The Economics of Restructuring the German Electricity Sector

by

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Abstract:

A recent debate about the development of on German household electricity prices after the liberalization of energy markets in 1998 raises the question of failures in market restructuring. However, a general consideration would be misleading for two main reasons. Firstly, the price development shows significant differences among the stages of the value chain. Secondly, the underlying cost structure might have changed from 1998 to 2004. While such effects can be expected to level out over time, they can distort the comparison of a small period of observation. For these reasons, we analyzed the different price components at a detailed level, finding a considerable price reduction of about 32% in generation and a much lower reduction of 13% in transmission and distribution tariffs. These decreases have been mostly compensated by a significant increase in taxes and subsidies (+56%).

Keywords:

Electricity Markets, Regulation, Competition

JEL-classification:

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I. INTRODUCTION

A worldwide movement towards the liberalization of energy markets took place during the last decade. In accordance with EU law, Germany joined this movement and liberalized electricity and gas markets in 1998 by enacting a new Energy Industry Act. However, in contrast to other European countries, the deregulation of Germany's energy markets had not been associated with the installation of a regulatory agency until July 2005, when the Federal Network Agency started its work. The agency faces a vivid discussion about the German electricity prices; the Association of the Industrial Energy and Power Industry claimed in multiple press releases electricity spot-market prices to be excessive (hypothesis 1) and network charges to be still monopolistic (hypothesis 2). The Association of the Electricity Industry whereas blames the German government for increases in energy prices and refers to high additional costs due to the so called renewable energy act and the promotion of combined heat and power plants (hypothesis 3) as well as – most notably – higher taxes (hypothesis 4).

In this article we analyze the development of the German electricity market since liberalization, verifying the hypotheses from above. Therefore, we concentrate the analysis on three major aspects: Firstly, we give an overview of the price development in the different German electricity industry value chain stages since liberalization. Secondly, we present the mechanisms leading to this price development and thirdly, we discuss the underlying market design in three key areas of the market and discuss potential improvements.

Consumer prices are a natural starting point for an analysis of the effects of market liberalization. For that reason, we discuss the development of household customer prices and their components from 1998 to 2004 in section II. This discussion will give an overview of the factors determining electricity prices in Germany and their development in the years since liberalization.

The most important price components will be discussed in detail in the following sections. Section III analyzes wholesale generation prices. We argue that the sharp price decrease from 1998 to 2000 was caused by a shift in the pricing paradigm from average costs to short run marginal costs. We discuss why prices increased again from 2001 onwards subsequently. Furthermore, we analyze issues of market design in the wholesale generation market. A major focus is put on real time metering, as it could increase the price elasticity of demand which will reduce price spikes as well as restrict the potential for strategic bidding on the supply side of the market.

In contrast to the generation market, both transmission and distribution markets are natural monopolies. Hence, questions of regulation and market design are crucial for an efficient functioning of these markets. The German government enacted the negotiated third party access (NTPA) as institutional frame instead of installing a regulation authority. As competition did not reach the intended level, the European Commission abolished the option of NTPA. Thus, the German government has to replace the current regulatory regime with regulated third party access. The question of how the German transmission and distribution markets should be regulated is currently controversially debated. While it seems inevitable that Germany is going to introduce a regulatory body, the rights of that body, especially with respect to ex-ante or ex-post approval of tariffs, are still debated. Up to now, a cost-plus regulation is in place in the sector. Many other countries made good experiences with incentive/performance based regulation. We analyze the development of network tariffs (in the following access charges) in chapter IV and give short recommendations concerning the future regulatory system.

In section V, we discuss the influence of politics on electricity prices, focusing on the renewable energy act. Even though the electricity tax causes higher costs per MWh, the renewable energy act is more interesting for a discussion. The main reason is that the act prevents competition in a significant share of the generation market. While the electricity tax mainly influences the demand side of the market by increasing the costs of electricity regardless of its origin, the renewable energy act distorts the dispatch on the supply side by increasing generation from renewable energies while driving competitive thermal capacity out of the market additionally. A similar argument holds for the German 'combined heat and power act'[1]. However, absolute subsidies paid on behalf of that act are lower and predicted to decline further in the future. Renewable energies supported by the renewable energy act, on the other hand, are expected to grow at a steep rate and are hence becoming significantly more important.[2]

II. THE DEVELOPMENT OF HOUSEHOLD PRICES

Before analyzing and explaining price developments in different market segments in detail, we show aggregated developments of household prices. Since they tend to show lower price elasticities than industry or commercial consumers and can hence be expected to benefit less from liberalization, they seem to be a reasonable focal point for an economic analysis: if household prices decreased significantly, it can be assumed that other prices declined at least in the same order.[3]

The development of electricity prices for household customers from 1998 to 2004 is shown in Figure 1. The figure distinguishes the different price components adding up to the final consumer price. Looking first at households' total electricity costs, it becomes apparent that prices declined significantly shortly after liberalization but increased again from 2001 on. In 2004, prices have nearly reached the level of 1998.

