

Paul Recknagel

Wind Power in China 2008

*An Analysis of the Status Quo and Perspectives for
Development*

Bibliographic information published by the German National Library:

The German National Library lists this publication in the National Bibliography; detailed bibliographic data are available on the Internet at <http://dnb.dnb.de> .

This book is copyright material and must not be copied, reproduced, transferred, distributed, leased, licensed or publicly performed or used in any way except as specifically permitted in writing by the publishers, as allowed under the terms and conditions under which it was purchased or as strictly permitted by applicable copyright law. Any unauthorized distribution or use of this text may be a direct infringement of the author s and publisher s rights and those responsible may be liable in law accordingly.

Copyright © 2008 Diplomica Verlag GmbH
ISBN: 9783836633383

Paul Recknagel

Wind Power in China 2008

An Analysis of the Status Quo and Perspectives for Development

Paul Recknagel

Wind Power in China 2008

*An Analysis of the Status Quo and Perspectives for
Development*

Paul Recknagel

Wind Power in China 2008

An Analysis of the Status Quo and Perspectives for Development

ISBN: 978-3-8366-3338-3

Herstellung: Diplomica® Verlag GmbH, Hamburg, 2009

Zugl. Hochschule Konstanz Technik, Wirtschaft und Gestaltung, Konstanz, Deutschland,
Diplomarbeit, 2008

Dieses Werk ist urheberrechtlich geschützt. Die dadurch begründeten Rechte, insbesondere die der Übersetzung, des Nachdrucks, des Vortrags, der Entnahme von Abbildungen und Tabellen, der Funksendung, der Mikroverfilmung oder der Vervielfältigung auf anderen Wegen und der Speicherung in Datenverarbeitungsanlagen, bleiben, auch bei nur auszugsweiser Verwertung, vorbehalten. Eine Vervielfältigung dieses Werkes oder von Teilen dieses Werkes ist auch im Einzelfall nur in den Grenzen der gesetzlichen Bestimmungen des Urheberrechtsgesetzes der Bundesrepublik Deutschland in der jeweils geltenden Fassung zulässig. Sie ist grundsätzlich vergütungspflichtig. Zuwiderhandlungen unterliegen den Strafbestimmungen des Urheberrechtes.

Die Wiedergabe von Gebrauchsnamen, Handelsnamen, Warenbezeichnungen usw. in diesem Werk berechtigt auch ohne besondere Kennzeichnung nicht zu der Annahme, dass solche Namen im Sinne der Warenzeichen- und Markenschutz-Gesetzgebung als frei zu betrachten wären und daher von jedermann benutzt werden dürften.

Die Informationen in diesem Werk wurden mit Sorgfalt erarbeitet. Dennoch können Fehler nicht vollständig ausgeschlossen werden und der Verlag, die Autoren oder Übersetzer übernehmen keine juristische Verantwortung oder irgendeine Haftung für evtl. verbliebene fehlerhafte Angaben und deren Folgen.

© Diplomica Verlag GmbH

<http://www.diplomica.de>, Hamburg 2009

Abstract

This study reviews the status quo of wind power in China in the year 2008 and offers an outlook to future development, in order to provide a sound basis for the alignment of the German Development Corporation's (GTZ) wind power activities with actual market conditions. Government policies as well as other determinants of wind power development are analyzed in-depth and possible pitfalls for development are identified. As a conclusion, the study presents recommendations for measures to promote a long-term sustained development of wind power in China.

Acknowledgments

I would like to express my gratitude to my supervisors Dipl.-Ing. Andreas DuBois (GTZ) and Prof. Dr. Beate Bergé (HTWG Konstanz) for taking the time to supervise my thesis as well as for their continued support, valuable expertise and comments.

A very special thanks goes out to Prof. Dai Huizhu (CEPRI) for her guidance, her contribution of invaluable insights into the Chinese wind power sector and her assistance in establishing contacts to numerous experts in the field.

I would also like to thank Mr. He Dexin (CWEA) for his support and commitment to study the conditions of human resources, education and training in the wind power sector in China.

For devoting their time to answer my questions, I extend my gratitude to all the experts interviewed in the course of this study. In particular, I would like to acknowledge the insightful contributions by Mr. Shi Pengfei (CWEA), Mr. Sebastian Meyer (Azure International) and Mr. Paolo Soares (Suzlon).

