The IMRE Journal Volume 1 (3) 2007
2007. TU Bergakademie Freiberg
http://www.wiwi.tu-freiberg.de/~urm/imre/journal/index.htm

The Role of the State for the Promotion of the Renewable Energy Sector in Germany and its Implications for Other Countries - A Case Study for State Government Practices in Germany

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Abstract

This paper explores the development of renewable energy in Germany. Recently, Germany has become the leading nation in the field of renewable energy. With its successful development, there have been many attempts to learn from Germany's past experiences. The German federal government has implemented a firm initiative while pursuing distinct objectives in renewable energy policy. They have introduced feasible financial aid schemes and have enhanced favorable general conditions through institutional and technical support instruments.

The research aims to discover the role of the state government as the main administrative body for the implementation of energy policies in its area. Each German state demonstrates various configurations within the matters of renewable energy. The development rate and installed capacity of renewable energy or the numerous goals for the achievement in the total energy mix are broadly different between states. On the one hand, this dissimilar pattern ensures that every state has different perspectives and follows specific goals or political strategies within the renewable energy issue. On the other hand, the role of a state government can be better clarified while discovering reasons that make each state perform so differently.

Keywords: energy policy, renewable energy, electricity market

Introduction

Germany has committed itself to cut its greenhouse gas emissions between 2008 and 2012 by 21 percent with its 1990 levels under the Kyoto Protocol regime. As one of the aggregate counter measures, the government set a goal to double the proportion of renewable energy sources by 2010 compared to 2000. With the national target in mind, the Federal Government has supported market development in renewable energy with several measures. The Federal Environmental Ministry (BMU) evaluated in the publication 'Renewable energy: innovation for the future, 2006 (BMU, 2006a)' that the most important instruments are:

- For the electricity market: the Renewable Energy Sources Act (EEG, 2000)
- For the heat market: the federal market stimulation program
- In the fuel market: reduction of the mineral oil tax for biofuels as a part of the ecological tax reform.

Revised: 05.09.2007
Online Publication Date: 25.10.2007

The main impact on the electricity market has been from the Renewable Energy Sources Act (2000, amended 2004)), which regulates the input and favourable fixed tariffs of electricity from renewable energies from the utilities. The EEG system has proven to be an extremely successful instrument for expanding renewable energy in the German electricity market. The EEG guarantees operators of renewable energy systems priority for feeding their electricity into the grid and this arrangement provides investment security. Some renewable energy sources are supported by individual promotion regulations, for example, the Biomass Ordinance (Ordinance on generation of electricity from biomass, 2001) and the Combined Heat and Power Act (KWKG, amended in 2002), and the eco-tax reform introduced in 1999 and the measures contained in the climate protection program of October 2000 have been pivotal methods of the government.

The German supporting instrument for renewable energy is identified as market development tools in the early stage. As one of the market development tools, the market incentive program has supported the construction of plants for generating heat and/or electricity from renewable energy sources. The program is particularly important when inaugurating into the heat generating technologies market. The program serves primarily for the expansion of heat generation from biomass, solar power and geothermal energy. In 2005, around 193 million Euros were allocated to this heat generation sector (BMU, 2006b). Smaller installations of private investors are supported with grants, larger installations with loans at a reduced rate of interest and partial debt discharge. In the residential sector the practice mainly focuses on the promotion of solar thermal collector systems and biomass heaters, pellet systems and wood gasification boilers. Besides, people who use a detailed energy advisory service for older residential building are eligible to obtain reimbursement of their portion of the consulting costs (BMU, 2006a).

Along with political instruments, research and development providing the basis for a further expansion of the use of renewable energies, have been key elements for the further expansion of renewable energy. It turned out that technical and political innovations can mutually promote each other (BMU, 2006a). The technological potential and future competitiveness in the renewable energy sector has been carried out by scientific improvement. Consequently, an investment in research and development and thus technological improvements could derive the political basis for public support in Germany.

A lot of economic and technical challenges in the market establishment of renewable energy sources have been resolved by research and development. Technology demonstration and commercialization efforts should be supported by energy R&D investment, and feasibility study, which examines an objective validity of specific projects before proposing an initiative, reasonable technologies are necessarily needed.

When reflecting deep involvement of law implementation and other administrative perspectives, the German state governments must be influential in the development of renewable energy. In Germany, law-making is the predominant job of the central state, the Federation, whereas the states are primarily responsible for administration while implementing the laws. State governments can indirectly control the use of renewable energy sources by using their administrative power without conflict against federal regulations. For example, the Renewable energy Source Act (EEG, 2000) as the main driving force, are to be implemented by the state's governments. For investors, they could obtain reimbursement under the EEG through states government's authorization. Thus, it is significant for investors that procedures are maintained as simply as possible and not many barriers.

Poor performance incurred by the complex administrative approvals is viewed in the French case. Although France set the ambitious target of boosting wind power installation through the EOLE-2005 programs, the target turned out to be an overestimation due to long "lead time"[1] and administrative burdens.

State experiences with renewable energy development: case studies

In Germany, although the federal legal act to promote the use of renewable energy concurrently applies across states, the capacity of implemented renewable energies varies. Installed wind capacity in the German states, for example, shows that each state has very different installation capacities (Table 1). Indeed, installed capacity of each renewable energy source is remarkably different between the highest and lowest states.

Federal State	Capacity installed total in MW	Potential annual energy yield (1) GWh	Energy consump-tion 2005 (2) GWh	Share of energy consumption %
Saxony-Anhalt	2,282	4,754	13,078	34.98
Schleswig-Holstein	2,289	4,733	13,636	34.71
Mecklenburg-Western Pomerania	1,119	2,049	6,509	31.48
Brandenburg	2,863	4,913	18,426	26.66
Lower Saxony	5,089	9,612	50,679	18.97
Thuringia	565	1,033	10,983	9.41
Saxony	724	1,258	18,788	6.70
Rhineland-Palatinate	882	1,453	26,714	5.44
North Rhine-Westphalia	2,317	4,079	130,455	3.13
Hesse	440	694	37,314	1.86
Bremen	52	93	5,542	1.68
Saarland	57	100	7,729	1.29
Bavaria	308	431	74,727	0.58
Hamburg	33	59	14,488	0.40
Baden-Württemberg	272	312	77,351	0.40
Berlin	0.00	0	13,381	0.00
Total Germany	19,229	35,393	519,800	6.81

Table 1: Wind energy distribution of capacity installed in the German states. Source: Windenergienutzung in Deutschland-Stand 30.06.2006, DEWI Magazin Aug.2006
1) The potential annual energy yield is calculated on the basis of the rated power installed as per 30.06.2006 assuming a 100 % wind year
2) Net electricity consumption: Nettostromverbrauch 2005 ltd. VDEW Pressemeldung vom 28.02.2006
(Bundesländer hochgerechnet)

Taking into account the fact that each state belongs to the same federal entity and therefore individuals and regional communities therein are also subject to the same federal energy regulations or support schemes, significantly different distribution of energy capacity between federal states should be unusual. Certainly, there must be reasons for such vast differences between German states. While each state-possessing different resources is pursuing individual goals or political strategies in the energy sector, the reason for such dissimilarity could be as varied as the differences themselves. At this point, the fundamental questions for this analysis can be posed:

1. Why does each state perform differently?
2. Which criteria determine dissimilar patterns of renewable energy development?

