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Good environmental governance for renewable energies - the example of Germany: lessons for China?

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Good Environmental Governance for Renewable Energies – The Example of Germany – Lessons for China?

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Executive Summary

Germany's pioneering role in the field of renewable energies (RES) can best be observed by its world leading position in installed wind power and photovoltaics. Also its first European rank in the production of biofuels and installed solar thermal collector space is remarkable.

These successes are not due to an exceptionally good natural resource base; mainly they are the result of an innovative national support policy. Pressure from the European and international commitments also have contributed to the German success story in RES.

The current paper analyses the main factors of the German case in the development of RES, including the design elements of the national promotion instruments and support programmes, the policy impacts from the European and the international level, technical as well as cognitive conditions. In addition, a description is given of further driving forces for a successful RES development in other European countries.

The paper ends with the question which of the described success factors of the German RES case might be transferable to China - and which not.

1. Introduction

Since the mid 1970s, German policy makers both at national and regional level have been increasingly active in adopting several renewable energy policies. Whereas the period between 1974 and 1988/89 almost exclusively comprised research and demonstration measures, the time since the end of the 1980s until the latest, important RES policy regulation in summer 2004, was clearly marked by major market creation and stimulation measures. Their effectiveness – together with other driving forces - tells its own story: World leader in total installed wind power capacity in 2005, with 31 percent of global capacity (GWEC 2006) as well as in newly installed photovoltaic (PV) capacity in 2004 and 2005, ranking first together with Japan in the cumulative installed PV power capacity. But will the German success in RES policy continue? Is it a special case? Could it be transferred to a China? If so, which lessons could China draw from the German case for its future RES policy approach?

To answer these questions, this paper at first gives an overview of the German energy paths and energy balance as well as on the driving forces of the German success in the promotion and development of RES. This includes the design of the main RES promotion instrument, the Renewable Energy Sources Act (EEG), the 100,000 Roofs-PV-Programme, and the Market Incentive Programme (MAP) for the creation of the RES market.

Furthermore, the influence of the European and international level on the German RES governance approach, through the respective EU Directives as well as the Kyoto Protocol, will be analysed. In addition, technical driving forces like the necessity to modernise the German energy generation system as well as cognitive success conditions are being described.
By the same token, the main barriers for a further expansion of RES in Germany, like the limited grid capacity or the strong influence of the coal industry will also be discussed. After analysing the German case, a short look is given on the driving forces for a successful RES development in other European (EU) countries.

In the last part of the paper the question is asked which of the described success factors of the German RES case might easily be transferable to the China - and which not.

2. Germany's energy paths and energy balance

In fossil fuel reserves, Germany possesses considerable hard and brown coal resources. The proven reserves at the end of 2004 amounted to 64 billion tonnes (Gt), corresponding to 6.7 percent of the global reserves and an estimated reserves/production (R/P) ratio for Germany of 305 years (Euracoal 2005: 36; BP 2005: 30). In the EU-25, Germany is the second largest coal producer behind Poland and the world's leader for lignite production. Besides, the German hard coal-mining industry since decades receives extensive subsidies, amounting to 23 billion Euro for the period between 1998 and 2005 (Reiche: 2004). According to an agreement between the German government and the German hard coal-mining industry these subsidies will continue at least until 2012, even on a declining scale, amounting to (another) 7.3 billion Euro for the period between 2006 and 2008 (WEC 2005a: 65). However, the exploitation of German coal has been declining for years.

Germany also has small reserves of oil (2004: 31 Mt) and natural gas (2004: 201 Gm3) with an estimated R/P ratio of 14 years in the case of oil (NLfB 2005: 3 et sqq.) and 12 years in the case of natural gas.

In contrast to the latter, Germany has a big RES potential as shown by many studies, although these studies differ in their conclusions, depending on assumptions about the availability of suitable sites, technical characteristics of the RES technologies and other factors. The figures presented in Table 1 originate from one of the most recent and extensive RES potential assessments in Germany undertaken by the Federal Environment Agency (UBA).

Table 1 also presents figures from the final report of the Enquete-Commission of the German Bundestag on a sustainable energy supply (Deutscher Bundestag: 2002). Based on these studies, the technical potential of RES in Germany can be estimated between 6,000 and 21,000 PJ/yr. Compared with the German primary energy consumption in 2005 of 14,238 PJ (BMU 2006a: 4), this shows that more than 40 percent of the German energy demand could be covered by RES. With a higher utilisation of geothermal energy and/or greater efforts in energy saving and in energy efficiency, even the whole German energy supply could in principle be met by RES.

Table 1: Technically available potential of RES in electricity and heat generation for Germany (Deutscher Bundestag: 2002; UBA 2002)

RES Technology	**RES potential assessment by Enquete-Commission (PJ/a)**		**RES potential assessment by UBA (PJ/a)***	
	Electricity	thermal	electricity	thermal
Biomass	140.4-205.2	428.4-694.8	212.4	597.6
Photovoltaics	751	-	302.4	-
Solar thermal	-	2,112	-	1,540.8
Hydro power	119	-	90	-
Wind power (onshore)	299-457	-	298.8	-
Wind power (offshore)	468-853	-	306	-
Geothermal energy	1,620-15,950 (electricity & thermal)		237.6	2520
Total	5,937.8-21,142		6,105.6	

* The original data in the UBA potential assessment is given in TWh/a. For a better comparability, we converted it in PJ/a.

To cover its energy demand, Germany so far strongly relies on energy imports. In 2004 the share of energy imports in the primary energy consumption amounted to 61 percent, quite above EU average of 48 percent (WEC 2005a: 49 et sqq.). The most important energy supplier for Germany is the Russian Federation. Natural gas, oil and hard coal from Russia amounted to 21 percent of the whole German energy supply in 2004, respectively to 35 percent of the whole energy imports. Further important suppliers of energy raw materials for Germany are Norway, Great Britain, the Netherlands, and Libya (WEC 2005a: 56 et sq).

With regard to the structure of German primary energy consumption in 2005, *Table 2* reveals that mineral oil by far remained the most important source of energy, followed by coal and natural gas (with nearly the same percentages) and somewhat further behind by nuclear energy. Renewable energy sources - even with a growing tendency - only contributed to 4.6 percent (composed of 2.0 percent electricity, 2.1 percent heat and 0.5 percent fuel) (BMU 2006: 4). In the case of gross electricity consumption in 2005 (see also *Table 2*), the share of coal accounted for 48.5 percent of the whole production, with 23.1 percent from hard coal and 25.4 from brown coal. In 2005, nuclear energy had a share of 27.4 percent of electricity consumption in Germany. The contribution of RES to Germany’s net electricity generation in 2005 reached 10.2 percent (with wind power as the most important source amounting to 4.3 percent) (BMU 2006a: 4; AGEB 2006).

Table 2: Actual primary energy consumption and gross electricity consumption in Germany, 2005 (AGEB 2006; BMU 2006a: 4)

Energy source	**Primary energy consumption**	**Gross electricity consumption**
	percent	**percent**
Mineral oil	36.0	1.6
Natural gas	22.7	10.1
Hard coal	12.9	23.1
Brown coal	11.2	25.4
Nuclear energy	12.5	27.4
RES	4.6	10.2
Others	0.1	2.2
Total	100.0 (14,238 PJ)	100 (610.5 TWh)

Table 3 shows that more than half of RES production in Germany in 2005 was based on biomass. Regarding heat production by RES, the share of biomass amounted to 94.3 percent, whereas in electricity production wind energy for the first time generated more electricity (42.7 percent) than hydro power (34.6 percent) (BMU 2006a: 5). Compared with the technically available potential of RES in Germany presented in *Table 1*, the current use of RES represents a share of 2.8 percent, in relation to the most optimistic RES technical potential assessment, and 9.9 percent in relation to the most conservative one.