However, concluding that the liberalization of the German market was not an economic success would be misleading. For one thing, taxes and subsidies have increased significantly. Their share of the final consumer price rose from 25 % in 1998 to 40 % in 2004. This sup-

1 Gesetz für die Erhaltung, die Modernisierung und den Ausbau der Kraft-Wärme-Kopplung (Kraft-Wärme-Kopplungsgesetz)

2 The steep growth in volumes will overcompensate the degression in subsidies per MWh.

3 We are abstracting from cross subsidization from households to industry before liberalization.

ports the hypotheses 3 and 4, indicating that political decisions increased the electricity prices. Households' total costs for generation, transmission, and distribution in 2004 are still 22 % below their 1998 values. In addition, the success of liberalization cannot be evaluated based on a two year comparison. Both medium and long term effects prevent such simple proceeding. Medium term effects such as fuel prices[4] or hydro and wind availabilities might influence generation costs and prices. Hence, the same price for household customers might be driven by underlying costs in one case but may well be above costs in another. While the first would be an efficient outcome (the good is offered at marginal costs), the second case can contain significant inefficiencies. Hence, especially on the generation side, a comparison of prices and costs is needed. This is what we look at in section III.

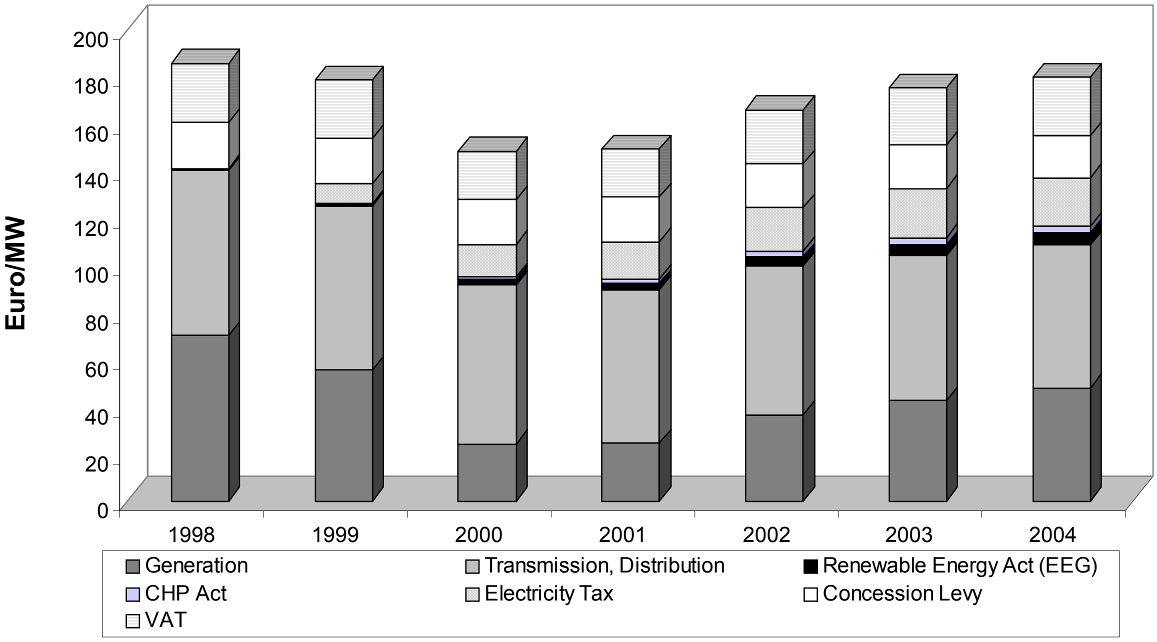
Nonetheless, the development of the prices residential customers had to pay for the provision of electricity, namely generation, transmission, and distribution, shows interesting aspects. While the price component for transmission and distribution decreased steadily at a slow rate, the generation price components' development shows more fluctuation. The price households had to pay for generation decreased significantly from 1998 to 2000 (- 65 %), but started to rise again from 2001 onwards. In 2004, they are still significantly below their level from 1998 but have doubled in comparison to their minimum values in 2000. Both the driving factors of generation prices as well as transmission and distribution tariffs will be discussed in the next sections.

The significant increase in taxes and subsidies is mainly due to the electricity tax which was introduced with the environmental tax reform. Introduced in April 1999 at the amount of 11 $Euro_{2004}$/MWh, this tax and has been increased annually up to 20.85 $Euro_{2004}$/MWh since January 2003.

Another major and growing share of the tax burden on electricity is caused by the renewable energy act. Corresponding taxes increased from 0.87 $Euro_{2004}$/MWh in 1998 to 5.10 $Euro_{2004}$/MWh in 2004. They are predicted to increase further in the future. Besides the already mentioned costs inflicted by the combined heat and power act, there are two more direct and one indirect fees and taxes to mention: Concession levies are paid to municipalities for the right to deliver electricity to the municipality's citizens. While the levy's amount can be determined by the municipalities, a federal decree sets upper limits. The last component of the electricity price in Figure 1 is the value added tax which is 16% during the whole period of observation. In addition to the taxes shown the figure 1, the gas tax should be mentioned, since it increases the costs of fuel for electricity generation. This taxes' effect on electricity prices is included in the wholesale electricity price component.

4 Hard coal prices can illustrate this point as they nearly doubled from 1998 to 2004. Since hard coal plants are often setting the price in Germany, this development should be included in an assessment of an efficient price structure.