Finally, I want to show my deepest appreciation to my family for their love and unfailing support.

Table of Contents

1	<u>INTRODUCTION</u>	7
1.1	BACKGROUND	7
1.2	CONTENT & METHODOLOGY	9
2	<u>THE GLOBAL DEVELOPMENT OF WIND POWER</u>	10
2.1	DEVELOPMENT OF THE GLOBAL WIND POWER MARKET	10
2.2	DRIVERS AND TRENDS OF WIND POWER DEVELOPMENT	12
3	<u>THE GTZ CHINA WIND POWER PROJECT</u>	17
4	<u>ENERGY POLICY IN CHINA</u>	19
4.1	ENERGY SUPPLY AND DEMAND	19
4.2	RELEVANT PLAYERS IN ENERGY POLICY MAKING	22
4.3	RENEWABLE ENERGY AND WIND POWER POLICY	24
4.3.1	THE CONCESSION PROGRAMME AND ORIGINS OF WIND POWER PRICING	24
4.3.2	THE RENEWABLE ENERGY LAW	28
4.3.3	INVESTMENT CONDITIONS & FINANCIAL INCENTIVES	32
5	<u>WIND POWER IN CHINA</u>	38
5.1	WIND ENERGY RESOURCE CHARACTERISTICS AND DEVELOPMENT POTENTIAL	38
5.2	CURRENT STATUS OF DEVELOPMENT	41
5.3	MARKET FORECAST.....	44
5.4	WIND TURBINE MANUFACTURERS.....	46
5.5	WIND TURBINE COMPONENT SUPPLIERS	53
5.6	PROJECT DEVELOPERS.....	53
5.7	PROJECT ECONOMICS	55
6	<u>POTENTIAL PITFALLS FOR WIND POWER DEVELOPMENT IN CHINA</u>	57
6.1	POLICY.....	57
6.2	HUMAN RESOURCES	59
6.3	WIND FARM PERFORMANCE & LACK OF TRANSPARENCY	61
6.4	GRID INTEGRATION	63
7	<u>RECOMMENDATIONS FOR THE GTZ CHINA WIND POWER PROJECT</u>	65
7.1	WIND POWER EDUCATION & TRAINING	66
7.2	R&D AND TECHNOLOGICAL CAPACITY BUILDING.....	68
7.3	INFORMATION SERVICES	69
7.4	FINAL REMARKS	71
	Bibliography	72

Figures

Figure 1	<i>Global Installed Wind Power Capacity Development</i>	10
Figure 2	<i>Drivers of Wind Power Development</i>	13
Figure 3	<i>Total Primary Energy Demand in China 2005</i>	20
Figure 4	<i>Major Players in Energy Policymaking in China</i>	23
Figure 5	<i>NDRC Approved Feed-In Tariffs</i>	30
Figure 6	<i>Medium and Long-Term Development Plan for Renewable Energy</i>	31
Figure 7	<i>Policy Framework Governing the Wind Power Sector in China</i>	32
Figure 8	<i>China Coal and Electricity Price Growth</i>	34
Figure 9	<i>Distribution of Wind Power Density in China</i>	39
Figure 10	<i>Imbalance of Power Production and Consumption in China</i>	40
Figure 11	<i>Development of Wind Power Installations in China</i>	41
Figure 12	<i>Geographical Distribution of Wind Farms in China</i>	42
Figure 13	<i>Market Shares According to Turbine Size in China</i>	43
Figure 14	<i>China Market Forecast 2008 - 2012</i>	45
Figure 15	<i>Wind Turbine Manufacturer Market Shares in China (Annual Installed)</i>	46
Figure 16	<i>Technology Sources of Chinese Wind Turbine R&D</i>	48
Figure 17	<i>Average Capacity of Wind Turbines</i>	49
Figure 18	<i>Wind Turbine Manufacturers' Market Shares in China 2008</i>	51
Figure 19	<i>Planned Expansion of Chinese Wind Turbine Production</i>	52
Figure 20	<i>Wind Power CDM-Projects in China</i>	56
Figure 21	<i>International Support of the Chinese Wind Power Sector</i>	65
Figure 22	<i>CWPP Options to Support Education and Training</i>	67