Table 3: Structure of energy supply by renewable energy souces (RES) in Germany, 2005 (BMU 2006a: 5)

Energy source	**percent**
Biomass heat	46.7
Biomass electricity	8.0
Biofuels	12.6
Hydropower	13.1
Wind power	16.2
Photovoltaic electricity	0.6
Solar thermal	1.8
Geothermal heat	1.0
Total	100.0 (163.9 TWh)

3. Main factors of the German success in RES governance

With regards to capacity growth of renewable energies during the last years, in several technology fields Germany is the leading nation at global, respecively European level:

- Germany is the world leader in total installed wind power capacity, which amounted to 18,428 MW by the end of 2005 (31 percent of global capacity, GWEC 2006).
- As to newly installed photovoltaic (PV) capacity in 2004 and 2005, Germany showed the strongest growth with 500, respectively 600 MW new PV installations, reaching a totally installed capacity of 1,400 MWp by the end of 2005 (BSW 2006) - thereby ranking first together with Japan in the cumulative installed PV power capacity.
- The German market for solar heating systems is the biggest and most rapidly increasing one in Europe amounting to 7.2 Mio. m2 of installed solar collector space at the end of 2005, with a newly installed capacity during that same year of 950,000 m2 (BMU 2006a: 2).
- Germany was the European leader in the production of biodiesel, with 1.7 Mio. t, in 2005 (BMU 2006a: 2).

These successes are the result of a bundle of interrelated driving forces. We identified the following: (1) A favourable design of RES promotion instrument, the EEG; (2) a comprehensive RES promotion approach with a lead market focus; (3) external pressure deriving from European and international commitments in RES policy and active climate protection; (4) a positive cognitive environment towards RES, as well as (5) certain technical driving forces.

3.1 Favourable design of RES promotion instruments

Although there is no real superiority of any promotion instrument, until now so called renewable energy feed-in tariffs (REFITs) have shown the best effectiveness concerning the creation of new RES installations. The leading wind energy countries, Germany and Spain, have installed successful REFIT systems and almost all old installations in Denmark are based on this system, too. Nearly 78 percent of all wind power capacity in the EU-25, accounting to 40,504 MW at the end of 2005, was installed in these three countries (EWEA 2006).

What are the reasons for this impressive development? In the first place this is the planning security the three countries offered possible investors with the specific design of their REFITs. Germany, for example, guarantees investors the feed-in tariff for a period of 20 years (and even 30 years for hydro, until 5 MW).

Another very important design criterion for a successful RES development is the *technology-specific remuneration* for RES electricity, easily adjustable within a REFIT system. If the different power production costs of the individual RES technologies are considered in the form of varying remuneration, the possibilities to reach a broad RES supply (or technology mix) seem higher than with a uniform remuneration level. The German Renewable Energy Sources Act (EEG) established such a broad promotion approach with remuneration rates depending on the technology used, the size of the plant, and in the case of wind energy in addition also depending on the age and the generated power output of the installation (Reiche/Bechberger 2006: 206 et seq.).

Germany has a long tradition in promoting green electricity with feed-in tariffs. Already in 1991 the Act on Supplying Electricity from Renewables (Stromeinspeisungsgesetz, StrEG) entered into force which introduced for the first time feed-in tariffs for RES electricity. An amended version followed in 1998.

On April 1, 2000, the *Renewable Energy Sources Act* (Erneuerbare-Energien-Gesetz, EEG) came into force, carrying forward the approach of its predecessor, the StrEG of 1991, in an extended and improved manner. The design of the former StrEG included several points that harmed the development of RES. This made necessary a determined and quick change. The most important structural elements of the new EEG can be summarised as follows: Firstly, the remuneration system was uncoupled from the average utility revenue per kWh sold and replaced by fixed, degressive and temporarily limited feed-in tariffs for the whole amount of generated RES electricity. Secondly, a priority purchase obligation for RES power was introduced, to be fulfilled by the nearest grid operator. Thirdly, a German-wide equalisation scheme was adopted for the costs which grid operators incur as a result of the different amounts of RES each region feeds into the power grid; this leads to an evenly distribution of the RES power amounts and extends remuneration to all energy supply companies - and ultimately to all end consumers. Fourth, the EEG also contained provisions concerning the financing of grid connection and grid extension (Bechberger/Reiche 2004).

The first amendment of the EEG was the extension of its ambit: Besides the energy sources already considered in the StrEG, the EEG also included electricity from geothermal energy and pit gas. The power limit for hydro plants and installations using sewage or landfill gas of 5 MW fixed in the StrEG now also concerns installations based on pit gas or solar energy. In contrast, the power limit for biomass plants was raised from 5 to 20 MW.

The most far-reaching changes in comparison to the StrEG are related to the remuneration scheme. The EEG raised all remuneration rates, although in different scale, depending on the source of energy, capacity or location of the plant. Except for hydro power, where the amortisation of the power plants normally takes several decades, the EEG fixed the purchase guarantee and the feed-in tariffs for 20 years after putting into operation of every new plant.

To stimulate innovations and to ensure a better compatibility with the European law on state aid, the remuneration paid under the EEG also included a digressive element: From 2002 on, new installations of biomass (minus 1 percent), wind (minus 1.5 percent) and PV (minus 5 percent) received lower tariffs. From 2003 on, new installations of these types received tariffs lowered by a further 1, 1.5 or 5 percent, and so on for the following years.

To comply with the European law, the EEG set three further provisions. Firstly, by 30 June every two years after the entry into force of the law a report shall be submitted on the progress achieved in terms of the market introduction and the cost development of RES power generation plants. Where necessary, this report shall propose adjustments of the remuneration amounts and of their reduction rates, in keeping with technological progress and market developments with regard to new installations.

Secondly, relating to the remuneration for wind power, the different quality of plant sites was taken into account ("*Referenzertragsmodell*"). The purpose of this new provision is to avoid payment of compensation rates that are higher than what is required for a cost-effective operation of such installations, and to create an incentive for installing wind energy converters at inland sites.

Thirdly, the remuneration scheme for PV power contained a special provision that is connected with the compliance with the European law. The guaranteed remuneration shall not apply to PV systems commissioned after 31 December of the year following the year in which PV systems reach a total installed capacity of 350 megawatts. This limit was raised to 1,000 MW in June 2002 because the 350 MW seemed to be surpassed already in 2003 and the successful PV sector needed further planning security. In the amendment of the EEG in 2004, this capacity limit was revoked completely.

Moreover, the EEG comprised a clear regulation concerning grid costs. Accordingly, the costs for grid connection have to be paid by the plant operators whereas possible costs for upgrading the grid must be borne by the grid operator. For the settlement of any dispute in relation to grid costs, the Federal Ministry of Economics and Technology (BMWi) established a clearing centre, with the involvement of the parties concerned.

Finally, the EEG constituted a multi-level and nation-wide equalisation scheme for RES electricity purchases and compensation payments. This provision was designed to remedy a shortcoming in the former StrEG, as a result of which the electricity purchases to be made were far above average in some regions. The equalisation provision in the EEG is aimed at the operators of transmission grids. (This is a small group with a limited number of players which will easily be able to handle the transactions associated with the equalisation scheme and which will also be able to monitor each other).

In August 2004, an amended version of the EEG came into force. Compared with the previous EEG, the amendment provides for a more differentiated fee structure, taking into account of efficiency aspects. In particular, the payment conditions for biomass, biogas, geothermal as well as photovoltaic energy were improved[1]. If existing large hydropower plants are modernised or expanded (up to a capacity of 150 MW), the additional electricity generated is included in the fee. For 2006, fees under the new EEG range from 5.28 Euro cents/kWh for electricity from wind energy (basic payment) to 56.80 Euro cents/kWh for solar electricity from small façade systems. The annual digression in the fees for new installations was increased to strengthen the incentives for technical innovations and cost cutting, e.g. 2 percent for wind energy, 1.5 percent for bio energy and 5 percent for photovoltaic energy starting from 2005. From 2006 onwards, the degression for new PV installations on open spaces was even increased up to 6.5 percent. For the first time also a degression of 1 percent for new geothermal plants was introduced, starting from 2010.