Figure 1: Development of Electricity Prices, Representative Household Customers, Euro$_{2004}$/MWh



Source: VDEW, EWI

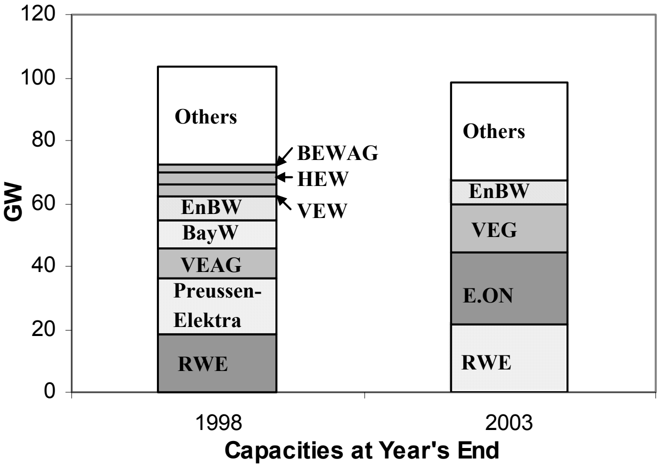
III. THE WHOLESALE GENERATION MARKET

Before the German electricity market was liberalized, wholesale electricity prices were regulated on a cost-plus basis. Vertically integrated generation companies were allowed to charge electricity prices in their regional monopolies sufficient to cover all costs. Hence, the costs households had to pay for electricity generation were determined by average generation costs. It is well known that such a regulatory setting gives incentives for overinvestments. In the case of the German electricity supply industry, there is evidence that this happened.

After liberalization, beginning in 1999 but mainly during 2000, excess capacities and fierce competition brought German wholesale electricity prices down to short run marginal costs. Müsgens (2004) showed that wholesale prices were at the level of short run marginal costs at least from June 2000, when the first German power exchange started operations, to August 2001. Hence, the huge drop in prices from 1998 to 2000 seems mainly due to a regime shift from average cost pricing to marginal cost pricing.

However, excess capacities on the supply side of the market were reduced gradually. German plant operators took close to 10GW of generation capacity out of the market. On the other hand, new capacity has been installed to a much lower extent. Hence, installed net generation capacity in Germany decreased significantly following the market liberalization.[5] In addition, most capacity additions appeared in subsidized technologies, either combined heat and power plants or renewable energy sources. At the same time, increasing demand in Germany (about 1 % p.a.) further reduced excess capacities. Another factor which has reduced competition in the German market is increasing concentration due to mergers and acquisitions. The number of large generation companies has declined from eight to four. Both decreasing capacities as well as increasing concentration are shown in Figure 2.

Figure 2: Development of Net Generating Capacities Germany, Excluding Wind and Rail, 1998 and 2003



Source: EWI

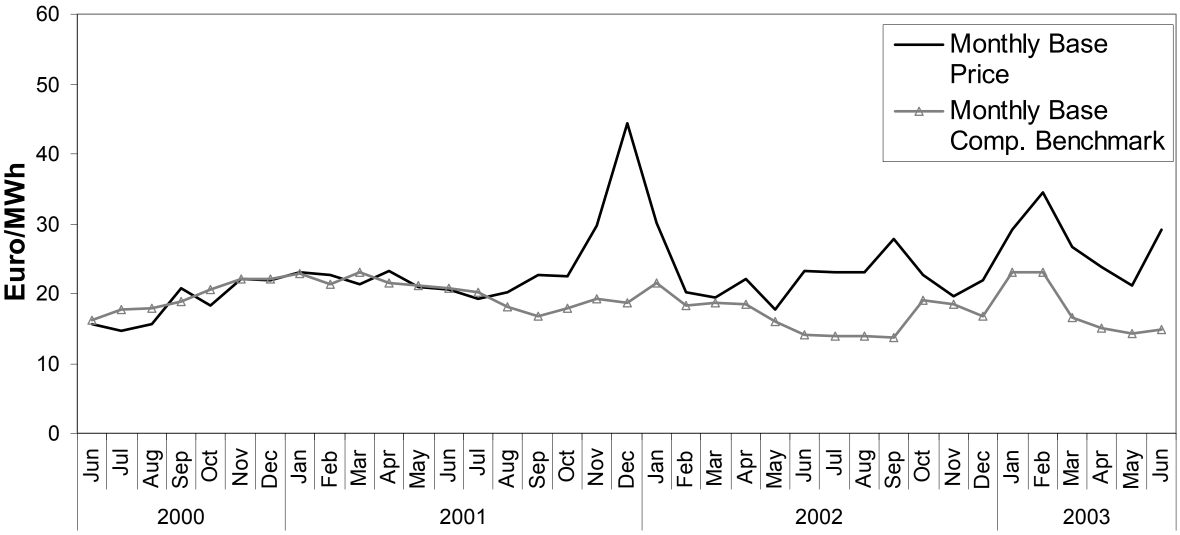
The development of prices and marginal costs has been discussed in detail in Müsgens (2004). The author compares prices and competitive short run marginal cost estimators derived with an empirical partial equilibrium model. The key result is shown in Figure 3. From June 2000 to August 2001, wholesale prices are very close to marginal costs. However, a structural break is identified between August and September 2001. Prices have been significantly above short run marginal costs in the second period since September 2001.

