The planning directives included provisions for public hearings prior to any actual applications for siting of turbines, which was a significant help in getting public acceptance for their installation (Krohn, 2002).

A fixed feed-in tariff for electricity production was introduced in 1993 and decoupled the power purchase price from existing electricity rates. The price paid for electricity generated from wind turbines was set at 85% of the utility's production and distribution costs.

In addition, wind projects received a refund from the Danish carbon tax and a partial refund on the energy tax. These refunds effectively doubled the payment to wind projects for the first five years of their operation (Bolinger, 2001).

This support was provided equally across the country, irrespective of the wind conditions, which prompted wind farm developers to establish wind turbines at the best onshore locations. The outcome of the "Energi 2000" plan was that 10% of Danish electricity consumption would be supplied by wind energy by 2005.

Phase 4:

Fourth Energy Plan (Energi 21): 1996

In the fourth plan, it was envisaged that renewable energy would provide 12-14% of total energy consumption in 2005, and 35% by 2030. By 1997 a further set of planning regulations had been developed for offshore wind farms, with the creation of a central national authority. The Danish Energy Agency was in charge of implementing the renewable energy policies. This solution provided a dedicated agency for supervising planning permissions (Krohn, 2002).

By 1996, there were around 2 100 cooperatives throughout the country, which created the basis for continuing popular support for wind power in Denmark. By 2001, wind turbine cooperatives, including more than 100 000 families, had installed 86% of all turbines in Denmark. In 1998 the Danish government ordered an additional 750 MW of offshore wind power to be installed across five parks (Krohn, 2002).

By the turn of the century Denmark had become a net exporter of energy. In the following years, rising oil prices and an increased awareness of climate change influenced new energy policy guidelines, with higher ambitions for renewable energy.

Phase 5:

Electricity market liberalisation (1999-2008)

In 1999, the new government passed a resolution to liberalise Denmark's electricity market by 2002[42]. The electricity reform set the target for electricity from renewable sources at 20% of the Danish electricity consumption by 2003, largely from wind and biomass (Department of Trade and Industry (DTI, 2004).

In 1999, Denmark decided to abandon its feed-in tariff and to support renewable energy through a renewable portfolio standard (RPS) mechanism with a system of tradable green certificates. Although a new tradable green certificate system was introduced, the supporting legislation failed to be passed by parliament (DWIA, 2012).

Under the new policy guidelines, the Danish government emphasised the need to increase competition in the

[42] Outside Denmark's major cities, the consumers traditionally owned electricity supply and distribution networks. Competition was introduced into the electricity supply sector when it was liberalised in 2002, but the distribution networks remained monopolistic.

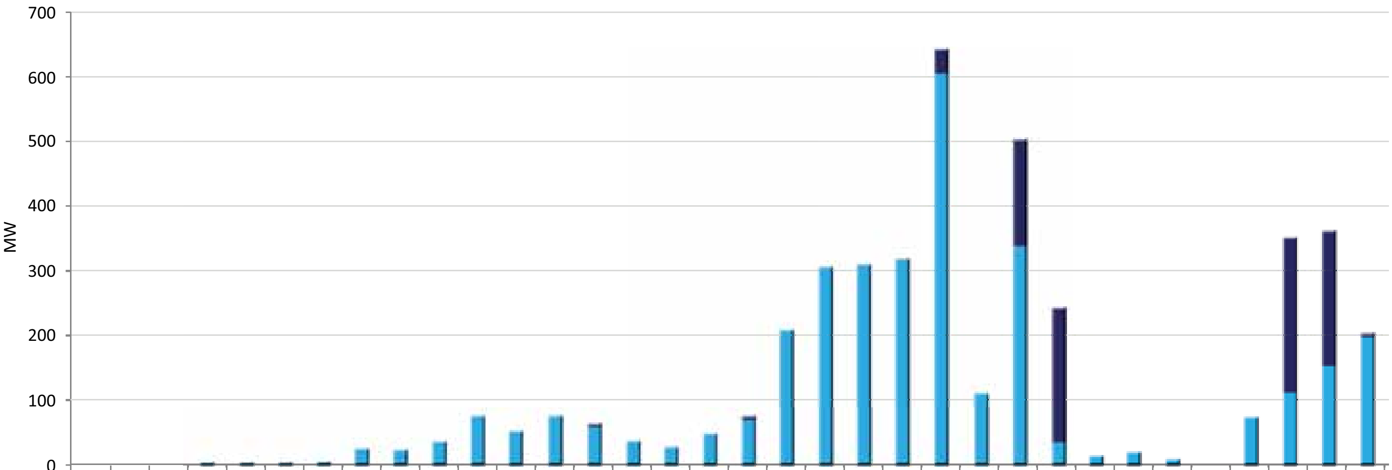
[43] Support instruments are regulated by Law No. 1392/2008 on the Promotion of Renewable Energy, by the Act on Electricity Supply, and by the Act on Transmission Grid Operator Energinet.dk

energy sector, and to encourage greater competitiveness of the renewable energy plants. As part of the new governmental policy, two of the planned five offshore parks were cancelled and the feed-in tariffs were changed substantially in 2002.

By 2003, all wind generators were connected to the grid under the new renewable portfolio standard. The remuneration was made up of the market price plus a premium. This premium was capped, setting a maximum price that the wind producers could receive. However, the new scheme no longer guaranteed interconnection.

Additions to wind power capacity declined rapidly, and the wind energy market stalled until 2008, when a new support framework was introduced. From 1993 to 2004, Danish wind power grew from 500 MW to over 3 000 MW but once the feed-in tariff was abandoned in 2004, the wind power development stagnated.

Between 2001 and 2008, the energy policy developments in Denmark were considered very unambitious. The period 2004 to 2008 saw an addition of only 129 MW of wind capacity.



	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Offshore	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
Onshore	1	0	2	4	4	4	6	27	25	40	78	56	79	62	43	32	53

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Offshore	5	0	0	0	0	40	0	164	209	0	0	0	0	0	238	207	4
Onshore	74	215	309	315	320	605	112	340	38	15	22	12	3	78	116	157	202

Figure 7: Annual Wind Installations in Denmark 1978-2011 (DWIA, 2012)

In 2004 there was considerable restructuring of Denmark's power supply sector. The power companies were privatised, and power distribution, transmission and production became independent sectors each with distinctive frameworks (Maegaard, 2009).

» Power distribution became the responsibility of local not-for-profit cooperatives, municipalities, or companies with a concession.

» Power transmission (> 60 kV) became the responsibility of Energinet, a new, wholly state-owned company.

» Power generation was divided as follows (a) central power plants owned by DONG Energy (76% owned by the Danish state), (b) Plants owned by Vattenfall (a Swedish state-owned company) and E.ON (a German company), (c) municipal and local consumer-owned combined heat and power plants, and (d) wind power with 85% ownership by Independent Power Producers and the rest by the central power companies.

In 2008, the government developed an energy agreement valid until end 2012, which included the installation of two offshore parks of 200 MW each (installed in 2009 and 2010), and gave responsibility to the municipalities to plan for 75 MW onshore wind power in 2010 and 75 MW onshore in 2011 (Greenpeace Denmark, 2012).

In its energy policy statement of 2008[43] the Danish government committed itself to address climate change at minimal economic costs and without risking security of energy supply. This included making improvements in the nation's energy efficiency, increasing renewable energy and technological development. The government specifically committed to:

» Reduce total energy consumption by 2% by 2011 and by 4% by 2020, based on 2006 figures; and

» Increase the use of renewable energy to 20% of gross energy consumption by 2011.

To help meet these ambitious targets, the government committed to increasing funding for R&D and demonstration of energy technology to EUR 135 million (USD 201 million) per year.

Phase 6:

Rejuvenation and strengthening of the wind sector: 2009-2012

In 2009, Denmark saw a significant rise in installations with 116 MW of new capacity being erected onshore and 238 MW in national waters, bringing the total installed wind capacity up to 3 482 MW (DWIA, 2012).

In 2009, the main policy support mechanism for wind energy in Denmark was an environmental premium of DKK 0.25/kWh (USD 0.05/kWh) for 22 000 full load hours (equivalent to some 10 years of operations) added to the market price. An additional compensation of DKK 0.023/kWh (USD 0.004/kWh) was provided for balancing costs. The grid connection costs for offshore wind farms were financed by the electricity consumers, and special tariffs were defined based on competitive tenders (GWEC), 2009).

The support scheme for electricity from renewable energy sources was based on price premiums added to the market price, and tenders for offshore wind power. The financing instruments were conceived and managed by the Danish Energy Agency. The combination of market price and premium ensured stable revenues for the producer. All subsidies costs were passed on to consumers as an equal Public Service Obligation tariff on their total electricity consumption (Rathmann, *et al.*, 2009)[44].

During that period of time, many of the wind turbines installed in the 1980s and 1990s were reaching the end of their lifespan. The repowering of old turbines was likely to become an important part of the national market[45].

In February 2011, the government published its Energy Strategy 2050. The government's goal under this strategy was to achieve independence from coal, oil and gas by 2050, with an interim objective of 30% of the final energy demand supplied by renewable energy by 2020.

In 2011, a new government was elected. The winning party's manifesto had, among other things, proposed the following actions under its plan on energy and climate:

» All energy needs shall be covered by renewable energy in 2050.

» The electricity and heat sector shall be 100% supplied by renewable energy in 2035.

» Coal will be phased out from power plants and private oil boilers will be phased out by 2030 at the latest.

» The government will adopt a target of reducing the greenhouse gas emissions by 40% compared to 1990 levels.

» Half of the traditional electricity consumption shall come from wind by 2020.

» A comprehensive new strategy will be developed for creating smart grids.

In March 2012, a broad energy agreement was reached for the period up to 2020 (Danish Ministry of Climate, Energy and Building, 2012). According to this agreement, wind energy in 2020 would cover 50% of electricity consumption, and the greenhouse gas emissions from the Danish energy sector would be reduced by 34% in 2020 compared to 1990 levels. The remaining six percentage

[44] For onshore wind since 2009: guaranteed price premium of DKK 0.25/kWh (USD 0.05/MWh) for 22 000 full load hours. Additionally, DKK 0.023/kWh (USD 0.004/kWh) is received during the entire lifetime of the turbine to compensate for the cost of balancing. Systems financed by utility companies: maximum subsidy (premium plus market price) of DKK 0.33/kWh (USD 0.06/kWh), applicable for 10 years from the date of connection of the system, plus guaranteed bonus (unlimited term) of DKK 0.10/kWh (USD 0.02/kWh).

For new offshore wind since 2009: premium plus market not exceeding (depending on location) DKK 0.518 or DKK 0.629/kWh (USD 0.1 or USD 0.12/kWh) for up to 10 TWh within 20 years of grid connection. Systems financed by utility companies: maximum subsidy (bonus plus market price) of DKK 0.353/kWh (USD 0.07/kWh), applicable to 42 000 full load hours, plus guaranteed bonus (unlimited term) of DKK 0.10/kWh (USD 0.02). Additionally, DKK 0.23/kWh (USD 0.04) is received during the entire lifetime of the turbine to compensate for the cost of balancing etc.

[45] For wind turbines connected to a grid on 21-02-2008 or later, the premium (on top of market price) offered was DKK 0.08 /kWh (approximately USD 15.9/MWh) or maximum subsidy (premium plus market price) of up to DKK 0.38 /kWh (approximately USD 75.7/MWh) for electricity production corresponding to 12 000 peak-load hours, provided the double the amount of the installed output of the dismantled wind turbine (Rathmann, *et al.*, 2009).

[46] For new onshore turbines coming online from 1 January, 2014 the premium will stand at DKK 0.25/kWh (approximately USD 0.05/kWh) for the first 22 000 full load hours, reduced when the market price of electricity exceeds DKK 0.33/kWh (approximately USD 0.06/kWh), and set to zero when the electricity price reaches DKK 0.58/kWh (approximately USD 0.11/kWh) or higher (Greenpeace Denmark, 2012).

La Ventosa, Oaxaca, Mexico ©AMDEE

Table 4: Share of Wind Energy as percentage of total electricity consumption in Denmark (Energinet.dk, 2012)

2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
12.3%	14.0%	16.0%	18.8%	18.7%	17.0%	19.9%	19.3%	19.4%	22.0%	28.3%

points to meet the 40% reduction of domestic carbon emissions by 2020 would be addressed through efforts in the transport and agriculture sectors in line with the forthcoming climate change plan.

It was also decided to build a total of 3 300 MW new wind power capacity. The Danish wind sector is expected to expand under this agreement. Offshore, the wind parks of Horns Rev III (400 MW) and Kriegers Flak (600 MW) will be tendered over 2013-2015 and are due to be commissioned over 2017-2020 (DEA, 2012b).

Furthermore, 500 MW near-coast wind and 1 800 MW new onshore wind are foreseen, from which 1 300 MW will be achieved through repowering.

The expansion of the electricity grids will be financed through a Public Service Obligation (PSO) scheme via the Energy Bill under the new agreement (DEA, 2012a). In the first half of 2013 the possibility of further reduction in surcharge (price-adder) for onshore wind where the full surcharge is not needed will be discussed and agreed to[46].

CURRENT CHALLENGES

In order for Denmark to reach its goal of 50% wind power penetration in 2020, industry developments will need to progress faster than current levels.

Connection to the electricity grid is a challenge. The Transmission System Operator (Energinet.dk) is supportive of the developments, and plans to supply 50% of the demand with wind power by 2025. The following chart (Energinet.dk, 2011) outlines the company's approach and the steps it would take between now and 2025 to meet this target.

Over the last ten years some sections of the local communities have been protesting against any further building of onshore wind turbines across the country. This has made private sector development of wind farms very cumbersome in the last decade.

	Short Term	Medium Term	Long Term
Primary focus: Power system balancing	• Expansion of interconnections • Reinforcement and exapnsion of existing power grid • Downward regulation of generation aided by negative spot prices • Maket coupling • Better wind power forecasting	• Geographic distribution of offshore wind farms in the gas system • Offshore grid • Demand response • Flexible electricity generation • Smart Grid	• Electricity storage in the gas system • Compressed Air Energy storage • Electricity storage in batteries
Primary focus: Intergration of RE electricity into other sectors	• Heat pumps at CHP plants • Electric boillers at CHP plants • Heat pumps in households	• Plug-in hybrid vehicles • Electric vehicles	• Use of (electrolysis-based hydrogen in the transport sector • Use of (electrolysis -based) hydrogen in the gas network.

Source: Energinet.dk (2011)

CONCLUSION

Renewable energy and the efficient use of energy have played a central role in Danish energy policy for more than three decades. The country is the pioneer of wind energy development in Europe, and its wind farms now provide on average more than a quarter of the country's electricity needs. Its wind industry is today among the most significant exporting industries of the national economy. Denmark has for a long time been a global centre for wind turbine manufacturing with Bonus, LM, Siemens and Vestas -some of the world's leading turbine manufacturing firms– based in the country. According to the Danish Energy Agency, close to 100% of the manufactured wind turbines in Denmark were exported during the years 2004-2008, and the trend has continued to date.

Under its energy plans, the Danish government was Europe's first country to bring in large subsidies for its nascent wind industry, including the feed-in-tariff system[47], which was successfully replicated in Germany. The industry also received significant subsidies for R&D in the late 1970s and the 1980s.

As a result of the Danish energy debate, the four energy plans, and the comprehensive reform of the electricity sector by the current Danish government, Denmark has for several years now been a net energy exporter[48]. The country's electricity grid connects hundreds of small-scale "distributed" generators making use of wind resources and efficient use of a range of fuels.

The country is also a pioneer in the use of environmental taxation, with a range of primary energy taxes introduced since the 1980s. These taxes were designed inter alia to reduce air pollution and CO2 emissions, encourage energy efficiency, and support renewable energy. These taxes helped support development, with the revenue being used to support a range of technologies[49] (DTI, 2004).

Cooperatives have played an important role in the development of wind power by helping create public acceptance. Their engagement has ensured that communities directly benefitted from wind power development, especially in the form of profit-sharing from electricity generation from renewable energy sources and

[47] The tariff for wind energy in Denmark depends on several variables: the start date of operations, the number of full-load hours delivered, and whether the project is located offshore or onshore. The tariff comprises a market price element, a compensation for balancing, and a government subsidy. The level of support for electricity produced from wind turbines was increased during summer 2008. New wind turbines, both onshore and offshore, are receiving a price premium of EUR 0.033/kWh (approximately USD 0.05/kWh) for 22 000 full load hours.

[48] Denmark's grid is connected to the Nordic Power Market (consisting of Finland, Sweden and Norway) and Germany, which helps evacuate excess power, especially at night. Norway and Sweden's dams act like large battery storage for excess wind electricity.

from lower energy taxes. The planning responsibility for offshore wind farms is currently managed at government level, while the planning of onshore wind farms is collaborative.

In the 1970s rising environmental awareness, the oil crisis and the anti-nuclear debate had a major impact on the reformulation of the Danish government's energy policy. In the 1980s the government focused its policy on reducing dependence on fossil fuels and subsidising clean energy sources. The large wind energy market in California was a major importer of wind turbines, and drove the Danish industry. However, with the reduced demand from overseas markets by the mid-80s, subsidies to the industry were curtailed and rationalised.

In the early 1990s, a new energy plan provided a feed-in tariff for wind, which led to rapid growth in the wind sector between 1994 and 2002. Coordinated government support mechanisms such as long-term R&D support, premium tariffs for wind electricity generation and ambitious national targets helped the domestic wind industry to mature. However, with a change in government in 2001, and the phasing out of the feed-in tariff there was stagnation in the wind sector till the end of 2008.

In 2009 the market was revived due to the United Nations Climate Change Conference in Copenhagen 2009, and the setting of a long-term European target for promoting electricity generation from renewable energy sources. (Lund, *et al.*, 2010).

[49] Denmark was one of the world's first countries to introduce a CO2-tax on both household and businesses energy consumption. With the aim of encouraging energy efficiency and switching towards fuels with less CO2 content a standard tax rate was set at EUR 13.4 (approximately USD 27). As part of an overall reform of the Danish tax system, energy and CO2 taxes on household energy consumption were increased in 1993. The revenues from the environmental taxes were used to compensate for labour taxes. The social disparities of indirect environmental taxation on lower-income groups were compensated by reductions in low-income taxation and an increase in child support.

ANALYSIS OF ENABLING CONDITIONS FOR WIND ENERGY

Effective rule of law; and transparency in administrative and permitting processes	A coherent and long-term policy framework has been in place since 1979. However, the wind sector experienced stagnation on the period 2001-2008, due to limited political support for the technology. There has been a strong revival of political support for wind energy post-2009.
A clear and effective pricing structure	Electricity production from renewable sources is supported through price premiums added to the market price, capped at a maximum amount, and tenders for offshore wind power. These instruments are drawn up and managed by the Danish Energy Agency. The combination of market price and premium ensures stable revenue to the producer. All subsidy costs are passed on to consumers as an equal Public Service Obligation.
Provisions for access to the grid (incentives & penalties for grid operators)	Priority access is guaranteed to renewable energy producers.
An industrial development strategy	Four energy plans – the outcome was that Denmark became a net exporter of electricity.
A functioning finance sector	The investment for wind farms initially came from individuals through cooperatives. However, turbines became larger, the size of the projects increased, requiring private sector investment. Small individual developers have difficulties in investing in large projects (onshore), due to the amount of investment required. Offshore projects are mostly financed by utilities.
Expression of political commitment from government (e.g. targets)	The country aims to generate 50% of its electricity consumption from wind power by 2020, aiming at a full independence from coal, oil and gas by 2050.
A government and/or industry led strategy for public and community buy-in.	Stakeholder engagement and consumer awareness have played an important role in shaping the Danish energy sector. The country has a large number of cooperatives. The 1996 Energy Plan aimed at creating an energy sector rooted in a "democratic, consumer-oriented structure".
An employment development strategy	Subsidies have been available to the wind sector for R&D, and the government supported the initial phase of exports.
NOTE	**Continuous government support has been in place since the 1980s, including support to long-term R&D, premium tariffs and the setting of ambitious national targets. All of these have helped the domestic wind industry to expand internationally.**

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GERMANY

MARKET OVERVIEW

Germany is the world's third-largest market for wind. In 2012, the country installed 2 415 MW of wind capacity, bringing its cumulative total to 31 308 MW. According to the National Renewable Energy Action Plan, the percentage of energy from renewable sources in the gross final energy consumption will rise from 6.5% in 2005 to 18% in 2020, and could even be surpassed to reach an aspirational target of 19.6% (Bundesministerium für Umwelt, Naturschutz Und Reaktorsicherheit (BMU), 2011a). By 2020, renewable energy will represent at least 35% of the gross electricity consumption of Germany (BMU, 2011b).

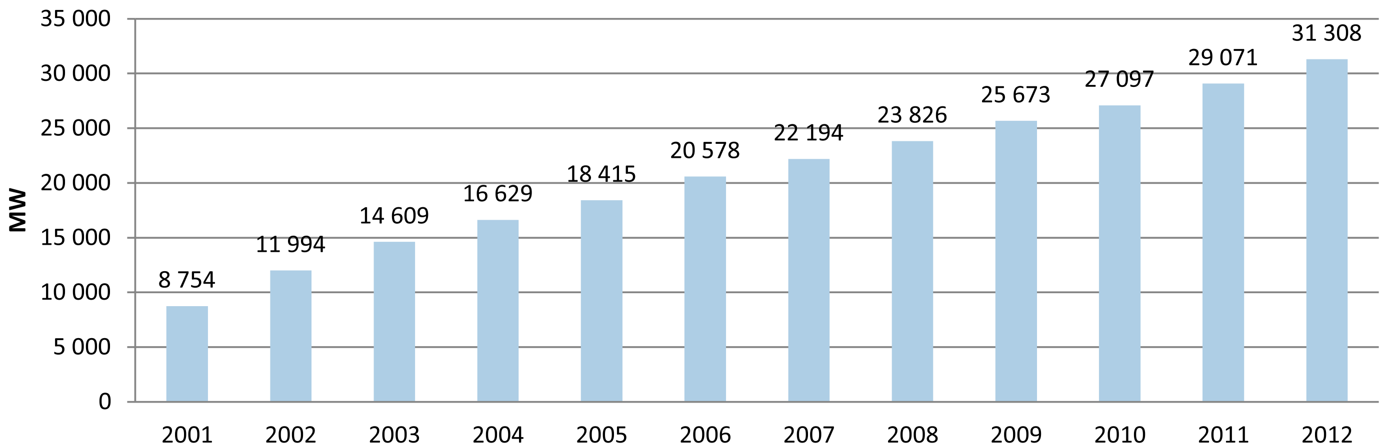

Figure 8: Cumulative Wind Installation (MW) of Germany (GWEC, 2013)

HISTORY AND EVOLUTION OF POLICY AND REGULATORY FRAMEWORK FOR WIND ENERGY

The discussions on sustainable electricity generation started with the two oil crises of 1973 and 1979, which stressed on the need for reducing dependence on energy imports. The initial discussions however focused on using more coal and nuclear.

Phase 1:

Support for technology demonstration and limited market growth (1979-1990)

A tariff for renewables based electricity generation was introduced in 1979 to stimulate market demand. It encouraged distribution companies to purchase locally produced renewable electricity at a price equivalent to the avoided costs. The system was similar to the Public Utility Regulatory Policies Act (PURPA) rules in the US (see page 136 for further details). Since the estimated avoided costs were low, the proposed price was also low and this initiative had no significant impact.

Until the end of the 1980s, Germany's electricity supply system was dominated by very large utilities relying on coal and nuclear generation. Small and decentralised forms of generation were at a disadvantage. However, during the late 1980s a series of events shaped the future regulatory framework for renewables.

In 1986, the Chernobyl accident had a profound impact on public opinion and subsequently on energy policies. Between 1987 and 1990, a series of proposals for institutional change were formulated, which included a feed-in law for the electricity produced from renewable sources. These proposals were supported by several government-funded R&D projects.

Phase 2:

Market creation and introduction of the Electricity Feed-In Act (1991-1999)

The first Electricity Feed-In Act (EFL), which came into effect in 1991, regulated the purchase and price of electricity generated by hydropower, wind energy, solar energy, landfill gas, sewage gas, and biomass.

The EFL guaranteed connection to the grid and proposed a Renewable Energy Feed-In Tariff (REFIT) to renewable energy generators. It also helped develop a national wind industrial base. For wind energy, the feed-in tariff was set at 90% of the average electricity utility rate per kWh[51]. Together with the 100/250 MW programme and subsidies from various state programmes, the EFL provided considerable financial incentives to investors in renewable energy projects (Sijm, 2002).

The rapid penetration of wind energy by the turn of the century can be attributed to the EFL, as can the obligation for power companies to purchase renewable energy from producers at fixed rates (Runci, 2005).

In addition, the government encouraged rural development by changing the Building Code in 1996. The code distinguishes between urban and non-urban areas and gives certain buildings in non-urban areas a special status. For these buildings, a construction permit should be granted, unless it infringes public interest. Since January 1997, wind power plants have been considered as having this special status.

In 1997, the EFL was incorporated into the Act on the Reform of the Energy Sector, which transposed the European Renewable Energy Directive into national law[52]. In 1999, when EFL reform started, Germany's national wind turbine industry had grown to be the second-largest in the world.

Phase 3:

Market consolidation and Renewable Energy Sources Act (2000 -2012)

The seminal Renewable Energy Sources Act (Das Erneuerbare-Energien-Gesetz or EEG) came into force in 2000. This Act, which provided the main stimulus for the national wind market, established a feed-in tariff for each kWh produced, and awarded priority connection to the grid for power generation based on renewable energy.

A two-component tariff was designed for wind energy, with an initial fixed tariff for a period of five years, and a second period of 15 years with a tariff level modulated by the local wind conditions[53]. A strong element of the EEG was the obligation for power utility companies to purchase renewable energy at set tariffs over a period of 20 years.

From 2002 onwards, new installations received lower tariffs. Different elements such as technology learning were considered to set an annual tariff degression[54]. The degression rate for new wind contracts was fixed at 2% per year, and later revised to 1%. This provided wind turbine manufacturers with an incentive to systematically reduce production costs and offer more efficient products each year. By defining the tariffs for different technologies based on the yield/generation costs of each plant, the stepped tariffs mirrored the learning curve of the technology. They capped the producer's profits, and lowered costs to consumers (WWF Finland, 2008).

In 2002 the government published a strategy paper on offshore wind energy (Die Bundesregierung 2002), which marked the beginning of the development of the national offshore wind sector. Its objective was to establish large-scale wind power capacities offshore to increase the share of renewable electricity in the energy mix. The renewable energy targets of the European Renewable Energy Directive reflected the German offshore policy.

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[50] For example if consumers had paid, on average, EUR 0.10/kWh (approximately USD 0.2/kWh) in 1991, a farmer setting up a wind turbine received EUR 0.09 (approximately USD 0.17) for every kWh fed into the grid in 1993. For electricity produced from other eligible sources of renewable energy, the corresponding feed-in tariffs were set at lower rates of either 80% or 65% of the average consumer price, depending on the output capacity of these sources.

[51] This reform ensured that the feed-in rates would remain unchanged. The removal of policy uncertainty resulted not only in further expansion of the market for wind turbines, but also in the entry of larger firms into the wind turbine industry as well as into the business of financing, building and operating wind farms.

[52] Wind installations on very good sites (reference yield of 150%) receive tariffs for only five years. This period could be extended for turbines on sites with lesser wind conditions. In total, tariffs were paid for 20 years. No compensation was granted for turbines with a reference energy yield of less than 60%, to discourage installation of wind turbines on unfavourable sites.

[53] This "degression" rate varied with technology. The degression was intended to reflect the learning curve, as costs lower with increased production volumes. The degression mechanism was chosen in part as a means of gradually eliminating the premium paid to renewables relative to the market price.

Due to existing environmental protection laws for Germany's coastal regions, the offshore developments were limited to the Exclusive Economic Zone. The offshore sites were situated at least 12 nautical miles from the coast, which required putting up structures in deeper waters than the Danish projects for example (20-30 m depth instead of 5-10 m). This challenge to locate deeper sites further from the coast than as the state-of-art projects of that time did inspire the German wind industry to develop turbines that could withstand more difficult environmental conditions.

At the same time the government established and financed R&D programmes for offshore wind[55]. After the 2008 financial crisis, concerns regarding finance and insurance, as well as technical challenges, contributed to a lower expansion rate of the offshore installations than initially planned.

The EEG was amended in January 2009. It included an increased initial tariff for both onshore[56] and offshore wind energy. The tariff system was designed to respond to market dynamics[57] and the level of technology maturity. The new EEG required grid operators not only to expand the grid, but also to optimise its management. Failure to comply with these requirements could lead to claims for damages by any renewable power producer willing, but unable to connect to the grid.

In September of 2010, the government adopted the "Energy Concept", which includes long-term climate and energy targets[58]. As a response to the nuclear disaster in Fukushima in 2011, Germany decided on the gradual phasing-out of nuclear power by 2022, greater energy efficiency and an accelerated growth of renewable energies (BMU, 2011b). These decisions supplemented and accelerated the implementation of the measures set out in the "Energy Concept".

The continued and rapid expansion of renewable energies will be a central element for the future national electricity market. Greater coordination will be needed between renewable energy generation and conventional power plants, both for market and system integration.

The EEG was subsequently amended in January 2012 (BMU, 2012a). The main amendments included an increase in the tariff degression rate from 1% to 1.5% for onshore wind and a "repowering bonus", which improves the economic conditions of the repowering projects.

For offshore wind, several elements were revised:

» Integration of a "sprinter premium" (EUR 0.02/kWh / USD 0.03/kWh), added to the initial tariff, increasing it from EUR 0.13/kWh to EUR 0.15/kWh (USD 0.18kWh to USD 0.2/kWh)

» A tariff degression delayed from 2015 to 2018, as the offshore expansion has been delayed. In return, the tariff degression rate is increased from 5% to 7%.

» Launch of a EUR 5 billion (USD 6.8 billion) credit programme by the national development bank (KfW) in order to secure financing for about 10 wind farms at market interest rates[59].

» Development of a master plan for offshore grid connection, preferably by the Federal Maritime and Hydrographic Agency.

The offshore wind energy capacity increased to 108 MW in 2011, and is expected to reach 3 GW by 2015. To date, the national maritime authority and the federal states have licensed 24 projects, bringing the overall capacity close to 7 GW. The costs for connecting offshore wind farms to the mainland grid are supported by the transmission system operators, which started to plan for connection lines to clusters of offshore projects. Three 400 MW high-voltage direct current (HVDC) lines have been completed.

[55] Stiftung Offshore Windenergie (German Offshore Wind Energy Foundation) was created in 2005 and is the owner of the test site Alpha Ventus. The Foundation supports the expansion of offshore wind energy use in Germany and acts as a communication platform for politics, the offshore wind industry, and the R&D community. The Foundation is involved in public relations and mediation activities to overcome barriers to offshore wind, and improves public acceptance for offshore wind energy. The Foundation supported Alpha Ventus, the first German offshore wind farm, officially commissioned in April 2010. The government is still supporting the initiative in 2012 (Power Cluster, n.d.).

[56] EUR 0.092/kWh (USD 0.133/kWh), up from EUR 0.087/kWh (USD 0.13/kWh).

[57] An annual degression of 1% applies for new installations. In January 2010, the initial tariff for onshore wind was EUR 0.0902/kWh (USD 0.13/kWh). The tariff for offshore wind energy was increased to EUR 0.13/kWh (USD 0.18/kWh) plus an additional "sprinter bonus" of EUR 0.02/kWh (USD 0.03/kWh) for projects which start operation before the end of 2015. The initial EUR 0.15/kWh (USD 0.21/kWh) was to be paid for a period of 12 years, and then decreased to EUR 0.035/kwh (USD 0.05/kWh). The period is prolonged if the offshore site is located in deep waters and at a long distance from the coast. Offshore tariffs will annually decrease by 5% for new installations starting in 2015.A bonus for improved grid compatibility of EUR 0.005/kWh (USD 0.007/kWh) was also introduced, and the special tariff (repowering bonus) was kept for replacing turbines that are ten years or older, if the project doubles in rated capacity. In 2010, 56 MW was repowered and replaced by 183 GW of new turbines.

SUPPORT FOR R&D AND TECHNOLOGY DEMONSTRATION

The initial development of the German wind industry relied strongly on the government-funded R&D programme. In the period from 1977 to 1989, about 40 R&D projects were granted to industrial firms and academic organisations for the development or testing of small (e.g., 10 kW) to medium-sized (e.g., 200–400 kW) wind turbines (Jacobsson and Lauber, 2006).

In the 1980s, a set of demonstration programmes became part of the national R&D policy. Some 14 wind turbine suppliers were funded to produce 124 wind turbines between 1983 and 1991. This programme represented an important part of the national market for small wind turbines at that time. The total installed capacity reached 20 MW by the end of 1989 (Jacobsson and Lauber, 2006).

In 1989, the Ministry of Research initiated a demonstration and market creation programme for wind power. Initially, it aimed at installing 100 MW of wind power capacity. Due to the success of the first programme, the Ministry expanded the objective to 250 MW in 1991.

The programme mainly involved a guaranteed payment of EUR 0.04/kWh (USD 0.08/kWh) for the electricity produced, which was subsequently reduced to EUR 0.03/kWh (USD 0.06/kWh).

Long-term R&D support has been continuously available for the wind power sector in the country. Recent highlights include:

- The 2010 opening of the Alpha Ventus offshore test site, complementing the research initiative called "Research at Alpha Ventus" (RAVE). This offshore test site aims to acquire fundamental technical and environmental information for the future expansion of offshore wind energy (Lang, 2012a).
- Continued funding for the operation of three research platforms – FINO 1, 2 and 3 – in the North and the Baltic seas. These platforms provide data to industry and research institutions.
- Fraunhofer Institute for Wind Energy and Energy System Technology (IWES) coordinates 45 research institutions and companies, which are involved in wind energy research. Currently an important topic of research is the foundations and support structures for an offshore wind turbine, which account for about a third of its capital costs.
- In 2011, the BMU[60] approved 74 projects with a total funding amount of EUR 77 million (USD 99.9 million). In 2010, the BMU approved 37 projects with a total funding of EUR 53 million (USD 75.3 million).