For the area of bioenergy, in addition to the minimum fees laid down, the new version of the EEG provides for additional fees (*bonuses*), if the electricity is exclusively produced from self-regenerating raw materials, combined heat-power, or if the biomass was converted using innovative technologies (e.g. thermal chemical gasification, fuel cells, gas turbines, organic Rankine systems, Kalena cycle plants or Stirling engines). The bonuses can be used cumulatively.

The payment rate for wind energy on land was lowered in the amendment. Wind parks which could not achieve at least 60 percent of the reference yield at the planned location can no longer claim payment under the 2004 law. For coastal sites in particular, there are new incentives for "repowering" (the replacement of old, smaller installations by modern, more efficient ones). The higher starting fees for offshore wind parks will now be paid for installations commissioned prior to 2011 (previously 2006). Furthermore, the period for the higher starting fee for offshore wind parks was prolonged to a minimum of 12 years (before, 9 years). This period can also be extended for installations located further from the coastline and erected in deeper water.

Since July 2003 there has been an equalisation regulation for electricity intensive companies in the producing sector. This regulation was expanded in the amended EEG. Electricity intensive companies in the producing sector and environmentally friendly railways can be included under the equalisation regulation if their electricity consump-

[1] The increased rates for solar power compensate the expiry of the 100,000 roofs programme (see below) and already became effective in January 2004 by a preliminary act, the "PV-Vorschaltgesetz".

tion is higher than 10 gigawatts (previously 100 gigawatts), and the ratio of electricity costs to gross value added exceeds 15 percent (previously 20). The amendment to the EEG limits the total relief volume. This again limits the extra costs incurred by non-privileged companies due to the equalisation scheme. The electricity volumes which are distributed among the non-privileged electricity consumers are limited to a maximum of 10 percent above the share calculated pursuant to the EEG (BMU 2004a).

Table 4: Feed-in tariffs for electricity produced from renewable energy sources in Germany (as of 2006) (BMU 2004b)

Source	**Capacity**	**Tariff / kWh**	**Period/ years**	**Comments**
Hydro-power	Until 5 MW	9.67 cEuro up to 500 kW 6.65 cEuro over 500 kW to 5 MW	30	Limitations for sites starting from 2008
	Up to 150 MW	7.51 cEuro (to 500 kW) 6.51 cEuro (500 kW to 10 MW) 5.98 cEuro (10 MW to 20 MW) 4.46 cEuro (20 MW to 50 MW) 3.62 cEuro (50 MW to 150 MW)	15	Only when renewed plants and only re-compensation of additional capacity
Sewage gas, pit gas, landfill gas	Unlimited	7.44 cEuro (to 500 kW) 6.45 cEuro (500 kW to 5 MW) 6.45 cEuro (pit gas from 5 MW)	20	Sewage – and landfill gas: capacity over 5 MW will be recompensated according to market price
	Unlimited	9.44 cEuro (to 500 kW) 8.45 cEuro (500 kW to 5 MW) 8.45 cEuro (pit gas from 5 MW)	20	Implementation of specific innovative technologies
Bio-mass*	Up to 20 MW	11.16 cEuro (up to 150 kW) 9.60 cEuro (150 to 500 kW) 8.64 cEuro (500 kW to 5 MW) 8.15 cEuro (5 MW to 20 MW)	20	
	Up to 20 MW	3.78 cEuro (up to 20 MW)	20	Use of waste wood of categories A II and A IV from 01.07.2006
	Up to 20 MW	17.16 cEuro (up to 150 kW) 15.60 cEuro (150 to 500 kW) 12.64 cEuro (500 kW to 5 MW) 8.15 cEuro (5 MW to 20 MW)	20	Only when use of specific substances such as plants originating from agricultural, silvicultural, horticultural operations, or manure according to (EC) No 1774/2002, vinasse etc. (so called “nachwachsende Rohstoffe”)
	Up to 20 MW	17.16 cEuro (up to 150 kW) 15.60 cEuro (150 to 500 kW) 11.14 cEuro (500 kW to 5 MW) 8.15 cEuro (5 MW to 20 MW)	20	Burning wood in the sense of sentence 1

	Up to 20 MW	13.16 cEuro (up to 150 kW) 11.60 cEuro (150 to 500 kW) 10.64 cEuro (500 kW to 5 MW) 10.15 cEuro (5 MW to 20 MW)	20	Combined heat and power plants (gekoppelter Betrieb)
	Up to 20 MW	15.16 cEuro (up to 150 kW) 13.60 cEuro (150 to 500 kW) 12.64 cEuro (500 kW to 5 MW) 10.15 cEuro (5 MW to 20 MW)	20	Electricity from combined heat and power plants when innovative technologies are implemented
Geo-thermal energy	Unlimited	15,00 cEuro (up to 5 MW) 14,00 cEuro (5 MW to 10 MW) 8,95 cEuro (10 MW to 20 MW) 7.16 cEuro (over 20 MW)	20	
Wind-energy On-shore		8.36 cEuro (initial tariff) 5.28 cEuro (basic tariff)	20	Depending on reference revenue**, the initial higher tariff is granted between 5 and 20 years; no recompensation for plants with reference revenue of less than 60 percent***. Additional incentive (prolonged initial higher tariff) for repowering of plants.
Wind-energy Off-shore		9.10 cEuro (initial tariff) 6.19 cEuro basic tariff	20	Initial higher tariff is granted when put into operation until end of 2010. Depending on site 12 to 20 years. Additional prolongation for deeper waters and growing distance from coast.
Photo-voltaic energy	On top of or on buildings or on noise protection walls	51.80 cEuro (up to 30 kW) 49.28 cEuro (30 to 100 kW) 48.74 cEuro (from 100 kW)	20	
	Plants integrated in buildings	56.80 cEuro (up to 150 kW) 54.28 cEuro (150 to 500 kW) 53.74 cEuro (500 kW to 5 MW)	20	

	Plants on open spaces or others	40.60 cEuro	20	Specific criteria concerning site are to be fulfilled.

* Tariffs for electricity from biomass are subject to additional bonuses on top of the basic tariff, see e.g. the so called "nachwachsende Rohstoffe" (renewable primary products) in the third section (up to additional 6 ct/kWh). Various bonuses can also be combined: in 2006, a small plant up to 150 kW, using innovative technology, with combined heat-power and firing renewable primary products could get a total tariff of 21.16 ct/kWh.

** The reference revenue is calculated on the basis of the amount of electricity feed in during the first 5 years.

*** To be determined in advance.

3.2 RES promotion approach with a lead market orientation

The described favourite design elements of the EEG are, without doubt, the reason for a large part of the substantial investments in the German wind and photovoltaic market - and thereby for the success of the RES development in general. By the same token, these regulations also paved the way for the development of a "lead market" for environmental innovations, meaning the willingness of a nation state to bear the initial risks (and development costs) of environmental innovations until they reached market competitiveness. If such innovations could stimulate a global demand, the pioneering role of one nation might be recompensated with "first mover" advantages: export markets will be developed and economic advantages will be assured. Furthermore, this kind of pioneer policy won't lead to a political isolationism but may have a demonstration effect which can enhance international diffusion (Jänicke 2005).

An example for such a development is the German RES promotion policy which can be seen by the fact that Germany - despite relative unfavourable geographical/climatic conditions - is world leader in absolute installed wind power and photovoltaic capacity (the latter together with Japan). In the meantime, RES have become an important economic factor. The magnitude of employment in the RES sector by the end of 2004 had reached around 157,000, with 64,000 in the wind industry, whereof 30,300 were due to exports (Eurobserv'ER 2006: 58). The total turnover for German renewable energy industries in 2005 amounted to approximately 16 billion €. In 2005, the role of "green power" in energy policy has become more significant following the pressure to adopt pro-active measures to combat climate change (the "Kyoto-Protocol-effect").