The process of answering or explaining these questions will be described in the following pages

Driving political forces

Identifying the motives behind state governments engaging in renewable energy development is critical to understanding the varied performances of each state. In general, two factors are broadly known to stimulate actions: adhering to a mandatory regulation and generating benefits. The EU renewable energy directive (Directive 2001/77/EC of the European Parliament and of the Council) mandates each member state to achieve a national target, which specifies a proportional amount of renewable energy sources.
The national indicative target should be accomplished by 2010 with a specified amount of electricity produced from renewable energy sources contributed to gross electricity consumption. In this context, Germany set the target to supply at least 12.5% of its electricity from renewable energy sources by 2010. This obligation should lead state governments to increase their proportions of energy from renewable sources as one factor. Given that renewable energy policy is recognized as a priority measure by the federal government, state authorities are not exempt from the burden of promoting the use of renewable energies.
Public acceptance of renewable energies is a fundamental component in order to increase the number of renewable energy installations. Perhaps one of the largest factors in facilitating full support for renewable energy is the attitude of German citizens. The leading body to enact the Renewable Energy Source Act (EEG) in 2000, as well as other promotional measures to support renewable energy since then has been the German red-green party coalition (ruling from 1998 to 2005). Growing concern over greenhouse gas emissions has encouraged people to support more environmental-friendly parties and politicians, and participation in installing renewable energy systems at the individual and small community levels has been enthusiastic.
As citizens noticed a need to reduce carbon dioxide and other pollutants from the energy sector, public

acceptance of renewable energy has increased.

While the level of public awareness and participation in the environment and renewable energy issues constitute a fundamental basis for drawing the attentions of both the federal and state governments, promoting economic development may already be directly compatible with established state goals. The Federal Environment Ministry of Germany (BMU) announced that the renewable energy industry experienced a turnover of approximately €16.4 billion and provided approximately 170,000 jobs in 2005 (BMU, 2006b). Since states naturally focus on industries which produce capital and increase employment, the renewable energy sector could receive increased priority from state governments in the near future. As the renewable energy industry generates benefits to a region, prospective economic development is another factor which stimulates the state government's attempts to increase the use of renewable energy sources.

For states concerned about energy security, the diversification of energy supply sources through the implementation of renewable energies may be of value. To decrease the dependence on energy imports would be another desirable factor to consider in regards to renewable energy sources. Predictable, domestic energy sources in the future are becoming increasingly attractive as global fuel prices fluctuate, and renewable energy sources could be the solution, since a wide variety of domestic energy sources can help to stabilize a region's energy security. Moreover, for states struggling with public opposition against conventional air emissions from fossil fuels and safety concerns about nuclear energy, renewable energies offer the promise of energy with far fewer undesirable side effects.

Principal criteria

As seen in the dissimilar patterns of the installation capacities in the wind power sector (Table 1), each single state has different perspectives on renewable energy development. In order to determine the factors that cause such differences in the development of the renewable energy sector, four German states were selected for intensive analysis as case studies. The four states—Schleswig-Holstein, Baden-Württemberg, Saxony, and North-Rhine Westphalia—were chosen to maximize the diversity of key criteria. The four case studies are intended to be representative of current states' experiences with the use of renewable energy sources, but they are *not* to represent the best performances of currently demonstrated renewable energy usage.

These cases studies are drawn from diverse geographical regions, from north to south and from east to west, in Germany and represent different patterns of renewable energy growth rates and gross economic and political practice. In this regard, they are meant to provide a general picture of common patterns and divergences in current practice. Furthermore, in order to review each case study and compare it with certain other points of view, principal criteria are required. Each criterion will be used in the evaluation of each individual case study and, more fundamentally, to find out which elements are responsible for the dissimilar energy patterns. These criteria will be mentioned throughout the review of the case studies.

First, the installed capacity of renewable energy sources has been highly affected by geographical and comprehensive natural climate conditions. While the majority of wind turbines were installed in and around the coastal area at the beginning, the southern part of Germany facilitated solar systems such as photovoltaic and solar thermal collectors. The high potential of natural resources such as wind speed and annual irradiation levels have been one of the most decisive factors in the development of renewable energy. However, this tendency has been diminished in many respects to date. Many wind power systems have been set up along on land, and so most wind turbines in Germany were installed in Brandenburg, Saxony, and North-Rhine Westphalia as well as Lower-Saxony in recent years. Berlin showed a dramatic increase of solar energy utilization, becoming the solar city for years despite its limited average irradiation intensity.

Second, over time, states have tended to depend on their own natural and general resources such as fuel, human resources, specific technologies, or infrastructures to meet energy requirements. In turn, the conventional energy supply structure is likely to impact the movement to foster renewable energies. For states possessing fossil energy reserves in particular, they tend to be less passionate about developing a new energy system than those with no reserves or are at least slower in the matter of converting to an inexhaustible energy technology. For example, a state with abundant coal reserves may cling to its own natural resource to maintain its established, conventional industry and to minimize the impact on employ-

ment. They may try to invent zero-emission plant technology to convert existing plants and essentially keep the current systems in place, rather than support the establishment of renewable energy installations at the expense of closing down non-renewable ones. Virtually every state has kept an energy supply portfolio in accordance with own resources, and thus their compositions are variegated.

Third, states might be in different economic, social, and environmental situations. In some cases, a state which suffers contamination as a result of exploiting heavily pollutant industries tends to have more environmental concerns, and for a state experiencing an economic slump or underdevelopment, even a dirty and heavy energy industry would be welcome. In fact, these factors—economic, social, and environmental issues—might be considered by average citizens as more important than any other factors because theses three factors could directly affect standards of living.