CURRENT CHALLENGES

The Federal Building Code continues to be a key regulation impacting on wind power development. Under this law, wind energy plants are categorised as "privileged projects" and local authorities are required to designate specific priority or preferential zones for wind projects. The developments can also be restricted in specific areas (exclusion zones). In several regions, restrictions inhibit the turbines from installing at the best height for their operation, where they could yield the maximum amount of energy (GWEC, 2010). In 2010, the Federal government and some states started to reconsider the authorisation conditions to allow continuous development onshore, and have entered into discussions with local and regional planning authorities.

Another key challenge for integrating renewable energy generation is the expansion of the grid, including underground cabling in critical areas in order to increase public acceptance. In 2010, the equivalent of 150 GWh of wind power was lost because grid operators had disconnected the wind turbines due to overproduction, which had increased by 69% compared to 2009 (Sewohl, 2012).

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[58] The German "Energy Concept" includes official targets for Renewable Energy: "Renewable energies are to achieve an 18% share of gross final energy consumption by 2020, a 30% share by 2030, 45% by 2040 and 60% by 2050. By 2020 renewables are to have a share of at least 35% in gross electricity consumption, a 50% share by 2030, 65% by 2040 and 80% by 2050." (BMU, 2011b).

[59] The KfW special programme for offshore wind was also designed to help increasing competition in the offshore sector. Until recently only four of the large utilities could bear the investment risk. The special programme will give small- and medium-sized companies and municipal utilities access to loans via KfW.

[60] BMU has signed a Joint Declaration on Cooperation in the Field of Research on Offshore Wind Energy Deployment with the energy ministries of Denmark, Norway and Sweden to facilitate an exchange of knowledge about offshore wind energy, and has continued its work within the International Energy Agency's Implementing Agreement on Wind Energy Research (IEA Wind). As a rule, most of the projects have a term of three years. In 2011, EUR 44 million (USD 57 million) was allocated to on-going projects (2010: EUR 37 million or USD 52.5 million) (BMU, 2012b).

The EEG specifies that grid operators have to pay for the power when wind turbines are disconnected from the grid (called curtailment). In the short- to medium-term, energy losses from curtailment are likely to increase. A difficult element will be to ensure the social acceptance of the projects for transmission and distribution lines that are required by the growing amount of wind energy.

The overall grid transport capacity in Germany can also be improved through soft measures such as temperature conductors, load flow management and other "smart grid" options. The upfront costs for integrating higher shares of wind energy may need to be considered in the broader perspective of the integration of the European electricity market. Additional storage capacities and HVDC interconnectors would need to be planned. In the current economic conditions these developments are likely to face financing constraints, thereby affecting the pace of integration plans for renewable energy.

Repowering will play a large role in the future, and is estimated to have the potential to double the amount of onshore wind capacity and to triple the country's energy yield with significantly fewer turbines deployed. By 2015, almost 6 GW of installed capacity will be older than 15 years[61] and ready for repowering.

CONCLUSION

The current position of Germany in the global wind market can primarily be attributed to decades of progressive and targeted legislation. By the early 1980s, a growing environmental movement influenced the energy debate in the German Parliament and the energy policy of the federal government.

Geographically dispersed wind farms, largely developed by small enterprises and cooperatives, have characterised wind development in the country. Historically, private citizens and mostly cooperative programmes owned the majority of the wind turbines. The involvement of a large number of small investors has contributed to a broad public support for wind energy projects, and has significantly reduced the "not in my backyard" problem that has been encountered in other large markets. Another supporting factor was the interest of farmers, who helped develop the financing market for early wind projects by providing their land as collateral for development costs. Most of the early jobs created by the wind energy sector were in small- and medium-sized enterprises and in regions that were rural or economically less developed. This helped to create a positive view of the technology and its socio-economic benefits.

[61] Repowering a turbine is only economical after 15 or more years of operation.

Germany's renewable energy polices and wind energy market since the late 1990s had a positive impact on the global renewable energy debate. The rapid progress made in achieving the national renewable energy targets had a large impact on other national markets. The policies in place translated the idea of a sustainable and clean energy supply into concrete developments. This development is emblematic, since it has been accomplished by the world's fifth-largest energy consumer.

Germany ©Miriam Ebeling/GWEC

ANALYSIS ON ENABLING CONDITIONS FOR WIND ENERGY

Effective rule of law; and transparency in administrative and permitting processes	The legislation is clearly defined and has been enforced in a timely and targeted manner. Clear guidance is provided through the building codes, while siting and permitting laws are available for all landscapes.
A clear and effective pricing structure	A feed-in tariff has been available since 1991. Its subsequent revisions have allowed long-term certainty in the stability of the national market for both the local wind industry and its investors.
Provisions for access to the grid (incentives and penalties for grid operators)	Clear guidance is available to utilities, electricity generators and consumers on the role and duties of the grid operators. However, cooperation of regional grid companies in expanding the inland grid capacity and the offshore connections is not optimal. Issues related to grid integration are causing delays and adding risk to future projects.
An industrial development strategy	Focused and early support for R&D programmes was available for wind energy, as well as early support for demonstration projects both onshore and offshore. However the offshore development has run into delays.
A functioning finance sector	Wind projects have received long-term support from the National Development Bank (KfW) and the regional finance sector. Europe's current economic conditions and the impact of Basel 3 regulations[62] could influence the ability of German lenders to finance large projects (especially offshore) in the short- to medium-term.
Expression of political commitment from government (e.g., targets)	According to the National Renewable Energy Action Plan, the percentage of energy from renewable sources in the gross final energy consumption will rise from 6.5% in 2005 to 18% in 2020, and could even be surpassed to reach an aspirational target of 19.6%. Targets up to 2030 would be welcome, in order to provide long-term certainty for both the offshore and onshore developments.
A government and/or industry-led strategy for public & community buy-in	As a result of the national commitment to renewable energy, the country has seen a tremendous increase in renewable energy production since the 1980s as well as job creation and industrial development.

[62] Requiring higher shares of equity.

An employment development strategy	At an early stage, the regional governments provided regulatory and financial support for small- and medium-sized enterprises to build and operate wind turbines and farms. By 2011, Germany had created more than 100 000 jobs in the wind industry.
NOTE	**In Germany most of the early jobs created by the wind energy sector were in small- and medium-sized enterprises, often in rural or less developed regions. This helped create a positive view of the technology and highlighted its socio-economic benefits.**

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GREECE

MARKET OVERVIEW

Greece has 10 GW[63] estimated wind potential. The National Renewable Energy Action Plan foresees the wind power capacity to increase from 1.6 GW in 2011 to 7.5 GW in 2020, more than all combined other renewable energy technologies (International Energy Agency (IEA), 2011). Electricity produced from renewable energy resources accounted for 8.2% of the final energy consumption in 2009. Greece currently imports the majority of its oil and gas[64], and security of supply is one of the key objectives of the national energy policy (IEA, 2011).

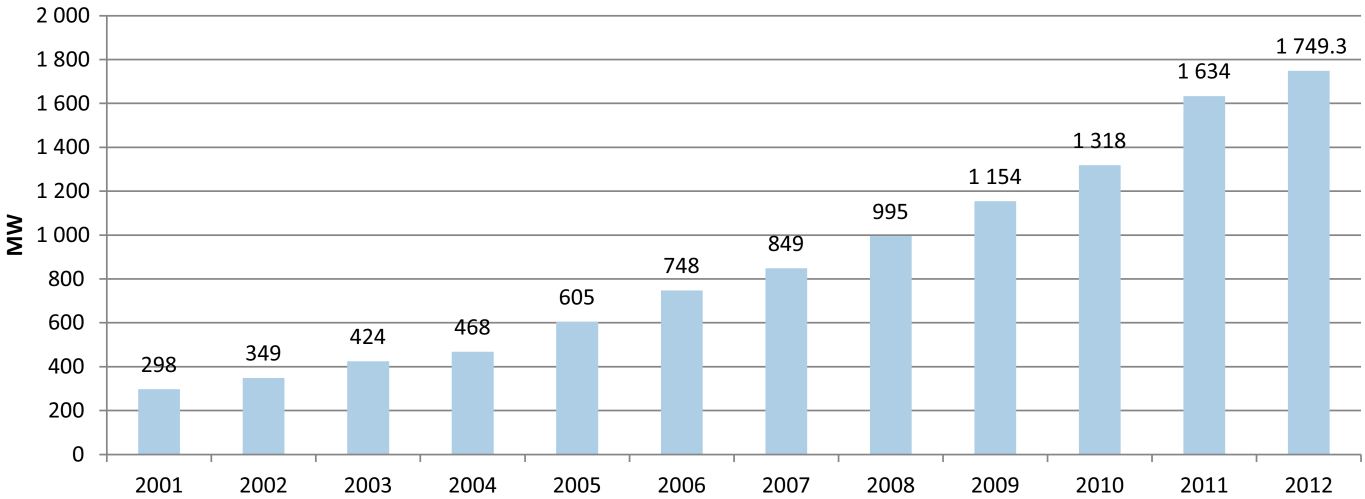

Figure 9: Cumulative Wind Installation (MW) of Greece (GWEC, 2013)

HISTORY AND EVOLUTION OF THE POLICY AND REGULATORY FRAMEWORK FOR WIND ENERGY

Up until the 1990s, a large part of the base load electricity came from indigenous lignite[65] (thermal) and hydro power plants[66]. The monopolistic electricity market was dominated by a public sector company called the Public Power Corporation (PPC), created in 1950 (under Law 1458/1950) as a vertically integrated, entirely state-owned public company.

The PPC enjoyed exclusive rights to developing, constructing and operating both hydro and thermal power plants, as well as the national transmission and distribution networks. At the same time, the law prohibited any private sector investment in the electricity sector[67].

Greece became a member of the European Union in 1981 and a member of the Eurozone in 2001. It applies a free market economy policy. Subsequently it was obligated to take part in the structural reforms of the European Union.

[63] According to the Hellenic Wind Energy Association 8.5 GW to 10 GW with existing grid planning.

[64] In the case of natural gas, the supply sources are already diversified. Russian gas is imported through the Greek-Bulgarian entry point, while the Greek-Turkish entry point allows Greece to import gas from the MiddleEast and the Caspian region. Greece also receives LNG, mostly from Algeria on long term contracts, as well as additional volumes from the spot market.

[65] Lignite is extracted mostly by PPC, due to its exclusive rights for extraction of lignite from surface mines, located mainly in the north-west part of Greece (Ptolemaida/Kozani) and also in Peloponnese (Megalopolis).

[66] Because of its strong reliance on oil and lignite, primary energy supply in Greece is the most carbon-intensive among the IEA member countries (IEA,2011).

[67] A decision was made in 1956 for PPC to purchase all private and municipal energy generating enterprises to ensure the existence of one controlling entity. PPC gradually purchased all these enterprises and hired their employees.

Phase 1:

Electricity sector maturation (1981-1993)

In 1982, the PPC established the Alternative Energy Sources Department (PPC/DEME). The first commercial wind park in Europe was built in Greece in 1983 on the island of Kythnos (five turbines of 15 kW each).

In 1985, Law 1559/85 was instrumental in setting up the initial framework to generate electricity from renewable energy sources in Greece. In addition to the PPC, municipalities and other public-owned companies were permitted to set up renewable energy projects. Under this legal framework, the Hellenic Telecommunication Organisation elaborated a programme to establish seven wind turbines, mostly in the islands of the Aegean Sea. However, the scheme met with limited success.

In 1987, the Centre for Renewable Energy Sources was established as the national institution under the Ministry of Industry, Energy and Technology[68] for providing technical know-how, carrying out R&D activities and implementing pilot projects in order to promote energy conservation and renewable energy technologies. The Centre still supports innovative projects and major activities for the promotion and consolidation of new and renewable energy technologies.

Phase 2:

Introduction of feed-in tariffs and authorisation for IPPs (1994-1998)

The special status granted to the PPC for electricity generation was limited for the first time under the provisions of the Law 2244/1994, which allowed independent power producers (IPPs) to produce electricity from renewable sources. The government also introduced a new feed-in tariff. This system was similar to the feed-in tariff laws in Germany during the same period (see page 64 for further discussion).

This Law also imposed an obligation on the IPPs to sell their electricity to the PPC on the basis of regulated power purchase agreements, one exception being the automotive industry that could use the electricity for its production facilities. In parallel, the Law imposed an obligation on the PPC to buy the electricity produced.

The regulated feed-in tariff did not discriminate between any of the renewable energy technologies. The tariff was defined as a percentage (90%) of the PPC medium-voltage retail price for electricity and an equal percentage (90%) of the PPC low-voltage retail price for electricity, which were produced on the mainland and the non-interconnected islands, respectively. Furthermore, each renewable energy installation on the mainland was granted a small additional remuneration for meeting its maximum capacity per month.

Law 2244/1994 allowed the first privately owned power generation units. The first privately owned wind parks were developed between 1997 and 1998 (PPC Renewables S.A., n.d.).

The PPC Renewables S.A. was established as a subsidiary entirely owned by PPC in 1998. Its objective was to engage in the generation of electricity from renewable sources. From 1 MW installed in 1991, the installed capacity grew to 27 MW by 1995 and to 109 MW by 1999 (UN data, n.d.).

Phase 3:

Electricity sector reform (1999-2006)

The liberalisation of Greece's electricity sector started with the enactment of Law 2733/1999[69], when the process of privatisation of Greece's PPC[70] was initiated. In accordance with Presidential Decree 333/2000[71], PPC became a public limited company[72] on 1 January 2001 (Iliadou, 2009).

The electricity transmission system was unbundled under the provisions of the Law 2733/1999:

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[68] In 1996 the Ministry of Development was created by combining the Ministry of Industry, Energy and Technology, the Ministry of Commerce and the Ministry of Tourism. Main responsibility for the energy sector was entrusted to the Ministry of Development via the Department of Energy and Natural Resources. The Ministry of Development is the main policy-maker for the power sector in Greece and was central to defining market rules, price regulation and administrative decisions regarding the power sector. The Ministry was renamed as the Ministry of Regional Development and Competitiveness in 2010. Then, in 2011 it was merged with the Ministry Maritime Affairs, Islands and Fisheries to be called as the Ministry of Development, Competitiveness and Shipping. Since 2011, the Energy Sector has been transferred to the Ministry for the Environment, Energy and Climate Change (MEECC).

[69] The main drivers behind liberalisation in Greece were the EU energy directives especially 96/92/EC, from which Greece has enjoyed derogations for full implementation. These derogations were set to expire at the end of 2007.Law 2773/1999 was subsequently amended with the provisions of Laws2837/2000, 2941/2001, 3175/2003, 3377/2005 and 3426/2005.

[70] Public Power Corporation Societe Anonyme and distinctive title "PPC S.A." or "PPC" was established by conversion and as a successor of the previously existing Public Corporation bearing the name "Public Power Corporation".

- Responsibility for operating the electricity transmission system was in principle delegated to a new independent company called the Hellenic Transmission System Operator (HTSO).
- The Greek electricity sector (generation, transmission, distribution and supply of electricity) was to be supervised by the Regulatory Authority for Energy (RAE[73]). This independent administrative authority would oversee the liberalisation of the energy market by monitoring the operation of all market segments[74].

According to the provisions of the 1999 Law, the Greek electricity sector was divided into two parts:

(a) the transmission and distribution network, which remained monopolistic and regulated and (b) electricity generation and supply on which free market rules were applied.

The Law also required a licence issued by the Ministry of Development after seeking the opinion of the RAE for any activity in the electricity sector (Iliadou, 2009).

In addition, as a part of the reform process the 1999 Law adopted the basic rules for the organisation of the electricity system and market operation. It also empowered the Minister of Development (in consultation with RAE), for issuing the secondary legislation for specific organisational issues, including price regulation.

Under this process the first few years of the market reform saw the introduction of key pieces of secondary legislation such as the System Operation Code (2001), the Power Exchanges Code (2001) and the Supply Code (2001). Following the liberalisation of the Greek electricity market in February 2001, any company (or individual) was authorised to produce electricity. Individual consumers were gradually granted full rights to choose their energy supplier by July of 2007, except the remote islands consumers.

Between 2001 and 2004 the completion of renewable energy projects was delayed, largely due to the reforming and restructuring of the electricity sector. By the end of 2004 Greece had installed 468 MW of wind power capacity.

Law 3175/2003 introduced extensive amendments, including a mandatory wholesale electricity market to advance and develop an open market and to increase competition in the electricity sector.

RAE subsequently prepared proposals for a new operation system and power exchange code. This was approved in 2005 after two years of public consultation that included the HTSO and PPC[75].

Complete application of this code was scheduled for 2008 (Iliadou, 2009), but did not take place until 2010 due to structural difficulties cited by PPC.

The key provisions of the 2003 Law were:

- The right of consumers to choose a supplier. Household customers became eligible on 1 July, 2007, with the exception of those customers based on islands with no interconnections.
- Reform of the licensing procedures regarding generation units of islands with no interconnections.
- Clarification of HTSO duties and responsibilities, regarding the maintenance and expansion of the transmission system.
- Reinforcement of the TSO's independence with regard to the PPC.
- Facilitation of the criteria for the granting of supply licences.
- Enhancement of the regulator's (RAE) role and duties.

Up until 2006 only a few renewable energy projects that had been granted licences were completed. An IEA study of the Greek Energy Policy pointed out insufficient grid capacity as a significant barrier to faster uptake of renewable energy sources during that time.

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[71] Articles of Incorporation.

[72] Under civil law systems, a society or corporation in which liability is limited to the capital invested.

[73] RAE was established on the basis of the provisions of Law 2773/1999, which was issued within the framework of the harmonisation of the Greek Law to the provisions of Directive 96/92/EC for the liberalisation of the electricity market. RAE's operational independence was guaranteed under the provisions of Law 2837/2000. RAE's resources are managed in accordance with the Presidential Decree 139/2001 on Regulation for the Internal Operation and Administration of RAE.

Phase 4:

Promotion of renewable energy (2006-2008)

As part of Greece's efforts to comply with European Union legislation, Law 3468/2006 (Hellenic Republic, 2006) further promoted electricity generation from renewable energy sources along with high-efficiency cogeneration of electricity and heat.

This Law was aimed at establishing a clearer and transparent process in issuing licences and further promoting renewable energy investments. It also ensured privileged access of renewable energy producers to the distribution system (Hellenic Republic, 2006).

To list some of the important aspects of Law 3468/2006:

- It set the national target for the share of renewables at 20.1% of net domestic power consumption by 2010.
- It ensured privileged access of renewable energy producers to the distribution and transmission system and restated the obligation of the system and distribution operators to dispatch the production from renewable energy sources as a priority (Hellenic Republic, 2006).
- New feed-in tariffs were defined, with a significant increase in the case of photovoltaic systems (EUR 500/MWh or USD 814.32/MWh).
- It improved the terms for sale of renewables-based electricity in order to facilitate bank financing. A 10-year validity period of the power purchase agreement could be extended for an equal period simply upon the receipt of a power producer's unilateral declaration to the responsible operator. Furthermore, it withdrew the right of the minister in charge of calling for a price reduction for renewables except for solar PV.
- The limit on installed capacity (50 MW) above which operators were not obliged to grant priority to renewable energy plants during load dispatching, was removed.
- It permitted the installation of off-shore wind parks for the first time.
- The Law defined the means of remuneration for the energy produced and the capacity available for hybrid systems that combined renewables with storage.
- It introduced the guarantees of origin.
- It increased the limits for installed capacity up to which the issuance of production, authorisation, installation and operating permits were not required.
- It increased the definition of a small-scale hydroelectric plant from 10 MW to 15 MW so that a greater number of plants utilising hydraulic power would enjoy a feed-in tariff regime plus priority by load dispatch.
- It increased the special levy paid to local municipalities from 2% to 3% of the gross proceeds which were accrued from the sale of generated electricity.

According to a report by the Greek Ministry of Development the licensing process was significantly improved (Stefanou, n.d.) as a result of those regulations.

HTSO and the PPC developed plans to reinforce the grid through the Electricity System Development Plan 2006-2010.

A national campaign which was aimed at raising public awareness and supporting the development of renewable energy was to be launched throughout Greece. However, broader economic and structural concerns delayed it.

Since the end of 2008, the Special Spatial Framework for Renewables has been providing guidelines and criteria for siting renewable energy projects.

This framework indicates exclusion zones, distances from these zones, quantitative criteria for the assessment of visual impact and methodology for calculating the maximum number of wind turbines permitted at municipal level.

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[74] The Greek electricity system (generation, transmission, distribution of electricity) was now supervised by the Regulatory Authority for Energy. However, the effectiveness of the RAE was limited (Papamichalopoulos, Douklias and Gonithellis, 2012).

[75] In December 2005, a new law (3423/2005) for the introduction of biofuels in the Greek market was approved in Parliament, which transposed the EU target of 5.75% biofuels contribution in 2010.

Phase 5:

Renewable energy targets and administrative reform (2009-2011)

Improved targets

According to Law 3851/2010, the Greek National Renewable Energy Action Plan raised its commitments to produce 20% of the final energy consumption and 40% electricity generation from renewable sources by 2020 (Greek Ministry of Environment, Energy and Climate Change, 2012).

According to the National Action Plan, the installed wind energy capacity would reach 7.5 GW by 2020, which translates into annual installations of approximately 600 MW[76] between 2011 and 2020. Accelerating the licensing process would be a critical success factor to reach this objective.

A new Ministry for the Environment, Energy and Climate Change (MEECC) was established in 2009, in order to bring the bodies involved in the licensing of power projects, under a single administrative structure. Different responsibilities were considered, such as energy, environment and fiscal aspects, as well as long-term requirements to address climate change[77]. One of the objectives in creating the new ministry was to facilitate effective utilisation of the considerable renewable energy potential, besides safeguarding the natural environment of Greece[78].

The Renewables Investment Facilitation Service was created within the new ministry in order to operate as a one-stop-shop for investors in the sector in the future.

Clear administrative deadlines

A new legal framework to accelerate deploying renewable energy was created (Law 3851/2010) (Greek Ministry of Environment, Energy and Climate Change, 2012), along with the Renewables Investment Facilitation Service, which was formed to accelerate the licensing procedure. According to an assessment carried by the IEA (IEA, 2011), this Law has in some cases shortened the licensing process for renewables from several years to just a few months. Its aim was to reduce the average procedure from 3-5 years to 8-10 months. In fact, the average licensing procedure for wind parks took more than five years and in some cases even reached 10 years (Greek Ministry of Environment, Energy and Climate Change, n.d.). The new legal framework also helped to increase the public acceptance of renewable energy projects by providing more financing from the electricity generators to the local communities.

A crucial part of the 2010 strategy was to accelerate the licensing process, and the authorities were required to meet mandatory deadlines. The most important changes concerned the production license, the first stage in the approval process. This license was issued by the regulatory authority, and had a two-month deadline. In addition, a preliminary environmental impact assessment (EIA) was no longer required. Instead, only one assessment would be required to apply for the installation license[79]. The authorities were given four months to provide their decision based on the EIA.

According to the Hellenic Wind Industry Association (HWEA), although there are visible signs of increased efficiency for the permitting process, much remains to be done, especially in improving the application of the non-energy legislation (e.g., land use, environmental legislation, etc.).

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[76] Greece has large off-shore wind potential; however off-shore will play a limited role in meeting the 2020 target. Greece has opted for competitive tenders for off-shore wind. The government was carrying out strategic environmental assessments in promising areas in 2011, with a view to launching the tenders sometime in 2012 and bringing the first 50 MW online by 2016 (Dodd, J., 2011).

[77] The new ministry was to replace two previous ministries: the Ministry of Environment, Physical Planning & Public Works and the Ministry of Development.

[78] Since 2010, the Ministry of Environment, Energy and Climate Change has been responsible for environmental policies related to the energy sector, including climate change policy. It works closely with the National Observatory of Athens (NOA) and the Ministry of Development in the formulation of climate change policies and measures for the implementation of Greece's 2020 targets.

[79] Under the new system, developers can apply for clearance from the Forestry Commission and for a grid connection, and sign a power purchase agreement before the EIA is completed. However, none of the agreements come into effect until after the installation licence has been issued.

[80] If the island is eventually connected to the grid, producers would continue to receive the higher tariff, and could earn 10 to 25% more if they paid for the interconnection themselves, depending on the length of the connection and the installed capacity.

[81] According to the Law there are three kinds of incentives under Art. 6 Law 3908/2011:

Law 3851/2010 made important improvements in the grid connection framework. It imposed clauses aimed at rationalising the process and eliminating the restrictions on renewable energy producers who connect their plants to the grid, by giving them the right to build and own their interconnection networks.

The new Law also seeks to rationalise the feed-in tariff to extend the grid to non-interconnected islands. Prior to this law, the developers could apply for subsidies amounting to around 30% of capital expenditure.

Under the new Law, the tariff rates would be 20% higher if the project developer chooses not to apply for capital subsidies. The system is moving towards a more rational tariff policy that favours long-term operation of a project.

In 2011 the tariff stood at EUR 87.5/MWh (USD 121.8/MWh) for a wind plant on the mainland and EUR 99.4/MWh (USD 138.36/MWh) on any of the non-interconnected Greek islands[80]. The tariff would be valid for a 20-year term. At the end of 2011 these were one of the most attractive tariffs available for wind industry across Europe.

Investments in renewable energy (except PV) are eligible to access the Investment Incentives Fund (Law 3908/2011). The subsidy varies according to the size of the enterprise and to the project location. The subsidy cannot exceed 50% of the qualifying cost of the investment under any circumstances[81].

The government also passed a new environmental law in 2011[82]. This law is likely to help project developers determine the extent of protected areas and avoid any conflicts during the environmental assessment process. In the past, a number of projects were contested in court due to such conflicts.

Rewarding local communities

In order to ensure direct local benefits to the local communities, Law 3851/2010 imposed a redesign of the special levy of 3%[83]. A third of this sum will be directed to local residents as a credit on their electricity bills and 0.3% to a "green fund"[84] to support Natura 2000 reserves.

The remainder will be directed towards supporting local authorities. According to HWEA, electricity consumption in some households is very low, so they may get their electricity free.

CHALLENGES AHEAD

A comprehensive policy framework is now in place, with strong support for renewable energy. In the past, despite a favourable feed-in tariff, the long and costly administrative process for licensing and other grid-related issues hindered the development of wind power (European Renewable Energy Council (EREC), 2009). It is hoped that the newly designed decision-making process will address this issue.

The Greek case is a good illustration of the importance of involving and rewarding local communities, as well as planning land use. Public support for wind projects has been low in the past, which could be due to a lack of adequate information about wind power and its benefits to communities.

In addition, the absence of land planning (as foreseen by the Laws 2742/99 and 3868/06) raised opposition to wind project siting. Although a new Special Spatial Framework for Renewables was introduced towards the end of 2008, legal procedures could delay a project by

- Tax relief, comprising exemption from payment of income tax on pre-tax profits, which result from an enterprise's activities. The amount of tax relief is calculated as a percentage of the value of the subsidised expenditure of the project, or the value of the new machinery and other equipment acquired by leasing, and constitutes an equivalent un-taxed reserve.
- A grant comprising a free payment by the State of a sum of money to cover part of the subsidised expenditure for the investment plan is calculated as a percentage of that expenditure.
- A leasing subsidy comprising a payment by the State of part of the instalments is paid under an executed leasing agreement in order to acquire new machinery and other equipment. It is calculated as a percentage of the purchase price and included in the installments paid. The leasing subsidy shall be granted for no longer than seven years.

Renewable energy investments fall into the "regional cohesion" category and are eligible for subsidies capped at 70% for existing enterprises and 80% for new ones compared to the same amount of other investment categories.

[82] New Environmental Law: Law 4014/2011 (OGG A/209/21.09.2011).

[83] A 3% tax is levied on the pre-VAT sale price of electricity to the operator of the system or the network of the islands not connected to the mainland's interconnected system.

[84] Since October 2011, 95% of the funds from the Green Fund have been allocated to the national budget in order to reduce the country's deficit.

several years. However, the 2010 legislation considerably streamlined the planning and approval processes.

PPC and the System Operator are facing delays in extending and upgrading transmission grids. Secondary legislation would help in fully implementing the New Grid Operation and Power Exchange Codes. A comprehensive Distribution Network Code would facilitate the connection of projects located in areas with excellent wind resources but limited grid capacity.

Lastly, the market distortion that favours conventional (lignite) power production over renewables has delayed renewables from achieving their true potential[85].

CONCLUSION

Greece has two main support mechanisms for wind energy: a feed-in tariff and investment subsidies. The actual impact of such measures has been limited, not because of the lack of incentives, but largely due to lengthy administrative processes. The latest legislation addresses those challenges and might significantly improve market development. However, the severe economic crisis affecting the country has had an impact on the investment climate.

The government has adopted ambitious targets, policies and measures to increase to use renewable energy. The 2020 target for renewable energy in gross total final consumption was increased to 20%, which is 2% higher than the obligation under the EU Renewable Energy Directive (18% by 2020).

In the past, Greece was considered as an emerging wind energy market, attracting high interest from investors. However, despite significant potential, limitations on land use and a lack of clarity in licensing procedures delayed market growth.

The complexity of the permitting procedure was of concern. Several permits were required from different authorities. The 2010 legislation tried to overcome these barriers by streamlining the authorisation process and concentrating powers of licensing in the Regulatory Agency of Energy (RAE) for regulatory support in the Ministry of Environment, Energy and Climate Change. It also extended the length of purchase contracts from 10 to 20 years.

Until 2010, the regulator monitored the compliance of the projects according to the terms of their licences. Under the new 2010 Law, the RAE's duties have been significantly increased and now include the authority to approve the licences for renewable energy projects.

The main elements of the 2010 legislation are based on learning and experiencing in the sector over the past decade. The relevant aspects include:

» Clear and ambitious targets for each renewable energy source, providing long-term clarity to investors and industry on the market volumes.

» A significant reduction of the number of administrative steps involved in the permitting process ("a one-stop-shop"), providing clarity on the administrative process.

» Clear administrative deadlines, ensuring that developers will receive decisions after a reasonable pre-determined and fixed time.

» A clear tariff structure, ensuring a stable return on investment, complemented by financing support.

» A reward system targeted towards local communities, ensuring benefits to the local communities and individuals.

» Further detailing of a spatial planning policy, ensuring clarity and non-recourse for the proposed project locations.

According to a 2011 report by the IEA, while market competition is emerging in Greece, the PPC continued to be a dominant player both in the wholesale market (75%)

[85] For example, consumers in Greece pay an additional "fee" for renewable energy sources in their electricity bills to finance renewable energy development. However, only about half of this goes towards supporting the feed-in tariff scheme. Several successive increases of the "fee" for renewables in electricity bills, needed in order to finance deficits in the TSO accounts, have made renewables look expensive to the average consumer.

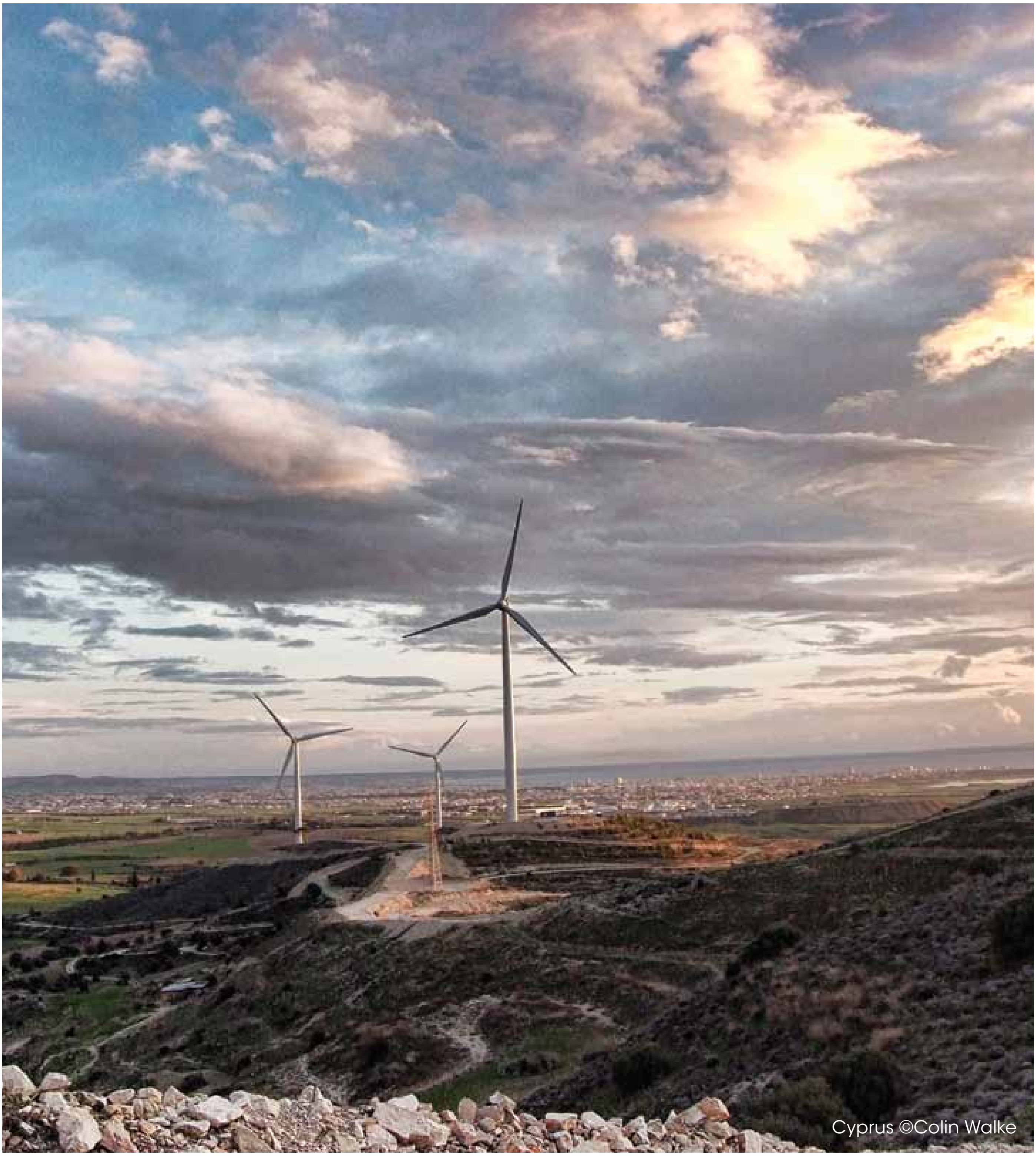
[86] The operator of the transmission system and wholesale market.