It has often been argued that prices have to be above short run marginal costs since total costs for new capacity could not be covered otherwise. However, this is not necessarily true. We understand marginal costs as the intersection of supply and demand, which can be above generation costs of the last inframarginal unit. If demand reaches a binding capacity constraint, the supply function is vertical and the elasticity of demand determines the price. In such a case, prices can – and will in equilibrium – be high enough to cover all costs for new investments. Hence, prices equal to short run marginal costs understood the way described above

5 The large increase in installed wind power capacity does soften the capacity decrease at first glance. However, due to the large volatility in wind generation, EWI calculated that additional wind power reduces necessary thermal capacity by less than 10 %.

would be an efficient scarcity price signal.[6] Following this line of argument, the difference between marginal costs and prices described in Figure 3 means a loss in social welfare.

Figure 3: Marginal Costs and Prices in the German Wholesale Market



Source: Müsgens (2004, p. 12)

However, it is questionable whether short run marginal cost pricing can work in reality. Three main arguments have been raised against it. Firstly, offering all units at marginal costs is inconsistent with players' profit maximizing behavior as will be described later. Secondly, a low price elasticity of demand might lead to excessive prices or might even prevent a market clearing. Thirdly, price spikes inherent in this pricing scheme are likely to be unacceptable for regulators and politicians which might prevent investments.

The first argument is probably the strongest. Ausubel and Cramton (2002)[7] showed that bidding at marginal costs is not profit maximizing in a multi unit auction if a company is producing more than one unit – which is the rule and not the exception in electricity markets. On every unit but the first, the bidder has an incentive to raise the bid above marginal costs. If the unit has a positive possibility to be the marginal unit and hence set the price, all inframarginal units will also gain from the higher price. Hence, while short run marginal cost pricing gives an efficient benchmark, it is unlikely to be consistent with individually rational profit maximizing behavior by market participants. A player's incentive for bidding capacity above marginal costs increases with the size of its capacity but decreases with the price elasticity of demand.

However, short run price elasticity of demand is very low in electricity markets. It has been pointed out that the demand side determines the price whenever a binding capacity limit is reached. The low price elasticity of demand leads to excessive price spikes during these

6 This so called peak load pricing scheme was first presented by Boiteaux in 1949 (in French). An English translation appeared in 1960 (Boiteaux (1960)).

hours. Kahn (2002) discusses this problem extensively. He concludes that prices of 6000 USD/MWh might be necessary to cover investment costs for peaking units.[8] We agree with Kahn that the solution to this problem should not be averaging prices above longer periods of time. High prices indicate the scarcity of electricity at peak hours. Consuming electricity at times of scarcity should be expensive since the corresponding costs for additional electricity are very high. However, people will only react on these price signals when they are confronted with them. Hence, Kahn proposes real time metering. Real time metering can be expected to increase the price elasticity of demand. This would soften the price spikes during periods of scarcity. Such a change of electricity pricing seems to be necessary, since the public seems to be highly sensitive to price spikes driving both politicians and regulators to act on their prevention. Investors will be reluctant to invest if they fear that prices will be 'capped' during the few hours when turnover is high and plants' investment costs can be amortized.

Given these arguments against marginal cost pricing, it can be argued that prices in fact have to be above short run marginal costs during some hours to cover investment costs for new capacity. However, we have not discussed other sources for revenues besides spot markets so far. Especially capacity markets could be a way to recover investment costs and provide for security of supply.

To sum up, it is possible in principle to estimate both short and long run marginal costs in electricity market due to the relatively good availability of data. Prices above short run marginal costs, as currently observed in Germany, are not necessarily an indication of losses in social welfare considering the problems with short run marginal cost pricing. A fairly complex analysis is needed whether new investments are necessary in the market. If new investments are necessary, expected prices have to cover total costs of technologies entering the market.

We already stated our belief that an increased short run price elasticity of demand (mirroring short run generation costs) is essential for a proper functioning of electricity markets. Real time metering is an important mean to increase the elasticity of demand. Increasing the elasticity of demand will not only reduce price spikes but also lead to less variation in demand over time. This will result in a load profile that is cheaper to serve. In the future, the demand side can also help to absorb a further increase in variation of the load profile brought by an increasing share of wind power in the market.

In addition to that, elasticity of demand will restrict the potential for strategic bidding in electricity markets. The more elastic electricity demand, the less profitable are bidding strategies above marginal costs and the less severe is the loss in welfare associated with strategic bidding. The intuition behind this is that with a higher price elasticity of demand, prices will rise

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7 The first draft of the paper appeared in 1995.

8 It is important to note that these prices are necessary to cover total costs of investments. These prices have been paid before liberalization, but they were 'hidden' in average prices.

less for a given amount of capacity withdrawn from the market clearly making strategic behavior less beneficial.

A last benefit of real time metering could be an improved outage prevention. Arbitrary customer cut-offs could be replaced by a market based solution: those customers who value electricity the most would be served, other customers not. While outages are currently not a problem in Germany, they might become more important in the future.