The success of the German RES governance approach as was already said is not only based on the EEG, but also on a broad policy mix. Such a complex pattern of political regulation (or *smart regulation*) is based on the finding that a success oriented policy should not be limited to the deployment of one single measure. Moreover, the implementation of policies will be facilitated by negotiated targets and concrete requirements (Jänicke et al. 1999: 107 et sqq.).

Such a strategic approach can be observed in all segments of German RES policy. Whereas the target for the contribution of RES-E was set to reach 12.5 percent by 2010 and even 20 percent by 2020, biofuels should reach a market share of 5.75 percent by the end of 2010 (both target marks for 2010 date from respective EU-Directives, and were transposed into national law).

For the achievement of the targets, the German RES governance approach is marked by a flexible instrumentation, with a mature support mechanism for the whole range of RES technologies. This comprises classical interventionist measures like the EEG (the supply companies have to purchase the RES electricity and the end customers finally pay it through an apportionment onto their monthly electricity bills), or promotion programmes like the Market Incentive Programme (MAP) with direct investment subsidies and soft loans mainly for RES heat applications – and financed through an earmarked part of the tax earnings of the Environmental Tax Reform, amounting to € 193 million in 2005 (BMU 2005c). Also market-based instruments are applied like the (partial) exemption of biofuels from the mineral oil taxes. With the privilege of wind power, hydro and biomass installations in the German Building Code, the broad RES policy mix is complemented by a planning instrument.

In conclusion, the German RES promotion approach tries to support *all* kind of renewable energies according to their respective needs, and not only the most economic or competitive technologies. The technology-specific remuneration of the EEG or additional measures like the 100,000 roofs PV programme (which expired by the end of June 2003 after successfully supporting the installation of 300 MWp of PV capacity) shall bring a comprehensive development of all RES sectors in the course of an ecological transformation of the whole German energy system (Reiche 2005: 4 et seq.).

3.3 European and international commitments in RES

To fully understand the success of the German RES policy it is also necessary to take a look at the European and international level. At European level, the most influencing driver was the Directive 2001/77/EC which contained ambitious indicative targets for all EU Member States with regard to the increase in RES electricity to total power consumption from 13.9 percent in 1997 to at least 21 percent in 2010 for the EU-25. The individual target for Germany was set by 12.5 percent, starting from 4.5 percent in 1997, representing an ambitious goal as it requires to nearly triple the national RES-E share in a thirteen years period.

Even though, according to a first assessment of the EU Commission, most of the EU countries are likely to miss their RES-E targets, Germany was appraised to be one of the few EU Member States to reach its goal (European Commission 2004: 14). In its 2005 report on achievement of the target for electricity consumption from renewable energy sources by 2010 the Federal Government anticipates that "… the EU´s indicative target for Germany will be met by 2010, whereby the EEG will act as the principal mechanism for this purpose" (BMU 2005b). Several predictions assume that the target will be reached even earlier than 2010 as the RES-E share in gross electricity consumption at the end of 2005 already reached 10.2 percent (see above).

A further important driver for German RES policy at international level is its commitment to the "Kyoto Protocol". As Germany obliged itself to reduce its greenhouse gas (GHG) emissions by 21 percent until 2008-12 as compared to 1990 emissions level, promoting the CO_2-free or neutral renewables (i.e. via investments in RES projects on the basis of the Clean Development Mechanism, CDM) is one way for Germany to fulfil its obligations under the Climate Convention. Although Germany by the end of 2004 already fulfilled more than 90 percent of its total reduction commitment (19.2 percent out of 21 percent) (DIW 2005: 14), the complete goal attainment still needs further action.

3.4 Cognitive success conditions

Even though the national regulative RES approach as well as the European and international commitments concerning RES-E promotion and active climate protection might be seen as main reasons for the success of RES in Germany, it is important to emphasise that the outcome of setting a political framework in the end very much depends from the people who fill them with life. Every law or regulation is only as good as its acceptance and compliance by the public.

Nearly 2,700 biogas and more than 17,500 wind plants at the end of 2005 as well as 175,000 newly connected solar installations in 2005 (100,000 solar thermal and 75,000 PV, amounting to a total of 800,00 solar thermal as well 200,000 PV installations) are a strong evidence that the setting of a favourable political RES framework in Germany corresponds with an interested public (BSW 2006: 1 et sqq.; DEWI 2006; Fachverband Biogas 2006). The success or effectiveness of the main German RES promotion instruments like the EEG and the Market Incentive Programme was therefore also much caused by an adequate demand within society. The 100,000-roofs PV programme proved so successful that the overall budget of 510 million Euro had to be distributed within a shorter period as originally planned to satisfy the strong demand (Reiche 2005a: 64).

The high level of acceptance of RES within the German public can also be demonstrated by surveys on energy policy. A 2005 survey by the *Forsa-Institute* shows that a large majority holds the promotion of RES the best approach to a sustainable energy policy. 62 percent of the German population are in favour of an increased support of RES; only 4 percent plead for reduced or ceased support. With respect to preferred energy sources, the majority opts for solar energy; coal ranks last.

A representative survey of the *Allensbach Institute* in 2005 largely confirmed these results. A 2005 survey on “Wind power plants and tourism” of the *SOKO-Institute* showed that only 24 percent would consider wind power plants in German resort areas a nuisance, but 75 percent would be annoyed by nuclear and coal power plants; 58 percent by high-rising buildings, and 55 percent by motorways.

The favourable cognitive environment with regard to RES in Germany can also be shown by the fact that more and more people participate in cooperative RES projects. Already at the end of 2002, 340,000 Germans had invested about € 12 billion in renewable energy projects (Sawin 2004: 25).

3.5 Technical driving forces

Although the electricity demand in Germany is supposed to decrease during the next years, due to the age structure of the power generation system as well as the decision of the German government to phase out nuclear energy, it will be necessary to replace older power plants with a power capacity of about 40 GW until 2020 (UBA 2005: 107). This might open a new “window of opportunity” if the decision makers instead of replacing the old fossil power plants mainly with new fossil based ones would opt for an alternative energy path, including energy efficiency and RES based energy supply.

The chances for such an ecological transformation of the energy sector in Germany are better than one might think at first glance: a recently published study on the growth of RES in the German electricity sector revealed that the share of RES-E could cover already 25 percent of the gross electricity consumption by 2020 (BMU 2005d: 5); a prerequisite however would be a further decline of RES costs.

A positive example is the cost development of wind power in Germany, where the average investment costs of a wind energy plant was reduced from 2,150 €/kW in 1990 to 865 €/kW in 1999 (Bechberger/Reiche 2006); the “Wind Force 12” study estimated further cost reductions of more than 36 percent between 2003 and 2020 from - 804 €/kW to 512 €/kW (EWEA/Greenpeace 2004: 70). According to the German Wind Energy Association, the prices of wind power in Germany will be cost-competitive in 2015 at the latest, due to economies of scale in the wind sector on the one hand, and growing electricity prices from conventional energy sources due to higher fuel prices and emissions trading, on the other (BWE 2006: 1).

4. Barriers to a further expansion of RES in Germany

Although opinion polls show a very positive attitude (and support) of renewables by the general public, this attitude seems to have a strong NIMBY ("Not-In-My-Back-Yard") component. Especially, there are local resistance movements against wind energy projects. Reasons given are visual intrusion, noise, land devaluation, health problems due to radiation, negative impact on local tourism, etc. (REALISE-Forum 2005: 30). Besides this, the consumers´ willingness to change to a green electricity supplier in the liberalised market is still limited. The main reasons for that are the allegedly higher prices for green power and a certain resistance to change the supplier in general (only 4 percent of all households until the end of 2003) (Reiche 2004).