Tables

Table 1	<i>Global Total Installed and New Wind Power Capacity 2007</i>	11
Table 2	<i>Participants in CWPP Advanced Training</i>	18
Table 3	<i>Sources of Power Generation in China 2007</i>	21
Table 4	<i>Top Project Developers in China - Installed Capacity and Pipeline (June 2008)</i>	54
Table 5	<i>Typical Training Needs of Project Developers & Manufacturers in China</i>	67

Annex

A77-A114

Abbreviations

ADB	Asian Development Bank
BCSE	Australian Business Council for Sustainable Energy
BMU	<i>Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit</i>
CAGR	Compound Annual Growth Rate
CDM	Clean Development Mechanism
CEPRI	China Electric Power Research Institute
CLYPG	China Longyuan Power Group
CMA	China Meteorological Association
CNY	China Yuan Renminbi
cp.	compare
CRED	Center for Renewable Energy Development
CREIA	Chinese Renewable Energies Industry Association
CWPP	GTZ China Wind Power Project
DE	domestic enterprise
EEG	<i>Erneuerbare Energien Gesetz</i>
EEP	EU-China Energy and Environment Programme
ERI	Energy Research Institute
EWEA	European Wind Energy Association
FIE	foreign-invested enterprise
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
GTZ	<i>Gesellschaft für Technische Zusammenarbeit</i>
GW	gigawatt
GWEC	Global Wind Energy Council
IGES	Institute for Global Environmental Studies
IMAR	Inner Mongolia Autonomous Region
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producer
m	meter
MW	megawatt
NDRC	National Development and Reform Commission
NEA	National Energy Administration
NREL	National Renewable Energy Laboratory
O&M	operation and maintenance
OECD	Organisation for Economic Co-Operation and Development
PPA	power purchase agreement
R&D	research and development
RE Law	Renewable Energy Law
REEEP	Renewable Energy and Energy Efficiency Partnership
REN21	Renewable Energy Policy Network for the 21 st Century
SWERA	Solar and Wind Energy Resource Assessment
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP	United Nations Environment Programme
US	United States
VAT	value added tax
WERT	Wind Environment Research & Training Initiative (BMU & GTZ)
WED	Danish-Chinese Wind Energy Development Programme
WTG	wind turbine generator
WTO	World Trade Organisation

1 Introduction

1.1 Background

The last two years mark a turning point in public perception of human-induced climate change as a problem of global importance.¹ The widespread acceptance that “*most of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas [GHG] concentrations*”² has increased political pressure on governments to reduce GHG emissions. At the same time, rising oil prices have made the reduction of dependence on energy imports and diversification of the energy mix strategic imperatives for many countries around the world.

While governments worldwide are confronted with this dual challenge, it is of special relevance to China. On the one hand, China has recently become the world’s largest emitter of CO₂, accounting for 24% of global annual CO₂ emissions.³ China is therefore one of the most important players to effectively mitigate global warming and pressure from governments around the world on China to join emission reductions efforts is mounting. On the other hand, energy demand is growing exponentially and China is increasingly relying on energy imports to satisfy energy needs.⁴ Worried that growing dependency on energy imports may be accompanied by foreign-policy and economic pressures that might threaten national security as well as social and political stability, China has implemented a number of policies to address this issue ranging from policies to save energy and reduce energy intensity, to the diversification of oil supply sources and routes, the support of equity oil overseas acquisitions and the build up of strategic oil reserves to the diversification of the energy portfolio.⁵

In line with the objective to diversify the composition of the energy mix, China’s leadership is increasingly realizing the need to reduce emissions and support renewable energy development. At a recently held *Politburo* study session, President Hu Jintao exclaimed: “*Our task is tough, and our time is limited. Party organisations and governments at all levels must give priority to emission reduction and bring the idea deep into people’s hearts*”.⁶ To address the issue of energy security, the Chinese government has adapted a two-pronged approach. While measures to promote energy savings and efficiency curb the increase in energy demand, the support of renewable and nuclear energy reduces dependency on energy imports and contributes to the broadening of the foundation of energy supply.⁷

This study focuses on China’s renewable energy policy and the development of wind energy in China in particular. Commitment by the highest levels of government and a host of favourable policies have

¹ Main drivers of public awareness of climate change were Al Gore’s movie “An Inconvenient Truth” (May 2006), the Stern Report (October 2006), the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (2007) and the Nobel Peace Prize for Al Gore and the IPCC (December 2007).