[87] The Independent Power Transmission Operation (IPTO or ADMIE) was established in compliance with Law 4001/2011 and European Union Directive 2009/72/EC regarding the adoption of common rules in the organisation of EU electricity markets. According to Law 4001/2011 ADMIE undertakes the role of Transmission System Operator for the Hellenic Electricity Transmission System and as such performs the duties of system operation, maintenance and development so as to ensure Greece's electricity supply in a safe, efficient and reliable manner.

and in the retail market (90%) in 2010. The PPC continued to be the owner of transmission and distribution assets and until recently had a 49% stake in the HTSO[86]. There have been significant changes in recent months.

The market operator (100% state-owned for now) (LAGIE, n.d.) and the HTSO (owner of transmission assets, 100% PPC subsidiary, but independent[87]) are now two different bodies. The Distribution System Operator (DSO) is also an independent company (100% subsidiary of PPC).

New confidence was infused into the wind sector after the creation of the Ministry of Environment and Climate Change and the steps being taken to meet Greece's 2020 target for renewable energy sources since 2010. However, current economic concerns about Greece's economy may impact on the wind sector in coming years.



Cyprus ©Colin Walke

ANALYSIS OF ENABLING CONDITIONS FOR WIND ENERGY

Effective rule of law; and transparency in administrative and permitting processes	A comprehensive energy sector reforms began in 1999 but full implementation is still lacking. In 2010, Law 3851/2010 (OGG A/85/04.06.2010) helped reduce the bureaucratic barriers to some extent. The permitting process was also improved under Law 3851/2010, which addresses these issues under the authority of the Ministry of Environment, Energy and Climate Change. However, between 1999 and 2009 project developers had to face serious delays in getting planning permissions.
A clear and effective pricing structure	Greece introduced a tariff for renewable energy in 1994 with Law 2244/1994 (OGG A/168/07.10.1994.) The tariff rates were amended by Law 3468/2006 (OGG A/129/2006) and Law 3851/2010 (OGG A/85/04.06.2010). However, broader structural reforms to complement the sector were not implemented concurrently. In March 2012, a revision to the methodology for calculating the tariff was on-going.
Provisions for access to the grid (incentives and penalties for grid operators)	Law 3468/2006 (OGG A/129/27.06.2006) ensures privileged access of renewable energy producers to the distribution system. However, grid connection was problematic until recently. The costs for grid connection are met by the power producer, and the date of connection depends on the contractual terms. If grid expansion is required to fulfil the obligation, the grid operator has to cover the corresponding costs.
An industrial development strategy	Not Applicable
A functioning finance sector	Not Applicable
Expression of political commitment from government (e.g. targets)	Greece has committed to increase the share of renewable energy in its gross total final consumption to 20% by 2020, which is 2% higher than its EU obligation.
A government and/or industry-led strategy for public and community buy-in.	This was undertaken after the passage of the 2010 bill, before the economic crisis delayed the efforts.
An employment development strategy	Not applicable
NOTE	**The creation of the Ministry of Environment and Climate Change and the steps being taken to meet Greece's 2020 target for renewable energy sources since 2010 are well perceived by investors. However, current economic concerns may affect the wind sector for the years to come.**

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INDIA and the States of Gujarat, Maharashtra and Tamil Nadu

MARKET OVERVIEW

India is one of the five largest wind energy markets in the world today. Renewable energy sources (excluding large hydro) represent 12.2% of India's installed capacity, with 70% of this contribution coming from wind energy[88].

In 2011 USD 10.3 billion were invested in clean energy in the country, which accounted for 4% of global investment in the sector (McCrone, 2012). In 2011, India installed a record 3 019 MW of new wind capacity (Global Wind Energy Council (GWEC), 2011). In 2012, the country installed 2 336 MW of new wind capacity (GWEC, 2013).

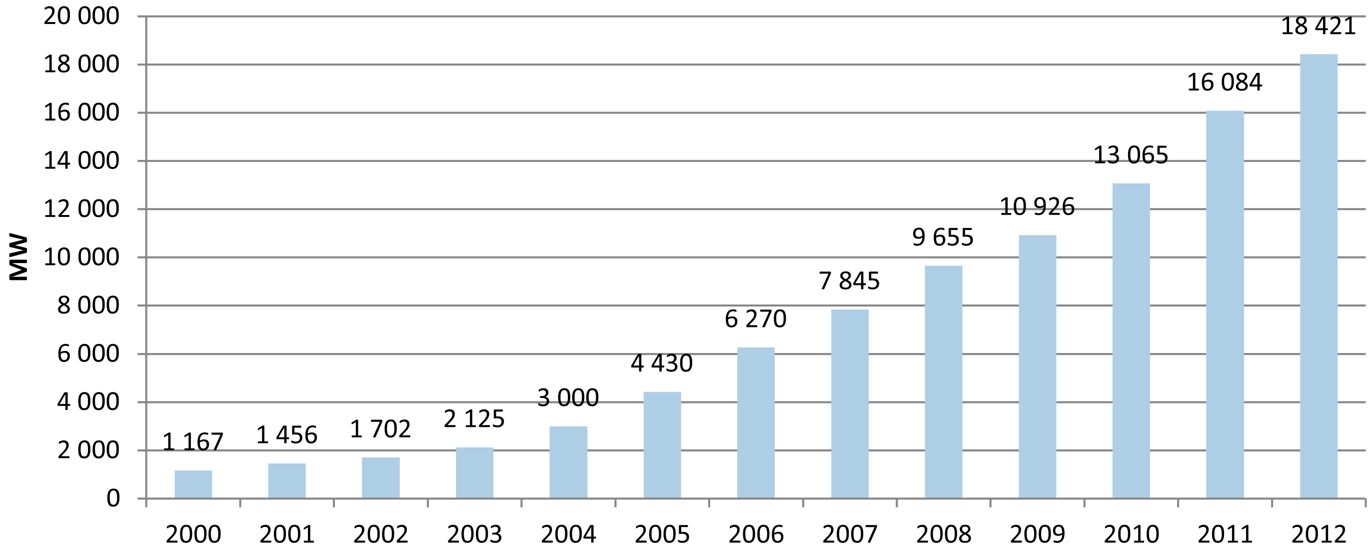

Figure 10: Cumulative Wind Installation (MW) of India (GWEC, 2013)

HISTORY AND EVOLUTION OF POLICY AND REGULATORY FRAMEWORK FOR WIND ENERGY (1980-2011)

The desire for energy self-sufficiency was a major driver for the development of new and renewable energy after the two oil crises of the 1970s. The sudden increase in the price of oil, uncertainties associated with its supply, and the adverse impact on the balance of payments eventually led to the establishment of the Commission for Additional Sources of Energy (CASE) under the Department of Science & Technology in 1981[89].

Phase 1:

Technology demonstration and R&D (1981-1990)

The erstwhile Commission for Additional Sources of Energy was charged with formulating programmes for the development of new and renewable energy, in addition to coordinating and intensifying R&D in the wind technology sector. In 1982 an independent Department of Non-conventional Energy Sources (DNES) was constituted under the Ministry of Energy (Ministry of Non-conventional Energy Sources (MNES, n.d.). The

[88] Ministry of New and Renewable Energy (website accessed on 1 October 2012): The installed capacity increased from a modest base of 41.3 MW in 1992 to 17 967 MW by 31 August 2012. Wind turbine generator capacity addition in India has taken place at a Compound Annual Growth Rate (CAGR) of 24.67% for the period of 1992-2010 (GWEC, 2011).

[89] MEfforts to harness wind energy in India can be traced back to 1973 when attempts to develop water-pumping windmills were made at the National Aeronautical Laboratory.

Department commissioned the Indian Institute for Tropical Meteorology to publish the first assessment of the wind resource available in the country[90] (Mani and Mooley, 1983).

The government realised the importance of private sector participation in wind power. Subsequently in 1984, DNES supported the construction of the first grid-connected wind turbine, which was privately owned. It was set up and commissioned in Verawal, Gujarat as a collaborative project[91] in 1985.

DNES initiated a wind farm demonstration programme in 1986 that offered substantial grants to five projects of 550 kW each across four states[92]. In conjunction, a national programme was initiated during the 7th Five-Year Plan (1985-1990) to exploit the estimated potential of 20 GW (revised in 1990 to 45 GW[93], to 49 GW in 2010 and further revised to 102 GW in 2012[94]) by adopting a market-oriented strategy (Mizuno, 2005). These policy initiatives gave the private sector a good incentive to set up wind projects. The major fiscal incentives provided were:

» 100% accelerated depreciation on investment on capital equipment in the first year of installation (later reduced to 80% and then to 15%[95] in 2012, likely to be phased out after introduction of Direct Tax Code in 2013).

» Five-year tax exemption on income from sale of power generated by wind energy.

» Mandatory purchase of electricity by the states' Electricity Boards at specified tariff rates.

» Industry status given to SMEs and large-scale producers of wind equipment, enabling them to benefit from tax holidays, relief from customs and excise duty, and liberalised foreign investment norms.

» Some states allowed third-party sales[96] of power generation from wind projects

» Banking and wheeling facility[97].

These incentives led to significant commercial deployment of wind power technology and substantial additions to power generation capacity in the country. The national programme led to the setting up of some 550 kW and 1 MW projects by the Department of Non-conventional Energy Sources across the country. Wind power generation capacity rose from 2.2 MW to 37 MW during the 7th Five-Year Plan (1985-1990), and approximately 70 million units of wind power was fed into the respective state grids (Cherail, 1992).

Further commercial-scale development of the sector was supported by external cooperation[98] between the Indian government and the Danish aid agency (DANIDA). The Danish contribution was significant in the initial stages of wind power development in India.

In 1988, DANIDA supported plans to develop two commercial projects of 10 MW each in the states of Gujarat and Tamil Nadu. These DANIDA-sponsored projects were the first demonstrations of large-scale grid-connected wind farms. In fact, it was largely the success of these demonstration projects that helped provide real data on the techno-economic feasibility of wind energy generation in India. These demonstration projects, along with favourable policy initiatives taken by the government, led to the initial expression of interest by the private sector in producing wind energy.

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[90] The book presented data on surface winds at 343 observatories and upper winds at 65 stations. A detailed analysis for 37 wind-monitoring stations was also presented. The data had its limitations as it had initially been collected for aviation and meteorological purposes.

[91] This project was a joint venture between Gujarat Energy Development Agency (GEDA) and JK Synthetics Limited. It involved setting up a 40 kW imported Dutch turbine. This was the first-ever technical demonstration of a modern grid-connected wind turbine in India (Pillai (eds.), 2006).

[92] Okha in Gujarat,Devgad in Maharashtra, Tuticorin in Tamil Nadu and Puri in Orissa (Pillai(eds.), 2006).

[93] Based on analysis carried out by Jami Hussain at Tata Energy Research Institute in 1988-89 (Pillai (eds.), 2006).

[94] The estimated potential of 102 GW at 80 metres by Centre for Wind Energy Technology needs to be validated.

[95] Central Board of Direct Taxes Notification No. 15/2012 [F.No.149/21/2010-SO (TPL)] S.O.694 (E), dated 30 March, 2012, states that all the new wind farms commissioned after March 31, 2012 shall only claim a standard depreciation rate of 15% (Income Tax Department, 2012).

[96] Direct sales to third parties were permitted so as to attract investments from industries that needed more power. Open access is nevertheless currently restricted to each state; a resolution was yet to be reached by the end of 2011. A manufacturer or industry plant can therefore only get electricity from wind farms set up in the same state.

[97] Through the Electricity Regulatory Commissions Act of 1998, Electricity Act of 2003, National Electricity Policy of 2005 and Integrated Energy Grid Code 2010 (GWEC, 2012)

[98] An agreement was signed in the year 1987 for Danish tied grant of DKK 180 million (USD 58.99 million) for supply of wind turbines, erection, commissioning and monitoring of wind farm projects at Lamba (10 MW) in Gujarat, Kayathar (6 MW) and Muppundal (4 MW) in Tamil Nadu.

Furthermore, a dedicated public sector financing arm called the Indian Renewable Energy Development Agency (IREDA) was incorporated as a government-owned public limited company under the aegis of the Department of Non-conventional Energy Sources in 1987. The agency was set up to provide term soft loans for renewable energy and energy-efficiency projects in the country.

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Phase 2:

Economic liberalisation and institutionalisation (1991- 2000)

By 1991, under broader economic reforms the government implemented policy directives that encouraged private investment in the wind sector[101]. Under these economic reforms joint ventures, financial and technical collaboration with foreign entities were permitted in several sectors, including wind. An important change came after the introduction of a new trade policy, in particular a change in custom duties.

The Indian electricity market was opened to private investors, both domestic and foreign. Import duties and taxes were reduced for Independent Power Producers (IPPs) and secured rates of return were offered to foreign investors through cost-based tariffs. These changes were all enacted as part of the broader national economic liberalisation strategy (Loy and Gaube (eds.), 2002).

Creation of the Ministry of Non-conventional Energy Sources (MNES), 1992

In 1992, the Department of Non-conventional Energy Sources was upgraded into a full-fledged ministry called the Ministry of Non-conventional Energy Sources (MNES). During this phase detailed policy guidelines for promotion of power generation from renewable energy sources were developed. Encouraged by the results of the previous demonstration projects, MNES put up a target of 500 MW for wind energy through private sector participation during the 8th Five-Year Plan (1992-97).

As part of the economy-wide reform process, MNES put in place fiscal incentives and policies to increase the private sector participation in the renewable energy sector. This included detailed guidelines for the states to design their market-oriented incentive programmes for promoting renewable energy[102]. MNES released its strategy document on September 13, 1993. This included new and revised provisions of the former incentives: accelerated depreciation, concessions related to the banking, wheeling and third-party sales, among others.

Among other benefits of the policy framework announced by the Ministry was the provision of a power purchase price of INR 2.25/kWh(USD 0.18/kWh), with an escalation of 5% every year. This scheme created price certainty for renewable energy project developers. Prior to these guidelines, there was no specific tariff for purchase of power generation from renewable sources. The tariff was uniformly applicable to all renewable energy technologies without discriminating for cost or maturity of any of the options.

By the end of 1993, India had installed 40 MW of wind power capacity, set up mostly by private entrepreneurs with support from the Ministry of Non-conventional Energy Sources and international grant assistance.

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[99] IREDA was established on 11 March 1987 as a Public Limited Government Company under the Companies Act, 1956.It promotes, develops and extends financial assistance for renewable energy and energy efficiency/conservation projects.

[100] DNES became the Ministry for Non-conventional Energy Sources, which became the MNRE in October of 2006.

[101] This economic reform of 1991 greatly changed the wind energy policy situation. It shifted the focus of wind energy policy from state-funded R&D and pilot projects to a stronger private sector involvement.It extended public finance to private sector wind-power projects and provided fiscal and financial incentives to encourage private investments. Investment assistance with soft loans and tax benefits for wind project investments started in 1992 by the central government, although these tax benefits and the interest rates on soft loans changed frequently over the years.

[102] A number of other national institutions were now involved in promoting renewable energy technologies, namely the Planning Commission, the Ministries of Agriculture and Rural Development; Science and Technology; Biotechnology: and Environment and Forests. Most of these government institutions are also represented at the state level. Wind power projects were now also subject to the Central Electricity Authority, which is responsible for setting national policy and planning objectives for the power sector and to the Ministry of Power, which establishes the rules by which these are carried out (Amin, 1999).

In 1994 the Ministry, with support from IREDA, worked on identifying sites of high wind potential to provide plots for the installation of wind turbines by individual investors as a joint public-private partnership. Starting from a USD 4 million base in 1987, IREDA had sanctioned renewable energy projects worth approximately USD 3.6 billion by way of soft loans (IREDA, 2012) by February 2012[103].

The first technology quality standards and certificates and project procedure guidelines were introduced in 1995 only after a large number of abuses of the existing incentives had been reported between 1992 and 1995 (Mizuno, 2005). In the late 1990s the wind sector experienced a slowdown. Analysts believe the underlying reasons were delays in securing land approval, poor installation practices and lowering of tax benefits by the government (Lewis, 2011).

However, up until then there was no long-term industrial strategy for research in wind energy. Scientific R&D activity in India remained limited to the collection of wind speed data. Domestic manufacturing was set in motion by a series of licensing agreements between 1990 and 2005 with Danish (Vestas, Micon) and German (Enercon, Nordex, DeWind, Sudwind GmbH[104]) firms among many others from the global wind energy industry[105].

The role of international cooperation in supporting early market development

Between 1993 and 1999 World Bank's Renewable Resources Development (RRD) project[106] of USD 195 million was implemented through IREDA's Wind Power Programme. The RRD project supported commercial-scale renewable energy development. Until then, the renewable energy programme was run by government agencies using government procurements and subsidies to support local industry. The private sector's role was limited to supplying equipment, design and installation services.

Phase 3:

Passing of Electricity Act, provision of tariffs by the states (2000-2008)

Until the passing of the pivotal Electricity Act of 2003, there was no dedicated legal framework in India to promote renewable energy. The development of the Electricity Act was based on a number of policy instruments, in particular the Electricity Regulatory Commission Act of 1998.

The Electricity Act subsequently led to the introduction of defined tariffs for wind energy. Prior enactments had no specific provisions that could promote renewable energy sources. The Electricity Act introduced provisions that accelerated the development of grid-connected and stand-alone (off-grid) renewable energy generation.

The Electricity Act also provided for time-bound policy formulation by the central and state governments, by mandating State Electricity Regulatory Commissions (SERC) to take steps to promote renewable energy. This legislation accorded significant responsibilities to the Electricity Regulatory Commissions in setting tariffs for (grid-connected) renewable energy-based electricity generation, and setting quotas for renewable energy as a percentage of total consumption of electricity in the area of distribution licensing.

Under Section 61(h) of the Electricity Act of 2003, promotion of generation of electricity from renewable sources of energy has been made the explicit responsibility of SERCs, which are bound by law to take these considerations into account while drafting their terms and conditions for tariff regulations. Nearly all SERCs incorporated suitable clauses into their tariff regulations, which will enable them to provide preferential treatment to renewable energy during the tariff determination process.

[103] Cumulative Sanctioned amount = INR 17 806.44 Crore and Actual Disbursement amount = 9 283.12 Crore. Converted to USD at the rate of USD 1= INR 49.

[104] Sudwind Energiesysteme GmbH and Suzlon (India) entered into an agreement to share technical know-how relating to 0.27 MW, 0.30 MW, 0.35 MW, and 0.60 MW and 0.75 MW turbines in 1996. In this regard, Suzlon's approach was markedly different from other Indian players like RRB (Vestas) and NEPC (Micon). Suzlon evolved into a company with a turnkey business model. By 2000 the company had set up wholly owned subsidiaries in Germany and Netherlands that functioned as technology development centres. In 2005 Suzlon made a public offering and was listed on the Bombay Stock Exchange. Today it is one of the top ten manufacturers of wind turbines in the world.

[105] Over 24 Indian companies had formed collaborations with companies from Austria, Denmark, Germany, the Netherlands, Belgium, Sweden and the USA. Many of these collaborations had ended by the turn of the century.

[106] The RRD project of the World Bank supported the development of commercial renewable energy. It became operational in 1993, following recommendation from the Energy Sector Management Assistance Programme (ESMAP). The RRD included a technical assistance component from the Global Environment Facility, with bilateral donors.

Under Section 86 (1) (e) of the Electricity Act of 2003, the SERCs were made responsible for the following:

i) Ensuring suitable measures for connectivity of renewable power to the grid.
ii) Sale of renewables-based electricity to any person.
iii) Requiring purchase of a certain percentage of total energy consumption from renewables.

As mandated under Section 86 1(e) of the Electricity Act of 2003, SERCs have to fix quotas (in terms of percentage of electricity being handled by the power utility) to procure power from renewable energy sources. The mandate is called a Renewable Purchase Specification (RPS).

The state regulators were now required to determine the tariff for all renewable energy projects and ensure connectivity to the grid for project sites that are generally in remote locations and away from major load centres.

Section 3 of the Electricity Act of 2003 mandated the formulation of the National Electricity Policy (2005), the National Tariff Policy (2006) and the Rural Electrification Policy[107] (2006). These policies emphasised the importance of setting renewable energy quotas and preferential tariffs for renewable energy; stipulated several conditions to promote and harness renewable energy sources and their procurement by the states. The Ministry of Non-conventional Energy Sources (MNES) was renamed the Ministry of New and Renewable Energy (MNRE) in 2006.

Phase 4:

New incentives and reinforcement of tariff scheme (2009-2012)

In 2009, the Government of India implemented a Generation-Based Incentive (GBI) scheme for grid-connected wind power projects[108]. GBI was introduced to promote more wind power generation. The GBI is over and above the tariff approved by the Electricity Regulatory Commissions and disbursed on a half-yearly basis through IREDA.

The GBI scheme attempts to build a business case for Independent Power Producers. The GBI was limited to cover a maximum capacity addition of 4 000 MW during the 11th Five-Year Plan period (2007-2012). The GBI and accelerated depreciation benefits are mutually exclusive. This scheme was applicable to wind power projects commissioned before 31 March 2012.

State Electricity Regulatory Commissions have specified the RPSs for their distribution companies as required under section 86(1)(e) of the Electricity Act[109]. These renewable energy purchase obligations vary across the Indian states. There is also wide divergence in the tariffs of different technologies set by different Electricity Regulatory Commissions. As of June 2012, 26 SERCs had set RPSs, which vary from 0.5% to 10% in various states over the fiscal year 2012-13.

As of March 2012, 13 of the 25 SERCs had issued preferential feed-in tariffs for purchase of electricity generated from wind power projects. All the states adopted a "cost plus" methodology to fix the feed-in tariff, which varies across the states depending on the resources, project cost and other tariff-computing parameters for each state (GWEC, 2012).

Given the variation in natural resources across different states, in 2010 the Central Electricity Regulatory Commission proposed a complementary mechanism to allow less-endowed states to meet their RPSs through tradable Renewable Energy Certificates (REC). All renewable energy projects commissioned after March 2010 became eligible to register under the REC framework. For wind power generation, this range was

[107] In compliance with Sections 4 and 5 of the Electricity Act, 2003, the central government prepared the Rural Electrification Policy (REP) published in August 2006. The policy under its Section 3 (3.3) for the first time provided a policy framework for decentralised distributed generation of electricity based on either conventional or non-conventional generation, thereby providing the relevant regulatory direction for off-grid/stand-alone small-scale wind farms.

[108] A GBI of INR 0.50 (approximately USD 0.01) per kWh, with a cap of approximately USD 29 000 per MW per year, totaling approximately USD 116 000 per MW over 10 years of a project's life was offered under this scheme. Wind power projects selling power to a third party/merchant power plant are excluded from the GBI incentives. Implementation of the incentives and progress on the ground has been much slower than expected. According to IREDA, between March 2010 and October 2012, 2 021 MW capacity of wind projects had availed themselves of the GBI benefit of a total allocation of 4 000 MW (GWEC, 2012).

[109] Section 86 (1) (e) of the Act mandates SERCs to specify RPS for obligated entities, which include distribution licensees, open access consumers and captive consumers. Accordingly, various SERCs have specified RPO targets applicable to all these entities consuming power in the area of the distribution licensees.

[110] Registered Renewable Energy Generators as on 15 November 2012: Total of 3 588 MW from 697 units of which wind accounted for 2 019 MW from 526 units. One Renewable Energy Certificate = 1 MWh of electricity generated and fed to the grid (Renewable Energy Certificate Registry of India, n.d.b).

set at INR 1 400 to INR 3 480 (USD 26 to USD 65) per certificate. Some 3 761 754 non-solar certificates were issued till mid-November 2012 (Renewable Energy Certificate Registry of India, n.d.a). Wind energy made up over half of the projects registered for the certificates[110].

In the following section, the development of policy framework for the key states of Gujarat, Maharashtra and Tamil Nadu are discussed in some detail[111].

EVOLUTION OF REGULATORY FRAMEWORK FOR WIND IN THE STATE OF GUJARAT

The western State of Gujarat is an example of industrial hub in India[112]. In the 1980s power shortages had a massive impact on the ability of small and medium-sized enterprises across the state to operate normally.

In 1986 Gujarat was the first Indian state to install a wind power project, and currently has the third-highest installed capacity of any state. In 1986, through a joint venture with the Natural Energy Processing Company and the Department for Non-conventional Energy Sources (DNES), a 1.1 MW demonstration wind project was set up in Mandvi, Gujarat. DANIDA's continued support in 1988 for the 10 MW wind farm near the coastal town of Porbundar brought the latest grid-connected wind technology at that time to the notice of the government.

Gujarat benefitted from the early support from DNES and its collaboration with the Gujarat Energy Development Agency (GEDA) to set up demonstration projects along with private sector partners. However the market for wind energy did not witness continuous growth. It saw a dip in 1997, due to reduced tax benefits to the sector, and also due to wider structural and regulatory bottlenecks such as inadequate grid capacity, siting and permitting issues, and inadequate technical expertise.

In summary the Government of Gujarat introduced policies for offering incentives to the wind sector in 1993, 2002 and in 2007[113]. In January 2010, the Gujarat Electricity Regulatory Commission (GERC) passed the second tariff order for wind energy generation[114]. The GERC also allowed third-party sales without any cross-subsidy to take place in the state.

In the context of the Central Electricity Regulatory Commission's regulation on Renewable Energy Certificates, GERC was the first commission in the country to incorporate the provisions of REC in its regulations[115]. According to MNRE by 31 March 2012, Gujarat had installed 2 966 MW of wind power and has the second-highest state-wise installed capacity.

EVOLUTION OF REGULATORY FRAMEWORK FOR WIND IN MAHARASHTRA

The State of Maharashtra along the western coast of India had a chronic shortfall of electricity supply of about 20% in the mid 1990s. As a direct measure to increase the uptake of renewables Maharashtra introduced incentives (largely in the form of sales tax benefits) that supplemented the fiscal and regulatory benefits from the central government. This was done to encourage its private sector (mostly small and medium-sized enterprises) to set up captive power units to make up the power supply deficit[116] (Wind Power Monthly Magazine, 1996).

Maharashtra saw a dramatic rise in wind power projects only after 1998 when it augmented the central government support with state-wide sales tax benefits. As a result of this scheme, any industry operating a wind farm would be exempted from sales tax. This incentive was phased out in March 2003. From 1999 to 2003, Maharashtra developed the second highest number of wind energy installations in the country (400 MW).

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[111] The state government earlier followed a forward-looking policy for promotion of captive generation and as a result, Gujarat is one of the front-runner states to have a large capacity of captive power plants. As on 31 March 2010, 60 captive power plants, with an aggregate capacity of 3 337 MW, were operating in parallel to the state network.

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[113] New Wind Energy Policy 2007 in accordance with the Electricity Act of 2003. Energy and Petrochemicals Department of the Government of Gujarat passed resolution No. EDA1020013054B on 13 June 2007. The wind policy order of 2007 was to be in effect till 30 June, 2012.

[114] The Commission revised the tariff from INR 3.37 (USD 0.079) per unit to INR 3.56 (USD 0.083) per unit.

[115] The Commission has revised the RPO percentage from 2 to 5, 6 and 7 respectively for the years 2010-11, 2011-12 and 2012-13.

[116] Within six weeks of the introduction of incentives for renewable energy development in the state of Maharashtra, NEPC (Micon) installed two 225 kW turbines at its wind farm in the Chalkewadi district. The two wind turbines were the first to be privately owned in the state (Wind Power Monthly Magazine, 1996).

Another important development was the establishment of the Maharashtra Electricity Regulatory Commission (MERC) in August 1999, under the provisions of the Electricity Regulatory Commission Act of 1998. The MERC had the powers to determine tariffs, regulate power purchase, and promote competition, efficiency and economy in the activities of the electricity sector.

The three-member MERC was fully constituted in September 1999 and, as part of its obligations under the Electricity Act of 2003, went on to issue the first legally binding feed-in tariff order for wind, in November 2003 (MERC, 2003). The 2003 Tariff Order of the MERC became a reference for the rest of the states in their process for tariff determination[117].

MERC has set the RPS (non-solar[118]) percentage at 6.75% and 7.75% respectively for the years 2011-12 and 2012-13 (MERC, 2010). According to the MNRE, by 31 March 2012 the state had installed 2 733.2 MW of wind power and currently has the third-highest state-wise installed capacity.

EVOLUTION OF REGULATORY FRAMEWORK FOR WIND IN THE STATE OF TAMIL NADU

The southern State of Tamil Nadu has some of the best wind resources in India. It has been a leader in harnessing its wind energy potential since 1985, when a demonstration programme for grid-connected wind farms was introduced with support from the former Department of Non-conventional Energy Sources. In 1988, DANIDA's 10 MW demonstration project was implemented at two sites in the state.

Based on early successful demonstration projects, the Tamil Nadu Electricity Board (TNEB) was able to attract private investment to the wind sector by identifying potential sites and developing the initial infrastructure for setting up wind turbines.

The TNEB undertook proactive efforts to establish the techno-economic feasibility of wind farms, which led to the addition of 19.4 MW of wind capacity between 1986 and 1993. This was supported by attractive state-level policies (wheeling, banking and option for third-party sales).

In the early 1990s federal fiscal and financial incentives, coupled with soft loans from IREDA, further supported the growth of wind power in Tamil Nadu. However, the real wind power developments in Tamil Nadu started with the establishment of the Ministry of Textile's Technology Upgradation Fund Scheme[119] (TUFS) in 1999 to catalyse investments in all the sub-sectors of textiles and jute industry.

The owners of textile units could avail this capital subsidy to either set up captive power plants, or to sell it on to third-party buyers. The textile industry was allowed to set up wind farms under this scheme. Furthermore, under TUFS the Tamil Nadu Industrial Corporation Limited (a state-owned company) financed efforts to purchase and erect wind turbines for local energy consumption. By September 2002, the installed wind power capacity was 895 MW, which was equivalent to 53% of India's installed capacity in the wind sector at the time (Source: MNRE).

Tamil Nadu is also host to the prestigious Centre for Wind Energy Technology (C-WET), a national institution under the aegis of the MNRE, which provides wind resource assessments, along with standardisation and certification support to the wind industry in India[120].

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[117] Subsequently, the Commission, through its Renewable Purchase Obligation Order dated August 16, 2006, (Case No. 6 of 2006), extended the validity of the tariff orders of all the renewable energy sources up to March 31, 2010.

[118] Non-solar REC includes wind; non-fossil fuel (including bagasse) based co-generation projects; biomass power; small to micro hydro plants; and municipal waste plants. There is no sub-classification by technology. kW turbines at its wind farm in the Chalkewadi district. The two wind turbines were the first to be privately owned in the state (Wind Power Monthly Magazine, 1996).

[119] The Government of India operated a Technology Upgrade Fund Scheme for Textile and Jute Industries (operational from 1999 till 31 March, 2012) for upgrading the technology and modernising the production facilities in the textile units. Under the scheme, the Government of India gives an interest subsidy of 5%. The subsidy will be reimbursed to the units every quarter, as and when received from the Government of India. The scheme was initially approved from April 1999 to March 31, 2004.

Subsequently, the scheme was extended in 2004 and again in 2007 to 2010 and then with modifications up to 31 March, 2012. In 2003 IREDA was co-opted by the Industrial Development Bank of India (IDBI) for the operation of the TUF Scheme for installation of captive wind energy plants by non-SSI (small-scale industry) textiles units to enable them to receive 5% interest incentive from the Ministry of Textiles.

[120] C-WET offers services and seeks to find solutions for the entire spectrum of the wind energy sector. It also provides support to the wind turbine manufacturing industry in achieving and sustaining quality, and supports the wind turbine industry in promoting export of products and services (CWET, n.d.).

Te Rere Hau wind farm, Manawatu, New Zealand ©Windflow Technology

The R&D unit within C-WET was established in 1999 with support from DANIDA to provide generic information and knowledge to innovate wind turbine components and sub-systems suited for India's specific conditions.

Correspondingly, the National Wind Resource Assessment Programme continued under the aegis of C-WET, constantly updating data and wind development potential while considering the impact of technical upgrades. In the context of the CERC's notification on Renewable Energy Certificates (REC) in 2009, Tamil Nadu Electricity Regulatory Commission set a renewable purchase specification of 8.95% for 2011-12. According to MNRE, by 31 March 2012 Tamil Nadu had installed 6 987.6 MW, about 40% of India's total wind power capacity.

CURRENT CHALLENGES

The historical growth of India's wind sector is unusual, in the sense that for more than two decades a significant majority of the investment has come from the private sector. By August 2012, over 17.8 GW of wind power capacity was installed in India, with the support of various fiscal and regulatory incentives, provisions of the Electricity Act of 2003 and other complementary national policies for power generation (MNRE).