Although three separate criteria were identified to determine an explanation for the indicated fundamental questions given, in many cases these criteria are interdependent; factors integrate into one another and closely interact. When the main energy industries compete with renewable energy—for instance, in North Rhine-Westphalia, Saarland and Brandenburg, which have coal industries in their own areas—state governments exert strong pressure on the federal government to defend established coal interests and oppose sustainable renewable energy programs (Volkmar and Lutz, 2004). When national elections approach, coal stakeholders push to have banned programs running counter to coal from the agenda altogether. This stems from a pure interest in self-preservation; the establishment of renewable energy infrastructures would inevitably lead to competition with existing structures, and coal would begin to lose its grip on the energy sector. The case of coal shows that conflicts between natural resources, economic and political factors exist. This is why each criterion must be evaluated as part of one whole, and not individually

Case Studies

Schleswig-Holstein

A. Energy consumption and production structure

Schleswig-Holstein is the northernmost federal state (Bundesland) in Germany, with coastlines on both the North and Baltic Seas. It is a comparatively small state in the matter of average population (2.8 million residents) and total area (15,763km^2). However, the percentage of total electricity output that is generated by renewable energy is higher than in any other state. Currently, taking into account electricity exports to neighboring states, wind power in Schleswig-Holstein generates over 30 % of total electricity produced locally (Government of Land Schleswig-Holstein, 2006). Given its current position in renewable energy development and use, Schleswig-Holstein is a leading state.

Despite its high domestic wind energy exploitation, fossil fuels and nuclear energy have played a major role in the state's primary energy balance. While nuclear energy's proportion of primary energy output is surely decreasing, it still accounted for 43 % of total energy provision in 2002. The proportion of oil and natural gas were 37 % and 16 % respectively. Together (96 %), the primary energy production of Schleswig-Holstein still relied almost entirely on fossil fuel and nuclear power in 2002.

	Schleswig-Holstein		Germany	
	1000t SKE[4]	%	1000t SKE	%
Hard Coal	1,807	9.7	64,300	13.1
Lignite[1]	267	1.4	56,600	11.6
Oil[2]	6,968	37.3	184,200	37.4
Natural gas[3]	2,966	15.9	107,300	21.9
Nuclear power	8,067	43.2	61,400	12.5
Wind & Hydro	375	2.0	4,900	1.0
Exchange(Export)	-1,878	-10.1	100	0.0
Others	104	0.6	11,600	2.4
Total	18,676	100	489,400	100

Table 2: Primary energy output in Schleswig-Holstein and Germany in 2002 . Source: Energiebilanz Schleswig-Holstein 2002, Ministry of Economy Schleswig-Holstein, 2003

1) Including waste, peat and other solid fuel

2) Other liquid and refinery gas are inclusive

3) Gas from landfill and sewage are inclusive

4) A SKE (Steinkohleeinheit) is hard coal unit, 1 ton SKE =8140 kWh

The energy supply structure in Schleswig-Holstein is exceptional in comparison with the German total for nuclear power (12.5 %). At present, three nuclear power plants with a total capacity of around 3,500 MW are situated on the river Elbe; however, since nuclear energy capacity rather exceeds the requirements of the state, much of the electricity output is exported to Hamburg (Eurostat- Schleswig-Holstein, 2004).

While hard coal and lignite together are the second most predominant energy sources (24.7 %) and the most important domestic fossil fuels in Germany, the shares in Schleswig-Holstein in 2002 were only 11 %. There exist only three small-scale coal power plants in the state.

The most important renewable energy source in Schleswig-Holstein is wind power. While only 35 MW had been installed in 1990, the total installed capacity in 2002 was 1,749 MW; wind power took over 24.4% of domestic electricity consumption while producing 3,038 GWh of electricity in the state. The total amount of primary energy output in Schleswig-Holstein was less than 4% of Germany's gross output, but wind power in the region covered more than 14% of Germany's wind power production alone. The number of wind farms in Schleswig-Holstein is still increasing.

Regarding the fact that numerous offshore wind parks are currently in the planning process or already under construction, and a large portion of the potential area for more wind parks belongs to the state, the development rate of the wind power sector in Schleswig-Holstein is expected increase remarkably. By 2010, it is expected that approximately 2,200MW of electrical capacity will be achieved on just the Schleswig-Holstein coast (Klaus Müller, 2006). Moreover, thanks to technical innovation in recent years, the re-powering of small wind turbines is anticipated to boost the wind energy sector significantly.

Aside from wind power, Schleswig-Holstein does not have many installations from other renewable energy sources. In 2002, 91.7 % of electricity from renewable energy sources was supplied by wind power, followed by energy from waste (6.3 %). Together, solar, photovoltaic, and biomass only contributed 1% to electricity output in the area (Ministry of Economy Schleswig-Holstein, 2003).

B. Process and experience

The former red-green coalition government of Schleswig-Holstein adopted a climate protection program in 1996 that supported framework regulations and approaches at the federal level. Reducing CO_2 emissions by 2010 by half the level present in 1987 was one of the important targets in mitigating climate change by the coalition government. Among various measures, the state's priority focus was the development of renewable energy sources: supporting wind, biomass and solar energy. Most of all, it emphasized the use of wind power and biomass—measures that have proven today to be very successful.

Implementing a climate change program, several factors encouraged Schleswig-Holstein to consider renewable energy development and to push for renewable energy use on the state's political agenda. First, its coastal location increased concern about the direct threat of climate change in the form of rising sea levels (the Climate Group, 2005). The costs associated with coastal protection are high; from 1996 to 2005 around €50 million was spent (the Climate Group, 2005). The risks to their daily lives by global warming led local citizens to be more open-minded and aware about renewable energy, and their motivation encouraged the State to reduce its greenhouse gas emissions. Second, the state has a vast array of renewable resources, especially for wind energy, as it is located between the North Sea and the Baltic Sea, where wind is abundant and its speed generally high. Third, the state government was actively supporting citizens' participation with various promotional instruments such as financial incentives, political legislation, and technology development encouragement.

In 2005 *the Climate Group* described how the state government played a role of supporting renewable energy development:

"Whilst some initial plans in wind energy development were confronted by opposition, the Landesplanung (the department responsible for land planning) has ensured that only 1% of the State will be covered by wind energy parks, leaving 99% of the area turbine-free. Furthermore, in the area where the wind parks are built, a system has been initiated, which ensures that local citizens are able to invest in their operation, and can benefit from wind farm profits. One of the main successes achieved in the early 1990s was a high level local acceptance of wind energy use. Owners of the parks were not anonymous large firms, but the local people of the West coast, an area which had a weak infrastructure and poor economy."

In 2002, some 24% of the active workforce was employed in industry and 73% was in the services sector in Schleswig-Holstein (Eurostat-- Schleswig-Holstein, 2004), which meant that the industry sector accounted for a considerably lower proportion of total employment than in any other state.

Given this, the services sector—such as tourism and public service—became a predominant source of value creation in the field of renewable energy. Since the renewable energy industry is recognized as a new business field, the desire among local people to establish and provide an innovative energy industry service would be higher than in other German states. The Green party in Schleswig-Holstein reported in 2004 that the wind energy industry employed approximately 5,000 people in 100 businesses, which claimed 10% of all employees in the German wind energy industry, and electricity from wind power generators is increasingly one of the region's most important exports. Additionally, in 2004, the wind energy sector in Schleswig-Holstein earned around €350 million in income from the Renewable Energy Source Act (EEG, 2000).