A more recent development is the trading of CO_2 emission certificates since the beginning of 2005. Following EU legislation, these certificates were distributed free of charge, based on historic emissions for a reference period (2000-2002). It is efficient and at the heart of the idea of emissions trading that the certificate price translates into higher electricity prices. This is regardless of whether allowances are auctioned in a first step or donated. However, CO_2 prices can be another mean to increase profits on the electricity market: Exercising market power on the certificate market could be a profitable strategy for large electricity suppliers - even if it is not profitable on the CO_2 market because of increased profits on the electricity spot market. It is difficult to assess whether the currently high certificate prices of above 20 Euro/t CO_2 equivalents are the result of market power or based on marginal costs of CO_2 avoidance. While prices below 10 Euros were expected by most studies (e.g. EWI/Prognos 2005), short time frictions in the market might actually lead to higher prices. For example, some countries have still not effectively started trading at all in mid 2005. In addition, short-run costs of CO_2 avoidance might be significantly higher than long run costs.

With respect to the hypothesis of distorted spot prices, we have to draw a mixed conclusion. The analysis showed that prices are above the competitive benchmark for a long period of time. This is a strong indication for strategic behavior in the spot market, consumers are paying too much. On the other hand, prices in the long run equilibrium can be expected to cover total costs in the system. Prices are not considerably above the level of total costs for new generation units. Complexity was added by the beginning of the CO_2 emission certificate trading. Further research is necessary to evaluate whether excessive profits are earned at consumers' cost due to market power on the emissions market or whether high certificate prices are an efficient scarcity signals.

IV. TRANSMISSION AND DISTRIBUTION PRICES IN GERMANY

The institutional framework for access to German transmission and distribution networks is based on a set of contracts between energy producers and industrial consumers (associations' agreements; *Verbändevereinbarungen,* abbreviated *VV*), subject to ex-post control by the Federal cartel office. These agreements implement the EU electricity directive (96/92/EC) and the national energy act 1998 (EnWG), into a system called Negotiated Third Party Access (NTPA). In contrast to the more common regulated third party access, the German regulatory system is not associated with a regulatory agency and a corresponding ex-ante regulation scheme.

In 1998, the first associations' agreement VV I was implemented followed by a modified and expanded agreement VV II in 1999. The final agreement VV II+ replaced the earlier one in 2001 lapsing at the end of 2003. Since then, it was accepted as a general code of practice by law. However, due to the EU acceleration directive from summer 2003, a regulatory authority has had to be appointed until 1 July 2004, replacing negotiated with regulated third party access. However, the German Government missed the installation of a regulatory body until summer of 2005.

The first associations' agreement network access was designed as point-to-point transmission; the access charges were calculated in regard to the so called contract path principle, based on the distance between a supplying power plant and the final customer. This procedure was critized for being anti-competitive, as it was complicated and produced comparatively high transaction costs (Monopoly Commission 2002, p. 527).

Due to political pressure, the next agreement VV II replaced the contract path concept by a model called *access-point tariff* (Brunekreeft 2001), which is rather a postage stamp concept approach.

A paradigmatic change in the orientation of the cartel policy occurred in April 2001 after a review of network access in the German electricity markets. Since ex-post control of the federal cartel office had concentrated on the control of non-discriminatory third party access to the networks (Federal Cartel Office 2001), it changed its focus to the level of access charges, as the charges have been considered to be excessive (Brunekreeft 2004). Taking this development into account, VV II was replaced by VV II +. This latest agreement contains basic principles for the calculation of network tariffs, required their publication and introduced industrial self-regulation (Brunekreeft and Twelemann 2005).

The duty to publish access charges was intended to be the crucial improvement within VV II+ as being a major issue of the design of a (national) comparison market scheme. Aimed to identify comparable network operators, the agreement differentiates three structural features: *population density* (for low voltage networks) or consumption density (for medium and high voltage networks), *cable rate* (which is the percentage of underground lines of the total network), and *East and West Germany*. This scheme categorizes each network operator; the association of system operators publishes network access charges of each operator for typical consumption cases as well as average prices (Monitoring Report 2003). To restrict monopoly power and to induce regulatory threat, network operators whose tariffs are within the upper 30% price bracket of their structural category have to justify the level of their charges at a board of arbitration, if a network user so demands. However, the board has no final power of decision; if the operator and the customer do not find an amicable agreement, the plaintiff has to enforce its claim through the cartel offices (Monopoly Commission 2002, 529), which is responsible for maintaining the common anti-trust instruments against market power abuse (*threat of intervention*).

The development of the electricity network tariffs in Germany since the energy market liberalization in 1998 has been examined by basically two empirical studies: Kühn and Schulz

(2002) analyze the tariffs of 78 transmission and distribution companies covering approx. 70% of the German electricity network. They identify for the period 1999 to 2002 two different trends: first, on average, the network charges decreased slightly for all voltage levels. Second, the variance of the charges decreased as well. The authors attribute the latter development to two phenomena: while the expensive network operators reduced their prices over time, the majority of the suppliers kept their charges constant or increased them slightly.