The policy and regulatory framework for renewables is varied, due to the dual mandate of the individual state governments and the central government to define the legal framework for the energy sector. Unlike some other

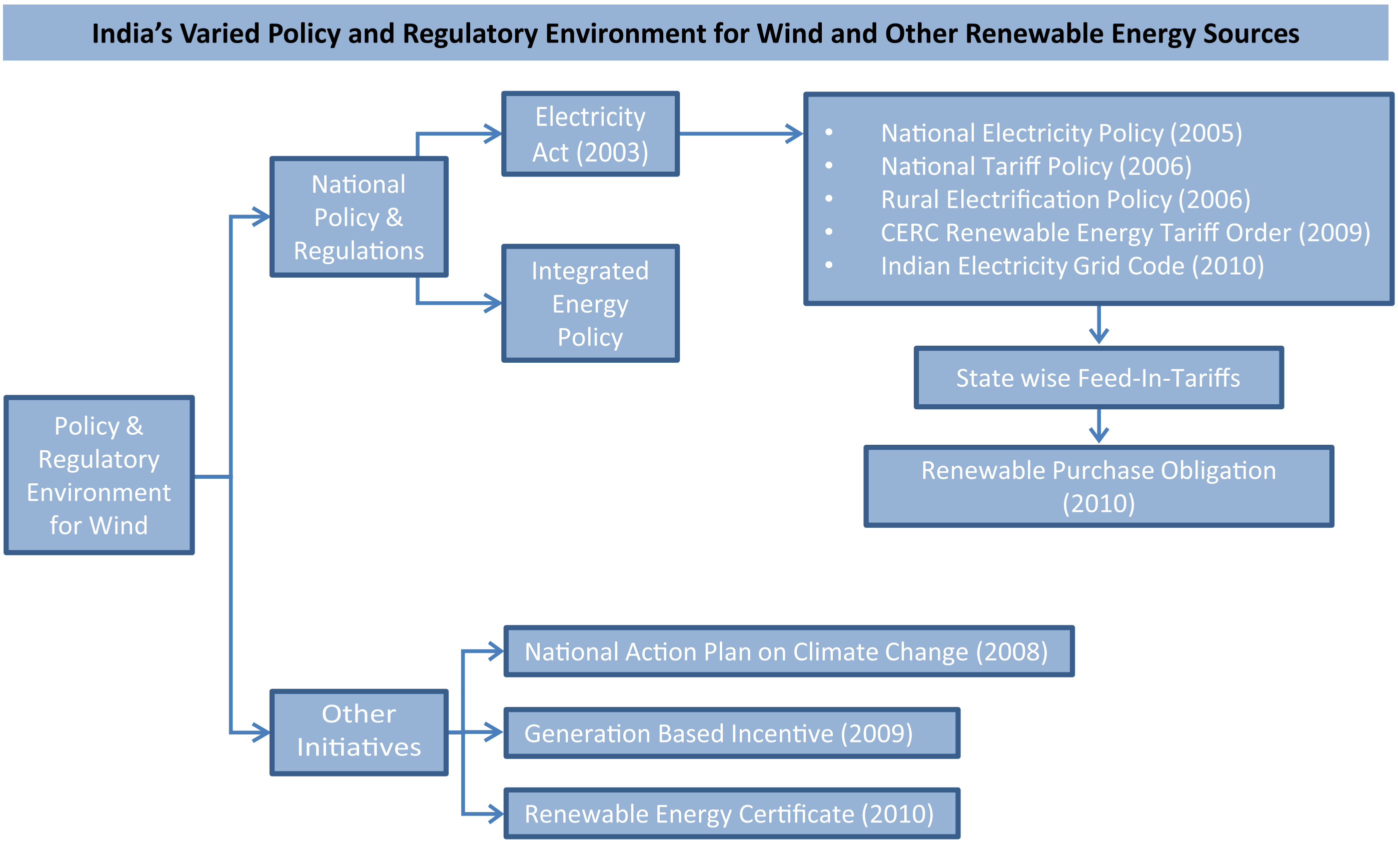

Figure 11: India's varied policy environment for renewable energy (GWEC, 2011)

[121] More than 5 000 MW of new capacity was installed during the fiscal years 2010/11 and 2011/12 in India, and more than two-thirds of the projects commissioned during this time opted for accelerated depreciation benefits instead of the Generation-Based Incentive. Only about 2 000 MW of projects applied for the GBI.

[122] On 30 June 2008, the Prime Minister's Council on Climate Change approved the National Action Plan on Climate Change. The plan stipulates that a dynamic minimum renewable purchase target of 5% (of total grid purchase) may be prescribed in 2009-2010 and this should increase by 1% each year for a period of 10 years. That would mean that by 2020, India should be procuring 15% of its electricity from renewable energy sources.

[123] The Planning Commission brought out the "Integrated Energy Policy: Report of the expert committee (IEP)" in October 2006, which provided a broad overarching framework for the multitude of policies governing the production, distribution, usage etc. of different forms of energy from various sources (conventional and non-conventional).

mature markets, India does not as yet have a dedicated renewable energy law.

The issues of grid integration, forecasting and scheduling are becoming critically important to the health of India's wind energy sector. The power sector is plagued with structural inefficiencies and reliability problems that create a challenging environment for sustained wind power growth. There is an urgent need for modernisation of the transmission networks to improve the grid's ability to absorb higher levels of variable power. While the policy environment for wind power in India has improved in recent years, until recently the industry was heavily dependent on tax incentives that tended to attract a narrower range of private investors[121].

Besides that, there are a number of contradictions between existing policy guidelines and frameworks. For example the National Action Plan on Climate Change[122] (NAPCC) and the Integrated Energy Policy[123] (IEP) of the Government of India are in opposition to each other on the issue of renewable energy.

The NAPCC stipulates that by 2020, India should be producing 15% of its energy needs from renewable energy sources (other than large hydro). This provision conflicts with the IEP, which visualises only 5% renewable energy penetration by 2032.

CONCLUSION

Wind energy is seeing a high level of commitment from the Ministry of New and Renewable Energy and several state governments. This has translated into medium-term policy certainty for the wind energy sector. The domestic and global wind industry has taken advantage of the variety of support mechanisms available to deepen its engagement in the Indian market especially post 2003.

The Indian government has been supporting R&D in wind power technology since the 1980s. Tax exemptions, preferential feed-in tariffs, in addition to the RPS offered by various states and a generation-based incentive, have been key to the sector's growth in recent years.

The government set a target for renewable energy to contribute 10% of total power generation capacity by 2012. By August 2011 that target had already been exceeded and today India's energy mix includes 11.5% of renewable energy capacity. This achievement is largely due to wind energy installations.

Kutch, Gujarat, India ©Wind Power Works

India has developed a strong manufacturing capability, which is driven by strong domestic demand and the potential for export to foreign markets. The Indian wind industry has also benefitted strongly from the Clean Development Mechanismof the Kyoto Protocol under the United Nations Framework Convention on Climate Change.

The key factors for the success of the wind sector in India were early interest by entrepreneurs to invest and work towards indigenisation of the technology to suit Indian conditions; early institutional support from the central and some of the state governments; tax benefits for a sustained period of time; the passing of the Electricity Act in 2003 and the subsequent stipulation of state-wise Renewable Purchase Obligations supported by the development of a national Renewable Energy Certificate scheme.

Other factors that helped the sector were initial support from international development banks and bilateral donor agencies for wind energy demonstration plants; early tax-based incentives and the recent move towards diversifying from a support mechanism led by tax benefits to generation-based incentives.

The most important requirement for India is to develop an integrated energy policy framework, which has a vision, a plan and an implementing mandate to accelerate deployment of all renewable energy technologies. Such a framework, if adopted, can help to reduce concerns of investors related to long-term regulatory certainty and associated market risks.

The next steps for promoting a long-term and sustainable future for the wind sector in India are the enactment of a comprehensive renewable energy law and large-scale grid modernisation. The lessons from India's efforts to promote its wind energy sector could be replicated across most countries, especially those with a similar socio-economic profile.

ANALYSIS OF ENABLING CONDITIONS FOR WIND ENERGY

Effective rule of law; and transparency in administrative and permitting processes	The policy framework is complex and varied. The lack of an overarching policy framework reduces the long-term market visibility for the industry. A long-term policy framework is desirable for all renewables. The administrative and permitting processes vary from state to state, which delays the projects. Several states have recently introduced the mechanism of "Single Window Clearances" for obtaining various approvals and permits for developing wind farms. Improvements are possible.
A clear and effective pricing structure	Tax breaks (accelerated depreciation) are likely to be modified by the introduction of a new Direct Tax Code. The fiscal year 2012-13 saw a downward revision from 80% to 15% for the depreciation rates. There is limited clarity on the nature and timeline for the introduction of the new Direct Tax Code. The certificates market is increasing and an upward revision of the GBI is possible in the future.
Provisions for access to the grid (incentives and penalties for grid operators)	Increasing incidence of curtailment of electricity from wind farms across key States. A joint working group, composed of the MNRE, the Ministry of Power, the Central Electricity Authority and the Power Grid Corporation of India, was constituted to look at the issue of transmission in early 2012
An industrial development strategy	Relief from customs and excise duty has been provided since the 1990s. However, the domestic wind turbine-manufacturing sector is yet to be granted a priority sector status, in order to achieve and sustain long-term and predictable growth.
A functioning finance sector	Public finance support through IREDA is available. The Indian market is maturing and provides medium-term policy certainty to investors and is hence able to attract both domestic and foreign investment.
Expression of political commitment from government (e.g. targets)	The National Action Plan on Climate Change has renewable energy targets but these have not been inscribed into the Five-Year Plans. The targets for the Integrated Energy Policy document differ. MNRE sets five-yearly targets as part of its work plan, which the wind sector has met and exceeded in the past two plan periods.
A government and/or industry-led strategy for public and community buy-in.	Not Applicable
An employment development strategy	Not Applicable

NOTE	**India has had renewable energy programmes since the early 1980s. The wind energy development has been mostly financed by private investments. The next steps for promoting a long-term and sustainable future for the wind sector in India include the enactment of a comprehensive renewable energy law and modernisation of the grid infrastructure.**

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IRELAND

MARKET OVERVIEW

Ireland has one of the best wind regimes in Europe. Its installed wind capacity stood at 1 738 MW by the end of 2012. Wind is the largest source of renewable energy in the country, representing 24% of the 6 829 MW total installed capacity (EIRGRID, 2011).

According to Ireland's National Renewable Energy Action Plan, the country would produce 16% of its final consumption from renewable sources in 2020. Renewable energy would represent 40% of the gross electricity consumption by 2020 (Sustainable Energy Authority of Ireland (SEAI), n.d.).

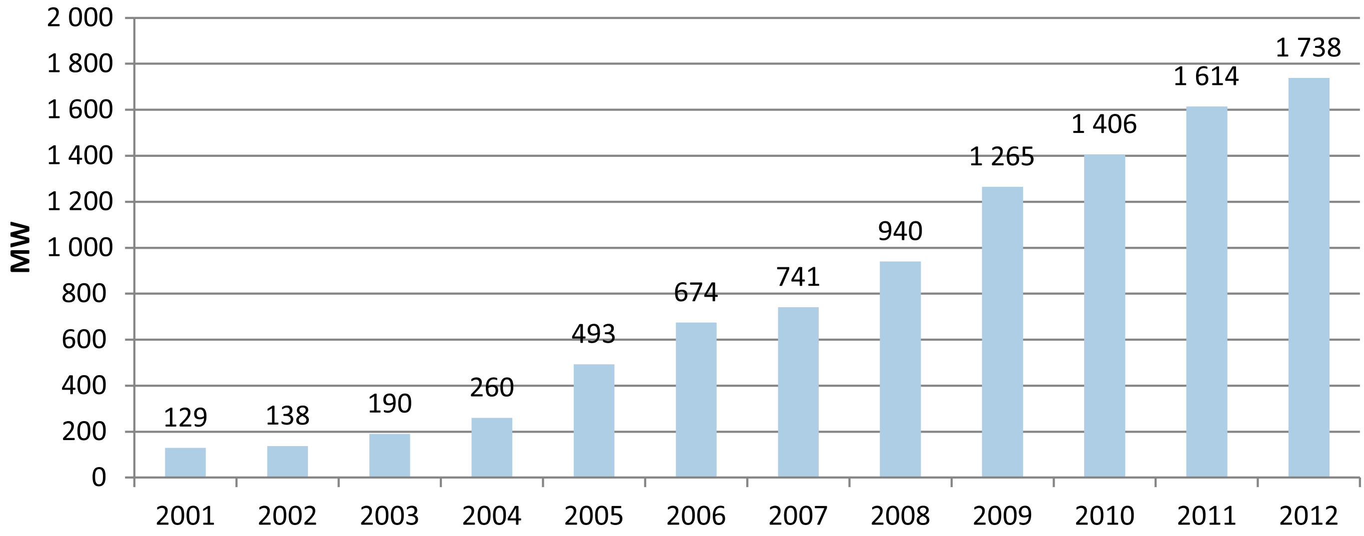

Figure 12: Cumulative Wind Installation (MW) of Ireland (GWEC, 2013)

HISTORY AND EVOLUTION OF POLICY AND REGULATORY FRAMEWORK FOR WIND ENERGY

Phase 1:

Demonstration projects

In the early 1980s several demonstration wind turbines were installed in Ireland. The first detailed investigation of the wind resource and the first significant wind energy installation were done under the VALOREN[124] programme funded by the European Commission (EC)[125] (Staudt, 2000).

In 1990, Ireland was a heavily import-dependent energy economy. The dominant energy source was oil, which accounted for 46% of the energy mix in 1990, followed by gas. The government initiated significant reforms of the energy sector in the 1990s. Up until then the energy sector was essentially a monopoly of the Electricity Supply Board (ESB), the state-owned electricity utility (Staudt, 2000).

Phase 2:

Competitive tender, targets and market reform (1993-2005)

In 1993, the government initiated the Alternative Energy Requirement (AER) programme, to install 75 MW of renewable energy capacity by 1997. A competitive bidding process was launched in 1994, complying with European procurement rules and State Aid guidelines. The projects had to qualify technically before submitting their offers for a grant amount. The lowest bids in each category were offered contracts up to the available capacity. The successful applicants were granted a Power Purchase Agreement (PPA) of up to 15 years, not extending beyond 2010. The national utility company (ESB) had to purchase the electricity produced, and was compensated for the net additional costs incurred from a Public Service Obligation (PSO) levy funded by electricity consumers[126].

The 1996 national strategy "Renewable Energy – A Strategy for the Future" stated wind connection targets of 31 MW per year between 2000 and 2010. The document addressed the issue of access of third parties to the electricity grid, and promoted small-scale renewable energy projects to enhance energy self-sufficiency (Staudt, 2000).

The initial phase of the AER programme was successful in terms of proposed projects, but less so in terms of actual deployment:

» For the first round of the AER programme (1995), the initial target was set at 75 MW. A total volume of 300 MW was proposed, and 111 MW were accepted. Wind represented 73 MW of that total[127], of which only 45.8 MW was commissioned (Department of Communications, Energy and Natural Resources (DCENR), 2005).

» The third Alternative Energy Requirement (AER 3) competition was launched in 1997, with an objective of 100 MW of new generation capacity. The final result awarded almost 160 MW, from which 137 MW is wind power.

Unlike AER 1, the AER 3[128] awarded projects on the basis of price support per kWh, not a grant level. A grant from the European Regional Development Fund was made available to the successful bidders, and was discounted from the proposed kWh price.

The initial commissioning deadline for all projects under AER 3 was extended from 1999 to 2000. Several projects failed to receive planning permission[129] or failed to proceed for other reasons, such as problems related to site access. Only six wind energy projects were developed under AER 3, totaling 37.51 MW (DCENR, 2005).

A revised strategy for sustainable energy was proposed in 1999. The 1999 "Green Paper on Sustainable Energy" set a target to install 500 MW of renewable energy capacity between 2000 and 2005, later revised to 500 MW by 2007 under AER 5 and AER 6. The strategy included concrete proposals on the liberalisation of the electricity market, planning processes and grid connection[130]. The Green Paper became a central feature in the national greenhouse gas abatement strategy (DCENR, 2005).

The AER 5 competition was launched in 2001, with an initial target of 255 MW of which 363 MW were awarded. AER 6 (2003) awarded 365 MW of capacity, including two 25 MW offshore wind demonstration projects[131].

Liberalisation of the electricity market

The Electricity Regulation Act 1999 (ERA 1999) established the Commission for Energy Regulation (CER), to regulate the electricity and natural gas sectors. It also created the

[124] The total amount of European Commission funding allocated to Ireland under the VALOREN programme (Council Regulation (EEC) No. 3301/86) was 25 Million European Currency Units (MECU), equivalent to approximately USD 49.3 million in 2011 USD value. The total resources devoted by the European Commission to the programme amounted to 400 MECU and Ireland's share represents 6.25% of this (Burke, 1989).

[125] This 6.45 MW wind farm at Bellacorick consisted of 21 Nordtank machines.It performed with an average load factor of 30%. Subsequent installations have load factors around 40%.

[126] This process ensured that general customers incur the smallest price increase on their electricity bills through the operation of a Public Service Obligation (PSO) levy that was required to support RES electricity generation.

[127] According to the Irish Wind Energy Association the initial expectation was that wind would secure about 30 MW.

[128] The second round AER 2 was not open to wind energy; it focused on waste to energy and biomass projects. Contrary to AER 1, the role of the ESB in AER 3 was limited to providing connection cost estimates, connection agreements and PPAs. The remuneration was awarded on the basis of a price per kWh, not as a grant. The price was adjusted seasonally and on a time-of-day basis with the time-weighted average being equal to the bid offer.

[129] Ireland centralised the planning approval process. The Strategic Infrastructure Board was created under the National Planning Authority (An Bord Pleanála). It approves transmission plans on a national basis, and a single approval is needed for a wind developer to connect to the grid.

[130] Some key proposals of the "Green Paper on Sustainable Energy" included the liberalisation of the electricity sector, reforming the AER, and measures support the deployment of renewable energy, planning process and grid connection.

[131] The amount of overall support available in both AER 5 and AER 6 was limited by government policy and State Aid clearance (N 553/01) issued by the European Commission. Due to the high degree of interest shown in the competition, a State Aid clearance for an additional 140 MW was approved in 2004.

regulatory framework for introducing competition into the production and distribution of electricity.

An independent Transmission System Operator (TSO) was created for operating, developing and ensuring maintenance of the transmission network. The TSO does not own the lines, and the transmission owner (now called EirGrid) was to carry out the construction and maintenance. Renewable electricity suppliers could sell their electricity directly to the final customers. However, the grid planning and connection permission process became an issue. The TSO faced difficulties in handling the large amount of requests received in the years 2003-2004.

Up until 2004, the applications for connecting to the grid were processed on a case-by-case basis. In October 2004, a joint system operator was proposed, based on a centralised approach. Applications were grouped based on their geographic locations and the level of electrical interaction with the grid (CER, 2004). The installed wind power capacity increased rapidly from 169 MW in 2003 to 744 MW at the end of 2006.

In addition, it was essential to reinforce the grid capacity to integrate large amounts of variable electricity supply. In 2003, the Republic of Ireland and Northern Ireland decided to create an all-island energy market. In 2007, the Single Electricity Market (SEM) became a cross-border wholesale electricity market[132].

Phase 3:

Feed-in tariff programme (2006-2010)

Ireland's first renewable energy feed-in tariff (REFIT) programme was launched in May 2006 and approved by the European Commission State Aid regulations in September 2007. The programme aimed to more than double the contribution of renewable energy technologies from 5.2% in 2005 to 13.2% in 2010 (initial target under Directive 2001/77/EC).

The bidding process under the AER was replaced by a feed-in tariff scheme. Due to low bidding prices and lack of profitability for many projects, a significant amount of the wind capacity awarded had not been built.

The feed-in tariff scheme was funded through the Public Service Obligation levy charged to all electricity consumers. This levy is revised every year by the regulator, based on the amount of projects eligible for the payment of the feed-in tariff. The power purchase agreements were valid for 15 years.

Details of the Public Service Obligation (PSO):

- The legal basis for the PSO was set out in Section 39 of the 1999 Electricity Regulation Act. Statutory Instrument No. 217 of 2002 under Section 39 required that the CER calculates and certifies the costs associated with the PSO, and set the associated levy for the required period.
- The PSO levy took into account the estimated and actual costs incurred in undertaking generation activities, which were covered in the relevant PSO legislation.
- The PSO levy year ran from 1 October to 30 September. The CER collated information from all licensed electricity suppliers to calculate the levy for the upcoming year. The feed-in tariff was eligible to suppliers notified to CER for the next PSO period.

[132] The grid capacity needed to be increased in order to integrate the renewable energy production. The Republic of Ireland in the south and Northern Ireland in the north had committed to creating an all-island energy market. A joint steering group was established in 2003(International Energy Agency (IEA), 2007). The new cross-border wholesale electricity market became operational in 2007. In the south, the Electricity Regulation (Amendment) (Single Electricity Market or SEM) Act 2007 was signed in March 2007. The SEM Act amended the 1999 Electricity Regulation Act to establish and operate a single competitive wholesale electricity market on the island (CER, 2011).

[133] The REFIT 1 scheme was open for applications until 31 December 2009. No new applications were accepted after that date. Projects accepted into the scheme were granted a time extension to become operational, and continue to be developed.

[134] The estimated additional cost for the first 400 MW of capacity was EUR 119 million (USD 171.9 million). Under REFIT 1, the tariff amounted to EUR 57/MWh (USD 82.36/MWh) for large-scale wind and EUR 59/MWh (USD 85.25 /MWh) for small-scale. The feed-in tariff is protected from inflation (DCENR, 2012).

[135] The East-West Interconnector will connect the Irish power system to the UK electricity grid through undersea and underground cables. The Interconnector will have a capacity of 500 MW.

Under the terms of the REFIT scheme, each generator entered into a PPA of 15 years with a licensed supplier. In the first version of the feed-in tariff (REFIT 1), similar to the AER scheme, the energy suppliers were compensated for the net additional costs they incurred.

The balance was funded through a PSO levy on the consumers (EC, 2007). At its launch the scheme was limited to 400 MW[133] which was later revised to 1 450 MW. The rules of REFIT 1 allowed the government to extend the capacity limitation by public notice[134].

Under the REFIT 1 scheme, 1 242 MW of renewable energy capacity was added to the system. Detailed rules for the second version of the feed-in scheme (REFIT 2) were to be announced in 2012 (Department of Communications, Energy and Natural Resources (DCENR), 2012).

In 2010, Ireland produced almost 15% of its electricity from renewable sources, exceeding its target of 13.2%. Due to the country's high wind resources (average capacity factor of 34%), the feed-in tariff was significantly lower than in other OECD countries. However, since 2009 broader economic concerns have affected the rate of new wind installation, with just 153 MW completed in 2010, down from 221 MW installed in 2009 (Wind Power Monthly Magazine, 2011).

CURRENT CHALLENGES

Ireland's banking crisis caused difficulties for the wind sector. The banks became extremely selective and would only lend to developers with a strong track record. The limited availability of credit created difficulties for small players who had approvals and grid-connection offers in place to proceed to the construction stage.

Although some efforts have been made to improve grid capacity, more efforts are required for Ireland to meet its 2020 targets. In 2006, the government requested that the CER initiate the construction of an East-West Interconnector to Britain by 2012 . The project led by EirGrid is a part of the National Development Plan 2007-2013 (Edwards, 2010), and was completed in September 2012[135]. Furthermore the "all-island grid" brings together the grids of the Republic of Ireland and Northern Ireland. In the beginning of 2011, more than 1.8 GW of wind had been installed on those territories, accounting for more than 10% of their cumulative installed capacity[136].

Until 2011, wind farms were regularly curtailed, and financially compensated. The regulators examined the effect of 4.6 GW of wind power capacity on the system operation[137]. The curtailment rules for wind were then reviewed[138] and in the last quarter of 2011, the regulators started to consider a new policy on curtailment. The rules favour established wind farms over new developments and have resulted in some projects being stalled[139].

CONCLUSION

Ireland has one of the strongest wind regimes in Europe. However, its limited grid capacity and domestic demand is insufficient to absorb the large wind production, which is leading to curtailments[140]. The first steps have been taken towards developing interconnectors with Northern Ireland and the UK, and are expected to solve a large part of the curtailment problem.

In the past decade the energy policy has been driven by concerns about energy security, cost-competitiveness and environmental protection. The deployment of renewable energy sources in the electricity sector has been increasing steadily in recent years. The country has committed to increase the share of renewable energy in electricity consumption to 40% by 2020.

Under the AER, a significant part of the capacity had not been built, and the scheme was replaced by a feed-in tariff system. The failure of the tendering system was due to the low price offers proposed, and the lack of profitability of the projects. This experience is similar to that of the UK with the NFFO tenders (see page 117 for further discussion) (IEA, 2007).

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[136] Currently there is a high-voltage DC line linking the island (Republic of Ireland & Northern Ireland) grid to the UK. The maximum load capacity of this HVDC line is 6.5 GW and the minimum load capacity is 2.4 GW

[137] As well as looking at how generation should be scheduled and dispatched, the review is also studying rules for constraining generation off the system at times of congestion.

[138] Wind in Ireland was only curtailed if there was a system security issue. In the event of a system security issue, curtailment is applied in the following order: indigenous peat stations, large combined heat and power, hydro, and then wind. In 2009, wind was primarily curtailed due to transmission maintenance occurring in a high wind area with low load. New transmission is under study. EirGrid expects to limit curtailment due to congestion (Rogers, Fink and Porter, 2010).

[139] Rules limiting the amount of wind energy on the Irish electricity system prompted state energy company ESB to put a EUR 40 million (USD 54.91 million) development on hold in February 2012 (O'Halloran, 2012).

[140] Eirgrid completed a 650 MW interconnector between the UK and Ireland in August 2012. Another 8 GW of interconnection capacity is under construction.

The current renewable energy feed-in tariff (REFIT 1) scheme is capped at 1 450 MW, most of which will be provided by projects which have already received connection offers. Only a small part of the 3 000 MW, currently under process for connection offers, will be eligible to receive incentives under the scheme, creating considerable uncertainty for developers. The upcoming REFIT 2 might resolve some of these issues. The final design of the support mechanisms and/or tariff bands that result from these discussions will be critical to the future of wind power development in the country. Furthermore, the outcome of ongoing discussions between developers and regulators on the latest policy guidelines for curtailment will be critical to future investments.

Antarctica ©Chris Wilson/GWEC

ANALYSIS ON ENABLING CONDITIONS FOR WIND ENERGY

Effective rule of law; and transparency in administrative and permitting processes	Continuous support and a long-term policy framework were available from 1993 to 2010. The Sustainable Energy Authority of Ireland completed a series of surveys to assess the public attitude towards wind farms and future energy policy. The public is generally positively disposed to the introduction of wind farms. Detailed local planning guidelines and environmental guidelines are available.
A clear and effective pricing structure	The tariffs were first determined through auctioning under the AER programme, followed by a feed-in tariff system. A regulatory review after the financial crisis has had an adverse effect on the growth of, and confidence in, the wind industry. The sector now expects a review of the feed-in tariffs (REFIT 2).
Provisions for access to the grid (incentives & penalties for grid operators)	Electricity produced by renewable sources has priority over other energy production facilities. The national grid development strategy, Grid25, plans for the grid expansion until 2025. The share of electricity from renewable sources should reach 40% by 2020. At present planning regulations are not in phase with grid connection timelines. The standard planning permission granted to a wind farm development typically expires after five years, but it can take up to six years to process a grid connection application (Staudt, 2000).
An industrial development strategy	Regulatory and policy support were made available for the growth of a domestic wind industry.
A functioning finance sector	After the 2009 financial crisis, commercial lending was difficult to obtain, in particular for developers with limited track records.
Expression of political commitment from government (e.g., targets)	There is a long-term renewable energy target of 16% by 2020 under the 2009 European Renewable Energy Directive. However, regulatory support and secondary legislations are not in place, which causes significant delays to projects.
A government and/or industry-led strategy for public & community buy-in.	EirGrid organises public engagement through public education efforts and outreach for specific transmission projects.
An employment development strategy	Not Applicable
NOTE	**Despite a difficult economic atmosphere, the development of a green economy is set to be a key driver of the economic recovery and future growth of Ireland.**

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ITALY

MARKET OVERVIEW

By the end of 2012, Italy's total installed wind capacity reached 8 144 MW. The country has the fourth-largest installed wind capacity in the European Union (European Wind Energy Association (EWEA), 2013).

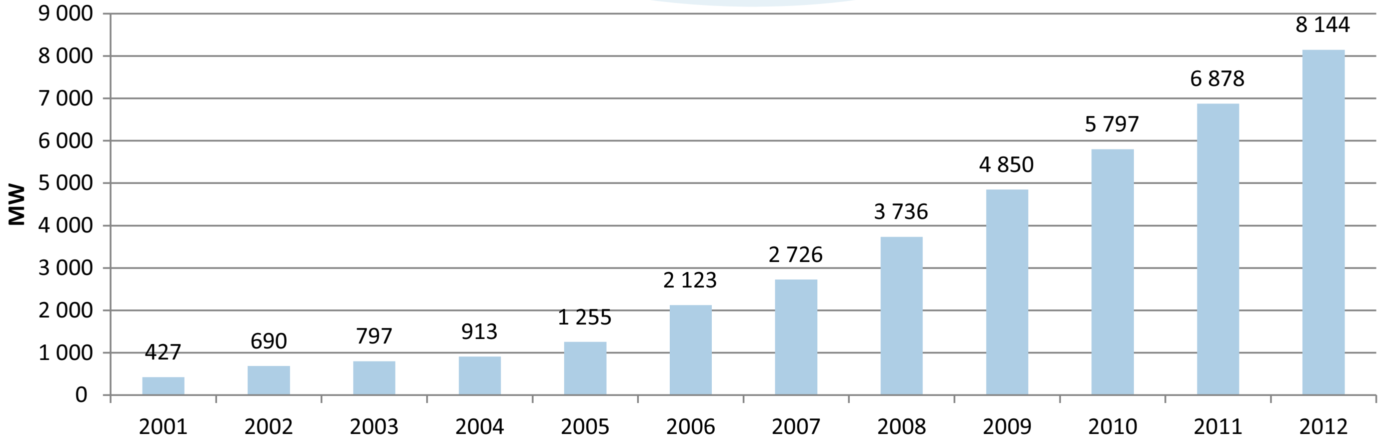

Figure 13: Cumulative Wind Installation (MW) of Italy (GWEC, 2013)

HISTORY AND EVOLUTION OF POLICY AND REGULATORY FRAMEWORK FOR WIND ENERGY

Phase 1:

National Energy Plans and Feed-in tariff system (1981-1998)

The first National Energy Plan was elaborated in 1981, setting objectives and targets for the development of renewable energy across the country. In 1982, Law 308/82 established the basis for future regulations, institutional rules and financial incentives for energy efficiency and renewable energy.

The second National Energy Plan was put forward in 1988 with objectives for 2000. This plan included implementation guidelines for energy saving, the rational use of energy, protection of the environment and human health, development of national energy sources and improvement of industry competitiveness.

In 1991, as part of electricity sector reforms, Law 9/91 allowed for producing energy from renewable sources through simplified authorisation procedures. The regional governments were obligated to propose energy plans (Law 10/91), with renewables as a policy priority.

In 1992, the CIP6/92 regulation established the first fixed feed-in tariff, covering the first eight years of energy production. The tariff was based on avoided investment and production costs for ENEL, the state-owned power company in charge of the national electricity system (including production, transmission and distribution).

The tariff enabled investors to see a predictable return on their investment. The initiatives that received support under CIP6/92 were chosen according to a procedure approved by the Ministry of Economic Development and consistent with ENEL's national electricity programme.

Both Law 9/91 and CIP6/92 were successful in establishing new rules for the electricity sector, liberalising electricity generation and moving towards a free electricity market. Independent power producers (IPPs) could produce electricity from renewable sources without any capacity limit[141]. CIP6/92 created certainty on the financial flows, as ENEL was obligated to buy all electricity produced, simplified the remuneration to IPPs (on the basis of kWh produced) and provided a clear definition of the remuneration for each technology.

The permitting procedures were lengthy due to complex and inconsistent rules across the country. The permitting procedures for small and large wind farm developers were identical, and disadvantaged smaller producers. The developers faced a lack of grid connectivity in rural areas.

Some of the local governments in southern regions[142] provided capital cost subsidies under the regional support programme (POP programme) funded by the European Structural Funds. The POP programme covered a given percentage of the capital costs and could be combined with the CIP6/92 feed-in tariff. This initial tariff regime was implemented between 1992 and June 1995 for the proposed projects.

Phase 2:

Liberalisation of the electricity market and introduction of the green certificate system (1999-2005)

The 1999 Legislative Decree[143] 79/99 (widely known as the Bersani Decree) addressed the restructuring and gradual liberalisation of the Italian electricity market, in line with the European Directives for the liberalisation of energy markets. It encouraged electricity production from renewable sources by introducing priority on grid access for renewables based electricity generation, as well as a renewable energy quota system.

Unlike the fixed guaranteed feed-in prices under the CIP6/92 regime, the new support mechanism was designed as a market-based mechanism. The Bersani Decree also introduced a tradable green certificates[144] system, under the quota obligation.

This green certificate mechanism required power producers and importers to produce a certain percentage of electricity from renewable sources, starting from 2% and gradually increasing. Green certificates were to be used to fulfil this obligation. Producers and importers could also fulfill their renewable quota obligation by purchasing certificates from third parties. The certificates were traded on a parallel market independent of the electricity market[145]. The price of a green certificate stood at EUR 109/MWh (USD 172.7/MWh) in 2005.