An obstacle for wind energy – which is the most important renewable energy source in the German electricity market – is the present grid capacity. Grid expansion measures are needed. According to the grid study by the German Energy Agency (*dena*) by the year 2020 various grid sections covering an overall length of approximately 400 km will need to be reinforced and routes spanning around 850 km will need to be completely rebuilt. Furthermore, the grid needs to be extended by about 5 percent (BMU 2005b). This however this seems to be a feasible task, as the costs per year for this amount of grid extension would only be 110 million Euro. By way of comparison: the grid operators invest 2 billion Euro every year in their whole 1.6 million km-long grid. (The grid charges could increase due to the expansion of the network by 2.5 hundredths of a cent per kWh in 2015; that is less than 1 Euro per year per household). Due to the expansion of wind energy, conventional power stations with an output of approximately 2,000 MW could be replaced. That is equivalent to three large coal-fired stations. No additional power stations need to be built for balancing energy generation. (The additional 5.6 TWh minutes and hours reserve required per year can be supplied by the existing normal power stations). The impact on electricity prices will only amount to 6 to 8 hundredths of a cent per kWh in 2015, which is between 2 and 3 Euro per year per household. According to the German Wind Energy Association the costs of the network expansion, balancing and reserve energy amount to about 0.1 cent/kWh in 2015 (BWE 2005).

Another obstacle for the future wind energy development may be a more restrictive policy of some the German States (*Länder*), such as for example North Rhine-Westphalia (NRW). In May 2005, Christian Democrats (CDU) and Liberals (FDP) replaced the red-green government (Social Democrats, SPD, and the Green Party). One of the first measures of the new government was a new provision for distance and height limitations of wind turbines. This has reduced the potential for further onshore expansion. Possibilities to replace old with more powerful new installations ("repowering") are also affected by these provisions of the *Länder* (BMU 2005b).

A general barrier for further development of renewable energies in Germany is the availability of coal and the strong political influence of the coal sector. This resulted, for example, in a virulent campaign against wind power in Germany in connection with the amendment of the EEG of 2003 and the assurance of the then Chancellor Schröder to further subsidise hard coal mining industry between 2006 and 2012 with € 17 billion. Another problem for the future RES development in Germany is the procurement policy in the case of natural gas. The supply contracts with the most important providers will not expire before 2011 and some contracts are even fixed until 2030. Most of these have so called “take or pay” conditions (Reiche 2004). Although there has been a sort of convergence of interests between the gas and RES sectors, especially in the heat market, a too strong volume of gas could somehow create priority conflicts and slow down RES deployment in the electricity market.

5. Driving forces of RES development in other EU countries

As the German RES promotion approach has shown, the effectiveness of a single promotion instrument like the REFIT system depends on the specific construction of the tool. The main explanation for countries that use REFITs successfully is that they offer investors long-term security, like for example Germany with a payment guarantee within the EEG of 20 years, or even 30 years in the case of small hydro power (see above). Other countries followed the successful German approach, like Spain or Portugal, which both in 2004 amended their support systems and even introduced a guarantee of remuneration for the whole lifetime of the RES installations.

So, it is not surprising that Portugal nearly doubled its installed wind capacity within only one year from 522 MW in 2004 to 1,022 MW by the end of 2005. In 2004, Spain was even world leader in newly installed wind capacity (2,065 MW) and reached third place in 2005 (1,764 MW) (EWEA 2005 & 2006; GWEC 2006).

The Spanish success in wind energy development, besides life long remunerations for RES installations, is also based on the choice between two different payment options within the promotion system, where RES producers can choose between a pure fixed feed-in tariff with a high planning security and a market-based option, where they participate in the conventional pool system and gain a mixture of electricity pool price, green bonus and a special market bonus. The latter option is more risky, but also rewards with higher total remunerations (mainly because pool prices increased significantly in 2005), and paves the way for a better integration of wind power into the conventional power system.

Another positive solution with regard to remedy local resistance movements against wind energy projects (the so called “NIMBY” effect, see above) was implemented in Greece (in 2002) and in Portugal (in 2005), where RES plant owners must pay 2 percent (in the case of Greece), respectively 2.5 percent (concerning Portugal) of their RES electricity sales to the municipalities where the particular RES project is located, thereby strengthening the local public acceptance of RES projects.

6. Transferability of the German RES case to China?[2]

As the development of renewable energy sources in Germany is considered a success story, a lot of countries already followed the German RES promotion approach. Neighbouring nations like France or Czech Republic "copied" or oriented their own RES promotion laws at least partly on the German EEG; and even a country like Brazil adopted a RES promotion law which resembles the German one. In this chapter we briefly will analyse which of the German drivers of its successful RES promotion might be transferable to a country like China - with different framework conditions regarding economic development, political system, energy mix or demographic structure.

The first main driver for Germany's success in its RES development was the favourable design of the EEG with regard to an effective RES promotion. These success conditions seem to be achieved - at least to some extent -with the new Chinese RES promotion law, adopted by the National People's Congress on February 28, 2005 that finally entered into force on January 1, 2006.

The major provisions are (1) a clear definition of RES (comprising wind, solar, hydropower, biomass, geothermal energy, oceanic energy, etc.); (2) a breakdown of the responsibilities of the different institutional levels with chief responsibility at central, state level; (3) a purchase obligation by the grid operators for the RES-E produced by the selected projects combined with certain minimum tariffs; and (4) a right to network access for RES-E producers with the possibility for grid operators to pass on the costs for grid connection in the charges for grid use (including a balancing mechanism amongst grid operators to equal possible extra costs of RES in one region).

These outcomes seem to be the result of a close cooperation between Chinese experts consulting the National Peoples' Congress and international experts, including the German Society for Technical Cooperation (GTZ). But as the new Chinese RES law only codified the mentioned basic promotion conditions, the decisive details are to be specified through 12 regulations like the concrete financing mechanism based on feed-in tariffs or the regulation of the national balancing mechanism (GTZ 2005: 5 et seq.). In mid January 2006, the first three regulations were published, including the specific tariff regulations. Therein it was decided not to implement a REFIT system for all RES-E producers with fixed and technology-differentiated tariffs for all kind of RES-E technologies like in the German EEG, but to introduce a tendering scheme and thereby promoting concrete RES-E projects via the awarding of concessions (Neue Energie, 2/2006: 79). Therewith the Chinese government continued its previous RES tariff policy (the tariffs in the hitherto concession projects oscillated between 2.8 and 3.8 € cents/kWh), although the national and international experts as well the Chinese and

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[2] We would like to thank *Matthias Corbach* for his valuable aide with regard to this chapter on China.

foreign wind developers, operators and manufacturers almost unanimously pleaded for the introduction of a REFIT scheme. So, China will follow a RES-E promotion approach which on international level is more a discontinued model due to the negative experiences of the UK, which in 2002 already switched to a promotion system based on RES quotas in combination with tradeable green certificates, or Ireland as the last EU-25 country with a pure RES-E tendering scheme, which in 2005 decided to switch to a REFIT system (Reiche/Bechberger 2006: 203 et seq.).

The main problem with a tendering system is that a high number of bids of potential project developers might be of speculative nature, with project proposals below economic feasibility which can lead to a low level of realised projects. In the UK, after five calls for tender during the 1990s there was 2,236 MW of wind capacity approved, but by the end of 2003, when the awarded wind projects under the British tendering system finally had to be operative, only 649 MW of wind energy capacity was really installed. A further problem of the British tender scheme was that it did not create a significant market for manufacturers and a relatively low competition intensity among turbine producers and constructors. As these are the stages of the value chain that contribute most to the total cost of wind energy, the lower competition at these stages led to a slower decrease in costs as expected (Butler/Neuhoff 2004: 5 et sqq.; Dinica 2003: 544).

Actually, the experience that a number of bids might be of speculative nature, has also been made in China. Some tenders have been awarded to inexperienced developers which have considerable problems in making the wind parks work.