Along with wind power, the second emphasis in the field of renewable energies which the Schleswig-Holstein government set in their climate change program was on biomass energy. In 1996, the biomass initiative was started in cooperation with the ministries and the energy foundation of Schleswig-Holstein. The use of biomass has some additional advantages in a society, such as the creation of jobs and income perspectives for agricultural and rural regions. The state government started to support the use of agriculture and forestry residuals, and other by-products from biomass through investment subsidies, proceeding on technical and institutional advice and a strategy of sustainability in the state

This strategy was developed in a three-stage process (Kraus Müller, 2006):

The first stage (2001) was to develop a mission plan under the title, "Sustainable Schleswig-Holstein", while a work group involving all government departments tried to identify priorities and possible instruments for implementation. The main focus in the second stage (2002) was starting a dialogue with all stakeholders, and they worked together to develop prospects and measures to achieve sustainability in the state. Identifying concrete measures, quality objectives, and tangible indicators of "Sustainability in Schleswig-Holstein" were the main objectives in the third stage (2003). While initiating a strategy for the use of biomass, the general conditions to extract energy from biomass have improved in the past few years with a market incentive program and a state funding program for the period of 2001 to 2006.

From 1995 to 2003, more than 53 plants for wood and straw heat, biogas installation, and rape oil combined heat and power units were installed or were in the planning phase state-wide (Klaus Müller, 2006). In 2001, Schleswig-Holstein was the first state in Germany to have its biomass program co-financed by the European Union as part of its agricultural subsidies. In order to promote the use of biomass energy within the overall framework of the strategy for sustainability, the state's "potentials of multifunctional agriculture" was designated a future priority. Ahead of general support programs and structural policy, the Environment Ministry in Schleswig-Holstein commissioned technological research—namely, "bio-refinery"—so as to fully exploit the great potential associated with biomass refining.

In February 2005, the newly-elected state government announced plans to continue the expansion of renewable energies. The target of the former government remains to source 50% of its power from wind by 2010. Given that the state government has gathered together all important local stakeholders, granted funding for research and development and incentives to promote the use of renewable energy sources, and drafted ambitious goals, a small state like Schleswig-Holstein has attained a significant role in the renewable energy sector. From direct involvement to harmonization with local players in Schleswig-Holstein, the appropriate role of state government may be one of the most important factors in the implementation of renewable energy.

Baden-Württemberg

A. Energy consumption and production structure

Baden-Württemberg is in the southwestern part of the country to the east of the Upper Rhine. It is the third largest state in both area and population, with a total land area of 35,742 km² and 10.7 million inhabitants[2]. Although it is well known as a high-tech hub of Germany, scientific innovation toward clean renewable energy is not likely to take place in Baden-Württemberg, as it has shown only modest development in the renewable energy market.

Baden-Württemberg has a comparatively large energy market with highly industrialized manufacturing facilities. The primary energy output was about 55.27 Million ton SKE in 2002, which accounted for 11.3% of the entire primary energy output in Germany.

The energy output levels regarding the share of the population locally (13 %) and the Gross Domestic Product nationally (14,7 %) is not high. In 2004, the energy from renewable energy sources supplied approximately 3.2% of the state's primary energy consumption. This percentage was higher than the German total (3.0 %), but Baden-Württemberg's energy portfolio is not necessarily recommendable due to a high proportion of energy from wastes (Ministry of Economy Baden-Württemberg, 2004[3]).

The dominant energy sources in the state are, like Schleswig-Holstein, fossil fuels and nuclear energy. In 2002 mineral oil, natural gas, hard coal and nuclear power supplied 95.3 % of the primary energy need. While the use of lignite took a very small role in the energy supply, the share of nuclear power (26.1 %) was far larger than the German average (12.6 %). In 2002, 55.4% of electricity output was generated from the five nuclear power plants in Baden-Württemberg, and that percentage increased up to 57.6% in 2004.

Primary energy sources	Million t SKE	%
Mineral oil	21.54	39.0
Nuclear energy	14.42	26.1
Natural gas	9.55	17.3
Hard coal	7.05	12.9
Hydro and Wind energy	0.66	1.1
Import	0.88	1.6
Lignite	0.07	0.1
Other energy sources*	1.10	2.0
Total	55.27	100
*Wood, Waste, Gas from purification plants, Firedamp		

Table 3. Primary energy output in Baden-Württemberg in 2002 Source: Energiebericht 2004, Ministry of Economy Baden-Württemberg, 2004

According to figures in *Erneuerbare Energie in Baden-Württemberg 2005* (Ministry of Environment Baden-Württemberg, 2006), one of the most important renewable energy sources in the state has been hydropower. While accounting for around one quarter of all German output, hydropower met 6.2 % and 5.4 % of Baden-Württemberg's gross electricity output in 2002 and 2004 respectively. The share of electricity from renewable energies fluctuated because hydropower claims a large proportion in the state's renewable energy portfolio. Since hydropower operation is dependent on the amount of water, therefore, unpredictable general climate conditions impact energy production from hydropower plants. In 2003, when a very dry weather hit the state, the contribution of electricity from renewable energy sources dropped to 7.0 % of gross electricity consumption in 2003 from 9.1 % in 2002.

Biomass has experienced the most dynamic growth in the renewable energy sector in recent years. Between 2000 and 2005, the total plant capacity for generating electricity using biogenic resources (biomass and biogas) increased from 25 MW to 158 MW, and consequently, biomass contributed more than 16% of gross electricity from renewable energy sources, up from 0.2 % in 2000. In the same period, total heat generation from biomass reached 2,282 GWh from 566 GWh. Biofuels, such as biodiesel, bioethanol, and rape oil began to be produced in 2000, and the total production of biofuels reached 2,856 GWh in 2005.

B. Process and experience

The new climate protection program of Baden-Württemberg was released on 26 July 2005. The program, dubbed "Climate Protection 2010", defined new specific targets for reducing global warming and for primary political sectors of state interest so as to integrate several climate change measures (Ministry of Environment Baden-Württemberg, 2006). The state government set doubling the percentage share of renewable energy by 2010 as its new goal, more specifically raising it to 4.8% of primary energy production and to 11.5% of total electricity generation. The government also drafted strategies to ensure that this goal would be achieved. They included increasing energy efficiency, continuing nuclear power plant operations, and supporting research and development of fuel cell and hydrogen technology. The development of renewable energy sources was emphasized, such as hydroelectric power, biomass, geothermal power, and solar heating.