² IPCC (2007), p. 10

³ Netherlands Environmental Assessment Agency (2007), *online* / The Climate Group (2008), p. 5

⁴ In 2006, China relied on imports for 50% of its total oil consumption. China started to import gas in 2006, and has become a net importer of coal in 2007. The energy imports are expected to increase markedly in future, accompanied by a growing impact on international fuel trade. (cp. OECD/IEA (2007), p. 325 et seqq.)

⁵ cp. OECD/IEA (2007), p. 175 et seqq.

⁶ cp. Watts (2008), *online*

⁷ China is also supporting the development of a natural gas market as well as R&D and deployment of clean coal, coal-to-liquid and biofuel technologies.

triggered a boom in renewable energy in China, especially in the wind power sector. A major step in the development of renewable energy in China has been the *Renewable Energy Law* that came into effect in January 2006. In addition, the government has set ambitious targets for energy intensity reduction, and share of renewable energy of primary energy consumption.

China is on the way to become the world leader in renewable energies. In 2007, investment in renewable energies in China amounted to approximately US\$ 12 billion, second only to Germany. In terms of installed renewable energy capacity, China leads the world with 151 GW of installed capacity, largely due to the widespread utilization of hydropower for electricity generation.⁸ According to a report by the United Nations Environmental Programme, China is the world's leading manufacturer of solar cells, with an estimated annual production capacity of 3.000 MW.⁹ China's wind power market was the third biggest worldwide in 2007 and growth rates continue to exceed expectations. In 2009, China is expected to take the lead as the largest manufacturer of wind turbines.¹⁰

Hydro power represents the most important source of renewable energy in China and plays an important part in the power generation portfolio, most notably since the construction of the Three Gorges Dam. Hydro capacity is expected to double to 290 GW until 2020, but concerns about the social and environmental impact of large-scale hydro power are becoming stronger.¹¹ Although China is the world's leading solar manufacturer, installed solar photovoltaic power capacity amounts to a mere 0.01% of total power generation capacity (80 MW, approx. 50% of which are off-grid).¹² Solar power equipment is produced almost exclusively for export. Considering China's enormous energy demand and the pace of its growth, deployment of solar photovoltaic power is not viewed as a first-rate solution to satisfy China's energy needs, since it features high costs and low efficiencies compared to other renewables like hydro or wind power. While China does not have significant amounts of solar PV capacity, it is the biggest market for solar thermal systems for heating and hot water supply with 64,5% of global capacity, amounting to 68 GW.¹³ Biomass covers 13% of primary energy demand, mostly used in rural households for heating and cooking. In 2007, only 0,28% of power generation capacity were fuelled by biomass. The government plans to expand biomass capacity from 2 to 30 GW by 2020.¹⁴ Despite the impressive progress of recent years, renewable energies - excluding hydro - only contribute less than 1% to China's electricity supply and the skies above China's urban areas continue to be shrouded by smog.

Since coal-fired power generation accounts for 82,9% of total electricity supply, it is no surprise that half of China's emissions are attributable to power generation.¹⁵ With electricity demand growing rapidly alongside the economy, dependency on coal as the major source for power generation is likely to persist. However, as the most important source of renewable energy next to hydro, and growth of installed capacity constantly accelerating, peaking at about 130% in 2007, wind power is one of – if

⁸ Hydro power accounts for 145 GW out of 151 GW renewable energy capacity (2007). Cp. The Climate Group (2008), p. 8

⁹ Data from 2007. cp. May (2008), *online*

¹⁰ cp. Schwartz/Hodum (2008b), *online*

¹¹ cp. The Climate Group (2008), p. 8

¹² cp. The Climate Group (2008), p. 8 et seqq.

¹³ cp. REN21 (2008), p. 12

¹⁴ cp. cp. The Climate Group (2008), p. 11

¹⁵ cp. Shi (2008b), p. 1