With this experience, it is very hard to believe, that the recently adopted RES-E promotion scheme based on a tendering system will produce the 30,000 MW wind energy capacity which the Chinese Government foresees in 2020.

Apparently, the Chinese Government has foreseen another instrument to take care of that, which is a quota system for the big electricity producers. This has been indicated in some of the regulations. As the type of quota system was not yet made transparent, it is difficult to discuss its implication. If it is true, that the large electricity generators will be obliged to have a certain share (say 5 percent) of (specifically defined) renewable energy technologies in their capacity portfolio, this would force them to participate in the bidding. If this approach becomes reality, the generators would concentrate on capacity instead of energy generation from renewables. This would be an unfortunate feature.

A direct diffusion of Germany's RES promotion experience seems more likely with regard to the very successful German 100,000 roofs PV programme, as the Chinese

Government is discussing a similar programme for the city of Shanghai (WEC 2005: 35).

The second important driving force identified for the German success in RES, a comprehensive RES promotion approach with a lead-market orientation, might also be transferable for the most part to China. Albeit the German policy mix for the promotion of RES is still broader as the Chinese to date, China nevertheless already applies a combination of promotion measures, ranging from the tendering scheme with fixed tariffs for the selected projects as well as fiscal instruments like tax reductions (i.e., 50 percent reduction of value added tax for electricity generation from wind power since 2002), the granting of soft loans for local wind plant production to the raising of foreign funds for RES projects, like the “Renewable Energy Development Programme”, based on donations by the World Bank and the Global Environment Facility (*GEF*), or the German KfW development bank (GTZ 2005: 11 et seq.).

An own RES industry is already well established in the area of solar thermal application, and on a lower scale also regarding PV installations. By the end of 2002, more than 200,000 people worked in the Chinese solar thermal industry with a turnover of $ 1.3 billion. China has also by far the biggest installed solar collector surface, which amounted to some 51.4 million m^2 (38.8 percent of global capacity) by the end of 2003 with an annual production capacity of 12 million m^2 within the same year, and on top of an annual growth rate of 27 percent in installed area between 1998-2002. By the end of 2004, the total installed solar thermal collector surface had even increased to 65 million m^2 (Zhang 2005: 5; Li 2005; IEA 2005: 7).

Regarding the Chinese PV market, in 2004, solar modules with a capacity of about 70 MWp were produced in China, annual production capacity at the end of 2004 amounting to over 100 MW. In the same year, altogether more than 40 enterprises with over 10,000 employees were involved in the production, distribution and installation of PV systems and components (GTZ 2005: 9).

According to the latest market review by *SolarPlaza* the domestic PV market is still in its infancy, but the production and export of solar grade silicon, cells and modules has grown by 50-100 percent in 2005. The total available production capacity for cell and module production (of the current 30 major companies involved) is already above 20 percent of the world’s total, coming from less than 1 percent only 5 years ago. Most of the production is exported.

Currently, China is the world’s third country in terms of solar cell production capacity and is expected to grow to 820 MW per year in 2006, based on the ambitions of the 20 or more cell manufacturers active in this market. The overall goal of the Chinese government is to have 450 MW cumulative PV power installed in China by 2010, compared to the estimated current 75 MW in 2005. In order to achieve this, an average sales growth of 40 percent per year until 2010 is needed. The ambition has even been set to 8,000 MW by 2020 for the next decade, where PV could already be cost competitive. The main market segment apart from exporting its RES technology in China is rural electrification (see below) (*SolarPlaza* 2006).

Similar to the Chinese solar market development, also the domestic wind market has a big growth potential. Whereas the current installed capacity - amounting to 1,260 MW by the end of 2005 (GWEC 2006: 2) - is still relatively small, the overall Chinese wind energy potential is estimated at 1,000 GW (250 GW onshore and 750 GW offshore). According to EWEA/Greenpeace, up to 170 GW of wind power could be installed in China by 2020 to generate 417 TWh a year, needing total cumulative investment of more than 100 billion Euro. The scenario would create 382,000 jobs and reduce annual CO_2 emissions by 325.2 megatons (EWEA/Greenpeace 2004: 64 et sqq.). The Chinese Government plans to have 30,000 MW available by 2020.

The Chinese Government is fostering the localisation of wind industry by different means: Since several years, a high and rising local content quota is asked for in the wind concession tenders. In a growing wind market, this provision gives incentives to the international manufacturers to set up manufacturing in China or conclude licensing agreements with Chinese manufacturers.

Refraining from REFIT reduces the options for foreign developers in China to a minimum. They cannot compete with local developers for low prices, in particular if those developers are agents of the electricity generators which are obliged through silent or open quota to establish RE capacity.

More than half of the world’s small hydropower capacity exists in China, amounting to 34 GW, where an ongoing boom in small hydro construction led to nearly 4 GW of new capacity in 2004 (REN 21 2005: 7 et sqq.). Furthermore, China in 2004 already used 5 million m^3 of pit gas and announced to increase its use to 20 million m^3 by 2020. Finally, in the biofuels market China also set ambitious goals with a planned usage of 60 millions tons by 2020 (50 millions tons biodiesel and 10 million tons bioethanol) (Zhang 2005: 5 et seq.).

On the one side, all these RES targets comprise a big development potential for the Chinese RES industry. On the other side, and strongly related to the ambitious domestic targets, a fast growing Chinese RES industry would also produce huge export opportunities for innovative and cost competitive products, taking into account the global growth perspectives of RES. In an optimistic scenario published by the German Advisory Council on Global Change (WBGU), RES are expected to reach a share in total world energy supply of more than 52 percent by 2050, and even 86 percent by 2100 (WBGU 2003: 129 et seq.).

A further important driver – like in Germany – for a strengthened RES support in China could be an international commitment to active climate change policy.

China's CO_2 emissions nearly doubled from 2.289 billion tons in 1990 to 4.462 billion tons by 2004 (DIW 2005: 565). They are supposed to overtake the USA as the largest producer of CO_2 emissions by the year 2020. In contrast to the USA, in August 2002 China ratified the "Kyoto Protocol" as a Non-Annex I country, which means that it has not agreed to a binding target to reduce its greenhouse gas (GHG) emissions in the first commitment period 2008-2012 but has the possibility to be the host for clean energy projects under the "Clean Development Mechanism – CDM"). China, as the world's second largest energy user, presents a huge potential for CDM projects. Many of such projects could be on the basis of renewable energies.

The future of the growth of China's GHG emissions very much depends on the question whether China will accept binding reduction targets of its CO_2 emissions in a second Kyoto-period after 2012, as well as on its willingness to commit itself to domestic targets with regard to energy efficiency and RES. If so, China could take a leading role as a country with binding GHG reduction targets with an announcement effect for other developing countries. At least concerning the latter, China seems to already have taken a proactive approach.

In November 2004, China announced an energy conservation plan with the goal to conserve about 1.4 billion tons of coal equivalent (tce) and to limit its primary energy consumption by 2020 to about 3 billion tce (WEC 2005: 17). Regarding RES, on occasion of the "International Conference for Renewable Energies 2005" in Beijing in November 2005, a further increase of China's already ambitious RES goals were announced: by 2020 China will have installed 30 GW of wind energy (the previous goal was 20 GW), 20 GW of biomass and 2 GW of solar energy projects. Together with big hydro China thereby wants to reach a contribution of RES to its electricity consumption of more than 30 percent, respectively 15 percent concerning its primary energy consumption. Further development goals announced are to increase the total solar thermal collector space from 65 million m^2 by the end of 2004 to 300 million m^2 by 2020, as well as to raise the use of biofuels up to 50 million tons annually at the same time (Zhang 2005: 5).