Growitsch and Wein (2004) investigate the network operators' pricing behavior, predicting what behavior could have been expected for the post 2002 period. Since then, the VV II+ increased market transparency, bringing along the common knowledge of explicit intervention prices consequently. They argue that the specific design of the German electricity market, namely ex-post control, market transparency and the limitation of the threat on the upper 30% rule in particular (intervention frontier), induces wrong incentives in the following manner: The knowledge of the intervention frontier makes it rational for any network operators to adjust its price to the intervention frontier price within their structural class. Cheap operators are able to increase their price to the intervention frontier price without taking the risk of becoming part of the upper 30% in price on the other hand. This rationale stabilizes the intervention price from below. An overall increase in prices is prevented by the expensive suppliers' rationale; they can reduce the risk of being part of the most expensive 30% (and suffering enforced price reductions as a consequence) by decreasing their prices converging to the intervention frontier tariff. Therefore, collusion on high prices cannot be stable above the intervention frontier. However, with a decreasing variance in prices, the risk of pricing beyond the intervention frontier becomes irrelevant, as possible losses due to a cartel office intervention gradually disappear.

These theoretical predictions corresponded to observed price developments. Descriptive information on the tariffs' average growth rate of more than 400 suppliers for the time from 2002 to 2003 is reproduced in Table 1. Considering the means of the low voltage(household related) charges, it seems that they decreased between autumn 2002 and 2003: on average, access changes have fallen by 1.5 percentage points, while the median growth rate did not change at all. The maximum growth rate was 31% , while the minimum growth rate (which is the maximum price decrease) was (-) 39% respectively. Overall, the scale of decreasing values is very small. Hence, even if a reduction has genuinely occurred, the averages decrease is not important from an economic point of view.

Table 1: Growth rate of low voltage access charges between 2002 and 2003

	change in percent
Mean	-1.524
Median	0.000
Maximum	31.16

Minimum	-38.65
Standard deviation	6.22
N	444

Source: Growitsch and Wein (2004, p. 15)

In multivariate estimations using data for 370 operators, Growitsch and Wein show a highly significant price decrease of expensive suppliers (defined as supplier inside the upper 30% bracket); taking structural differences into account, such operators lowered their tariffs by roughly five percent points for low voltage level networks' access. On the other hand, cheap operators increased their prices by four percentage points . These results indicate strategic behavior of cheap suppliers and confirm the findings of Kühn and Schulz (2002).

Table 2: Growth rate of average access charges 2002/2003[1]

	Model 1 (low voltage)
Expensive 2002	-5.123*** (-6.296)
Cheap 2002	4.070*** (5.614)
Population density / Consumption density 2002	-0.356* (-1.790)
Cable rate 2002	-0.113* (-1.781)
East-Germany (yes=1)	4.731*** (5.410)
Constant	-0.025 (-0.026)
R^2 (adjusted)	0.212
F-test (P-value)	21.267*** (0.000)
Observations	377
Test of normality after Jarque/Bera[2]	H_0^a*** (0.000)
Test of homoscedasticity according to White[2]	H_0^{na} (0.283)
Estimation method	OLS

*[1]Significant on 10 %-, 5 %-, and 1 %-level: *, **, and ***; t-values in parentheses.*
[2]H_0^a: null hypothesis could be rejected; H_0^{na}: null hypothesis could not be rejected; p-values in parentheses.
Source: Data set 'Deregulated German electricity market'; estimated with EViews 4.0.

Source: Growitsch and Wein (2004, p. 20)

However, recent developments of network tariffs militates for a change in network operators' behavior. Descriptive statistics (table 3) show a slight increase in mean and median network access charges; the standard deviation has also increased (although none of these measures increases by more than one percent).

Table 3: Network access charges (low voltage) 2004 and 2005: descriptive statistics

	2004	**2005**	**change in percent**
Mean	5.466	5.471	0.083
Median	5.380	5.400	0.372
Maximum	7.770	7.770	0.000

Minimum	3.110	3.110	0.000
Standard deviation	0.572	0.577	0.766

Source: own calculations based on figures published by the Association of German System Operators.

From a firm level perspective, VIK (2005) reports an increase in network tariff of up to 20% from 2004 to 2005. Both observations could be interpreted as that the regulatory threat did not hold any more (Brunekreeft and Twelemann 2005) since the installation of a regulatory authority was announced in 2004. Instead, collusion became less reasonable than price increases, network operators seem to build up a "price reduction margin", anticipating price cuts by the regulator.

Recapitulating this section, it can be stated that the German institutional setting of negotiated third party access failed in terms of the aims of liberalization. As it is going to be substituted by regulated third party access soon, we are going to suggest crucial elements of upcoming regulatory setting. Regulation in general, although necessary in utilities industries due to market failures, intervenes into market processes and bears specific risks of distortions and wrong incentives. As it is therefore unavoidably inefficient, it should be restricted to non-competitive (monopolistic) market segments. As any regulator suffers from asymmetric information additionally, a regulatory system should be as least information demanding as possible. The regulatory scheme satisfying these requirements best is from our point of view Performance-based regulation (PBR, sometimes incentive regulation). This method is an established alternative to the 'traditional' cost of service regulation. While the latter allowed regulated companies to recover costs and a (percentage) surcharge ('cost-plus regulation') PBR establishes competitive market incentives into the regulated markets. Conventional PBR set up a revenue or price cap that is adjusted annually for inflation (RPI) on the one hand side and reduced by potential productivity improvements (X) to give incentives for eliminating efficiencies on the other ('RPI-X' regulation). Consequently, PBR creates strong incentives of cost reduction. However, these cost reductions may have negative impacts on reliability and quality of service. Thus, we suggest a PBR scheme that includes performance indicators related to reliability, market efficiency, and customer service. To allow for an appropriate calculation of the X factor, we recommend international comparison methods (international benchmarking). Given that, PBR is likely to result in reduced cost of regulation, reduced cost of negotiations concerning the distribution of utility cost reductions, and improved risk allocation between utilities and consumers.