Baden-Württemberg is an important innovation research region in Europe. 18% of employees are working in high-tech sectors (Eurostat-- Baden-Württemberg, 2004), and considerable resources are devoted to the research and development of state-of-art technologies such as fuel and solar cells. Nevertheless, geographical conditions for generating energy from renewable energy sources are not favorable and natural

resources are scarce in the state. Due to this, the state decided that saving energy and increasing energy efficiency rather than developing renewable energy sources would be the main climate protection strategy (Ministry of Environment Baden-Württemberg, 2006).

The payment under the Renewable Energy Source Act (EEG, 2000) shows functioning renewable energy sources while comparing the amount of money distributed to each area (see Table 4). Money paid to the hydropower, biomass and photovoltaic sectors amounted to approximately 20% of the federal average. This means that the amount of electricity from abundant renewable resources (water, biomass) or technology (solar energy) in Baden-Württemberg is higher than most of the 15 other states. The amount paid to wind energy, the biggest renewable energy source in Germany, only accounted for about 1% of the German total. This is because the geographical and climate conditions necessary for wind farms are scant in Baden-Württemberg.

	Baden-Württemberg		German Federation	
	EEG-feed [GWh]	EEG - payment [1,000 Euro]	EEG-feed [GWh]	EEG - payment [1,000 Euro]
Hydropower	868	64,639	4,616	337,670
Landfill, pits, sewage gas	123	9,136	2,589	182,170
Biomass	856	82,151	5,241	508.458
Geothermal energy	0	0	0	30
Wind energy	305	27,468	25,509	2,300,484
Photovoltaic	141	71,081	556	282,648
Total	2,293	254,475	38,511	3,611,460

Table 4. Electricity feed and remuneration under the Renewable Energy Source Act (EEG) in Baden-Württemberg and Germany, 2004. Source: Erneuerbare Energien 2005, Ministry of Environment Baden-Württemberg 2006

Over all, geographical and climate conditions tend to determine the main interests of climate protection and energy policies. In other words, the viability of renewable energy support programs directly corresponds to potential renewable energy resources in the area. For example, Baden-Württemberg intended to increase its energy efficiency to reduce its dependence on fossil fuels and make a positive contribution to climate protection. Supporting efforts to increase energy efficiency in the state are far more stressed than efforts to increase renewable energy use. While highly efficient at saving energy, the state tried to offset its lack of resources, wind power in particular, which is the predominant sustainable energy source in Germany. As a example of saving building energy, the 2002 initiative "Klimaschutz Plus (Climate Protection Plus)" provided support for the refurbishment of small- and medium-sized buildings, such as schools, in order to improve energy conservation.

While poor in natural resources such as fossil fuels and having a bad geographical location to import other energy sources, the state has focused on nuclear power plants as the most important energy supply source. According to a publication dealing with future climate protection concepts by the state government (*Klimaschutz 2010 Konzept für Baden-Württemberg*, Ministry of Environment Baden-Württemberg, 2005b), establishing new nuclear power plants might be a principal option because electricity from nuclear energy helps to secure energy supply. This plan by the state government was announced after the federal government reached an agreement to phase out nuclear power. So far, there has been no major outcry among the state's public against the state government's opinion that nuclear energy is climate neutral and should be continued in Baden-Württemberg. Subsequently, the high performance of nuclear power plants while producing no serious carbon emissions has contributed to the state being less enthusiastic about safer and regenerative energy technology.

Baden-Württemberg has paid much attention to high-end energy technologies. Every year the state has spent approximately 4% of its GDP on research and development (Ministry of Environment Baden-Württemberg, 2005a). To improve fuel cell and solar energy efficiency and research state of art energy-saving technologies were its main targets of funding. The state has continuously increased funding for the research and development (R&D) of energy technologies and has widely supported demonstration projects (Ministry of Environment Baden-Württemberg, 2005a). For instance, *Home Energy Supply Demonstration Projects*, in conjunction with the EU commission, implemented three fuel-cell buses to operate in Stuttgart. Baden-Württemberg also has an encouraging research infrastructure; outstanding science and technology facilities are located in this area, such as the Fuel Cell Research Alliance (universities, Fraunhofer and Max Planck Institutes), ZSW (Center for Solar Energy and Hydrogen Research Baden-Württemberg) in Stuttgart, Fraunhofer Institute for Solar Energy Systems (ISE) in Freiburg, as well as

the universities in Ulm and Stuttgart.
To summarize, there seems to be no rapid development in the renewable energy sector in Baden-Württemberg. The state is already faced with the demands of climate protection and energy security with limited natural resources. With a wide variety of factors to consider, sudden growth in the renewable energy sector is not feasible in Baden-Württemberg, while pioneering new alternative energy sources might not be best option at this moment

Saxony

A. Energy consumption and production structure

Saxony is the easternmost state of the Federal Republic of Germany and it shares its borders with Poland and the Czech Republic. Its surface area totals 18,407 km² with a population of 4.3 million. As Saxony was located in the former German Democratic Republic (GDR), it has enjoyed substantial restructuring and reconstruction since the reunification. For the energy sector as one of the industries and important social infrastructures, renovation towards high efficiency, less pollution, and modernization had been overwhelmingly achieved throughout the state over the 10 plus years since 1990. Although the most conventional infrastructures have been refurbished with recent technology, the heavy use of lignite has remained as a main energy resource in spite of criticism and heavy emission discharge
Saxony has a very unique energy structure compared to the other states in Germany. Most of all, it has been an electricity exporter to neighbouring states except for a couple of years while renovating existing power plants after reunification. An unusually high share of lignite and not a single nuclear power plant also make the state outstanding, lignite being the most important fuel and accounts for most of the state's electricity generation. Saxony is such a heavy exporter of energy that a report issued by the state government *Klimaschutzbericht 2005* (*Climate protection report 2005*, Ministry of Environment Saxony, 2005) explained that one third of CO_2 gas emissions came solely from exporting energy to neighbours.
While coal is the most important domestic fossil fuel in Germany, lignite (brown coal) is the most important domestic energy resource extracted from the two open-pit mines in Saxony (See Table 5).

Since lignite has been blamed for most of Germany's pollution, its direct use was greatly reduced, such as using it in domestic coal-fired stoves and in the chemical industry after 1990, and the indirect use as fuel in plants was also reduced. However, it continues to be utilized as fuel in power plants with high efficiency equipment and modern pollutant treatment facilities.