The Bersani Decree also enhanced the support to the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) to work on research, innovation, and technology transfer for renewable energy technologies (Italian National Agency for New Technologies, Energy and Sustainable Economic Development, n.d.).

The decree liberalised parts of the energy markets, in particular the activities of electricity production, which had been monopolised by ENEL up until then. This law also made the distribution and supply of electricity to captive customers subject to licensing, and reserved the transmission and distribution for the government. In addition, it provided for the creation of a Transmission

[141] The 3 MW power limit introduced by Law 308/82 was eliminated.

[142] Such as Apulia, Campania, Sicily etc.

[143] The decree was passed on 16 March, 1999 in compliance with Directive 96/92/EC.

[144] Green certificates were provided for the electricity produced from renewable energy plants put in operation after 1 April, 1999. Green certificates were issued on the basis of the electricity produced from renewable sources in the previous year or on the expected capability to generate electricity from plants in the current or following year.

[145] The exchange of green certificates can be made either bilaterally among operators, or using a platform facility organised by the Manager of the Electric Market (Gestore-delMercatoElettrico – GME).

[146] ENEL formed the national TSO (GRTN), which became operational in 1999.

[147] The Single Buyer was envisioned as a joint-stock company formed by the TSO to operate and stipulate supply contracts in order to guarantee the generating capacity necessary for franchise clients.

[148] The Market Operator was envisioned as a joint-stock company formed by the TSO to manage power exchange in accordance with criteria of neutrality and competitiveness among generators. The power exchange became operational in 2004.

[149] In 1998 ENEL published the White Paper (LibroBianco per la valorizzazionedellafontirinnovabili) to introduce the national target.

System Operator (TSO)[146] and a Single Buyer (SB)[147], and proposed the creation of a Market Operator (MO)[148] (Luciani and Mazzanti, 2006).

In 1999, a White Paper[149] on the exploitation of energy from renewable sources was adopted. This document provided the basis for policies and strategies for meeting production targets up to 2008-2012 (for each type of source). Wind was allocated 700 MWe by 2002, 1 400 MWe by 2007 and 2 500 MWe by 2008/2012 (Glorioso, Lionetti and Presicce, 2007). The White Paper also highlighted the role of regional governments in reaching these goals.

In 2003, the country implemented European Directive 2001/77 for the promotion of electricity from renewable sources under Article 2 of Legislative Decree 387/03. This decree introduced additional measures improving incentives and support for renewable energy projects. Under this EU Directive, the share of renewable energy was bound to increase from 5.2% in 2005 to 17% of the final energy consumption in 2010 (European Commission (EC), 2008).

Phase 3:

Revision of the green certificate scheme and the introduction of auctions (2007-2012)

In 2007 the green certificates price reached EUR 130/MWh (USD 197.2/MWh). According to Law 244/2007, small generators (up to 1 MW, for wind power limited to 200 kW) could choose to sell their green certificates on the market or receive a feed-in tariff (European Renewable Energy Council (EREC), 2009). The period for the release of green certificates was extended to 15 years for new and refurbished installations (Law 244/2007).

The 2008 Finance Act and the subsequent 2009 Ministerial Decree increased the quota by 0.75% annually over the years 2007 to 2012. This translated into a quota obligation of 5.3% in 2009, 6.05% in 2010, and 6.8% in 2011.

Under this Act, the Italian government introduced a "banding" mechanism into the certificate system, which accounts for the technology maturity. The quantity of green certificates granted to renewable energy producers having larger than 1 MW installations was multiplied by a coefficient, which is varied with the technology from 1.0 for onshore wind energy to a maximum value of 1.8 for wave and tidal energy.

The market regulates the value of the certificates, although in case of an excess of certificates on the market (long market), GSE must buy them at a fixed price. This price is calculated (article 25, paragraph 4 of the Legislative Decree 28/2011) as 78% of the price of certificates sold by GSE. In case of a shortage of certificates (short market), GSE can sell those certificates coming from the former feed-in (CIP6) scheme at a published price, calculated as the difference between EUR 180/MWh (USD 263.1/MWh) and the annual average market price of electricity in the previous year, which is EUR 87.38/MWh (USD 121.63/MWh) in 2011, net of VAT.

In addition, one green certificate was now worth 1 MWh, instead of 50 MWh which was the previous value. Therefore, the certificate system became more suitable for smaller renewable energy installations.

The certificate scheme was handled by GSE (electricity market operator) and AEEG (Regulatory Authority for Electricity and Gas). GSE's role was to verify that the participants were fulfilling their quotas and inform AEEG who could impose a penalty, in case of non-compliance.

The implementation decree of Budget Law 2008 (International Energy Agency (IEA), 2012) created a mechanism to withdraw unsold green certificates from the market in order to maintain the green certificate price. The price was set to the average price of the previous three years.

A new legislative decree (Number 28 of 3 March, 2011) (Gazzetta Ufficiale Della Republica Italiana, 2011) transposed the European Directive for the promotion of renewable energy sources (2009/28/EC) (IEA, 2012) into a national target of 17% of renewable energy in the gross final energy consumption by 2020.

Expected future changes

From 1 January, 2013 the quota system will be replaced by a a feed-in system for schemes under a given threshold and a tendering scheme for new plants (except biomass) with a capacity above the threshold. The threshold is differentiated by renewable energy sources. Details of the implementation will be elaborated in upcoming Ministerial Decrees.

GSE must buy all certificates that exceed the annual demand. Legislative Decree 28/2011 rules that for renewable energy installation starting operation after 31 December 2012, the feed-in premium system in place over 2011-2012 will be replaced by a feed-in tariff scheme. The tariff would include the price at which GSE purchased the electricity generated by renewable sources from the producers.


Belgium ©Sidney Van Damme/GWEC

The duration of the support will be equal to the average lifetime of the technology. This incentive is to be granted under private contracts with the national transmission system operator. The incentive will remain constant throughout the support period. The 2011 Decree sets a goal of 23 000 MW of renewable capacity installed by 2016 and is likely to produce major changes in the national support policy to renewable energy.

CURRENT CHALLENGES

During the past decade the Italian electricity system suffered from inadequate grid infrastructure, which led to frequent curtailment of wind power to avoid congestions. The administrative processes to develop the grid are not centralised, which slows the authorisation process.

The grid problem affects projects in Campania, Apulia and Basilicata and some in Sardinia. Problems occur due to the high concentration of projects in pockets and the low capacity of the grid, especially on old 150 kV lines, which do not allow all the power produced by the wind farms to be dispatched. In 2009, a number of wind farms operated at 30% less than their normal capacity due to this issue. In some cases, wind farms were limited by over 70%, while others were shut down completely.

Integration to the grid is a source of concern for accommodating both the current installed wind energy capacity and the planned capacity. At present, some projects are under development to include storage (battery-based) systems for renewable energy-based electricity. In addition, Italy also suffers from administrative constraints such as complex authorisation procedures and high connection costs.

The quota system enables considerably higher profits for onshore wind than most other European countries applying feed-in systems (Re-Shaping, n.d.). In the face of economic concerns in Italy, the generous levels of support for renewable energy sources may be revised downwards, as seen in recent months in neighboring countries like Spain, Portugal and Greece.

CONCLUSION

Several policy elements are characteristic of the Italian case:

» The green certificate system was an efficient support mechanism leading to strong growth in the wind energy market.

» However, Italy has the highest average expenditure for supporting wind power and small hydroelectric plants in the European Union (Rathmann, *et al.*, 2009). Although Italy's priority is to diversify its energy supply and to lower its dependency on imported gas in the electricity sector, the costs of the support policy might not be sustainable in the future.

» The country's generous support scheme has however attracted investors, despite long administrative procedures and grid constraints putting investments at risk.

» The regions play an important role in the deployment of renewable energy technology. Up until now developments have been mainly concentrated in the south of the country, causing grid overloads.

The national policy for renewables operates through a complex set of incentives which range from indirect regulatory support measures, such as feed-in tariffs and fiscal incentives, to market-based mechanisms, such as quota obligations and tradable green certificates.

The incentives schemes are not adjusted in line with the technology learning curve. The support for renewable energy is not within the range of production costs from other technologies. The high support levels have increased the number of investors involved in renewable energy production, and led to the successful growth of onshore wind power and solar PV.

ANALYSIS ON ENABLING CONDITIONS FOR WIND ENERGY

Effective rule of law; and transparency in administrative and permitting processes	A continuous and long-term policy framework has been in place since 1988. There is scope for improving regional permitting procedures to facilitate project development.
A clear and effective pricing structure	The tradable green certificates system under the quota obligations was an effective mechanism. The proposed shift to a feed-in system is likely to provide dependable support for wind power development.
Provisions for access to the grid (incentives and penalties for grid operators)	Electricity produced from renewable sources has priority for dispatch by the distribution companies and favourable connection procedures.
An industrial development strategy	The main driver developing renewable energy sources has been to promote energy security and reduce import dependency. No national industrial development strategy is in place. Some of the regions provide capital subsidies.
A functioning finance sector	Financing for wind projects has been available through the private sector.
Expression of political commitment from government (e.g., targets)	Long-term renewable energy target of 17% by 2020. Italy plans to produce 98 TWh from renewable sources by 2020, up from 27.5 TWh in 2010.
A government and/or industry-led strategy for public and community buy-in	Stakeholder engagement and consumer awareness have not been a specific activity undertaken by the government or industry.
An employment development strategy	Not Applicable
NOTE	**Italy's national policy for renewables operates through a complex set of incentives which range from indirect regulatory support measures, such as feed-in tariffs and fiscal incentives, to market-based mechanisms, such as quota obligations and tradable green certificates. According to a recent European study, Italy has the highest average expenditure for supporting wind power and small hydropower.**

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PORTUGAL

MARKET OVERVIEW

Portugal is one of the leading countries in Europe in terms of wind power penetration, with 17.6% of its electricity demand met by over 4 GW of wind power capacity in 2011. Wind energy is the second most developed renewable source, after hydropower. The country adopted a target of achieving 20% of its energy consumption from renewables by 2020 under its National Renewable Energy Action Plan. Existing and planned wind farms are mainly concentrated in the northern part of the country [150].

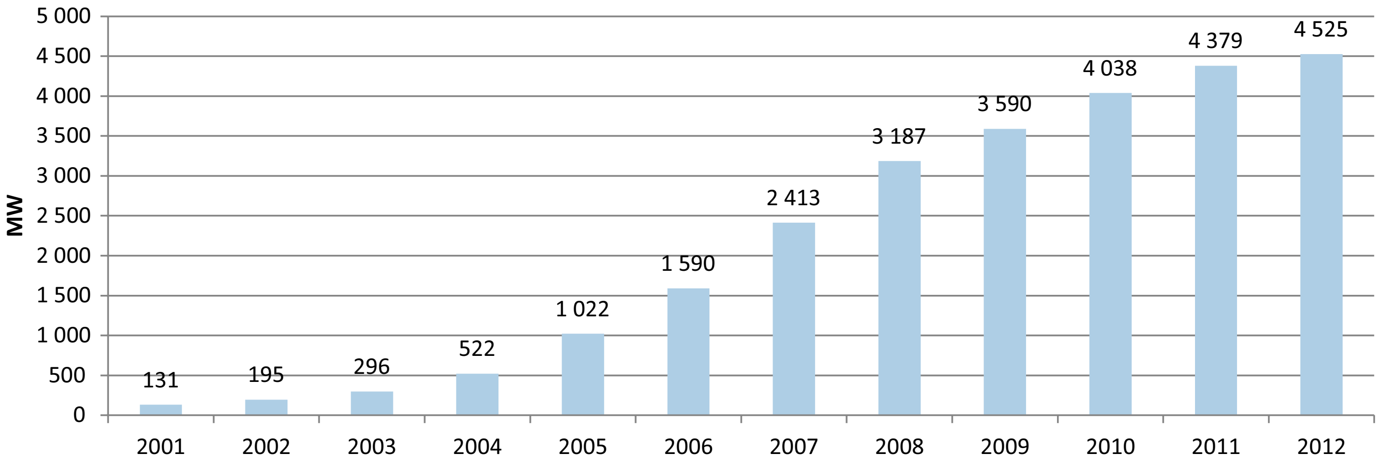

Figure 14: Cumulative Wind Installation (MW) of Portugal (GWEC, 2011)

HISTORY AND EVOLUTION OF POLICY AND REGULATORY FRAMEWORK FOR WIND ENERGY

Portugal has no proven oil or natural gas resources of any significance, although historically its energy supply relied largely on those fuels. The country's electricity consumption increased significantly from 23.5 TWh to 46.5 TWh during the period from 1990 to 2003.

Energy independence and the use of indigenous renewable energy resources have become an important part of the country's energy strategy. According to the Portuguese Renewable Energy Association (APREN) electricity generation from renewable energy sources accounted for 46.8% of mainland Portugal's total consumption in 2011 (Ascenso, n.d.).

Phase 1:

Early regulatory and tariff support for renewables (1988-2001)

The first law guaranteeing grid access for Independent Power Producers (IPPs) using renewable energy sources came into force in 1988[151]. At that time the legislative framework was only applicable to small hydropower (below 10 MW), but an amendment in 1995[152] extended it to other renewable energy sources, such as wind power.

[150] Most wind farms located in Portugal are in the northern half of the country. The windier locations in Portugal are usually in coastal regions and on mountaintops. However, as the Portuguese coast is densely populated, wind farms in Portugal have mostly been built inland, on mountains, to make the most of the country's wind resource (Eolicas de Portugal (ENEOP), n.d.).

[151] Decree-Law no. 189/88 passed on 27 May, 1988. With Decree 189/88, Portugal introduced a legislative framework to regulate the production of renewable electricity.

[152] Decree-Law no. 313/95 passed on 24 December, 1995.

The scheme has been reviewed several times since then, following the evolution of the electricity market and its liberalisation. The production of electricity from renewable energy sources was included in the PRE regulation (Produção en Regime Especial or Special Regime).

This legislation also set a feed-in tariff scheme for the first time. The scheme was revised in 1999[153], and a more complex formula was introduced. The new feed-in tariff formula took into account the avoided costs of investing in conventional power plants; the avoided costs of operating and maintaining a conventional power plant; avoided environmental costs in terms of CO2 emissions; and the inflation rate (GWEC, 2010). The feed-in tariff has been revised several times, but the concept of compensating for avoided costs is still in use.

Portugal started promoting research and development (R&D) on renewable energy technologies in the early 1990s, through the institute for Industrial Engineering and Technology (INETI). Several new companies were created at this time to explore the country's wind energy potential and develop wind energy technology. For example, the wind energy development company Enernova was created as a subsidiary of the public utility Electricidade de Portugal (EDP). These companies, along with the National Renewable Energy Association (APREN), created in 1988, were key drivers for the implementation of wind energy schemes[154] during the 1990s.

INETI has undertook a detailed evaluation of Portugal's wind resources, and published a wind atlas for the country. Financing became increasingly available for wind projects, leading to a surge in new projects from 2000 onwards. However, one of the limitations for wind energy in Portugal was the quality of the grid infrastructure, which increased the connection costs and delays.

Phase 2:

Incentives to stimulate renewable electricity production (2001-2012)

Consistent with the European Directive on renewable electricity (2001/77/CE), Portugal launched the E4 Programme (Energy Efficiency and Endogenous Energies) in 2001. The E4 set an objective of 39% (later increased to 45%) of the country's gross electricity consumption to be supplied from renewable energy sources (including large hydropower) by 2010.

A series of initiatives were launched between 2001 and 2003 to stimulate the electricity market, including:

» A Decree-Law establishing a range of favourable feed-in tariffs for electricity produced from renewable energy sources[155] .

» A Decree-Law regulating the delivery of electrical energy into the low-voltage grid (micro-generators, including PV)[156].

» A broadened scope for financial incentives for energy efficiency and use of indigenous energy sources in the framework of the POE/PRIME Programme[157] (the Operational Programme for Economic Development[158]).

In 2001, the new legislation supported the wind energy sector by clarifying the licence-granting process for grid access and simplifying the administrative procedures.

Along with these measures, in the same year, the feed-in tariff formula was also updated, with the introduction of a new factor, to differentiate between technologies. Under the new legislation, EUR 0.082/kWh (USD 0.144/kWh) would be paid for the first 2 000 hours of wind

[153] Decree-Law no. 168/99 passed on 18 May, 1999.

[154] A number of wind projects were established on Portuguese islands in the late 1980s and early 1990s, but the first mainland wind scheme was built in 1992. This consisted of twelve 150 kW machines, totalling 1.8 MW.

[155] Decree-Law no. 339-C/2001 passed on 29 December 2001 with following amendments.

[156] Decree-Law no. 68/2002 passed on 25 March, and amended in 2007. The share of wind power in micro-generation continues to be negligible.

[157] Provided direct subsidy payments, though it did not have a significant impact on the growth of wind energy.

[158] The Ministry of Economy, through the Secretary of State for Economy, was the public authority that oversaw the energy sector. The General-Directorate for Energy (DGE) is the entity responsible for the development, execution and evaluation of the energy policy.

[159] There numbers are based on 2002 values.

[160] Decree-Law no. 33-A/2005 passed on 16 February, 2005.

energy production each year[159]. The tariff was reduced by blocks of 200 hours, reaching a minimum of EUR 0.04/kWh (USD 0.07/kWh) after 2 600 hours.

A special tax, payable to the local municipality, of 2.5% of the total revenue from wind projects was also introduced (GWEC, 2010). This provision was introduced to ensure benefits to local communities (European Renewable Energy Council (EREC), 2009).

Between 2001 and 2005, a major source of investment support was the "Incentive Scheme for Rational Use of Energy' (SIURE)" which provided capital grants for different types of renewable installations. The scheme was run by the Ministry for Industry and Energy and supported by the European Union.

The most significant increase of wind power capacity in Portugal took place between 2004 and 2009. During this time more than 500 MW was installed annually.

In 2005, revisions to the previous feed-in tariff legislation[160] limited the power purchase agreements to the first 33 GWh produced per MW installed, or 15 years, and decreased the tariff to EUR 73/MWh (USD 114.83/MWh). Once this threshold had been reached, the operators would receive the market price plus the prevailing market value of green certificates at that time.

In 2005, a tender for 1 800 MW of wind power was released in three phases: phase A – 1 200 MW won by the ENEOP consortium; phase B – 400 MW won by the Ventinveste consortium; phase C – 200 MW distributed between several small projects[161].

Following completion of the tendering process, an industrial cluster for wind energy was developed, representing an investment of approximately EUR 290 million (USD 456.16 million). The industrial cluster was an outcome of the tendering conditions, since a condition of bidding involved working with local manufacturing companies to establish clusters of industries. The initiative aimed to create jobs and local economic development, while reducing the installation costs for new wind generators.

The Portuguese company Redes Energeticas Nacionais S.A. (REN) carries out the development of the transmission grid . There is a single operator for the national grid[162], EDP Distribuicao (EDPD[163]). Grid connection procedures are normally completed in a timely manner[164]. The National Transmission Grid Development and Investment Plan for the period 2012-2017 (P-DIRT) includes gradual and phased expansion of the electricity network.

No new wind power capacity was granted between 2005 and 2012. The National Renewable Energy Action Plan (NREAP) was presented to the European Commission in August 2010. The Plan included 6 875 MW for wind power of which 75 MW was for offshore wind. In order to reach this objective, approximately 1 000 MW of new wind projects are required, which will need to be contracted by future tenders.

Impacts of the economic crisis and reduction in renewable energy support

By middle of 2011, the Portuguese economy was under scrutiny by the International Monetary Fund, the Central European Bank, and the European Commission[165]. The Memorandum of Understanding (MoU) that rules the conditions for the financial assistance to Portugal defined measures to be taken on the energy sector. The provisions relevant for renewable electricity production under the Special Regime are as follows:

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[161] The reference tariff offered was determined under Decree-Law no. 33-A/2005, but each of the bid winners gave discounts, which ranged between 5% for phases A and B, to a maximum of 23% for one of the projects in phase C (meaning a bid of only EUR 57/MWh (~ USD 89.66/MWh)).

[162] To meet the terms of its bailout agreement the Portuguese government sold a 40% stake in REN for EUR 592 million (USD 800.06 million) to State Grid International of China and to the Oman Oil Company in early 2012.

[163] As part of Portugal's bailout plans the China Three Gorges Corporation agreed to pay EUR 2.69 billion (USD 3.74 billion) for 21% of EDP in December 2011 (Almeida and Reis, 2012).

[164] In Portugal electricity generation is allocated between: (a) PRO or Ordinary Regime Production, which makes offers on the market, includes plants such as oil/coal-fired conventional thermal, combined cycle gas turbines and large hydro, and (b) PRE or Special Regime Production, with feed-in tariffs. The PRE group includes all the renewable technologies generating electricity plus some non-renewable fuel-fired cogeneration plants. PRE gets priority in case of grid congestions. PRE production can only be restricted when a very specific production source can solve the grid congestion. Currently, the owner of a project in Portugal has no obligation or responsibility to forecast its production.

[165] Statement by the EC, ECB, and IMF on the First Review Mission to Portugal, Press Release No. 11/307 (August 12, 2011)

"5.8. Review in a report the efficiency of support schemes for renewables, covering their rationale, their levels, and other relevant design elements.

5.9. For existing contracts in renewables, assess in a report the possibility of agreeing a renegotiation of the contracts in view of a lower feed-in tariff.

5.10. For new contracts in renewables, revise downward the feed-in tariffs and ensure that the tariffs do not over-compensate producers for their costs and they continue to provide an incentive to reduce costs further, through digressive tariffs.

For more mature technologies develop alternative mechanisms (such as feed-in premiums). Reports on action taken will be provided annually in Q3-2011, Q3-2012 and Q3-2013."

Following the bailout, national elections were organised, and the government changed. Since 2011, there has been significant regulatory instability in the Portuguese wind energy market. The existing support schemes (feed-in tariffs) have been under negotiation with the producers and there were several policy changes that triggered insecurity, including a new legislation in February 2012[166] which suspended all new power generation allocation procedures indefinitely (APREN, 2012).

In April 2012, a public consultation was started to review the National Renewable Energy Action Plan, decreasing scheduled capacity for all renewable energy technologies in 2020. The wind power capacity was lowered to 5 300 MW in 2020, which corresponds to the remaining capacity granted in the 2005 tender, and a few other equipment projects[167].

As a consequence, no new wind power capacity would be allocated up until 2020, unless a review is conducted in 2014 as envisaged in the review document.

With Decree-Law 25/2012, the current negotiations and the new NREAP in place, the Portuguese renewable energy sector is waiting for the end of this period of instability, and for improved conditions after the 2014 review of the energy policy.

Development of Iberian (Portuguese-Spanish) electricity market

In 1999, the Portuguese and Spanish governments signed a "Protocol for Cooperation between the Spanish and Portuguese governments for the creation of the Iberian Electricity Market".

The Protocol was intended to guarantee Portuguese and Spanish consumers better access to domestic and foreign electricity networks. It gives Iberian electricity operators the possibility of contracting directly with the end consumers in a common Iberian electricity pool.

The Iberian Electricity Market or "MercadoIbérico de Electricidade" (MIBEL) became operational in July 2007. The initiative triggered the establishment of an integrated regional electricity market. MIBEL has one common price for electricity for Spain and Portugal if there is sufficient interconnection capacity.

The MIBEL spot market is to be managed by the Spanish market operator (OMIE), and the derivatives market is to be managed by the Portuguese market operator (OMIP).

Following the 2006 Badajoz Summit and the signing of the regulatory compatibility agreement between Portugal and Spain in March 2007 under the MIBEL, the first virtual capacity auctions took place. In Spain, they were organised jointly by Endesa and Iberdrola, and in Portugal, by REN Trading.

By the end of 2009, the governments of Portugal and Spain had formally published the International Treaty signed in Braga (in 2008) to establish the Iberian Market Operator (OMI), thereby taking another important step towards bringing the regional market to full maturity.

The first meeting of the common Board of Directors of the companies managing MIBEL – i.e. OMIE (spot market) and OMIP (derivatives market) – was held in 2011. It represented an important step towards the implementation of the Iberian Power Market Operator (OMI) after 11 years of negotiations for the creation of a regional electricity market.

CURRENT CHALLENGES

As part of Portugal's broader economic restructuring under its bailout obligations to the EU, the European Central Bank and the IMF, the country must privatise a significant portion of its energy sector, and transpose the European legislation for the liberalisation of the energy sector. The government is required to revise, reduce and revoke several of its incentive mechanisms for renewables in 2012-13. The credit crisis also impacted on project financing in 2011-12. Therefore, Portugal's planned 2014 review of its 2020 renewable energy targets will take place at a time of national economic restructuring and tight government budgets.

To increase the penetration of renewable energy in the energy mix, the country would need to increase its grid and storage capacities. The increase in storage capacity could be mostly achieved through an increase of the hydropower capacity. IPPs are facing severe difficulties in connecting to the grid, due to the low capacity of the system, and issues in accommodating all connection requests (Re-Shaping, n.d.).

CONCLUSION

Portugal implemented a stable feed-in tariff for wind energy of EUR 74/MWh (USD 107.13/MWh). This tariff was valid for 15 years, and was adjusted for inflation. Taking into account the 2005 tenders, the country has one of the lowest feed-in tariffs in Europe. The use of a mixed tariff-based and tendering process has enabled the wind sector to benefit from a constant project pipeline. This system proved to be effective, and resulted in excellent growth, both in terms of installed capacity and electricity generation, between 2005 and 2010.

Strong government support over a long period of time, and a large and continuous pipeline of projects, provided long-term market viability to the industry. Local municipalities received a portion of the gross income generated by the wind projects, which increased public acceptance and facilitated a cooperative environment between the power producers and the municipalities.

From 1990 to 2010 electricity prices in Portugal decreased to below the European Union average, which confirms the positive effect of the domestic energy policy (APREN, 2011). However, consumers were not charged the full costs of electricity production, which led to a tariff deficit of over EUR 2 million (USD 2.9 million). This deficit was mistakenly attributed to the renewable energy sector. In addition, VAT has been increased from 6% to 23%. Electricity producers and the government therefore face challenges in justifying inevitable future electricity price increases.

By 2020, Portugal intends to be generating 60% of its electricity from renewable resources, in order to satisfy 31% of its final energy consumption. Grid integration will be a critical element for developing wind power. Interconnecting with the larger Spanish electricity market and the large hydropower system[168] enabled to integrate large amount of wind energy to the grid. However the interconnection capacity with Spain is already insufficient, since the wind regime is similar in both countries, and both countries have an overcapacity of gas and coal generation. Smart grids are now being promoted and deployed throughout Portugal as part of the National Energy Strategy. Their introduction is being combined with more efficient management of the existing networks.

Tetouan Wind Farm, Morocco©CDER

[166] Decree-Law no. 25/2012, passed on 6 February.

[167] Decree-Law no. 51/2012, passed on 20 May, allowed for the installation of 20% more power than the power stated in the grid connection allowance, in return for a discount on the feed-in tariff.

[168] The implementation of the Large Hydro National Plan is expected to increase Portugal's pump storage capacity from 1 100 MW in 2011 to 4 850 MW in 2020, and thus reduce the limitations of wind production during off-peak hours, ensuring the economic feasibility of the installation of the new capacity.

ANALYSIS ON ENABLING CONDITIONS FOR WIND ENERGY

Effective rule of law; and transparency in administrative and permitting processes	Historically the regulatory framework has been stable. However, since 2010, there has been limited clarity on the future of the tariff and support schemes for renewables, due to the need for structural adjustments in the Portuguese economy. The short-term actions now being deployed to meet budgetary obligations may affect long-term investment priorities. According to the European Wind Energy Association, the average lead-time for project developments could now reach 58 months, when the EU average was 24 months in 2010.
A clear and effective pricing structure	Feed-in tariffs were available for almost all renewable energy producers. The tariff system is combined with tendering schemes, and has proven to be effective. The tariff system has led to a very steep growth of both installed capacity and electricity production over the last five to six years. Both the scheme and the tariffs have been continuously monitored against the level of market prices.
Provisions for access to the grid (incentives and penalties for grid operators)	Renewable energy projects have priority on access to the grid, as stated in the National Energy Strategy Plan. Sites for new wind and forestry biomass power plants are tendered and located where the grid can be efficiently and consistently developed.
An industrial development strategy	The government supported the development of industrial clusters, thus creating a local supply chain. Long-term targets for wind energy and a large pipeline of projects provided the necessary long-term visibility on market conditions to allow a local supply chain to be built.
A functioning finance sector	The stability of the support scheme, and of other fiscal incentives through the last decade, allowed for predictable returns on investments. Project financing was easily available until the economic crisis.
Expression of political commitment from government (e.g., targets)	Portugal intends to supply 60% of its electricity from renewable resources by 2020, in order to satisfy 31% of its final energy consumption.
A government and/or industry-led strategy for public & community buy-in	The 2.5% (of gross income from wind projects) tax-based contribution to municipalities helped to improve public acceptance and cooperation between project developers, power producers and the municipalities.

An employment development strategy	Small- and medium-size enterprises were supported to develop capacity and manpower for building and operating renewable energy projects and manufacturing equipment.
NOTE	**Portugal has had one of the most stable policy and regulatory regimes for wind. However, the ongoing financial and economic crisis will greatly affect the future of the sector.**

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SPAIN

MARKET OVERVIEW

Spain is the second largest European wind energy market after Germany, and has the fourth largest installed capacity in the global market. The country installed 1 122 MW in 2012, for a total installed wind capacity of 22 795 MW. The historic annual figures were usually much higher in the past, but the financial crisis and retroactive change on the renewable energy support legislation affected strongly the market, with no prospects for recovery in the near future. Spain has a target of producing 20% of its gross final energy consumption from renewable sources by 2020, which includes a total installed capacity of 35.75 GW of wind power (Ministry of Industry, Energy and Tourism, 2010).

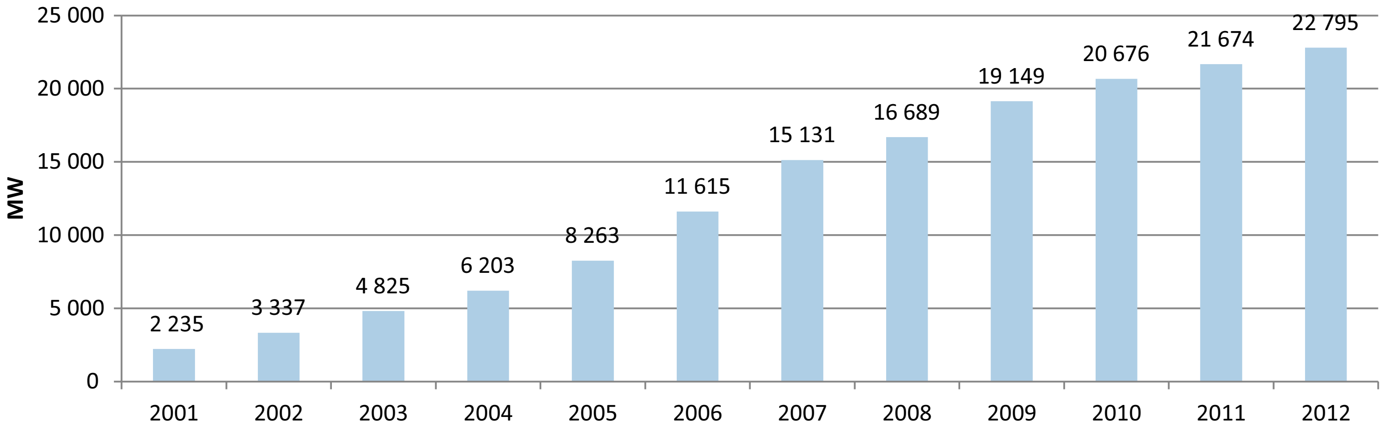

Figure 15: Cumulative Wind Installation MW) of Spain (GWEC, 2013)

HISTORY AND EVOLUTION OF POLICY AND REGULATORY FRAMEWORK FOR WIND ENERGY

Phase 1:

Technology demonstration and Renewable Energy Plans (1980-1996)

The Law of Energy Conservation (Ley 82/80 de Conservación de la Energía) was passed in 1980. The Law established the objectives of improving the energy efficiency of industry and reducing dependency on energy imports.

The first Renewable Energy Plan (PER'86) was published in 1986. This plan proposed targets for renewable energy production and for private and public investment in renewable energy systems. It was later replaced by the second Renewable Energy Plan (PER'89), which set further targets for development and investment in renewable energy projects. Both of these early plans focused largely on demonstration projects.

In 1991, the government approved a new National Energy Plan that included the Energy Saving and Efficiency Plan (PAEE 1991-2000). This plan set an overall target for energy production from renewable sources in the country. It also established an incentive programme for cogeneration and renewable energy to increase their share from 4.5% of domestic electricity production in 1990 to 10% by 2000.

The market developed strongly in the mid-1990s when utilities started to place large orders for wind farms.

The joint venture formed in 1994 between Gamesa (the dominant Spanish manufacturer today) and Vestas, allowed the Danish wind company to comply with local content requirements.

The Royal Decree 2366 of 1994 was the first attempt to introduce tariffs for renewable energy by providing tariff bands[169] as well as a method for estimating the remuneration level for the produced electricity (Sijm, 2002). However, this scheme did not provide significant support to the wind sector.

Spain was able to increase its installed wind capacity and simultaneously develop a local wind industry by actively supporting local manufacturing with policies. These policies encouraged foreign companies to establish manufacturing bases in Spain in return for access to the domestic market (Lewis and Wiser, 2005).