V. THE RENEWABLE ENERGY ACT

In section II, we mentioned that the share of fees and taxes for household customers has increased significantly since 1998 reaching 40 % of total costs in 2004. While taxes are lower for industrial consumers due to several exceptions, the share of regulatory inflicted costs increased due to these raises in the years after deregulation. One - major - reason for this development is the renewable energy act.

The Renewable Energy Act (EEG[9]) was implemented to promote the electricity generation from renewable energy sources (RES) in Germany. The revised version of this act has been enacted August 1st, 2004. The EEG pursuits several goals: Firstly, it aims at climate protection by reducing CO_2-emissions.[10] Secondly, it aims at increasing the long-term security of supply in Germany by reducing the dependence from imported gas and coal. In addition, the consumption of finite resources shall be restricted and technological progress in RES generation technologies shall be made. The act also specifies precise targets for RES’ share of total electricity generation, namely at least 12.5 % for 2010 and 20% for 2020.

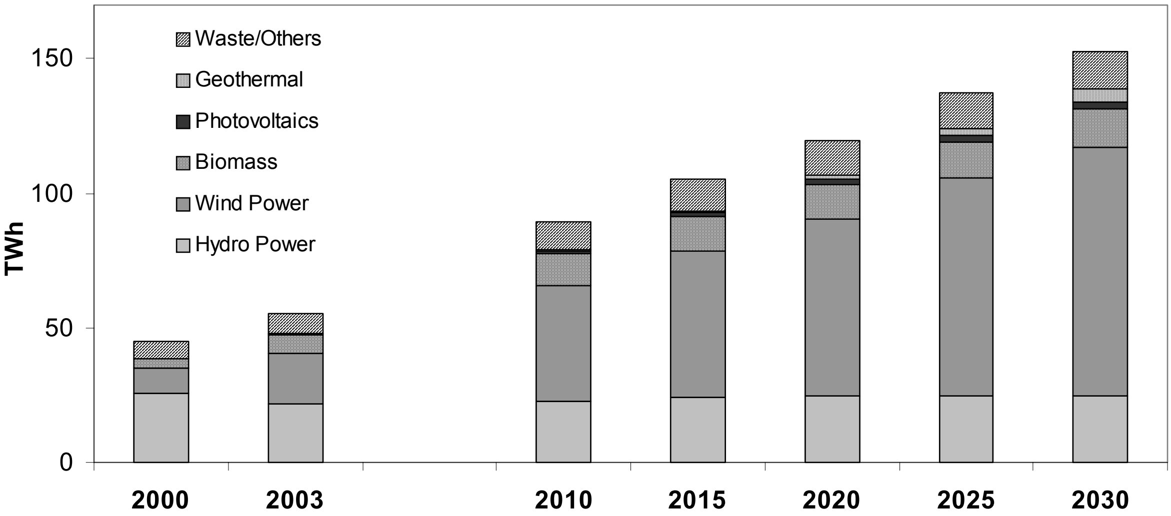
The subsidy scheme in the EEG is fairly complex. Firstly, it distinguishes between different technologies. The highest subsidies are paid to technologies with high costs of generation: Electricity from solar power is subsidized with at least 457 Euro/MWh. Nonetheless, solar power does still play a marginal role in the German electricity generation mix, as the climate in Germany is not favorable for the generation of power from solar energy.

On the other hand, wind power is a technology where the subsidies has triggered significant investments. The subsidy scheme for wind power distinguishes not only between on- and off shore sites but also between production potentials. On-shore wind mills receive a fixed subsidy of 87 Euro/MWh for at least five years after installation. The lower the wind supply at the site, the longer the subsidy applies. After that, the fee is reduced to 55 Euro/MWh. Figure 4 shows both the large increase in RES generation in the recent past as well as expected future growth which is mainly caused by increased generation by wind power.

9 **E**rneuerbare **E**nergien **G**esetz

10 Whenever we are talking about CO_2-emissions, we always include other greenhouse gases.

Figure 4: Electricity Generation from RES in Germany, 2000 - 2030



Source: EWI / Prognos 2005

The costs for the EEG are paid by electricity consumers. For the determination of these costs, all subsidies are aggregated over all RES technologies in a given year. However, the electricity generated by RES also contributes to the electricity system. Hence, the revenue of these sources' generation has to be subtracted to calculate the additional costs in the system brought about by RES. Afterwards, this resulting total additional EEG expenditure is distributed on the total electricity consumption in Germany giving a levy on every MWh of electricity consumed. However, large industrial consumers receive a discount which on the other hand further increases the charge for smaller consumers.