	2003	
	Germany %	Saxony[1] %
Lignite	11.3	44.1
Hard coal	13.9	0.7
Mineral oil	36.5	37.7
Gases[2]	22.6	22.9
Nuclear power	12.5	-
Electricity exchange	-0.2	-7.8
Others[3]	3.4	2.4

Table 5: Primary energy consumption by source in Germany and Saxony 2003. Source: Energiebericht Sachsen 2003, Ministry of Economy and Labour Saxony, 2004
1) Preliminary value
2) Imported natural gas, sewage gas, landfill gas
3) Renewable energy sources, energy from waste, heat from district heating network

In 2003, the share of renewable energy sources accounted for 1.4 % of primary energy output in Saxony (Ministry of Economy and Labour Saxony, 2004). Though the figure was still low, it has seen significant growth in recent years. Between 2001 and 2003, output from renewable energy sources increased from 4,651 Terajoule (TJ) to 8,572 TJ (See Table 6).
The role of biomass greatly increased, and biomass accounted for 46.9% of total energy from renewable energy sources in 2003. In 2004, 9.2% of gross electricity output was supplied by renewable energy sources with a total amount of 19,500 GWh, while the amount of energy from renewable energy sources increased to 48% between 2003 and 2004 (Ministry of Economy and Labour Saxony, 2004). The remaining 9.2% share of power supply by source was: wind energy - 5.8%, Hydropower - 1.4%, Biomass (biogas) - 2.0%, and photovoltaic - 0.034%.

B. Process and experience

Saxony's first climate protection program was adopted

in 2001, declaring two substantial goals to lower global warming gas emissions by 2010: reducing 2.5 million tons of CO_2 emissions from four main sources - transportation, private households, smaller users (Kleinverbraucher) and industry, and increasing the share of renewable energies to 5% of total energy output or 4.6 GWh of production capacity (Ministry of Environment Saxony, 2001).
Taking the statistics above into account, pursuing these goals could sufficiently be achieved in the coming years. The installation capacity of renewable energy has been rapidly increasing in Saxony and this growing trend will remain persistent at the present state of development. Between 2000 and 2004, total energy from renewable energy sources has increased from 1,042 GWh to 3,046 GWh, while the share of renewable energies increased from 1.1% to 3.3% of total energy output (Ministry of Environment Saxony, 2005).

	2001		2002		2003[1]	
	TJ	Share %	TJ	Share %	TJ	Share %
Hydropower	865	18.6	998	15.6	616	7.2
Wind power	1,908	41.0	2,665	41.6	2,937	34.3
Solar energy	2	0.0	6	0.1	9	0.1
Gases	424	9.1	565	8.8	894	10.4
Biomass/biogas	1,396	30.0	2,080	32.5	4,019	46.9
Others[2]	56	1.2	95	1.5	97	1.1
Total	4,651	100.0	6,409	100.0	8,572	100.0

Table 6. The renewable energy source structure in primary energy consumption in Saxony. Source: Energiebericht Sachsen 2003, Ministry of Economy and Labour Saxony, 2004
1) Preliminary value
2) Rape oil, Heat from heat pumps, RME(from rape oil)

The goal of the renewable energy promotional scheme under the climate protection program in Saxony (5% of total energy output) seems to not be as ambitious as in other states. However, this goal is not low when considering the fact that the contribution of renewable energy to total energy output was only 0.7% in 1998, with the federal average at 3.1%. The fact that there was no concept of modern renewable energies in Eastern Germany before the reunification should be taken into account before judging the present status of renewable energy in Saxony. In 1990, 84 large thermal power plants were in operation with a 35,000 MW capacity in Saxony. However, only 26 of those plants were generating electricity with a 14,000 MW volume in 1999 after a massive closing down of plants due to lack of adherence to environmental and safety standards, lack of technological efficiency, and substitution of other fuels (Ministry of Environment Saxony, 2001). In general, a downward trend in energy demand resulting from lack of business in main industries, massive migration to Western Germany and low-birth rates after reunification accelerated a basic restructuring of society. While the power sector produced 78% of total carbon emissions, a series of sector-wide renovations reduced as much as 83 million tons of CO_2 gas between 1990 and 1999 (Ministry of Environment Saxony, 2001). Nevertheless, lignite, the only domestic natural resource, remained Saxony's most important source of power. The restart of renewed lignite-fired power plants in Boxberg and Lippendorf allowed CO_2 emissions to rise again in 1999. Though the large-scale electricity plants are still main sources of carbon emissions, they are not part of the inventory in the climate protection policy thanks to the rapid emission decline.
The development of renewable energy can be a valuable instrument for economic development. Besides a vast amount of brown coal from open-pit mines, Saxony has limited natural resources as well as industry infrastructure. Unemployment is currently one of the highest among the 16 states in Germany. Like the other former German Democratic Republic (GDR, East Germany) regions, structural unemployment as a result of the loss of entire

branches of industry since 1989 appears to be the main reason of high unemployment rates (17.8% in 2004). However, by increasing financial benefits and creating jobs while treating residuals from agriculture and forestry, the use of biomass for generating electricity and heat has become a particularly attractive form of energy conversion in Saxony.

Saxony has emphasized the use of biomass, in which positive synergies exist as potential resources, such as high-density cattle units per capita which allows the establishing of biogas plants. Between 2003 and 2004 the growth of renewable energy covered 3.3% of the total energy output, up from 1.7%, stemming from a rise in biomass use while starting large plants. Furthermore, biomass has been designated a priority measure in order to achieve the goal of 5% of final energy output (4,600 GWh) from both heat and electricity, with a 3,080 GWh output in 2004. Thanks to current dynamic development of biomass, positive results are expected up to 2010.

Various support programs, which guarantee economic profit to investors at both the federal and state levels, are the driving forces leading the expansion of biomass energy. Besides the current minimum tariffs imposed by the Renewable Energy Source Act (EEG, 2000), Saxony in particular has granted subsidies to promote investment in facilities which use organic materials. Since 1997, the state has created subsidies at specific rates for renewable energy sources, biomass being among them in various incarnations: biomass power plants, biomass-photovoltaic combined power plants, household biomass systems, biogas plants, etc. Nowadays, construction or modification of heating boilers, power plants and other forms of biomass plants may receive an investment subsidy of up to 75% of total costs. As a result, on December 31 2005, it was reported that 54 biogas and 213 biomass plants were in operation across Saxony.

North Rhine-Westphalia (NRW)

A. Energy consumption and production structure

North Rhine-Westphalia is the largest Federal State of Germany in terms of population and economic output, situated deep in the west. It has over 18 million inhabitants and contributes almost a quarter of the Federal Republic of Germany's gross domestic product[4] and covers a land area of 34,083 km^2.

Along with its large population (22.5% of the total Germany) and highly industrialized economic power, the state has produced and consumed large amounts of energy in absolute and relative numbers. While a total 4.1 Million TJ or 152 TWh of energy were produced in 2003, one-third of Germany's electricity energy was produced in the state, and industries and households are responsible for almost 30% of gross energy consumption in Germany.

Even though North Rhine-Westphalia is the highest energy-consuming state in Germany, its recent performance in the renewable energy sector is incomparable to its energy consumption level. According to the state's estimation, only 0.8% of primary energy output was provided by renewable sources in 2003, and the electricity from renewable energy sources was roughly estimated as 2-3% in total for the same year[5].