Phase 2:

Targets for RES, introduction of feed-in tariffs and market development (1997-2000)

Electric Power Act 54/1997

The feed-in tariff system was fully developed through the Electric Power Act of 1997 (Act 54/97[170]). This Act introduced the process of liberalisation of the electricity sector in the country. It differentiates between the average rate of electricity production and the "Special Scheme" for facilities using non-consumable renewable sources as primary fuel[171]. The Special Scheme included obligations and rights for producers, including:

i) the mandatory incorporation of the electricity produced into the electric grid; and ii) the payment of a premium for this energy, with the intention of improving its market value. Under the Special Scheme, electricity producers could sell their surplus energy at a regulated tariff to the distributor, or to the market at a premium price. Under the new system the power producer could choose between the feed-in tariff and premium for the period of one year.

This Electric Power Act established a new "Plan for the Promotion of Renewable Energies[172]", to supply at least 12% of total energy demand from renewable energy sources by 2010. Under this Act, the electricity distributor had an obligation to buy all electricity produced from renewable sources. The National Commission of Energy (CNE[173]) was responsible for settling the costs incurred by the distributors. Under this tariff plan, the costs of renewable electricity production were accounted for in the annual calculation of the electricity price, thereby ensuring that the additional cost to consumers was proportionate to their electricity consumption. Transmission and distribution access were opened to third parties. A transitional period of 10 years was established for the liberalisation of electricity supply, whereby all consumers could gradually choose their supplier.

The Royal Decree (2818/1998)

The Royal Decree (2818/1998) on the production of electricity from renewable energy regulated the requirements and procedures for projects eligible to the Special Scheme. Among other things it set out the details of registration procedures in the National Energy Commission's (CNE) registry.

The 1998 Decree established the right of renewable energy producers to sell their entire electricity production to the grid, and to be paid the wholesale market price plus a premium. It set the initial values for these premiums and the process for their annual updates, taking into account variations in the average price of electricity

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[169] The Decree distinguished among six eligible technology groups, of which only three assumed the use of non-fossil fuel resources. For example, installations using wind, solar and geo-thermal were in Group A. This differentiation was only relevant for tariff levels or bands. It was applicable to projects smaller than 25 MW or 100 MW with special permission from the government. Large hydro projects were not included.

[170] Ley 54/1997 del Sector Eléctrico Español, Jefatura de Estado was passed in 1997,and modified by Royal Decree 436/2004.

[171] The law introduced the differentiation between the average rate of electricity production and the "Special Scheme" for facilities using non-consumable renewable energies as primary fuel, such as biomass or any other biofuels, in plants up to 50 MW.

[172] These targets were defined in the Plan for the Promotion of Renewable Energy Sources of 1999 (Instituto Para la Diversificacion y Ahorro de la Energia (IDAE), 1999). The plan had an indicative character and implied no compulsory behavior for energy sector actors.

[173] The National Energy Commission is the regulating body of Spain's energy sector. It was created by Act No. 34/1998 and Royal Decree 1339/1999 further developed its functions. Its goals are to ensure effective functioning of energy systems, while promoting objectivity and accountability in their performance.

sales. Additional sets of incentives were introduced in 1999, including research budgets and a programme for promoting renewable energy among the general public.

Wind had become a national success story, and the installed wind capacity grew from 7 MW in 1990 to over 377 MW in November 1997 – more than double the government's target of 168 MW by 2000. The efforts of various regional governments to capitalise on the development of the wind power market helped create a large support for local wind power development.

A large share of the investments (such as for manufacturing and construction) also benefitted local economies. Several regional governments used local content requirements to attract wind industry manufacturers to their regions in an attempt to increase industrial development and economic growth. These provinces included Navarra, Galicia, Castile and Leon and Valencia, many of which insisted on local assembly and manufacture of turbines and components before granting development concessions (Lewis, 2007).

The Royal Decree (436/2001) also established the methodology to update and systematically improve the legal and economic framework for the electricity sector's activities under the Special Scheme[174].

Decree 436/2004 obliged operators of wind farms with capacities greater than 10 MW to provide the distributor with a forecast of the electricity they intended to inject into the grid at least 30 hours before the start of each day. Penalties were established for deviations. This decree also supported distributors' obligation to purchase all the electricity produced at a price above the market rate.

Phase 3:

Strengthening targets and feed-in tariff (2000-2010)

To further strengthen the growth of renewables in Spain, the Institute for Diversification and Saving of Energy (IDAE) prepared a Plan for Renewable Energy (IDAE, 2005) involving members of the national government, the regional governments and academic and professional institutions. The 2005 plan set revised capacity targets for 2010, which included a wind target of 20 155 MW. This plan superseded the Renewable Energy Plan passed in 1999. IDAE was put in charge of monitoring the state of the 2005 plan's targets (European Renewable Energy Council (EREC), 2009).

The 2005 plan had an investment outlay of approximately EUR 23.6 billion (USD 38.1 billion). Of this amount almost 97% was expected to come from private sources. Just EUR 681 million (USD 1.1 billion) or 2.9% of the total, was to be provided as public investment aid.

The 2007 modification to the Spanish feed-in tariff system (Royal Decree 661/2007) introduced two alternative remuneration options for wind power.

- Feed-in tariff (guaranteed payment): comprising a guaranteed feed-in tariff[175] (understood as a state-regulated minimum tariff for all electricity from renewable sources); and a variable feed-in tariff for hydro-electricity operators and biomass projects, based on a variable, time-dependent tariff, set up by statutory law. This tariff varies with the time of day and the season. The feed-in tariff guaranteed an internal rate of return of 7% to wind energy.
- Feed-in premium: paid as a complement to the electricity market price with a minimum and maximum overall remuneration level (for all renewable sources except solar PV and geothermal), determined on an hourly basis.

The new decree laid out the administrative and authorisation procedures for offshore wind farms. During 2008, 7.6% of Spain's primary energy needs and 20.5% of the nation's electricity was produced from renewable sources.

Spain reached the 2010 target of 7.5% of gross energy consumption from renewables in 2008 (RECHARGE,

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[174] It further consolidated the regulatory framework laid down by Law 54/1997 for renewable energy producers operating under the Special Schemeand derogates the previous legislation under Decree 2818/98.

[175] Tariffs are differentiated by technology and project size, and guaranteed for different time periods. The tariffs are adjusted for inflation and account for other elements such as operational efficiency of the system, the cost of technology used, market development of the technology, etc. The updating process is also linked to the fulfillment of capacity targets per technology, as defined by the Renewable Energy Plan. Each time a "Special scheme" technology has exceeded the target, its remuneration scheme is reviewed in order to adapt to the new market conditions for the technology. PV and wind are two examples of technologies affected by changes of regulation due to meeting and surpassing their planned capacity targets.

n.d.a). The government then created a "pre-assignment register" in May 2009 to stop the sector overshooting the revised targets in its 2005-2010 renewable energy plan.

The tariff system was revised in 2010 (Royal Decree 1614), with the feed-in premium temporarily reduced by 35% (from EUR 30.98 to EUR 20.13/MWh – USD 44.4 to USD 28.9/MWh). This reduction only affected installations under the Royal Decree 661/2007. The new decree also included a provision to limit the number of hours of operation that would qualify for the feed-in tariff or premium each year[176].

For a given year, when the average number of equivalent hours for the overall wind power installation passes 2 350 hours, the individual wind farms that produced above 2 589 hours would only receive the market price for the hours below the limit[177].

The National Renewable Energy Plan 2011-2020, approved by the Council of Ministers on 11 November 2011, should enter into force in 2012/13. In line with EC Directive 2009/28/EC on the promotion of the use of energy from renewable sources, Spain should supply 20% of its gross final energy consumption from renewable sources by 2020. The 2011 plan follows up on the mandate of Royal Decree 661/2007, which regulated the activity of electricity production under the "Special scheme" and the Law 2/2011, of March 4, on "Sustainable Economy".

CURRENT CHALLENGES

In January 2012, the government passed a moratorium stopping subsidies to all new renewables capacity not already approved (McGovern, 2012). Wind projects already approved on the national pre-allocation register will not be affected by the moratorium.

The current uncertainties in the Spanish legislation are an example of the difficulties that a country can face in continuously adapting its legislative framework to broader economic constraints, while preserving a dynamic market. The delays in defining a regulatory framework for the period after 2012 could delay the achievement of the 2020 targets.

The economic crisis has put limits on budgetary allocations for renewable energy. This is likely to further slow down development of Spain's wind industry in 2012. Investors are uncertain on the rules for 2013, which makes it difficult for them to plan and invest in new projects. 2012 will be an unusual year for new installations in Spain. The capacity recorded in the pre-allocation register is the last to be installed in Spain under Royal Decree 661/2007. In September 2012, no new future capacity was planned, and manufacturers had received no new orders for the domestic market (RECHARGE, n.d.b).

CONCLUSION

Through the 1990s and early 2000s, the rapid development of renewable energy in Spain was a direct outcome of national and regional industrial and energy policies. Since 2008, the policies were influenced by the implementation of the European Directives. Some key characteristics of the Spanish market are:

- The country's rapid emergence as a centre for wind manufacturing was due to its local content requirements and its stable feed-in tariff policy, which created opportunities for investment in technology development.
- Government-led wind concessions were also widely used. Five wind concessions totaling 3 200 MW were granted to project developers through a tendering process. These projects helped support the development of new transmission capacity, since the financing of power lines was a requirement of the concessions (Lewis, 2007).
- The support scheme provided stable long-term support for the projects. This, in turn, created a stable market environment, where investors could predict their returns, and generated a constant demand for turbines. This constant demand enabled the industry to predict market volumes, and invest in manufacturing facilities and technology development.
- The 17 autonomous communities which constitute Spain have had a significant role in the development

[176] In 2010, significant changes affected the renewable energy market. The "deficit of the electricity tariff" is defined as the difference between the revenues of the renewable energy projects and the real costs in terms of energy generation, transport and distribution. The deficit was estimated at EUR 3 billion (USD 4.3 billion) in 2010. The government proposed a road map to reduce the deficit to EUR 2 billion (USD 2.7 billion) in 2011 and EUR 1 billion (USD 1.3 billion) in 2012. The temporary measures modified the remuneration schemes for wind, solar PV and CSP by limiting the possibility of choosing between the feed-in tariff and feed-in premium, reducing the tariff and the number of hours of production eligible under the scheme. This regulation was approved on a temporary basis (valid up to 2013) until the tariff deficit would be cancelled.

[177] A new regulation is expected by 2012 for the wind farms with a capacity over 50 MW (RD 1614/2010). The remuneration duration would be reduced to twelve years, for a maximum of 1 500 hours of production per year.

of renewable energy. In particular, the regional authorities mostly develop administrative procedures and provisions related to the environment, as well as planning provisions. For example, the autonomous region of Navarre was one of the first regions to actively support local wind industry development, opening the way for other Spanish regions to replicate the approach.

» The electricity grid has shown sufficient flexibility to operate with high levels of wind penetration, even above 50%, and with lower than originally expected costs of support services and spinning reserve (GWEC, 2010). The recent implementation of electricity exchanges agreements with Portugal, along with plans to reinforce the exchanges with France, would further increase the flexibility of the system.

» The contribution from the local industry to R&D was equivalent to EUR 189.5 million (USD 277 million) in 2008. The wind energy industry is a dynamic component of the national manufacturing industry.

» The growth of wind energy in electricity generation has led to environmental benefits, reduction of energy import dependence, development of an important technology and industrial base, and job creation.

According to the analysis undertaken by the European Wind Energy Association a key reason why Spain stood out from other European leaders in wind power, was that environmental issues were not the major driving force behind the sector's expansion. Spain's wind energy boom was much more about regional growth and economics.

The utilities were obligated to pay a guaranteed price that included a bonus incentive for wind energy, for five years. This price and bonus are adjusted every year based on fluctuation in the electricity market prices.

Spain's initial success has been possible due to the existence of a strong policy regime at a time when very few similar initiatives existed. A solid industrial sector was created, and the Spanish manufacturers developed strong export capacity. However since 2010, the wind sector has almost come to a standstill and its future beyond 2012 remains unclear.

Maranchón, Guadalajara, Spain ©Wind Power Works

ANALYSIS ON ENABLING CONDITIONS FOR WIND ENERGY

Effective rule of law; and transparency in administrative and permitting processes	A contiguous and long-term policy framework has been in place since 1985. Administrative and permitting processes are primarily the responsibility of regional governments. Detailed guidance is available to the industry.
A clear and effective pricing structure	Until 2009, there was strong support for renewable energy. Since 2010, revised legislation has slowed the growth of the wind sector. The revised legislation followed constraints on public expenditures caused by the financial crisis..
Provisions for access to the grid (incentives & penalties for grid operators)	Electricity produced from renewable energy sources has priority access. All electricity produced is purchased.
An industrial development strategy	The industry's growth has been largely due to the initial public support for wind turbine manufacturing. Two of the largest wind manufacturers are based in Navarre. The Navarran Hydroelectric Energy Company or EHN (presently called Acciona Energy) was created in 1989 under a public-private partnership. In 1994 GamesaEólica was created to manufacture wind turbines as a joint venture between the government of Navarre, GamesaEnergía and Vestas (with a 40% stake) .
A functioning finance sector	Spanish wind energy companies are among the largest in the global market. Financing was not a problem till 2010.
Expression of political commitment from government (e.g. targets)	There is a long-term renewable energy target of 20.8% by 2020.
A government and/or industry-led strategy for public and community buy-in	Early benefit-sharing among local populations (via rent for land use for wind farms, job creation, economic development in the community, etc.) has helped create positive support for the wind industry.
An employment development strategy	This was largely driven by the governments of the autonomous regions who provided additional support to both foreign and domestic investors in the 1990s to set up manufacturing units in Spain.
NOTE	**Through the 1990s and early 2000s, the rapid development of renewable energy was the result of Spain's national industrial and energy policy. Since 2008, the legislation has been influenced by the implementation of the European Directives.**

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UNITED KINGDOM (Including SCOTLAND)

MARKET OVERVIEW

The United Kingdom (UK) has one of the best wind regimes in Europe both onshore and offshore. As of 2012 the country had installed a cumulative capacity of 8 445 MW. It has the largest installed offshore wind capacity worldwide, with 2 947.9 MW installed capacity as of 2012. The majority of onshore wind farms in the UK are located in Scotland. The national renewable energy strategy has a target of generating 15% of all its energy from renewables by 2020 (RenewableUK, 2012)[178].

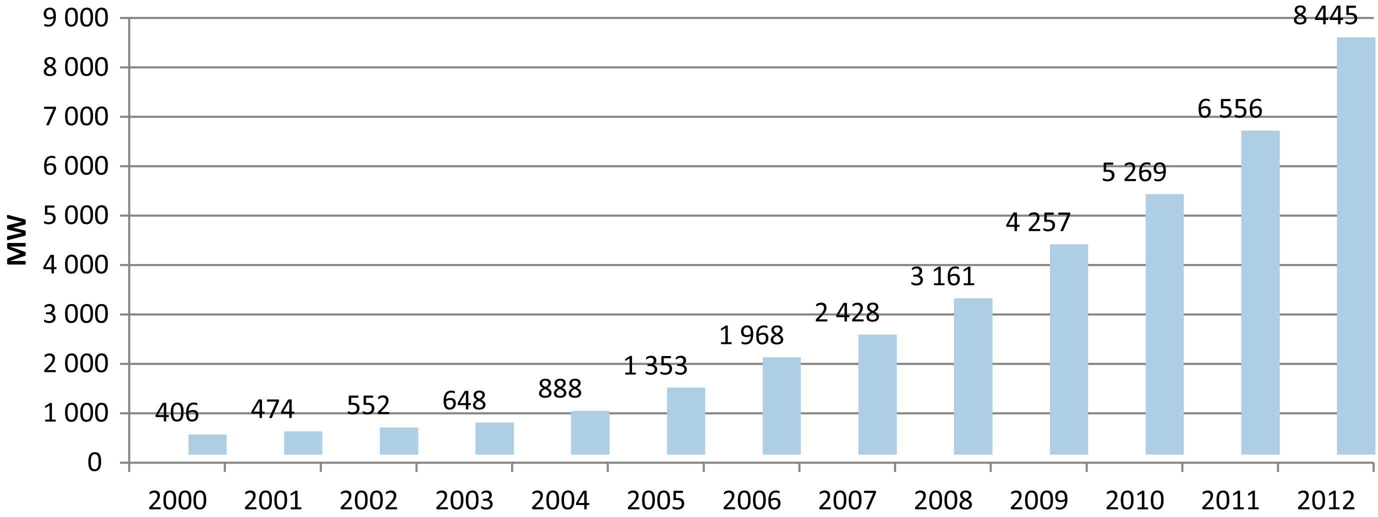

Figure 16: Cumulative Wind Installation (MW) in the UK (GWEC, 2013)

HISTORY AND EVOLUTION OF POLICY AND REGULATORY FRAMEWORK FOR WIND ENERGY

The UK has long been regarded as one of the best places in Europe for wind energy development.

After a slow start, developments over the last few years indicate that the country has started to realise its wind power potential.

Phase 1:

Electricity sector reform and privatisation (1982-1990)

The development of electricity production from renewable sources in the UK was largely driven by the reform and privatisation of the energy sector in the late 1970s and the 1980s[179]. The erstwhile Central Electricity Generation Board (CEGB) during the mid-1970s and the 1980s was involved in research and demonstration projects for renewable energy technologies. As early as 1980 the CEGB supported the development of several demonstration sites across the UK to promote the commercial use of wind energy (Price, 2006).

In 1982, the Oil and Gas (Enterprise) Act paved the way for the privatisation of British Gas and British Petroleum (BP). This Act set the stage for much of the national privatisation programme[180]. Over the following decade

[178] The UK has one of the highest offshore wind resources in the world with over 33% of the total European potential. The UK now has more than 1.8 GW of wind capacity installed offshore. A further 7.4 GW is under construction, approved, or in planning. The next round of offshore wind farms, Round Three, will add a further 32 GW, bringing the country's total to more than 40 GW before 2030 (RenewableUK, 2012).

[179] The Conservative government elected in 1979 had an unfavourable outlook towards providing subsidies and research grants for renewable energy technologies (Elliott, 2005).

[180] Pre-1990: A single nationalised organisation, the Central Electricity Generating Board (CEGB), was responsible for generating and transmitting the bulk supply of electricity in England and Wales. Post-1990, the CEGB was split into three generation companies: National Power (in 2000 renamed as International Power Plc.), PowerGen, and Nuclear Electric, as well as a single high voltage transmission company, National Grid.

Scroby Sands offshore wind farm, UK ©Ben Alcraft

this process eventually led to a very comprehensive reform of the energy sector (largely in England and Wales).

The 12 regional electricity companies (RECs) responsible for distribution and electricity retailing in the UK were privatised in 1990. This was followed by the privatisation of the two dominant power generation companies in the UK (National Power and PowerGen), which had more than 70% of the market share in 1991 (MacGeorge, n.d.). The privatisation process enabled the progressive entry of Independent Power Producers (IPPs) to the market.

Phase 2:

Auctions via the Non-Fossil Fuel Obligation (1990-1998)

The Electricity Act of 1990 provided the first real opportunity to deploy renewable energy in the UK. Under this act, the Non-Fossil Fuel Obligation (NFFO) was proposed in order to provide financial support for nuclear but also for renewable energy[181]. To pay for the NFFO, the Electricity Act of 1990 allowed a fossil fuel levy (FFL) to be raised.

The newly privatised regional electricity companies were obliged to purchase power from both nuclear and renewable energy generators at a premium price. The proceeds from the fossil fuel levy were used to reimburse them for the difference between this premium and the average monthly purchasing price in their regions. Based on this model, the first commercial wind farm in the UK was built at Delabole, Cornwall in 1991.

The Non-Fossil Fuel Obligation remained in place from 1990 to 1998[182]. Several bidding processes took place during this period, with proposals focusing on the best wind sites[183]. The NFFO bidding process focused on getting the lowest price and did not impose penalties on companies who were awarded a site, but did not initiate contracting. Contracts

[181] The definition of non-fossil fuel technologies under the 1990 Act included renewable energy technologies although initial support was directed towards nuclear power plants. The European Commission sanctioned the adoption of the NFFO to support nuclear power only for an eight-year period running between 1990 and 1998. Source: Interview with Dr. Gordon Edge of RenewableUK in September 2011 and in June 2012.

[182] Five NFFO rounds were organised: NFFO-1 (600 MW), NFFO-2 (1 000 MW), NFFO-3 (1 500 MW), NFFO-4 (1 700 MW), NFFO-5 (1 177 MW).

[183] The successful bidders received an allowance of five years to build and commission a project, followed by a 15-year power purchase contract. As all contracts for each round were awarded on the same day, the developers were all working in parallel to one another and to similar time-scales. It became particularly evident with wind projects

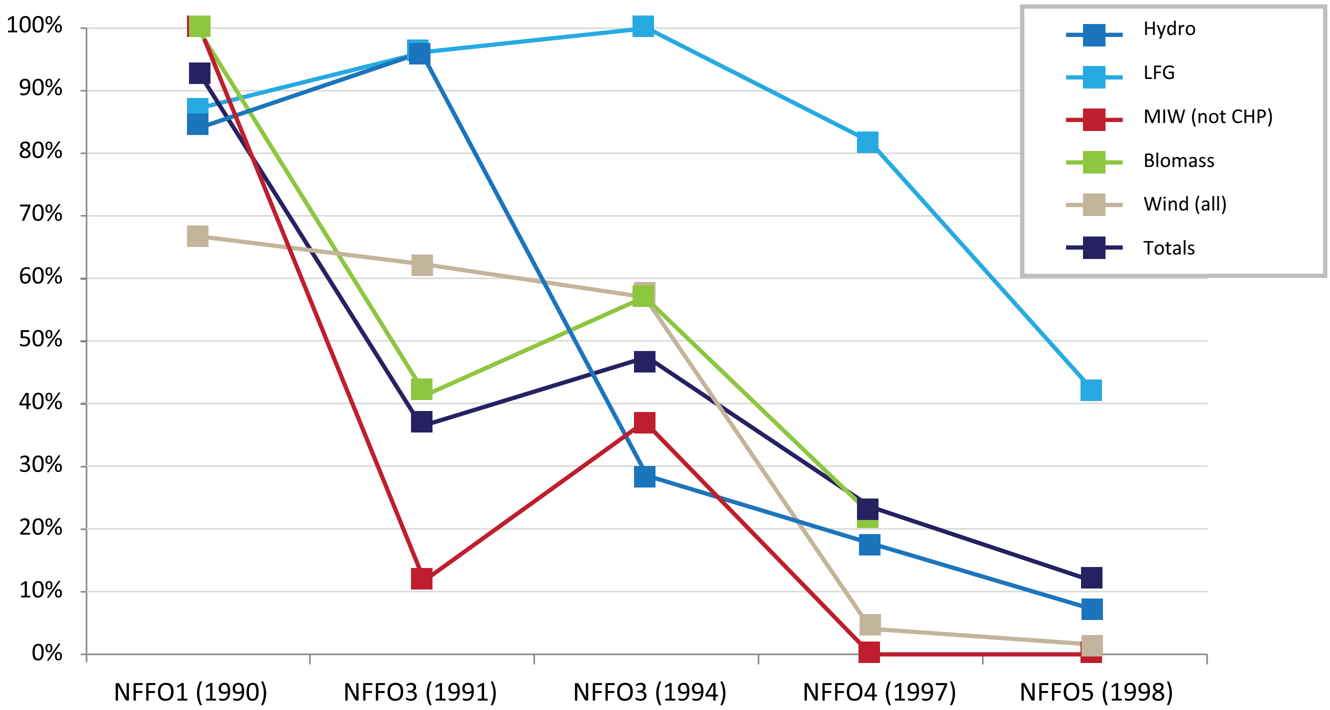

Figure 17: Overall completion rates for NFFO contracts up to 2003 in UK (Mitchell and Peter, 2004; Hartnell, 2003)

were also awarded very early in the development process, before planning permission was even applied for. Many projects failed to receive permission and a proportion of those that received permission were uneconomical due to their extremely low bid prices. As a result, a significant part of the awarded capacity was left unused (RenewableUK, 2012).

When the NFFO mechanism began in 1990, no specific capacity target was set for renewables. When the NFFO-1 contracts were announced, the target was set at 600 MW declared net capacity (DNC[184]).

The payments per kWh for NFFO-1 contracts were agreed between the public authorities and the power producers before the bids were proposed, leaving limited room for competition. Unlike the NFFO-1 contracts, most of the NFFO-2 contracts were for "new" capacity and there was some degree of competition. The declared net capacity for NFFO-2 was for 1 000 MW (Mitchell and Peter, 2004).

The integration of renewable sources into the NFFO-1 and 2 had wide-ranging impacts. The initial rush for setting up wind farms created a high level of anxiety among local communities and a high degree of "push-back" was created towards wind farms. The negative image engendered in the early 1990s continued to be felt into the next decade (Mitchell and Peter, 2004). In 1993, three more rounds of the NFFO were announced. The declared net capacity for NFFO-3 was set at 1 500 MW.

By 1997, the UK's newly constituted Labour government investigated a mechanism to overcome the problems of the NFFO, yet continued to use competitive markets to deliver the least-cost renewable energy solutions (Gross and Heptonstall, 2010).

The next round was announced in 1997[185] when NFFO-4 provided a capacity target of 1 700 MW for new contracts for renewables. The NFFO-5 order was announced at the end of 1998 with a capacity target of 1 177 MW but much

that planning permission was being applied for at approximately the same time by a host of developers, and the construction of wind farms was also taking place on similar sites simultaneously (Mitchell and Peter, 2004).

[184] DNC is the amount of base load capacity required to produce an equivalent amount of energy over a year – 4 MW of wind at a 25% capacity factor equates to 1 MW DNC (Wiser, 2002).

[185] In 1997 the manifesto of the newly elected Labour Party stated the party's target of procuring 10% of UK's electricity supply from renewable energy sources by 2010.

of this capacity was again left unutilised. As the NFFO did not provide penalties for companies who won at auction but failed to take up a contract, it created the opportunity for companies to make unrealistic low bids in order to prevent competitors from securing contracts (Mitchell and Peter, 2004).

No more NFFO auction rounds were held after 1998, although there were variations. The general trend for the later rounds of auctions was an allowance of five years to build and commission a project, then a contract period for Power Purchase Agreements (PPAs) of 15 years. The last of these contracts is set to expire in 2018.

The marginal bids set the price for Rounds 1 and 2, whereas Rounds 3, 4 and 5 were "pay-as-bid"[186]. The last rounds of auctions were largely considered to be financially unviable. Until recently these agreements constituted a major part of the UK's current renewable energy capacity, not including large hydropower (Department of Energy and Climate Change (DECC), 2003).

Table 5: Average price results (listed in GBP) for NFFO Rounds (1 to 5) in UK (Wiser, 2002)

	NFFO-1	NFFO-2	NFFO-3	NFFO-4	NFFO-5
Period of guaranteed contract	1990-1998	1991-1998	1994-2009	1997-2012	1998-2013
Capacity of winning bids (MW, DNC)	152	472	627	843	1 177
Installed capacity (MW, DNC)	145	172	293	156	55
Average price (GBP/kWh)	0.065	0.066	0.044	0.035	0.027
Average price (USD2011/kWh)	0.093	0.092	0.055	0.045	0.034

Phase 3:

Targets, Renewables Obligation Certificates and the Climate Report (2000-2010)

Until the early 2000s, the UK's policies were largely supportive of the privatisation of the energy sector. In 2000 the government announced a target of 10% of UK's electricity to be supplied from renewable energy by 2010, provided the costs were acceptable to the consumer (Department of Trade & Industry (DTI), 2003). The Utilities Act of 2000 further reformed energy markets in England and Wales, and the New Electricity Trading Arrangements (NETA) came into operation in April 2001. The regional electricity companies were separated into regulated distribution network companies and supplier functions.

In February 2000[187], the DTI published a call for public consultation on the Renewables Obligation[188]. The primary legislation was included in the Utilities Act 2000. In 2002, the Renewables Obligation (RO) came into effect, and succeeded the NFFO.

The RO imposed an obligation on all registered electricity suppliers in England and Wales to supply their customers in the UK with specified amounts of electricity from renewable sources. No distinction was made between the different renewable energy technologies, and all received the same level of support per kWh. As such, the RO was set up as a "pure" trading scheme[189] (Gross and Heptonstall, 2010).

The RO mechanism set a target for renewable energy, and allowed the trading of Renewable Obligation Certificates (ROCs), which would deliver the lowest-cost renewable generation. The ROCs were allocated on the basis of technology groupings, where emerging technologies[190], would be awarded more certificates per unit of electricity generated than mature technologies.

The RO required all licensed electricity suppliers to comply with their target for the supply of electricity from renewable sources. Suppliers could comply with these obligations by either presenting ROCs or by making a buy-out payment[191].

By 2003, the government had consented to more offshore wind power capacity than all the wind farms built over the decade 1990-2000. The first large-scale offshore wind farm in the UK, North Hoyle, was commissioned in December 2003 (RenewableUK, n.d.a).

The publication of the Stern Review (Stern, 2006) on the economics of climate change resulted in a substantial increase in the political profile of climate policy in the UK and had a strong impact in raising public awareness about clean energy choices.

The 2006 Energy Review provided an explicit recognition that there was room for significant improvement in the UK's renewable energy policy (DECC, 2006). The report proposed establishing a public consultation on adapting the RO, to reflect the fact that some technologies would no longer require its full support and that support for emerging technologies – such as offshore wind – would need to increase. It further proposed a formal consultation to "band" the RO and to provide differentiated levels of support to different renewable technologies.

In 2007 wind energy overtook hydropower to become the UK's largest renewable generation source, contributing 2.2% of the country's electricity supply, with onshore wind providing the major share.

The 2008 Climate Change Act committed the UK to reducing its emissions by 80% by 2050. This required a rapid advance in the growth rate of renewable energy. The Act further specified a reduction in emissions of at least 34% by 2020, on a 1990 baseline[192].

In 2008, the UK government revised the Electricity Act. In practice, due to the implementation of "banding" by 2009, 1 MWh from an onshore wind farm received 1 ROC while 1 MWh from an offshore wind farm received 2 ROCs, which was a shift from the earlier practice where all renewable energy technologies received 1 ROC per MWh.

Banding helped provide more economically viable support for the more costly technology options.

The annual compliance period for ROCs runs from 1 April in any year to 31 March in the following year. Separate ROCs are issued to generators in Scotland (SROCs) and Northern Ireland (NIROCs), but the three types of certificate are fully tradable and can be used by any UK electricity supplier for compliance with the RO.

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[186] In a pay-as-bid auction, prices paid to winning suppliers are based on their actual bids, rather than the bid of the highest price supplier selected to provide supply. For this reason, pay-as-bid auctions are also known as "discriminatory auctions" because they pay winners different prices tied to the specific prices offered in their bids.

[187] This was followed by a consultation on the mechanism for the Renewables Obligation in October 2000.The DECC published a response to this consultation in March 2001, alongside the Draft Renewables Obligation Order. A statutory consultation on the order was issued in August 2001.

[188] The RO is set out in the legislation called the Renewables Obligation Order (ROO). This is a form of secondary legislation known as a Statutory Instrument. It sets out the details of the RO and can only be amended if it is first subject to a consultation and then debated and approved by both Houses of Parliament.The powers enabling the government to introduce the ROO are set out in the enabling primary legislation. The ROO was made under Section 32 of the Electricity Act 1989 and imposes an obligation ("the renewables obligation") on all electricity suppliers, which are licensed under that Act and which supply electricity in England and Wales, to supply customers in the UK with specified amounts of electricity generated from renewable sources. See page 13, Schedule 1 for yearly obligations (DTI, 2002).

[189] The government supported the RO with its broader privatisation and markets-oriented policy development strategy in the 2003 Energy White Paper and until its Energy Review of 2006.

[190] The rationale being that emerging technologies needed more support, since they were carrying more technological and financial risk, and were more expensive due to the lack of technology learning.

[191] As an alternative to providing ROCs, the suppliers pay the buy-out price to the Office of Gas and Electricity Markets (Ofgem) for all or any part of their RO percentage, which is not covered by the presentation of ROCs, or they can combine the two options (ROCs plus buy-out price). This money paid to Ofgem, known as the "buy-out fund", is then "recycled" to suppliers who have presented ROCs to Ofgem. This "recycling mechanism" provides an incentive for suppliers to obtain ROCs, as those suppliers who rely on the buy-out route effectively subsidise their competitors.

[192] The 2009 UK Low-Carbon Transition Plan outlines the policies needed to decarbonise the UK economy to achieve those objectives as well as a seven-fold increase in energy from renewable sources over the same period. The 2011 Climate Action Plan describes the activities to be implemented in the next five years.

There is no minimum or maximum price for ROCs. The prescribed level of the RO and the level of compliance determine the price of a ROC through the "recycle mechanism" funded by the buy-out fund[193].

In April 2010, there were further changes, including the extension of the Renewable Obligation scheme for new projects from 2027 to 2037 which provided greater long-term certainty to investors and increased support to offshore wind projects[194]. The RO helped increase the share of electricity generation from renewables in the UK from 1.8% in 2002 to 6.8% in 2010.

A feed-in tariff scheme was introduced in April 2010 for small-scale renewable energy producers. The feed-in tariff opened electricity generation to communities, households and to micro-renewable generators with a capacity of less than 5 MW. It also offered an adaptable tariff that varied by technology and size of installation.

The UK government announced in December 2010 that it would introduce "phasing" for offshore wind projects accredited after 31 March, 2011 where generators can register the installed capacity for their projects in up to five phases (with a minimum of 20% in the first phase) (DECC, 2010a). Each phase will be eligible for support for 20 years (up to 2037).

By 2011, wind was generating 15 TWh, accounting for almost 5% of all UK power supplies, out of a total renewables contribution of 9.5%. Onshore wind provided two-thirds of this amount and offshore wind the remainder.