We pointed out that the subsidies of RES plants decrease over time. However, subsidies decrease not only over the life time of a plant but also for new plants depending on the year they are built. For wind power, the subsidy for new installations decreases by 2 % p.a. starting in the year 2006. Nonetheless, in the near future these effects are going to be overcompensated by the steep increase in volumes for RES generation. Furthermore, most studies (e.g. the Royal Academy of Engineering 2004) agree that electricity produced from RES will continue to be more expensive than electricity produced from conventional sources, even if CO_2-certificates increase fuel prices for conventional thermal capacity. Hence, the steep growth in RES generation is going to increase the costs for the EEG subsidies at the same time. For these reasons, the question whether the EEG is an optimal incentive scheme is of highest importance.

For an analysis of the EEG's market design, we first address the question of CO_2-emission reductions. EWI participated in a recent study (EWI et al. 2004) coming to the conclusion that CO_2-emission reductions could be achieved much cheaper by realizing the efficiency gains associated with the replacement of older thermal units with new capacity (mainly highly efficient CCGTs) and upgrading existing thermal units instead of additional RES generation. In addition, unexploited reduction possibilities have been identified on the demand side: sectors such as housing could also reduce CO_2-emissions at lower costs.

Nevertheless, it has been pointed out that CO_2-emission reductions are not the only goal of the EEG. The second goal of the EEG, increasing the security of supply, is difficult to evaluate. However, from the perspective of both security of supply as well as depletion of finite resources, hard coal has to be considered as an alternative.[11] The international energy agency (IEA 2004) estimates world coal reserves to last for the next 185 years. In general, these reserves are located in politically relatively stable regions: more than one third of world coal reserves are located in OECD countries. In addition, hard coal is cheap to store (even though it takes significant amounts of space). On the other hand, high pollution, in particular CO_2-emissions, is the main disadvantage associated with electricity generation from hard coal. Another possible source to increase security of supply is nuclear power. While nuclear power is free of CO_2-emissions in addition, this technology suffers from severe disadvantages such as nuclear waste disposal and nuclear accidents. In addition, political acceptance for this technology is currently missing in Germany.

At this point, it becomes apparent that RES are competing with other technologies in the achievement of the aims formulated in the act. While security of supply could be relatively cheaply achieved by increasing the share of coal generation, this is in conflict with the goal of climate protection and the restriction of CO_2-emissions. Nuclear power could achieve both of these goals at the same time; however, at the price of the risks mentioned above. Demand side issues – the reduction of energy consumption in particular – have not been addressed additionally.

To sum up, the introduction of the EEG increased electricity prices considerably and will increase them even more in the future. In principle, these costs can be justified by the political aims of the act. However, we present some evidence, that the related aims could be reached with lower costs to electricity customers – in other words: more efficiently.

VI. CONCLUSION

Beginning with a presentation of the development of household electricity prices for the years from 1998 to 2004, we showed that aggregated prices in 2004 are in the same order of magnitude as in 1998 (-3%). However, we argued that such a general consideration might be misleading for two main reasons.

Firstly, the price development shows significant differences among the stages of the value chain. The generation prices experienced a considerable price reduction of about 32% but rose above the level of a competitive market in the years following 2001. Hence, we can draw a

[11] To be precise, we are not talking about domestic hard coal mining which has to be heavily subsidized but about electricity generation mainly based on imported coal.

mixed conclusion with respect to hypothesis one. Transmission and distribution tariffs declined much less (13%) and seem to increase again since 2004. The hypothesis of abusive network access charges cannot be rejected therefore. The decreases in generation and transmission/distribution prices have been mostly compensated by a significant increase in taxes and subsidies (+56%), which definitely supports hypotheses three and four.

Secondly, we stated that the underlying cost structure - the steep increase in hard coal prices in the generation market for instance - might have changed from 1998 to 2004. While such effects can be expected to level out over time, they can distort the comparison of a small period of observation. For these reasons, we analyzed the different price components at a detailed level.

The main result on the price development for generation is that there is evidence for a paradigm shift from average cost pricing to marginal cost pricing happened after liberalization. However, prices seem to have risen above marginal costs since the end of 2001. Strategic behavior causes a suboptimal dispatch and distorted investment signals. These translate directly into a loss of welfare. Nevertheless, this loss of welfare has to be compared with the loss of welfare which would result in a tighter regulated market.

The access tariffs to the transmission and distribution networks decreased rather slightly or even remained relatively constant. This – regarding the aims of competition policy unsatisfying - result can be attributed to a deficient set-up of the German regulatory scheme. The national NTPA design allowed the network operators to set their network tariffs without the risk of governmental intervention, as long as their Price was within the cheapest 70% of suppliers. In association with an almost perfect transparency on the supply side, such incentive caused cheap suppliers to increase their prices. Though expensive operators reduced their tariffs due to regulatory threat, the German way of electricity network regulation has to be considered to be unsuccessful. We suggested installation of a regulatory agency and the introduction of incentive regulation to increase competition in the retail market and to raise efficiency reserves in network operation.

Finally, we analyzed one of the major subsidies in the German energy market, namely the renewable energy act. After a description of this subsidy’s structure, we discussed whether the aims formulated in the act, namely climate protection, increasing the security of supply, restricting the consumption of finite resources and promoting technological progress in RES generation technologies, could be achieved more efficiently by other means. We found that every single aim could indeed be achieved in a more efficient way using other means; however, a deeper analysis is necessary to quantify the act’s contribution to all aims simultaneously.

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