	Terajoule (TJ)	%
Hard coal	953,884	22.9
Lignite	856,112	20.5
Mineral oil	1,498,776	36.0
Natural gas	864,664	20.7
Others[1]	-10,332	-0.2
Total	4,163,104	100

Table 7. Primary energy consumption in North Rhine Westphalia in 2003. Source: National statistics office in North Rhine Westphalia (LDS-NRW), Energiebilantz 2003

1) Energy exchange with Federal States of Germany and all kind of renewable energy sources

Coal is the most important natural resource in North Rhine-Westphalia. Approximately 80% of hard coal and 60% of lignite in Germany are extracted from the mines located within North Rhine-Westphalia's borders. Abundant coal reserves launched the state to the top of the country's economy, becoming a powerhouse until the structural transition from heavy industry to modern technology took effect, and now most coal is used to generate power. As a tradition coal state, the international agreement under the Kyoto protocol demands a great deal of effort from North Rhine-Westphalia. However, the majority of citizens and the state government believe that coal will play an even more fundamental role in the future and they try to enforce the development of coal-fired power plants in a bid to secure a domestic energy supply.

North Rhine-Westphalia is the most industrialized state in the country, but most major industries are energy-

Intensive. Basic and fabricated metal, chemical, and machinery and equipment products industries are the main sectors producing gross value and consuming great amounts of energy. The state's Ministry of Environment announced in 2004 that factories and plants from industries wasted 40% of industrial energy consumption in Germany (Ministry of Environment in NRW, 2004). Due to a massive energy demand and supply structure, renewable energy shares a very small portion of gross energy production, although the figure has been growing steadily.

B. Process and experience

North Rhine-Westphalia has had very clear goals and a clear vision of future energy policy. According to a "State Initiative on Future Energies" launched in 1996 and sponsored by various state ministries, the government declared that its objective was to make the region the number one location for future energies. Along with this, it set three other main goals: efficient energy use, refining technology for using renewable energy sources, and utilizing domestic hard coal and lignite in an environmentally friendly way. In order to meet these goals, working groups and competence networks were established and have to date operated in 18 fields across the wide range of energy sources, from representative regenerative energy sources to decentralized power systems.

In spite of its low operation efficiency and massive carbon emissions, as well being expensive to use, the state has guaranteed coal's continued use in a high capacity. In the case of hard coal, the state granted subsidies even after coal lost its economic competitiveness. The state still plans to reserve €750 million to support the coal industry an additional four years after 2008, even though the federal government decided that coal subsidies would only be guaranteed until 2008 (LDS-NRW, 2006). The ongoing modernization of lignite and hard coal plants continues to be a priority for state and regional planning.

The reason the state continues to favour coal is that the industry and other related industries have been highly influential in the policy area. As mentioned in the previous chapter, the coal-producing governments (North Rhine-Westphalia, Saarland, and Brandenburg) adamantly defend their established coal interests, and any campaign agenda against coal is prohibited, particularly during national elections (Volkmar and Lutz, 2004). Numerous jobs and many business investments are highly dependant upon coal in these states as well. It is not a simple matter to consider the coexistence of the coal industry and renewable energy systems, especially in the political arena.

When it comes to national subsidies that are part of a limited budget, the promise of more financial returns might be as attractive to governments as it is to investors. This is evident in the dispute over coal subsidies and support schemes for renewable energy in Germany. Wolfgang Clement, Economic Affairs minister of the red-green coalition in the German Federal government in 2002, was a long-time politician from the coal state of North Rhine-Westphalia. An ardent defender of coal subsidies, he altogether opposed the Renewable Energy Source Act (EEG, 2000) during its 2003/2004 amendment phase (Volkmar and Lutz, 2004). State governments also are highly influential in certain policy areas, though they do not actively shape federal policies. Their power would be expressed in the Bundesrat, the upper chamber of German Parliament, or through direct pressure on the chancellor. In the case of coal, governments swimming in the resource attacked the EEG and tried to extend federal support for coal subsidies in the face of the European Commission's attempts to curtail them. As in most cases, existing political bodies carry more clout than newcomers, and governments will try to secure existing jobs in the energy sector, rather than create new ones.

In 1987, North Rhine-Westphalia initiated a promotional program called "Rational Energy Utilization and Use of Renewable Energy Sources (REN[6] Program)", which was devoted to energy efficiency and the use of renewable energy sources.

The REN program was an important and comprehensive measure, comprising a set of independent legal, advisory and financial tools in the renewable energy field. While having worked toward a way to moderate energy consumption and to boost technical development, it supported integrated, intelligent energy use and promoted a wide variety of projects associated with energy efficiency and inexhaustible energy sources. The number of projects implemented was more than 51,000 until the project ended in December, 2004 (The government of the State of NRW, 2006). However, output in the practice seems insignificant, despite earlier implementation and many projects supported by the 'REN' program.

North Rhine-Westphalia claims to be the number one state for the future energy prospects. In comparison with other German states, it has advantages in abundant capital and well-established infrastructure, but suffers from soaring energy consumption. The latest total capacity of wind power in the state is far lower than that of Lower Saxony and Brandenburg, and similar to those of Saxony and Schleswig-Holstein (Table 7). North Rhine-Westphalia recorded an installed biomass power plant capacity of 84.24 MW in 2004, after Saxony, Brandenburg, Baden-Württemberg, and Bavaria (Ministry of Environment Baden-Württemberg, 2005c). Although North Rhine-Westphalia has a modern economic structure, in many regions almost three-quarters of the surface area is used for agriculture or forestry. Wheat, barley and sugar beet are cultivated as the main crops in the state. All of them can be useful items in producing electricity and heat with biomass technology, but the state was ranked only 5th out of the sixteen federal states in installed biomass energy capacity. As far as the "The Federal Government 100,000 Roof Photovoltaic Programme" goes, North Rhine-Westphalia was ranked third in 2005 after Baden-Württemberg and Bavaria in output, accounting for approximately 11% of all installations (Ministry of Environment Baden-Württemberg, 2005c). Since there are many other kinds of renewable energy sources, it seems to be too early to judge the performance of North Rhine-Westphalia. Indeed, the growth potential of renewable energies in the state is unknown, but nevertheless, it is very doubtful that it is following its strategic concept to be the first state for future energy.

Conclusion

Each state's case showed a unique proceeding pattern with differing gross energy mixes and growth rates of the shares of renewable energy. For state renewable energy policies, though all states support the idea of boosting sustainable energy generation, the perspectives of each individual state turned out to be dissimilar. In spite of the differences, a series of important common practices by state governments were discovered and these factors have been used to explain the differing status-quo development of renewable energies between states in Germany.