Under the RO system, the UK produced 7% of its electricity from renewables in 2010/11, a poor wind year, compared to less than 3% before the obligation was introduced (RenewableUK, 2012). An important point is that the UK support system was not financed through the central taxation system, but as an addition to consumer energy bills.

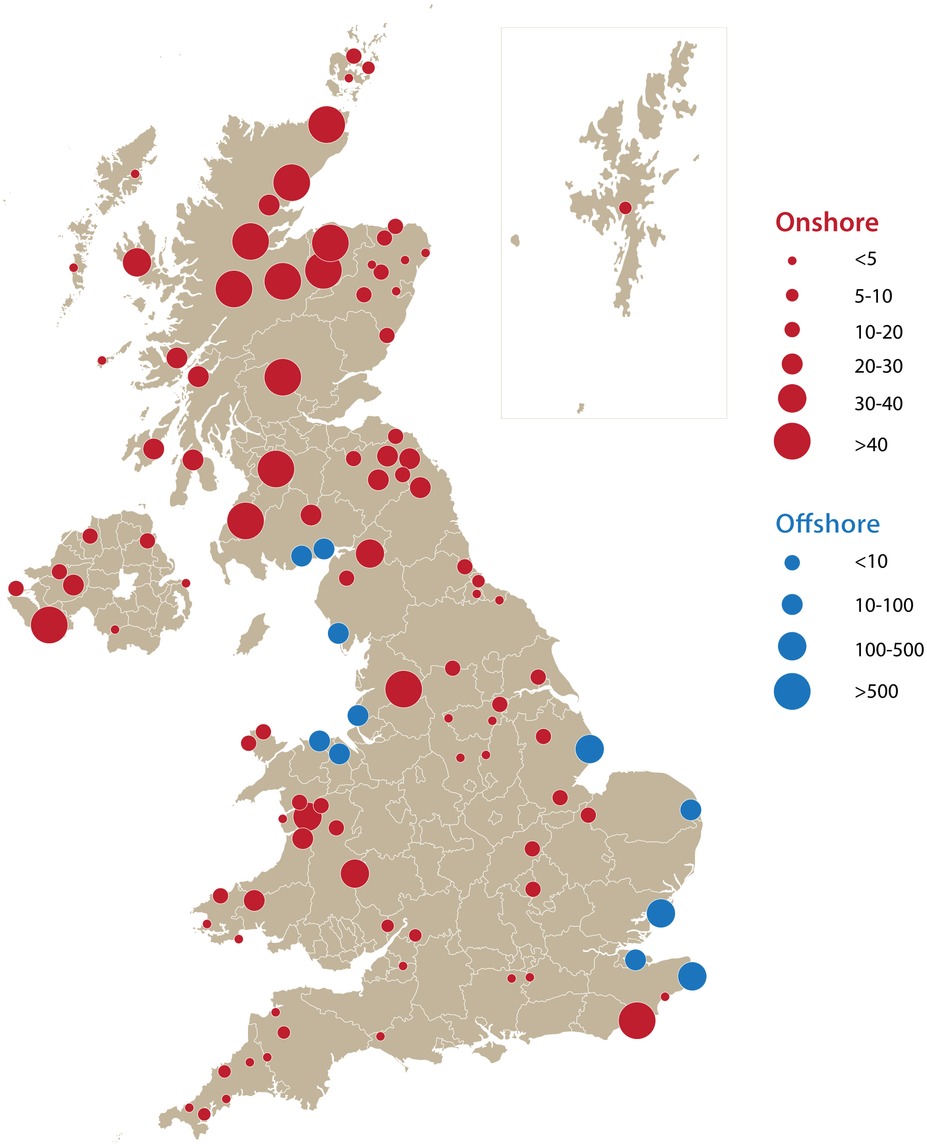

Figure 18:
UK Wind Farm Location and Capacities Map (2010) (DECC, 2011a)

Growth of offshore wind

In February 2012, less than a decade after the first marine wind farm became operational in the North Sea off Blyth in Northumberland, the UK's offshore capacity exceeded 1.7 GW. The UK coast has very large wind resources, with an area of sea about the size of London capable of meeting 10% of the country's electricity needs. In order for this resource to be properly exploited, the British Wind Energy Association[195] initiated discussions with the government in 1998 with the aim of drawing up formal guidelines for negotiations with the Crown Estate[196]. These were published in September 1999.

A group of prospective developers proceeded to co-operate with the Crown Estate, which released information on the process for site allocation and leasing in December 2000. The resulting Round 1 of UK Offshore Wind Development, consisting of 18 sites of up to 30 turbines around the UK coast was announced in April 2001.

Shortly after the start of Round 1 a series of capital grants for offshore wind farms was announced through the New Opportunities Fund. Approved projects received grants of up to GBP 10 million (USD 20.5 million in current value) per project, approximately 10% of the project costs, on condition that construction had started. These grants complemented the RO and mitigated the high offshore project costs.

Over the past decade some onshore wind developments had attracted strong local opposition, which led to lengthy and expensive development processes in many cases. To make sure that offshore wind development would not face similar difficulties, the industry association (RenewableUK) conducted "stakeholder dialogues" with parties having an interest in the development of an offshore wind energy industry, including fishermen, tourist boards and bird protection groups. The Environment Council mediated this process as an independent third-party convenor. As a result of the stakeholder dialogue, RenewableUK helped establish Best Practice Guidelines (RenewableUK, n.d.a) on consultation and public participation in offshore wind energy developments in 2001.

In 2003, the UK Department of Trade and Industry concluded its "Future Offshore" consultation. Its purpose was to develop a strategic framework for the offshore wind and marine renewables industries. Many issues were raised, including the consenting process and the legal framework, the need for Strategic Environmental Assessment (SEA), and the necessary electrical infrastructure.

On completion of the first phase of the SEA and the publication of the Energy White Paper, the Crown Estate invited expressions of interest from potential developers of new offshore wind sites under Round 2 in 2003. Only those companies that submitted an expression of interest were eligible to bid formally for Round 2 sites. The results were announced in December 2003, with 15 projects, with a combined capacity of up to 7.2 GW, allowed to apply for leases to operate offshore wind farms under Round 2.

The extension of the RO target to 15% by 2015 improved the economic viability of large-scale offshore projects. Furthermore, the Energy Act 2004 helped by creating a legal framework for development outside UK territorial waters.

In 2010 the Crown Estate announced the results for the Round 3 projects. Nine zones were awarded and the developers had to sign Zone Development Agreements committing them to developing 32 GW of wind farms that would be operational by 2020. Those projects would represent an investment of GBP 100 billion (USD 167.7 billion), excluding the cost of the grid. The Crown Estate also issued a framework document on zonal appraisal and planning (ZAP) to aid Round 3 developers identify sites within the zones, and to manage the risk of cumulative impacts arising from clustered development (The Crown Estate, 2011).

Rounds 1, 2, 3, the Round 2 extension and the projects in Scottish Territorial Waters zones represent a total project capacity of 48 GW awarded by the Crown Estate

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[193] All buy-out payments are pooled together to form the buy-out fund. The buy-out fund is proportionally redistributed back to suppliers for every ROC submitted for compliance. This is known as the "recycle payment" and is dependent upon the volume of renewable energy generation, the size of the RO target, and timely payments into the buy-out fund by the electricity suppliers.

[194] The Renewables Obligation (Amendment) Order 2010 came into force on 1 April, 2010.

[195] Now known as RenewableUK.

[196] This body officially owns all the ocean floor out to 12 nautical miles equivalent from the UK's shores. It is in effect the landlord for the ocean floor in this area and hence must give its permission for any offshore development to take place.

for possible development in the UK. At 2011 costs those developments represent an investment of GBP 150 billion (USD 242 billion) (DECC, 2011b).

Two ROCs per MWh of offshore generation are available until 2015, possibly reducing to 1.9 ROCs per MWh in 2015/16 and 1.8 in 2016/17 as a result of the "banding" consultations held in October 2011 (DECC, 2012). The future support level for offshore farms is still under discussion and one option would be to replace the RO with a feed-in tariff. However, due to delays in obtaining the planning permission and financing of projects, the expected commissioned capacity from all offshore projects should reach 5.5 GW by 2015 (Garrad Hassan, n.d.).

Evolution of wind in Scotland

As in the case England and Wales, the power sector reforms in Scotland led to the creation of a policy and regulatory environment favouring clean energy sources. Prior to 1990, Scotland's power sector was comprised of two vertically integrated, geographically distinct electric utilities, combining generation, transmission, and distribution, one serving the north and the other the south. The two electric utilities were privatised as vertically integrated regulated companies in 1991 after ownership of the nuclear power plants was transferred to a state-owned company (Choynowski, 2004).

Scottish Power[197] and SSE Plc[198] electric utilities are free to sell to the English market and use the English wholesale price as a reference price for Scottish trading. These utilities also compete for customers. Strong support for renewables was shown by those power companies at an early stage. Furthermore, with devolution of more political power to Scotland in the late 1990s, the regional power companies could influence the energy policy development towards their preferred sources of power generation.

Unlike in England and Wales, renewable energy developments were supported by Scottish local communities, as they would allow Scotland to harness its own resources and provide energy security. In addition, Scotland had a highly technically skilled population, which was helpful in scaling up wind farm development. Overall the public debate on renewables tended to be more favourable in Scotland than in England or Wales.

With 25% of Europe's offshore wind potential (estimated at 206 GW), and a strong manufacturing capacity, Scotland had a strong growth opportunity (The Scottish Government, 2011) for both the onshore and offshore wind industry[199].

The Renewables Obligation (Scotland), or ROS, also came into force on 1 April 2002, and was the key incentive to implement the renewable energy objectives. Early incentives for renewable energy development under the Scottish Renewables Orders (SRO) and the NFFO schemes were superseded by the ROS, which obligated the regional electricity suppliers to source a proportion of their power from renewable sources. In addition, given that Scotland was a net energy exporter in 2000 (due to hydro power), renewable energy development in Scotland could be used to fulfil suppliers' obligations elsewhere in the UK, either by the supply of renewable electricity through interconnectors or by the sale of ROCs (Scottish Natural Heritage, 2011).

The Scottish government is responsible for the planning system in Scotland. The Planning (Scotland) Act 2006 introduced substantial changes, and is part of a wider reform and development package set in the White Paper on Modernising the Planning System from June 2005 (The Scottish Government, 2005).

The White Paper allowed for the development and prioritisation of Scotland's resources. Its measures included increased devolution of decision-making with the possibility of appeals to local authorities, and the exemption of very minor developments from the planning application process. Local authorities in Scotland then became responsible for determining all wind farm proposals under 50 MW. The Scottish government, in

[197] Scottish Power has a renewables arm which operates over 20 wind farms with an installed capacity of over 1 000 MW [2010].

[198] SSE currently owns 740 MW of onshore wind capacity in the UK and Ireland, and has 695 MW in construction, including 350 MW at the Clyde wind farm in southern Scotland, which is expected to cost GBP 500 million (USD 806 million) when it is commissioned in 2012. By 2020, SSE aims to have over 3 GW of onshore wind in operation. SSE is entering the offshore market beginning with the construction of Greater Gabbard, a joint venture with RWE Power, which at over 500 MW, was expected to be the largest offshore wind farm in the world when commissioned in 2012.

[199] In March 2011 Doosan Power Systems announced an investment of GBP 170 million(USD 274 million) in Scottish wind power over the next 10 years. An R&D centre was to be set up near Glasgow, creating 200 jobs . The company is looking to establish a manufacturing and assembly facility in Scotland. Doosan expects its offshore wind plans in Scotland to create 1 700 jobs. In January 2011 the Spanish company Gamesa announced its intention of establishing an offshore wind technology centre in Glasgow. Dundee could also see the establishment of a manufacturing and maintenance base. This could represent a further investment of GBP 42 million (USD 67.7 million) in Scotland and the creation of 300 jobs. In December 2010 Mitsubishi Power Systems Europe announced its intention to invest in an engineering facility in Edinburgh to carry out R&D into offshore wind turbine technology. Mistubishi may create up to 200 jobs over the next five years and lever up to GBP 100 million (USD 161 million) investment into the local economy (The Scottish Government, 2011).

consultation with local planning authorities, determines all projects exceeding 50 MW.

In 2007 Scottish Power, one of Scotland's largest energy companies was taken over by Iberdrola[200]. By that time, the cumulative capacity of renewable energy sources in Scotland had exceeded that of nuclear energy. In September 2008, the Scottish government published its Energy Policy overview.

This document outlined the government's plans of establishing R&D centres for cutting-edge renewable technology in Scotland and conducting joint development with other European countries. This would allow Scotland not only to maximise its energy exports but also maximise the preservation of wealth, the development of skills, intellectual property rights, and manufactured products (The Scottish Government, 2008).

By 2008 Scotland already met 16% of its demand for electricity from renewable sources – primarily hydro and onshore wind. Progress towards renewable energy targets has mainly been driven by the RO legislation and by the demand from England and Wales via the RO.

The Renewables Action Plan was published in June 2009. Under the 2009 EU Renewable Energy Directive, Scotland would produce 50% of its electricity demand from renewables by 2020. And, following the election of a new majority government in May 2011, this objective was increased to 100% of Scottish demand to be met by renewables in 2020.

Although Scotland will be contributing to the UK objectives for the reduction of greenhouse gas emissions, and is sharing the same 2050 greenhouse gas reduction targets, it has set a more aggressive national plan whereby a 42% reduction on 1990 levels is to be achieved by 2020. This ambitious target has been based on the availability of large renewable resources in the country, strong public support, and active regulatory support to renewable energy development.

Furthermore, the government has taken several steps to ensure that local communities would benefit from the renewable energy generated in their area. A community benefit register was established in 2011, which will help empower communities and help generate loans for community-owned renewable energy projects.

The share of renewable electricity in the gross electricity consumption grew from 12.3% in 2002 to 27.4% in 2009. This placed the country on course to meet its interim target of 31% by 2011, and provides a platform to move towards the 100% target by 2020 (Taylor, R., 2011).

In June 2011 the government published the "2020 Routemap for Renewable Energy in Scotland[201]". This updated and expanded routemap reflected the new target of 100% electricity demand from renewable energy by 2020. By 2011, 2.4 GW of onshore capacity had been installed in Scotland with 1 GW under construction. There were two offshore wind sites within Scottish territorial waters[202].

In comparison to England and Wales, Scotland has been successful in ensuring significantly higher community buy-in, long-term targets and political support. This has been made possible by the government's strategy of developing wind as an energy source with several parallel benefits for Scotland –a cutting- edge industrial base, enhanced energy security, as well as environmental and community benefits.

CURRENT CHALLENGES

The UK wind sector has faced several barriers over the past two decades, some of which have been persistent. The UK government has launched a number of initiatives to support the growth of the wind sector by confronting critical issues such as grid access (Transmission Access Review), national planning (Planning Bill), local planning (the Killian Pretty Review), and the supply chain (establishment of the Office for Renewable Energy Development) among others.

[200] Iberdrola, S.A is Spain's largest energy group and the fourth-largest utility company in the world by market capital. As part of the Iberdrola group of companies, ScottishPower is the fifth-largest energy company in the world. Iberdrola's sister company ScottishPower Renewables, was the UK's largest developer of onshore wind farms as of 2010.

[201] This document was an update and extension to the Scottish Renewables Action Plan of 2009.

[202] (1) The Beatrice wind turbine demonstrator project in the Moray Firth – two 5 MW turbines, funded in part by a Scottish government grant; and (2) Robin Rigg, a 180 MW development in the Solway Firth.

However, despite these actions, the wind sector still faces considerable challenges, especially for onshore wind.

Grid capacity is limited in areas of high wind regimes, and site approval can be difficult to get. Building significant transmission capacity out to remote locations can take up to 10 years, which creates high uncertainty for investors[203].

Much of the UK, especially England and Wales, is densely populated, and the planning process is complex. The UK still is one of the most difficult places in Europe to get planning consent, which can take five times longer than the average for European countries. On a comparative basis the UK's offshore site approval process is less complex.

The UK does not have extensive domestic wind manufacturing capacity, though this is beginning to slowly change. A number of points in the supply chain are prone to shortages – the most important of which are wind turbines, vessels, cables, and offshore substations.

CONCLUSION

The key policy instruments for the support of renewables at the national level in the UK are the Renewables Obligation[204] (RO) and the recently introduced feed-in tariff for projects smaller than 5 MW. Prior to the RO, the wind sector was supported through the auctioning system (NFFO).

In the UK, support for renewable energy was driven by the reform of the energy sector in the late 1970s and the 1980s[205].

The RO has only contributed modestly to the deployment of renewable energy sources since 2002. Although over 20 000 MW of onshore wind projects have been proposed, their actual development has been hindered by planning and grid delays. In April 2009, the regulators looked at addressing this concern by introducing technology "banding" in the RO.

The UK government is also considering revising banding levels for the period 2013-2017. It is also consulting on its proposal to discontinue the RO from 2017 and introduce an expanded feed-in tariff to cover all electricity generation from low-carbon sources, including renewables. By 2011 the UK had secured 9.5% of its electricity from renewables, compared to less than 3% before the RO (RenewableUK, 2012).

Each NFFO round took the form of capacity auctions, where developers were invited to submit competitive "bids" for NFFO contracts. However, the lack of proper planning and a lack of penalties for not building allocated capacity led to limited growth of the wind sector.

The UK Renewable Energy Strategy, as implemented under the EU Renewable Energy Directive, mentions a binding objective of 15% of final energy consumption from renewables by 2020, implying 30% of electricity produced from renewable sources. Wind energy would be the largest contributor, with up to 33 GW of capacity, delivering over GBP 60 billion (USD 96.8 billion) of investment and creating 160 000 jobs (RenewableUK, n.d.b).

Each of the countries of the UK has its own distinct planning system; the responsibility for town and country planning is devolved to the Northern Ireland Assembly, the Scottish Parliament and the Welsh Assembly. Planning legislation varies across the countries of the UK, and must itself take into account the European Directives and International legislation (such as the Kyoto Protocol)[206]. However, improved access to the electricity transmission network would overcome a backlog of connections from renewable energy projects and encourage further investments. There are also opportunities for streamlining the planning and consenting process.

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[203] Historically, the grid operator, the National Grid, was granting access to the grid according to non-discriminative criteria. Renewables were thus not given priority (compared to conventional generators).The Department of Climate Change (DECC) undertook two public consultations on improving grid access for renewables in 2009 and 2010. This led to the introduction of the "Connect and Manage" (Socialised) regime for grid access in August 2010, which will enable new and existing renewable energy generation projects to connect to the network more rapidly (DECC, 2010b).

[204] The legislation is divided into the Renewables Obligation (for England and Wales), the Renewables Obligation Scotland (ROS), and the Northern Ireland Renewables Obligation (NIRO). These schemes are managed by the DECC, the Scottish government and the Department of Enterprise, Trade and Investment for Northern Ireland respectively. The UK electricity regulator, the Office of Gas and Electricity Markets, Ofgem, administers the scheme.

[205] Mrs Margaret Thatcher was the Prime Minister of the UK between 1979 and 1990. By November 1990, more than 40 former state-owned companies had been privatised (Ellliott and Treanor, 2000).

[206] The determination of planning applications is a primary function of Local Planning Authorities (LPAs). In the UK all wind turbine applications below 50 MW in capacity are determined by LPAs, and larger projects are submitted to the relevant national government for consideration. In Northern Ireland the situation is slightly different, with all applications currently determined by the Northern Ireland Planning Service, an agency within the Department for Environment. In determining an application, a planning officer will make a recommendation based on the content of local, regional and national planning policy and applicable legislation. All planning decisions should be based on planning considerations alone. A Local Authority Planning Committee usually makes the final decision for a wind turbine application.

ANALYSIS ON ENABLING CONDITIONS FOR WIND ENERGY

Effective rule of law; and transparency in administrative and permitting processes	A long-term energy policy framework has been in place since 2010 although it was not specifically designed for promoting renewable energy sources. The UK is developing a large renewable energy capacity, but current projects do not generate high local benefits. Since the country is densely populated, there has been opposition to wind farms in many rural areas.
A clear and effective pricing structure	The auction system was not favourable to small, local investors. The RO created uncertainty for investors, since future ROC prices could collapse if excess renewable generation were built. Due to this risk element, the cost of capital was increased, which favoured large companies able to finance the developments on their balance sheet. Before the banding process, the ROCs were awarded per MWh regardless of the method of generation. This system favoured mature, lower-cost generation technologies, such as landfill gas, over less mature technologies like offshore wind and wave power.
Provisions for access to the grid (incentives and penalties for grid operators)	Until recently renewable energy did not have priority access to the grid, making the UK among the most difficult markets to secure a grid connection for wind projects.
An industrial development strategy	The UK did not create a domestic industrial base for onshore wind. However, this is changing with the upcoming development of the offshore wind market, especially in Scotland.
A functioning finance sector	Since the 2009 financial crisis, commercial lending has been difficult to access, and the finance sector is yet to recover completely, as of 2012.
Expression of political commitment from government (e.g. targets)	The 2008 Climate Change Act committed the UK to reducing its emissions by 80% by 2050. This required a rapid advance in the rate of growth of renewable energy. The Act further specified a reduction in emissions of at least 34% by 2020, on a 1990 baseline.
A government and/or industry-led strategy for public & community buy-in.	The UK wind industry started working closely with other stakeholders to address the issue of local communities' hostility to onshore wind projects in the late 1990s. Today the UK has the most developed processes for public consultation and stakeholder engagement.
An employment development strategy	Not Applicable

NOTE	**The UK has some of the best wind resources in Europe. Improved access to the electricity transmission network would overcome a backlog of connections from renewable energy projects and encourage further investments. There is still room for streamlining the planning and consenting process for both onshore and offshore projects.**

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UNITED STATES and the States of California and Texas

MARKET OVERVIEW

In 2012 the United States installed 13 124 MW of wind power capacity. This made it the largest annual market in 2012. The country is the second-largest market for wind with a cumulative installed capacity of just over 60 GW at the end of 2012. The record year for new wind power resulted in 28% annual market growth, in line with the five year average for the US wind industry of 29%. For the first time, wind energy was the leading source of new electricity generating capacity in the US, contributing 42% of all the megawatts the power sector installed.

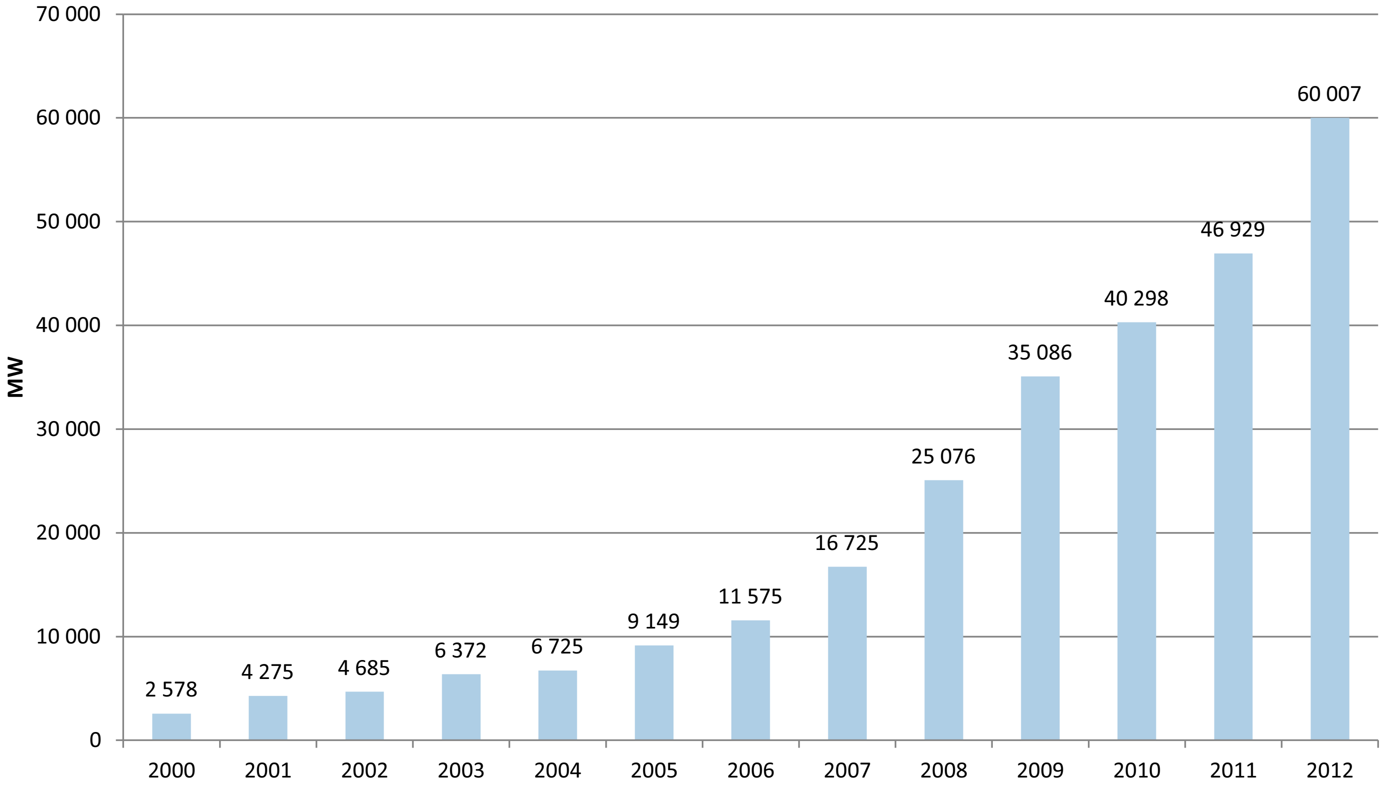

Figure 19: Cumulative Wind Installation (MW) of the US (GWEC, 2013)

HISTORY AND EVOLUTION OF POLICY AND REGULATORY FRAMEWORK FOR WIND ENERGY

The U.S. wind resource is among the best in the world, with an estimated potential of 10 500 GW at 80 metres[207]. In 2011 the U.S was the second-largest market for wind. It is also a market leader in the production of small wind turbines, which are defined as having rated capacities of 100 kW or less.

The growth of the wind sector has been intermittent, largely due to a lack of long-term policy certainty. The development of policy and regulatory framework for the wind energy market is described by three key phases (Martinot and Hamrin, 2006).

[207] At 100 metres the estimated resource is 12 000 GW (Elliott, *et al.*, 2010).

[208] Problems with administrative determinations of avoided cost, coupled with the abundance of QFs, persuaded some states to procure incremental QF capacity through a competitive procurement process. By the early 1990s, approximately 10 states had, or were using, bidding mechanisms to determine avoided costs and the QF projects that

UNITED STATES: ANNUAL AVERAGE WIND SPEED AT 80m

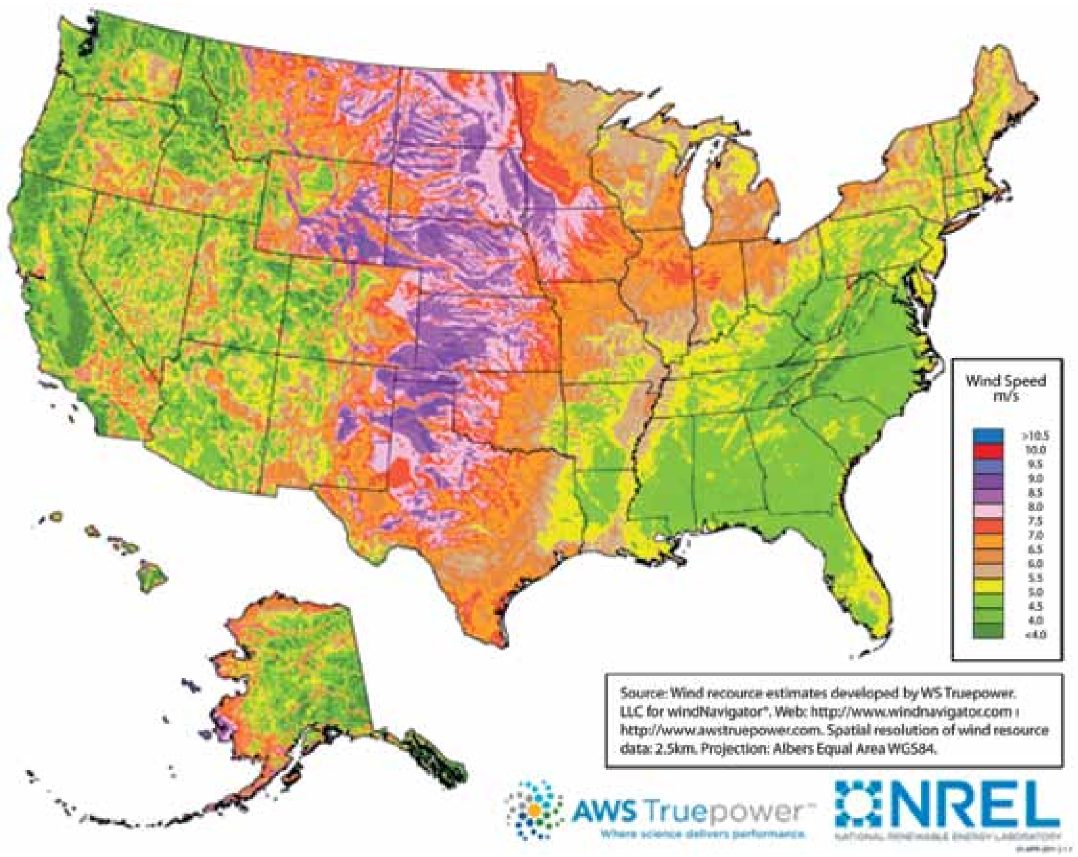

Figure 20: Annual Average Wind Speed at 80m in the US (U.S.Department of Energy, n.d)

Phase 1:

The PURPA era (1978 to 1990)

The oil crisis of 1973 caused an unprecedented escalation of energy prices accompanied by a major economic shock. A comprehensive federal energy programme was soon established to secure the country's long-term energy needs (Sissine, 2006). During the 1970s, the federal renewable energy programme included basic and applied R&D, demonstration projects in partnership with the private sector, commercialisation, and information dissemination. The federal government introduced market-based incentives, such as business and residential tax credits, and created a market for non-utility-produced electric power through the Public Utility Regulatory Policies Act (PURPA) in 1978.

PURPA was introduced to encourage more efficient generation development, and renewable energy sources were able to benefit from long-term contracts from utilities. Prior to 1978, electric utilities had no obligation to purchase power from third parties. PURPA required utilities to purchase power from qualifying third parties at the utility's "avoided cost", which is defined as the incremental energy and capacity cost the utility would have incurred[208].

PURPA faced early legal challenges that delayed its implementation until 1981. Once the scheme was in place, developers could secure financing for their projects under attractive contracts. The tariff was based on the projected wholesale cost of conventional (fossil-fuel) energy to the utility, and was intended to approximate the avoided costs to the Qualifying Facilities (QFs)[209].

The Federal Energy Regulatory Commission (FERC) issued regulations requiring utilities to purchase the energy produced by the QFs at rates equal to the utilities' avoided cost. However, the definition of avoided cost and

would be eligible for long-term contracts (Graves, Hanser and Basheda, 2006).

[209] Defined as co-generators (generating units that simultaneously produce electricity and steam) and small power producers (maximum size of 80 MW) that used a waste or renewable energy source as their primary fuel input.

implementation of the law varied from state to state, as illustrated later in this chapter by the example of California (Martinot and Hamrin, 2006). One of the most important effects of the act was to create a market for power generated by non-utility power producers.

Largely as a result of California's interpretation of PURPA (described in the following section) and favourable tax incentives, 12 GW of renewable power capacity was installed during the 1980s. This was supplemented by the federal incentive, the Investment Tax Credit (ITC) which offered incentives for the installation of wind turbines.

By the late 1980s, QFs had become a significant, and in some cases the primary, supplier of new generation capacity in some regions. Some concerns were raised about the methods for determining the avoided cost to QFs. Those concerns were largely solved by state retail markets and restructuring of PURPA[210] from the mid-1990s.

State and local governments also played an important role in the development of the renewable energy sector. For example, in the early 1980s, the state of California introduced an investment tax for wind energy which, combined with PURPA and the federal tax credit, helped in the development of the country's first utility-scale wind farms. The states of California and New York also invested state funds in R&D for renewable energy.

During this phase, renewable energy R&D funding grew from less than USD 1.0 million (USD_{2011} 2.73 million)[211] per year in the early 1970s to over USD 1.4 billion (USD_{2011} 3.8 billion) by 1980, and then declined steadily to USD 148 million (USD_{2011} 254.6 million) in 1990. R&D for renewable energy received approximately USD 14.6 billion (in 2003 constant dollars) (USD_{2011} 17.8 billion) from the U.S. federal government between 1973 and 2003 (Sissine, 2006).

Phase 2:

Stagnation and introduction of the Production Tax Credit (1990 to 1997)

Following the PURPA era, there was a period of stagnation from 1990-1997. Due to lower oil prices, and lower avoided costs, the attractiveness of investing in renewable energy was reduced under the PURPA regime. Very little overall capacity was added in the period 1990-1997[212]. At the same time several states developed other innovative incentives.

The post-Reagan era[213] saw a number of changes to the tax code with the most significant being the Energy Policy Act of 1992 (PL 102-486). Section 45 of the IRS code, enacted under the Energy Policy Act of 1992, provided for a Production Tax Credit (PTC) of USD 0.015/kWh (indexed) (USD2011 0.024/kWh) over ten years of the electricity generated from wind systems. This tax credit was gradually expanded to cover other renewable sources (in addition to wind and biomass). The tax credit has been extended and expanded over time and is currently only available until the end of 2012 (Metcalf, 2007), although there is a possibility of further extension.