Besides all this, a positive cognitive environment towards RES like in Germany would help the Chinese RES development to gain momentum. German campaigns like the "*Solar Campaign 2000*" with its slogan "*Solar - of course*" which between 1999 and 2001 successfully promoted solar thermal energy, or the recently started "*Information Campaign Renewable Energies*" from the German RES industry could also be adopted in China to inform the public about the benefits of RES. As China until 1993 was energy self-sufficient, such campaigns could highlight the contribution of RES to regain China's energy independency as well as to redound to a secure energy supply (Gu 2005: 2). A strong driver with respect to a favourable attitude towards RES is also supposed to come from China's continued efforts in its rural electrification, where PV systems play a major role and directly help to convince the local population from the benefits of RES (see below).

Finally, technical drivers will help China to pave the way for a stronger and sustained use of RES. Similar to the situation in Germany, but on a much larger scale, the Chinese power generation system not only needs to be modernised but also to be increased to satisfy the growing energy needs of the most populous country of the world. As the latest available development figures regarding the planned boost of China's power generation capacity foresee a doubling between 2005 and 2020 from 450 to 900 GW, the strong raise of RES will also be a top priority for the Chinese government. A stronger use of RES in the planned amount (112 GW RES capacity, excluding large hydro until 2020) (Zhang 2005: 5; WEC 2005: 32) will also show positive scale effects and thereby will bring RES costs down.

Another technical success condition for the further diffusion of RES in China is the development of the power grid. In recent years, formerly existing isolated grids have been integrated into regional integrated systems. Massive investments are underway to create a single national integrated grid by 2006. Even though 98 percent of the Chinese population have access to electricity, still some 30 million people are waiting to be supplied with electricity. From the remaining part of the population without power supply, particularly in the Western and Northern provinces, about 23 million are scheduled to receive basic supply through the ambitious "National Brightness Programme" by 2010.

In the peripheral areas, renewable energies are an economical alternative to grid supply and a more appropriate and environmentally cleaner option than conventional diesel stations. The energy needs in the remote areas correlate particularly well with the solar, wind, and micro hydropower potential, so that these alternative energy forms seem predestined for electrifying rural areas in China. The high potential in some regions will even allow renewable energies to be used for on-grid electricity generation, particularly in wind power.

At present, several national development programmes, partly with bilateral and multinational support, are being carried out to improve rural power supply in China. One of the world's most ambitious programmes is the Township Electrification Programme (*Song Dian Dao Xiang*). Financed with about US$ 560 million, almost 20 MW in PV systems or hybrid PV wind systems and 274 MW in small hydropower stations have been installed within only two years by the end of 2004 and connected to mini power grids.

While the first programme phase comprised over 1,000 municipalities with approximately one million inhabitants, a second phase from 2005 to 2010 will include another 10,000 municipalities (Village Electrification Programme - *Song Dian Dao Cun*) and PV village systems as well as solar home systems with a total capacity of 265 MW. Altogether 23 million people will be supplied with power by 2010 (GTZ 2005: 1 et sqq.).

7. Concluding remarks

In the previous chapters we have analysed the main drivers for the success of the German RES promotion approach like the favourable design of the EEG, a lead-market oriented RES promotion policy mix, European and international commitments and active climate change policy, a positive cognitive environment of the German population towards RES, as well as technical drivers supporting the whole process. We than showed that most of these drivers can also be found in the Chinese case, respectively should be transferable to the Chinese energy policy framework.

Nevertheless, albeit China shows a strong willingness to widely increase its renewable energy use, there are still some constraints to be taken into account. One possible obstacle to fully reach the ambitious RES targets set could be a financial conflict of goals with other (alleged) clean energy technologies like nuclear, big hydro or even the so called clean coal technology. As the development goal by 2020 for nuclear is 40 GW (from 8.7 GW in 2004) and 150 GW for big hydro (from around 75 GW in 2004) (GTZ 2005: 1; NDRC 2005; WEC 2005: 29 et sqq.), it remains to be seen if all these growth targets could be reached at the same time. Furthermore, there still seems to be a weak institutional structure. Currently there exists only one RES division within the National Development and Reform Commission (NDRC). The division is also in charge of the large hydro program.

Besides this, the nascent domestic RES industry still lacks the weight as political lobby within the central government, which seems to be more concerned with the large coal and growing oil industry.

The NDRC seems to have as principal goal to build up a Chinese RES industry. The influence of the NPC's Environmental Committee is growing but not strong enough to hold the large energy industry in check. Finally, there seems to be a lack of finance for the realisation of the ambitious RES targets. Although the recently adopted Chinese RES law comprises the constitution of a RES fund, it is still unclear, how its financial strength will look like. Also in the future it may remain necessary to attract foreign capital to help to fulfil China's RES goals. A strong signal could have been clear and ambitious feed-in tariffs within the new Chinese RES law. As now a tendering scheme was preferred, which in other countries like the UK or Ireland haven't shown the wished results, it remains to be seen, whether renewable energies in China will have the same success as in Germany.

References

Anonymous (2006): Keine Einspeisetarife in China, in: Neue Energie 2/2006, p. 79.

Arbeitsgemeinschaft Energiebilanzen (AGEB) (2006): Bruttostromerzeugung in Deutschland von 1990 bis 2005 nach Energieträgern (www.ag-energiebilanzen.de/daten/BRD_Stromerzeugung1990-2005.pdf).

Bechberger, Mischa/Danyel Reiche (2006): Diffusion of renewable feed-in tariffs in the EU-28. An instrumental contribution for the dissemination of renewable energies, in: Mez, Lutz (ed.): Green Power Markets – Development and Perspectives (forthcoming).

Bechberger, Mischa/Danyel Reiche (2004): Renewable energy policy in Germany: pioneering and exemplary regulations, in: Energy for Sustainable Development (ESD), Volume 8, No. 1, 2004, pp. 47-57.

British Petroleum (BP) (2005): BP Statistical Review of World Energy, June 2005.

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) (2006a): Entwicklung der erneuerbaren Energien im Jahr 2005 in Deutschland – Stand: Februar 2006, Berlin.

BMU (2006b): Pressemitteilung Nr. 026/06 – Erneuerbare Energien bleiben auf Wachstumskurs (www.bmu.de/pressemitteilungen/pressemitteilungen_ab_22112005/pm/36645.php).

BMU (2005a): Erneuerbare Energien in Zahlen – nationale und internationale Entwicklung – Stand: Dezember 2005, Berlin.

BMU (2005b): 2005 Report by the Federal Republic of Germany on achievement of the indicative target for electricity consumption from renewable energy sources by 2010, Berlin, October 2005.

BMU (2005c): Pressemitteilung Nr. 155/05 – Heizen mit Sonnenwärme wird attraktiver (www.bmu.de/pressearchiv/15_legislaturperiode/pm/35646.php).

BMU (2005d): Ausbau Erneuerbarer Energien im Stromsektor bis zum Jahr 2020 – Vergütungszahlungen und Differenzkosten durch das Erneuerbare-Energien-Gesetz, Berlin.

BMU (2004a): The main features of the Act on granting priority to renewable energy sources (Renewable Energy Sources Act) of 21 July 2004 (www.erneuerbare-energien.de/files/english/renewable_energy/downloads/application/pdf/eeg_gesetz_merkmale_en.pdf).

BMU (2004b): Mindestvergütungssätze nach dem neuen Erneuerbare-Energien-Gesetz (EEG) vom 21. Juli 2004, Berlin.

Bundesverband Erneuerbare Energien (BEE) (2005): Pressemitteilung vom 11.11.2005 – BEE begrüßt Bekenntnis der designierten Bundesregierung zu Erneuerbaren Energien (www.bee-ev.de/presse.php?pr=782).

Bundesverband Solarwirtschaft (BSW) (2006): Statistische Zahlen der deutschen Solarwirtschaft – Stand: 24. Januar 2006 (www.solarwirtschaft.de/typo3/ fileadmin/ user_upload/Solarwirtschaft-Daten-Jan2006.pdf).

Bundesverband Windenergie (BWE) (2006): Windstrom-Vergütungen und Differenzkosten (www.wind-energie.de/fileadmin/dokumente/Presse_Hintergrund/ HG_Differenzkosten_Windstrom.pdf).