First, the states tended to move uniformly forward with the existing energy infrastructure or system. They showed a tendency to advocate their present energy supply system and to plan to continue it for the short- to mid-term: Saxony intends to have lignite power plants; North Rhine-Westphalia will continue using hard coal and lignite; and Baden-Württemberg wants to continue to produce electricity with nuclear power plants. Though coal and uranium use has been criticized due to environmental and safety concerns, states have tried to convince their peoples of the indispensable need of those resources in order to provide a secure, independent energy source.

To address the question of the different patterns of renewable energy development, the state governments' preference toward existing resources can hinder newly developing sectors like wind energy, biomass or solar energy. As an inertial force in supporting business, power and industry sectors, using resources on-hand is more important to a state's political decision making, and this can throw renewable energy development out of favor. The coal industry in North Rhine-Westphalia as a prominent example, supporting the existing system will more likely than not block government subsidy of renewable energy system development. This can also be understood as conventional practice to protect the state's industries and employees.

Secondly, the states' energy policies are rather conservative, because they are relatively free from political discussion compared to the federal level. Nationwide, many stakeholders involved in the energy sector voice their own interests, increasing complexity. In turn, the federal government encounters political opposition due to its scale and complicated structure, and a rapid modification of policy is only possible in accordance with the political landscape after elections. When the Renewable Energy Source Act (EEG, 2000) was adopted and amended (2004) in favor of renewable energy by the red-green (SPD-Green) coalition government, many conservative states, the opposition (CDU, CSU, and FDP) and even some bureaucrats in the ruling parties attacked the legislation.

As seen from North Rhine-Westphalia's coal example, large regional stakeholders associated with coal industries had a direct impact on the state's decision making on a large scale, managing to counteract the elimination of coal subsidies. Thanks to a close interrelation between the political powers and stakeholders in the state, it was next to impossible to switch the basic composition of energy demand and supply.

States' conservativeness has had an impact, in particular, on the energy sector because long-term perspectives with massive infrastructures are necessary to develop proper energy policy. Overall, it can be expected that rising new renewable energy businesses would have a harder time competing against an existing industry than if they were the only providers.

Thirdly, the states tend to concentrate on a select few technologies. Among many renewable energy technologies, each state has selected only a few with high potential and abundant resources, and has concentrated on them so as to achieve a more fruitful output. The federal government must take into account several criteria, from energy security to economic competitiveness, while facing a number of advocates of various technologies throughout the nation. The state government, on the other hand, filters out technologies that do not survive the screening process or fail to figure in specific and detailed information and facts about its territory that are required in decision making, such as specific climatic conditions, compatibility, growth potential, investment scale, and the special care of renewable energy technologies, and therefore has fewer choices. With special regard to regional conditions, all explicit data available leads to successful decision making as well as active feedback from the actual renewable energy installation.

German state governments have been able to respond to the characteristic conditions of their area and this has led to more practical necessary support. While some initial plans—in wind energy development, for example—have been confronted by opposition in Schleswig-Holstein, the department of physical planning was able to persuade local residents. In the case of Saxony, the government considered two factors: high unemployment rate and lack of industrial infrastructures, and abundant agricultural and forestry resources, and rallied support for installing biomass-fueled plants. In areas where a renewable installation is built, a system was designed that ensured local citizens were able to invest in its operation, and could benefit from the profits. This supportive activity by state government has been one significant factor in gathering a high level of local support for the implementation of renewable energy.

To summarize common factors from the four states' experiences, the development of renewable energy is dependent upon geographical climate conditions.

Renewable energy is defined as domestic energy by definition because it uses regional energy resources, such as wind, solar radiation and biomass to produce power and heat. In case a state owns natural resources such as hard coal, this conventional energy source can be an obstacle for renewable energy development. Conventional energy sources often compete with the newly inaugurated renewable energy system to obtain a state subsidy. Generally, state governments are fiscally conservative.

They tend to support existing structures, and this tendency can delay converting to renewable energy technology in the beginning stages. Coincidently, North Rhine-Westphalia has achieved a very small percentage of renewable energy, far less than the federal level, while the other three states have performed similarly to the German average or more. Even still, technically there is no standard to judge renewable energy's improvement without a specific target. Drafting ambitious goals can be one of the most important roles of state government because it stands as a symbol of integrated action planning and strategy, and an essence of desire for the proliferation of renewable energy development. Contrarily, the reason for poor or merely good outcomes in attempting to promote renewable energy can be deduced by the level of the state's involvement, like intervention on affecting factors and comprehensive targeting or planning.

Four German states have been working to develop the use and expansion of renewable energy, although they have showed different attitudes toward growth rate and output. Above all, the most important and common role of state government is to harmonize critical driving components; resources, general local conditions, and support schemes, which have a great impact on the development of renewable energy, as seen in Figure 6.

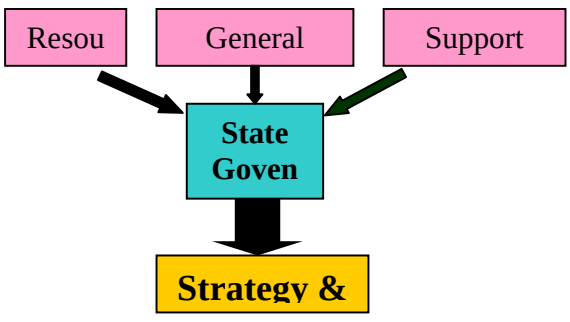

Figure 6: Role of state government in the energy sector. Source: Seong Yong Park

Uncertainty inevitably exists in a new investment project, but if the government participates not only as a policy-maker but also a positive market mediator, this would give confidence to investors. Besides integrating all important components and mediating the renewable energy market, another significant role of the state is to design the best strategy for renewable energy development. As illustrated in Figure 6, all input should be considered to make the best decision. State governments must establish strategies or action plans for renewable energy development based on specific regional data and integrated essential components. This state's strategy should revolve around a specific target.

Notes

1. The time-lag that is needed to carry out a project from the moves made about a site till the moment the electricity sales starts is referred to as 'lead time'.
2. Statistical Bureau Baden-Württemberg – regional data in 2005, http://www.statistik.baden-wuerttemberg.de/Veroeffentl/
3. The report, "Use of renewable energy sources 2002 in Baden- Württemberg", describes that the energy from municipal waste presents 32.9% of total renewable energy, whereas 35.9% from hydropower and 19.8% from wood.
4. Introduction of each state in Germany from the federal states parliament's (Bundesrat) official webpage http://www.bundesrat.de/cln_051/nn_10940/EN/organisation-en/laender-en/nw-en/nw-en-node.html?__nnn=true
5. Further information can be found at the state run web site, http://www.regionalrenewables.org/cms/front_content.php
6. Rationelle Energieverwendung und Nutzung Unerschöpflicher Energiequellen

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