The federal Renewable Energy Production Incentive (REPI) complemented the PTC. REPI provided USD 0.022/kWh (USD_{2011} 0.0352/kWh) for new eligible facilities owned by local, state and tribal governments; municipal utilities; rural electric cooperatives; and native corporations that had no tax liability. The incentive is paid subject to the availability of appropriations in each federal fiscal year of operation. The scale of programme funding is determined each year as part of the U.S. Department of Energy budget process.

The economics of wind equipment dictate that it is manufactured as close as possible to the market and point of delivery in order to keep transportation costs down and focus on quality control. During the 1990s the US attracted wind equipment manufacturing through its strong, stable growing market.

One noticeable feature of the programmes (PTC, ITC, or Treasury Grant) was that they did not impose any requirements on the sourcing or manufacturing of the equipment used in renewable energy projects. All wind energy equipment-manufacturing businesses were eligible under these programmes. In the early 1980s this approach was largely responsible for the growth of Danish wind turbine exports to the US.

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[210] Part of the U.S. has open retail markets, while the majority of the country does not. This creates a "split" industry structure of rate-regulated monopoly service providers and open retail markets. Recognition of this split industry structure figured prominently in the provisions of the Energy Policy Act (EPACT) of 2005 that modified Section 210 of PURPA. Section 1253 of EPACT 2005 eliminates a utility's requirement to purchase QF power only when the utility demonstrates that QFs can sell their power in a competitive wholesale market for energy and capacity.

[211] USD2011 indicates the indexed equivalent USD value for 2011.

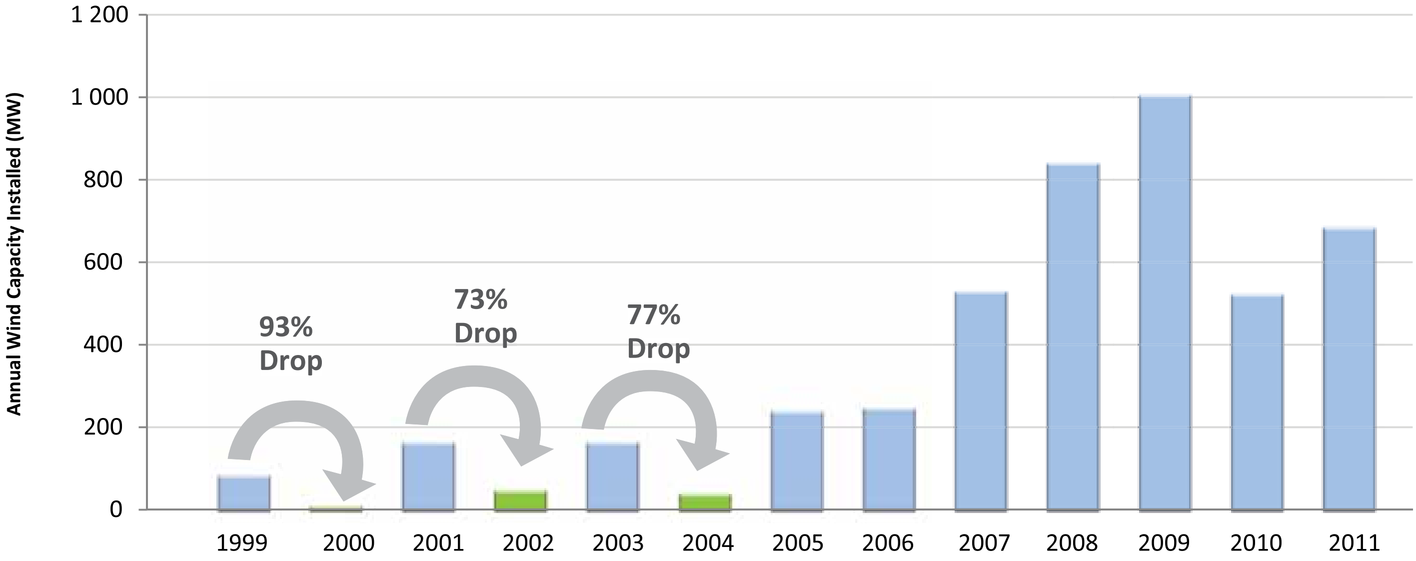

Figure 21:
Historic Impact of PTC Expiration on Annual Wind Installation (AWEA,2011)

Phase 3:

Market maturity, boom-bust cycle (1999 -2012)

In 1999, the US wind industry began a period of rapid expansion, occasionally slowed by expiring federal incentives. The installed capacity grew at a compound annual growth rate (CAGR) of 39% from 2004 to 2008 (FERC, 2009).

Most of this growth was due to a combination of state and local policies, along with federal support in the form of the Production Tax Credit (PTC), and cost reductions due to technology advances and economies of scale. Since the PTC was linked to electricity generation, it encouraged wind farm developers to maximise the wind farm output (Logan and Kaplan, 2008). The PTC was renewed in 2008 for one year, and in 2009 for a further three years. The 2009 extension period provided developers and equipment companies with better short-term assurance to invest in projects and manufacturing facilities.

The renewal of the PTC has had a direct impact on the wind industry. In 1999, 2001 and 2003, the PTC was suspended, causing strong declines in new installed capacity in the following years. This policy uncertainty caused loss of investor confidence, under-investment in manufacturing capacity, and variability in equipment and supply costs[214].

After 2002, however, costs rose again. Based on data collected by the Lawrence Berkeley National Laboratory, the average installed cost of wind projects in the US in 2006 was approximately USD 1 600/kW (USD_{2011} 1 792/kW), up from nearly USD 1 300/kW (USD2011 1 625/kW) in 2002. These increased prices may have been caused by the variable market cycle of important investment alternating with market collapse created by the one or two year extensions of the PTC between 1999 and 2006.

In 2002 an additional incentive was provided through the "Farm Bill". The Farm Security and Rural Investment Act of 2002 authorised USD 115 million (USD_{2011} 143.75 million) for the U.S. Department of Agriculture (USDA) to help farmers, ranchers and rural small businesses invest in renewable energy and energy-efficiency projects, including wind power.

[212] PURPA was relevant only until oil and natural gas prices became high or, in other words, PURPA only called for renewable energy sources if they were cost-competitive with conventional, polluting resources.

[213] President Ronald Reagan was in office from 1981-1989. His administration's policy focused on building a free market.

[214] Dr Ryan Wiser (2007).Work done by him at the Berkeley Lab.

To assist the USDA in interpreting Section 9006 of the Farm Bill, the US Government Accountability Office (GAO) published a detailed report (GAO, 2004), which examined various aspects of leasing land for wind turbines. The Farm Bill was revised in 2008, and will be in effect until 2012.

The most important piece of federal legislation during this period however was the Energy Policy Act of 2005 (EPACT05) which, among a variety of other provisions, extended and expanded coverage of Section 45 (production) and Section 48[215] (investment) tax credits.

Furthermore, in certain cases where transmission congestion existed, the Federal Energy Regulatory Commission (FERC) was authorised under EPACT05 to use its federal authority to site new transmission lines (Logan and Kaplan, 2008).

The FERC would approve funding plans for new transmission and charging the new generator for all costs associated with interconnection, rather than socialising the interconnection costs across all users of the transmission network. Finally, EPACT05 also directed FERC to establish incentive and norms for encouraging greater investment in the national transmission infrastructure, promote electric power reliability, and lower costs for consumers by reducing transmission congestion (DOE, 2005).

The 2008 Bill "Title IX: Energy" established a Rural Energy for America Program (REAP) under Section 9007. REAP was aimed at promoting energy-efficiency and renewable energy development for agricultural producers and rural small businesses through grants and other financial assistance.

The funds (approximately USD 1 billion or USD_{2011} 1.04 billion) (Capehart, 2007) were divided between:

- Section 9007(b): Energy Audits and Renewable Energy Development Assistance[216]; and
- Section 9007(c): Financial Assistance for Energy Efficiency Improvements and Renewable Energy Systems[217].

Wind project costs decreased substantially between the early 1980s and the early 2000s, demonstrating the success of public and private R&D investments and the commercial success of the technology by 2007. In 2008, 30 new manufacturing facilities were announced in the country.

The economic crisis of 2008 led to facility cutbacks, employee layoffs, project delays and equipment order postponements in 2009-10. In February 2009, the US Congress passed the American Recovery and Reinvestment Act (ARRA), which included several provisions to support wind energy. This Act enabled investments to be maintained at a consistent level until 2011.

An additional measure was the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 (H.R. 4853). Under this Act, projects (including wind energy) in service or under construction by 2011 became eligible to the US Treasury grant programme. The Federal Financing Bank (under the US Treasury) supported domestic clean-energy projects equivalent to USD 10.1 billion in 2011 alone (Bloomberg New Energy Finance (BNEF), 2012).

The federal PTC provided a USD 0.022/kWh credit during 2010-2012 (adjusted for inflation) for all wind facilities in operation by the end of 2012. Additionally, through Section 1603 of the American Recovery and Reinvestment Act of 2009, wind project developers can choose to receive a 30% investment tax credit (ITC) in place of the PTC. For projects placed in service before 2013, and with construction beginning before the end of 2011, developers could choose to receive a cash payment from the Department of Treasury equivalent to the value of the ITC[218].

On average project costs reflected an upward trend between 2004 and 2009[219] (Wiser and Bolinger, 2011a). Among a sample of projects built in 2010, for example, the capacity weighted average installed cost was USD 2 155/kW (USD_{2011} 2 219.7/kW), which was 65% higher than the average cost of projects installed from 2001 through

[215] Sections 45 and 48 were originally enacted under the Energy Policy Act of 1992. The investment credit is equal to 30% of expenditures, with no maximum credit for small wind turbines placed in service after 31December, 2008. Eligible small wind property includes wind turbines up to 100 kW in capacity (Database of Incentives for Renewables & Efficiency (DSIRE), 2011).

[216] Available to entities who provide assistance to agricultural producers and rural small businesses to become more energy-efficient and promote the use of renewable energy technologies and resources.

[217] Available to agricultural producers and rural business owners.

2004 (Wiser and Bolinger, 2011a). However, 2010 showed a plateau in project costs and a reversal of recent increases, which would be consistent with the decline in turbine prices globally. By 2011, US manufacturing capabilities grew to nearly 500 manufacturing facilities, producing 60% of the domestic market, thus lowering equipment transportation costs (AWEA, 2012).

Independent power producers owned 73% of all new wind power capacity installed in 2011, and 82% of the cumulative installed capacity (Wiser and Bolinger, 2012). The US wind turbine-manufacturing sector viewed the 2011-12 growth as short-term. The costly delays in the extension of the PTC, led to severe uncertainty and will result in a subdued market in 2013 and possibly in 2014.

Phase 3: Summary of key legislation passed between 2002 and 2010

2002	Farm Security and Rural Investment Act of 2002, called the "Farm Bill". The Farm Bill was revised in 2008, and will be in effect till 2012.
2005	Energy Policy Act of 2005, which extended and expanded the coverage of production and investment tax credits.
2008	2008 Bill "Title IX: Energy" established a Rural Energy for America Program under Section 9007.
2009	American Recovery and Reinvestment Act, which included several provisions to support wind energy.
2009	Production tax credit renewal for three years (2010-2012).
2010	Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act. Under this Act, projects (including wind energy) in service or under construction by 2011 became eligible to the U.S. Treasury grant programme.

Role of State Regulations

Renewables Portfolio Standards (RPS) have, within the last decade, emerged as the most popular form of policy supporting the deployment of renewable energy technologies at the state level. An RPS is a state policy that requires electricity providers to obtain a minimum percentage of their electricity sales from renewable energy resources by a certain date. As of October 2010, 29 states and the District of Columbia had established binding RPS targets. Several other states (North Dakota, South Dakota, Utah, Virginia and Vermont) have non-binding goals for adoption of renewable energy instead of an RPS. There are 17 states with an RPS of 20% or above, including three which will have an RPS of 25% by 2025, with California reaching 33% in 2030. The highest RPS is currently prescribed by the State of Maine, with a 40% target by 2017 (Database of Incentives for Renewables & Efficiency (DSIRE), n.d.).

In addition to RPS, other state-level policies include renewable electricity funds and various tax incentives. About 67% of all wind power capacity added between 1999 and 2008 occurred in states with RPS policies, according to the Lawrence Berkeley National Laboratory. In addition to serving the near-term market, these standards were designed to stimulate significant new development (see figure 22 for the latest RPS targets of each state).

[218] Given the relative scarcity of tax equity in the wake of the financial crisis (and in particular during 2009), Section 1603 of the Recovery Act also enables wind power projects to select a 30% cash grant from the Treasury in lieu of either the ITC or the PTC. More than 70% of the new wind capacity installed in 2010 selected the Section 1603 grant. Under the Recovery Act, wind power projects would start construction by the end of 2010, apply for the grant by 1 October, 2011, and be operational by the end of 2012, in order to qualify for the grant. In mid-December 2010, however, the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 extended two of these three deadlines by one year: in order to qualify for the grant, wind power projects had to be under construction by the end of 2011, apply for a grant by 1October, 2012, and be operational by the end of 2012.

[219] Wind power projects were not alone in seeing upward pressure on project costs – other types of power plants experienced similar increases in capital costs. For example, the IHS CERA Power Capital Cost Index of coal, gas, wind, and nuclear power plants showed a 115% capital cost increase from 2000 to 2010 (HIS, 2010).

U.S. WIND POWER INSTALLATION BY STATE

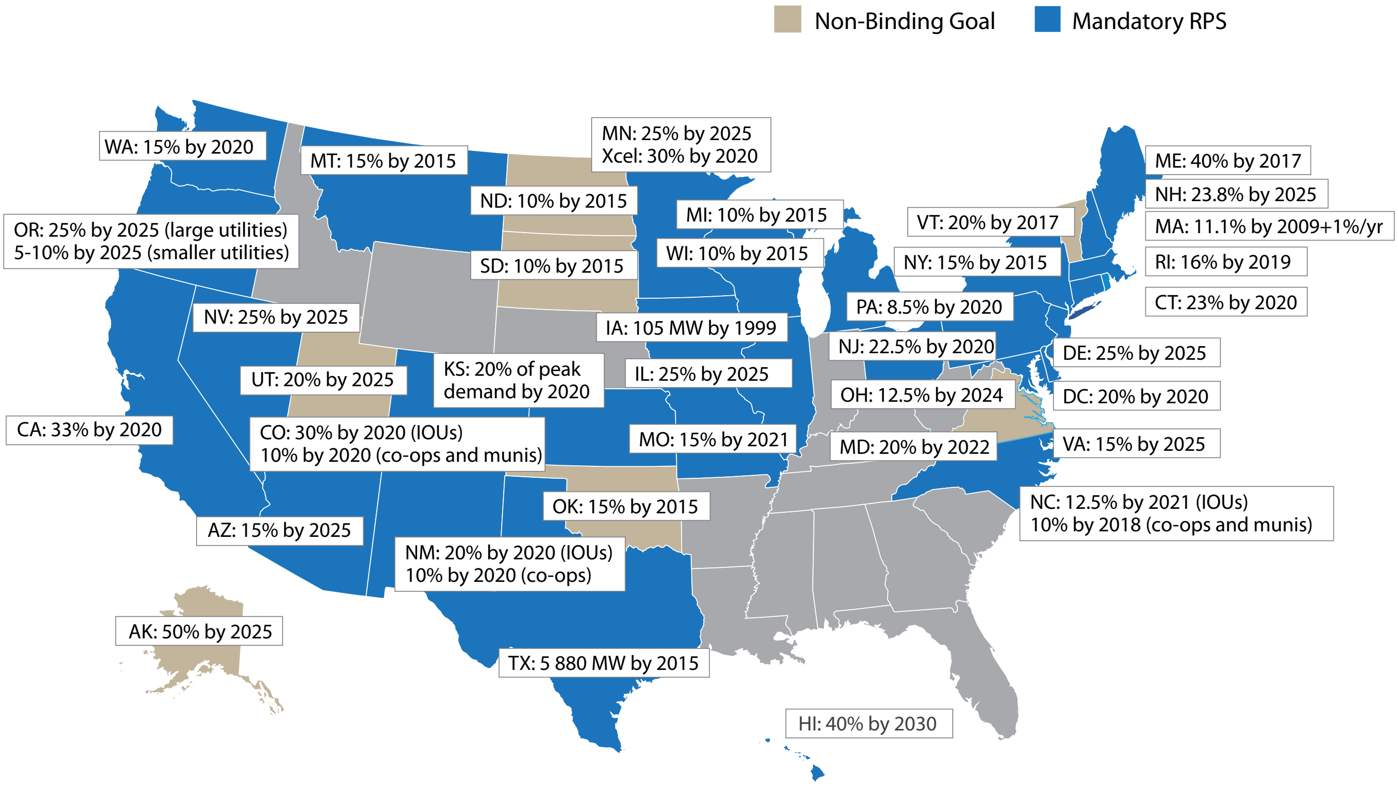

Figure 22: RPS targets declared by the US States as of 2011 (Wiser and Barbose, 2011b)

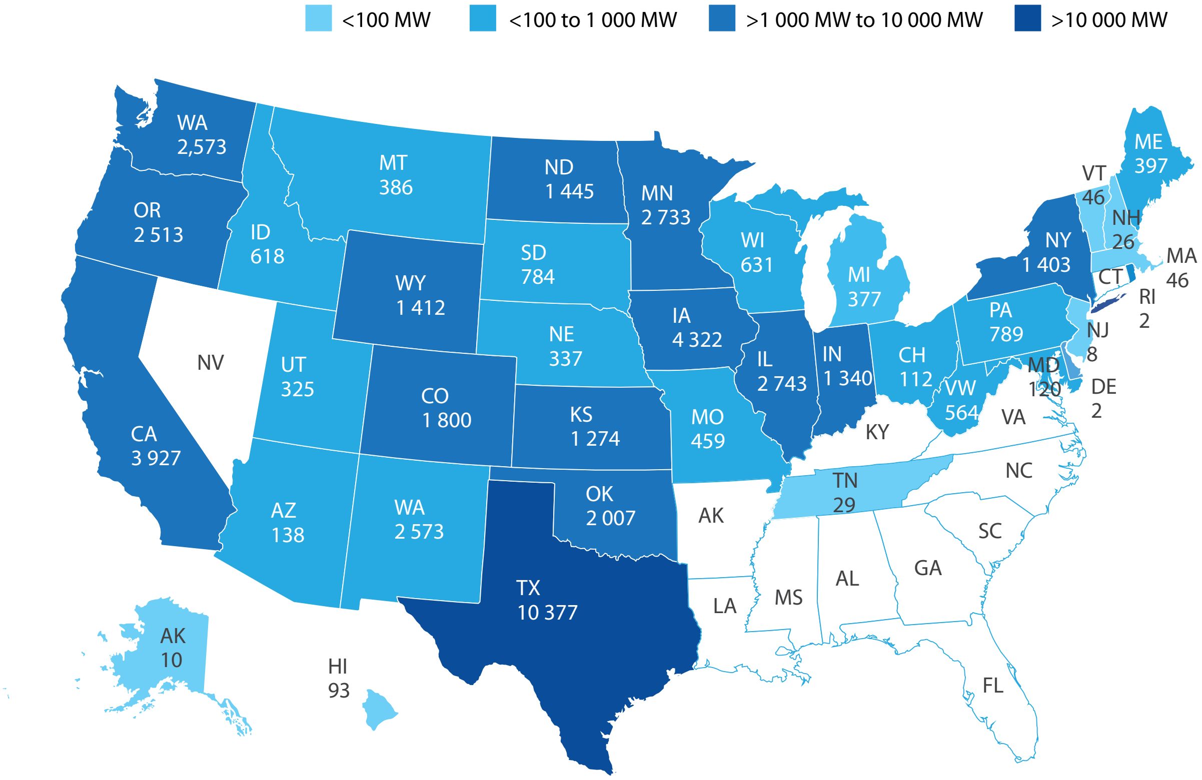

Figure 23: Wind power installations by US States as of December 2011 (AWEA,2012)

The top five states in terms of cumulative wind capacity installed by the end of 2011 were Texas, Iowa, California, Illinois and Minnesota. The top five states with the fastest-growing markets were Ohio, Vermont, Massachusetts, Michigan and Idaho (AWEA, 2012).

The following sections discuss the policy framework in California and Texas. California was one of the first states to develop utility-scale wind farms, and until 2000 had more wind energy installed than the rest of the country combined. Texas's wind resource is ranked first in the country and it is the first state to have installed more than 10 000MW of wind energy. According to the National Renewable Energy Laboratory (NREL), Texas's wind resource would be approximately 1 900 GW at 80 meters, which could provide 19 times the state's current electricity needs. California's estimated wind potential is in excess of 34 GW and its wind resource could provide 39.4% of the state's current electricity needs (AWEA, 2012).

Evolution of policy framework for wind in the State of California

The interpretation of the Public Utility Regulatory Policy Act of 1978 was fundamental for the growth of renewable energy technologies in California. The implementation of PURPA offered long-term (15-30 year) contracts at a fixed tariff for the first ten years of a renewable energy facility's operation.

These contracts were the so-called "Standard Offer 4" contracts (Martinot, Wiser and Hamrin, 2006), which provided long-term certainty in the electricity market for renewable energy sources. In the beginning PURPA regulations helped on-site industrial and co-generation qualifying facilities (QFs) in getting access to the fixed tariff.

The wind sector growth that followed PURPA was supported by a 25% California state tax credit for investments in wind power from 1980-1983 and an equivalent level of federal tax credit.

The renewable energy programme was a strong pillar for the development of wind energy in California. The Energy Commission's Renewable Energy Program (REP), initiated in 1998, provided market-based incentives for new and existing utility-scale facilities powered by renewable energy. It also offered rebates to the consumer for installing new wind and solar renewable energy systems. REP also supported public education programmes on renewable energy.

From 1998 to 2006, REP financed small-scale grid-connected projects in wind energy, solar photovoltaic, fuel cell, and solar thermal[220]. The programme's spending during the period 1998-2001 was USD 540 million (USD_{2011} 685.8 million); USD 675 million (USD_{2011} 756 million) in the period 2002-2006; and USD 288 million during the period 2008-2011.

The first Renewable Portfolio Standard (RPS) required electric utilities to increase procurement from eligible renewable energy resources by 1% of their retail sales annually, until they reached 20% by the end of 2010. In March 2010, the California Public Utilities Commission authorised utilities to use tradable renewable energy certificates to meet up to 25% of their RPS requirement on period 2011-13, and 10% on the period 2014- 2016.

The penalty for not meeting annual procurement targets on time was set at USD 0.05/kWh (USD_{2011} 0.051/kWh), for a maximum of USD 25 million (USD2011 25.75 million) per utility per year (American Council on Renewable Energy (ACORE), 2011).

As of 2010, California provides a full exemption from the state's "sales and use" tax for expenses relating to the industrial design, manufacture, production, or assembly of renewable energy equipment.

In 2011, California adopted a revised RPS of 33% retail sales by 2020. This new RPS applies to all electricity retailers in the state including publicly owned utilities, investor-owned utilities, electricity service providers, and community choice aggregators. All of these entities must adopt the new RPS goals of 20% of retail sales from renewables by the end of 2013, 25% by the end of 2016, and 33% by the end of 2020.

[220] In 2007, the solar portion was transferred to several entities, under the "Go Solar" initiative.

Development Timeline of California's Renewables Portfolio Standard

- 2002: Senate Bill 1078 establishes the RPS programme, requiring 20% of retail sales from renewable energy by 2017.
- 2003: Energy Action Plan I accelerated the 20% deadline to 2010.
- 2005: Energy Action Plan II recommends a further goal of 33% by 2020.
- 2006: Senate Bill 107 codified the accelerated 20% by 2010 deadline into law.
- 2008: Executive Order S-14-08 requiring 33% renewables by 2020.
- 2009: Executive Order S-21-09 directing the California Air Resources Board, under its AB 32 authority, to adopt regulations by 31 July, 2010, consistent with the 33% renewable energy target established in Executive Order S-14-08.
- 2011: Senate Bill X1-2, signed by Gov. Edmund G. Brown, Jr., codifies 33% by 2020 RPS.

Source: California Energy Commission (2011a)

Development of the Renewable Energy Funding Program in California

Renewable Energy Program Funding 1998-2001: Assembly Bill 1890 **AB 1890** - Statutes of 1996, Chapter 854, was the initial electricity industry deregulation legislation and was signed into law by Governor Pete Wilson in September 1996. It required California's three major investor-owned utilities (Southern California Edison, Pacific Gas and Electric Company, and San Diego Gas & Electric) to collect USD 540 million (USD_{2011} 685.8 million) from their customers via a "public goods surcharge" on electricity use. Bear Valley Electric, another investor-owned utility, also participated in the REP. In addition, voluntary contributions from the public added nearly USD 20 000 (USD_{2011} 25 400) to the Renewable Resource Trust Fund in support of renewable energy. The following year, **Senate Bill 90** implemented the provisions of AB 1890 by creating the Renewable Resource Trust Fund (RRTF) as a depository for AB 1890 fund collections and directed the activities of the Energy Commission relating to renewable energy.

Renewable Energy Program Funding 2002 to 2006: In September 2000 the legislature adopted the Reliable Electric Service Investments Act, Assembly Bill 995 **AB 995**, Statutes of 2000; and Senate Bill 1194 **SB 1194**, Statutes of 2000. These two pieces of legislation mandated the three major investor-owned utilities to collect USD 135 million (USD_{2011} 151.2 million) annually for 10 years beginning in 2002 to support the REP. **Senate Bill 1038** signed in September 2002 incorporated the "Investment Plan" with changes. The bill directed the Energy Commission on implementation of the REP from 2002 through 2006. The funding allocations differed from the initial allocations with subsequent changes due to the discontinuation of the Customer Credit Program.

Renewable Energy Program Funding 2007 through 2011: Funding allocations for 2007-2011, legislated by **SB 107** and **SB 1250**, changed with the enactment of **SB 1036**, effective 1 January, 2008. **SB 1036** abolished the Energy Commission's authority to award supplemental energy payments and eliminated the New Renewable Resources Account effective 1 July, 2008. The Energy Commission was also directed to refund unused supplemental energy payment funds to the utilities whose ratepayers contributed funds to support the RRTF. Accordingly, beginning in 2008 and going through to 2011, **SB 1036** established new funding allocations for the remaining programmes: Existing Renewable Facilities Program (20%), Emerging Renewables Program (79%), and Consumer Education Program (1%).

Source: California Energy Commission (2011b)


Italy ©Daniele Cambria/GWEC

Evolution of policy framework for wind in the State of Texas

Texas has the second-best wind resource in the country, with an estimated 1 901 GW of wind potential. According to NREL estimates, wind power alone has the resource potential to deliver over 19 times the state's electricity consumption.

In 1995 the Texas legislature amended the Public Utility Regulatory Policy Act (PURPA) to deregulate the wholesale generation market. The Public Utility Commission of Texas (PUCT) expanded the mandate of the Electric Reliability Council of Texas (ERCOT) to enable wholesale competition and facilitate the use of the power grid by all market participants. ERCOT was made responsible for the Renewable Energy Credit (REC) trading programme, which enabled utilities to achieve the objectives set under the Renewable Portfolio Standard (RPS) by purchasing certificates.

The RPS was for 2 000 MW of new renewable energy capacity to be built in Texas by 2009, later increased to 10 000 MW by 2025; and allowed customers to have access to providers of renewable power. On 1 January 2002, ERCOT launched the competitive retail electric market allowing individuals and corporations in most cities across Texas to freely choose their power suppliers.

The target of 2 000 MW was met in 2005, four years earlier than anticipated. It was increased to 5 880 MW by 2015 and a long-range target was set for the state to have 10 000 MW of renewable energy capacity by 2025. This goal was reached in 2010.

At that point the main obstacle to the growth of renewable energy in Texas was the lack of transmission lines. The 2005 legislation (Senate Bill 20) streamlined the Public Utility Commission's ability to create Competitive Renewable Energy Zones (CREZ) for the construction of new transmission lines to meet the state's renewable goals (Public Utility Commission of Texas, n.d.)[221]. The Texas PUC estimates the cost for CREZ at around USD 5 billion (USD_{2011} 5.75 billion), collected from ERCOT customers.

Overall, Texas offers an attractive market for wind manufacturers, and is home to turbine manufacturers, tower manufacturers and blade manufacturers. To date, the RPS, along with federal incentives, has been the primary tool used in Texas to support wind energy development. Texas' achievement is due to a unique combination of minimal siting restrictions, lax environmental regulations,

[221] The PUC commissioned ERCOT to present various scenarios for wind transmission in 2008. It selected a transmission scenario that would eventually transmit a total of 18 456 MW of wind power from West Texas (where the majority of the installations are) and the Panhandle to metropolitan areas of the state (where the demand is higher) (Public Utility Commission of Texas, 2008).

and CREZ which incentivises and expedites construction of transmission lines for connection to renewable sources.

Similarities in the success factors for California and Texas:

» An ambitious medium-term target was set, giving the scale and ambition of the programme.

» The target can be matched by the individual utilities through a combination of direct investments and a certificate system.

» The electricity producer receives the electricity market price, the federal incentive, and the value of the certificate.

» The programme is supported by tax exemptions both at state and federal level, and/or subsidies for equipment.

» The extension of the electricity network is planned and organised by the state, but investments and operations are performed by the private sector.

CURRENT CHALLENGES

The window of eligibility for the Treasury Grant Program closed at the end of 2011 (though most projects built in 2012 are likely to qualify) and with federal tax credits due to expire at the end of 2012, the current growth perspectives beyond 2012 are highly uncertain.

The wind sector's growth beyond 2012 may be negatively impacted by the limited need for new electricity generation in the country, given limited demand. With fairly low prices and reduced near-term price expectations, natural gas – wind energy's primary competitor in the US – appears to be more economically viable than in past years. The significant wind energy growth in recent years has exceeded aggregate RPS demands in key states, resulting in lower demand from RPS markets in the near term.

The electricity grid is old and overloaded in some regions, and new investment is required to ensure reliable, efficient transmission. Wind power additions are increasingly constrained by inadequate transmission infrastructure and curtailment; especially since the high wind resource areas are often far away from load centres. Investment is needed to develop a new transmission infrastructure designed to access remote wind resources. Although work is being done to alleviate those constraints, overhaulling and upgrading the transmission infrastructure will take time. Siting and permitting procedures at the local, state, and national levels can also delay and constrain wind power development.

Finally, in California and the south-west parts of the country, wind energy is beginning to face competition from solar in meeting state renewable energy requirements, as the cost of solar energy has declined substantially in recent years.

CONCLUSION

By 2011, wind energy made up 2.9% of U.S. power generation, an increase from 1.8% in 2009. The key policy instruments for the support of renewables at the national level in the U.S. are

» Renewables Purchase Specification;

» Production Tax Credit; and

» Investment Tax Credit (or cash grant).

The U.S. has excellent wind potential with an onshore wind resource of more than 10 500 GW at 80 metres and an offshore wind potential of more than 4 150 GW (Elliott, D., *et al.*, 2010). A variety of policy drivers at both federal and state levels have been vital for the expansion of the wind sector. At the federal level, the most significant policy incentives in recent years have been the PTC, accelerated tax depreciation[222], and two Recovery Act provisions that enable wind power projects to elect, for a limited time only, either a 30% ITC or a 30% cash grant in lieu of the PTC.

Wind energy has become increasingly competitive with other power generation options in the U.S. However there is continued opposition to wind power for aesthetic reasons. Policy support will be essential in providing long-term certainty to the US wind industry.

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[222] Accelerated tax depreciation enables project owners to depreciate their investments over a five- to six-year period for tax purposes. An even more attractive 50% first-year "bonus depreciation" schedule was in place during 2008 and 2009, and in September 2010 was extended retroactively for 2010 as well. The Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 that was signed into law in mid-December 2010 increased first-year bonus depreciation to 100% for those projects placed in service between 8 September 2010 and the end of 2011, after which the first-year bonus will revert to 50% for projects placed in service during 2012.

ANALYSIS ON ENABLING CONDITIONS FOR WIND ENERGY

Effective rule of law; and transparency in administrative and permitting processes	A long-term policy framework is not available at federal level. Although the DOE published the "20% wind energy penetration by 2030" initiative administrative and permitting procedures vary from state to state, which can create some difficulties in the process of getting approval.
A clear and effective pricing structure	There is a range of incentives available for the industry both at the state and federal level, which would benefit from the support of long-term federal targets. The extension of the PTC makes it difficult for investors to get long-term certainty of price support mechanisms.
Provisions for access to the grid (incentives and penalties for grid operators)	Renewables have priority access to the grid. However curtailment is increasing across several states. There are no penalties on grid operators for curtailing wind for grid stability reasons. From the industry's point of view, the electricity system could be improved to more effectively integrate wind power into electricity markets, create larger power control regions, include wind forecasting, and increase investment in fast-responding generating plants.
An industrial development strategy	Not Applicable
A functioning finance sector	Since the 2009 financial crisis, it has been difficult to access commercial lending which, coupled with the discussions on the extension of the PTC beyond 2012, has created a difficult situation, at least over the 2013-14 period.
Expression of political commitment from government (e.g. targets)	A target of 20% by 2030 (Department of Energy) but this is not yet part of any legislation.
A government and/or industry led strategy for public and community buy-in.	States such as California have been at the forefront of creating high levels of community awareness about wind. This is not a widespread tendency, even though industry associations and industry players have engaged extensively with local communities to explain the nature and benefits of wind. Wind energy has become increasingly competitive with other power generation options in the US. However, there is opposition to wind power in some locations – largely based on aesthetic reasons.
An employment development strategy	Not Applicable
NOTE	**For wind energy to have a credible long-term future, a strong political support is needed, along with a long-term target supported by a stable and uniform remuneration scheme.**

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IRENA

International Renewable Energy Agency

IRENA Headquarters
C67 Office Building, Khalidiyah
P.O. Box 236, Abu Dhabi
United Arab Emirates

www.irena.org