Butler, Lucy/Karsten Neuhoff (2004): Comparison of Feed in Tariff, Quota and Auction Mechanisms to Support Wind Power Development. Cambridge Working Papers in Economics CWPE 0503, Cambridge (www.wind-energie.de/fileadmin/dokumente/ Themen_A-Z/Verguetungsmodelle/studie_comparison_cambridge_2004.pdf).

BWE (2005): Timetable given for expansion of wind energy (www.wind-energie.de/ index. php?id=402&tx_ttnews[tt_news]=85&tx_ttnews[backPid]=166&cHash=9794bb0e0a).

Deutscher Bundestag (2002): Schlussbericht der Enquete-Kommission "Nachhaltige Energieversorgung", Kapitel 4.3.6 Erneuerbare Energieträger im Strom- und Wärmemarkt (www.bundestag.de/gremien/ener/schlussbericht/04_08Kap_436.pdf).

Deutsches Windenergie-Institut (DEWI) (2006): Windenergie in Deutschland Aufstellungszahlen für 2005 (www.dewi.de/dewi_neu/deutsch/themen/ statistic/pdf/ statistik_2005.pdf).

Deutsches Institut für Wirtschaftsforschung (DIW) (2005): Wochenbericht Nr. 39/2005 – Weltweite CO_2-Emissionen auf neuem Höchststand, Berlin.

Dinica, Valentina (2003): Sustained Diffusion of Renewable Energy, Enschede.

EnergieNed (2004): Energy in the Netherlands 2004, Arnheim.

Eurobserv'ER (2006): Wind Energy Barometer (www.energies-renouvelables.org/observ-er/stat_baro/observ/baro171.pdf).

European Association for Coal and Lignite (Euracoal) (2005): Coal industry across Europe 2005, Brussels.

European Commission (2004): Communication from the Commission to the Council and the European Parliament – The Share of renewable energy in the EU, COM(2004) 366 final, 26.5.2004, Brussels.

European Wind Energy Association (EWEA) (2005): News release – Wind power continues to grow in 2004 in the EU, but faces constraints of grid and administrative barriers (www.ewea.org).

EWEA (2006): Wind power installed in Europe by end of 2005 (cumulative) (www.ewea.org).

EWEA/Greenpeace (2004): Wind Force 12 – A Blueprint to Achieve 12 percent of the World's Electricity from Wind Power by 2020, Brussels (www.ewea.org).

Fachverband Biogas (2006): Biogas in Deutschland 2005 (www.biogas.org/datenbank/ file/notmember/presse/Pressegespr_Hintergrunddaten1.pdf).

Gesellschaft für Technische Zusammenarbeit (GTZ) (2005): Energy Policy Framework for Electricity Markets and Renewable Energies in the PR China – Updated version, Eschborn/Beijing, September 2005.

Global Wind Energy Council (GWEC) (2006): Press Release – Record year for wind energy: Global wind power market increased by 43 percent in 2005 (www.gwec.net/uploads/media/Statistics2005_170206.pdf).

Gu, Xuewu (2005): Chance für erneuerbare Energien in China: Eine politische Betrachtung, Berlin.

International Energy Agency (IEA) (2005): Solar Heating Worldwide – Markets and contribution to the energy supply 2003 (www.iea-shc.org).

Jänicke, Martin (2005): Governing Environmental Flows: The Need to Reinvent the Nation State, FFU-Report 03-2005, Berlin (http://web.fu-berlin.de/ffu/download/rep_2005_03.pdf).

International Atomic Energy Agency (IAEA) (2005): Power Reactor Information System (www.iaea.org).

Li, Hua (2005): From quantity to quality: How China's solar thermal industry will need to face up to market challenges, in: Renewable Energy World, January-February 2005 (www.earthscan.co.uk/news/article.asp?UAN=323&SP=3325586987363424503346&v=3).

National Development and Reform Commission (NDRC) (2005): China Renewable Energy Overview (http://www.ndrcredp.com/english/id.asp?id=1107).

Niedersächsisches Landesamt für Bodenforschung (NLfB) (2005): Erdöl- und Erdgasreserven in der Bundesrepublik Deutschland am 1. Januar 2005, Hannover.

Reiche, Danyel (2005a): Wind- und Solarenergie – Deutschlands Pionierrolle, in: Jahrbuch Ökologie 2005, München, pp. 59-68.

Reiche, Danyel (2005b): Netherlands, in: Reiche, Danyel (ed.): Handbook of Renewable Energies in the European Union – Case studies of the EU-15 Member States (second, completely revised and updated edition), Frankfurt/Main, pp. 231-246.

Reiche, Danyel (2004): Rahmenbedingungen für erneuerbare Energien in Deutschland – Möglichkeiten und Grenzen einer Vorreiterpolitik, Frankfurt/Main.

Reiche, Danyel/Mischa Bechberger (2006): Diffusion von Einspeisevergütungsmodellen in der EU-25 als instrumenteller Beitrag zur Verbreitung erneuerbarer Energien, in: Bechberger, Mischa/Danyel Reiche (ed.): Ökologische Transformation der Energiewirtschaft - Erfolgsbedingungen und Restriktionen, Berlin, pp. 199-217.

Reiche, Danyel/Mischa Bechberger (2005): Renewable energies in the EU-15 States in comparison, in: Reiche, Danyel (ed.): Handbook of Renewable Energies in the European Union – Case studies of the EU-15 Member States (second, completely revised and updated edition), Frankfurt/Main, pp. 19-37.

Renewable Energy and Liberalisation in Selected Electricity markets–Forum (REALISE FORUM) (2005): Workpackage 3 – Country report Germany (www.realise-forum.net/pdf_files/060103_German_Report.pdf).

Renewable Energy Policy Network (REN 21) (2005): Renewables 2005 Global Status Report, Washington (www.ren21.net/globalstatusreport/RE2005_Global_Status_Report.pdf).

*Sawin, Janet (*2004): National policy instruments. Policy lessons for the advancement and diffusion of renewable energy technologies around the world, International Conference for Renewable Energies, Bonn (www.renewables2004.de/pdf/tbp/TBP03-policies.pdf).

Scheer, Hermann (2002): Solare Weltwirtschaft, 5th edition, München.

Scheer, Hermann (2005): Energieautonomie. Eine neue Politik für erneuerbare Energien, München.

SolarPlaza (2006): Management Summary The Chinese PV Market and Industry report (www.solarplaza.com/content/pagina/China%20conclusions/43444).

Umweltbundesamt (UBA) (2005): Die Zukunft in unseren Händen – 21 Thesen zur Klimaschutz-politik des 21. Jahrhunderts und ihre Begründungen, Dessau.

Umweltbundesamt (UBA) (2002): Langfristszenarien für eine nachhaltige Energienutzung in Deutschland, Berlin.

Verband der Elektrizitätswirtschaft (VDEW) (2005): VDEW-Jahresbericht 2004 – Energiepolitische Ziele in Einklang bringen, Berlin.

WBGU - German Advisory Council on Global Change (2003): World in Transition. Towards Sustainable Energy Systems, Berlin (www.wbgu.de/wbgu_jg2003_engl.pdf).

Weidner, Helmut/Lutz Mez (2005): Climate Change and Renewable Energy Policy in Germany: The Driving Forces and Conflicts, Paper prepared for the Environmental Politics, Section "The Politics of Renewables", ECPR Conference in Budapest, 8-10 September 2005.

World Energy Council (WEC) (2005a): Energie für Deutschland 2005 – Fakten, Perspektiven und Positionen im globalen Kontext, Berlin.orld Energy Council (WEC) (2005b): English Edition of "Energy for Germany 2005" by WEC's German Member Committee, Berlin.

Zhang, Guobao (2005): Speech at Minister Forum of Beijing Intantional Renewable Energy Conference (www.birec2005.cn/pdf/zhang%20guobao(en).