How much cost-plus is in German cost-plus network charges

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1. Introduction

The 1998 German Energy Act introduced the right for all customers to choose their supplier. However, the Energy Act did not contain any specific rules for the regulation of network access, which was left to self-regulation by the industry. This self-regulation manifested itself in agreements of the major German industry associations of both the electricity supply industry and customers. These association agreements, German *Verbändevereinbarungen*, set the rules for the network charge calculation.

Basic approach for network charge calculation according to the Verbändevereinbarung was a rate of return regulation.[1] Network charges were calculated on the basis of the profit and loss statement (P&L) of the last year. All network related expenses (material, personal, etc.) were included in the network cost base. Depreciation of the P&L was replaced by a calculated depreciation on replacement costs. As the difference between P&L deprecation and calculated depreciation was subject to taxation, a further cost component to neutralise these taxes was added to the cost basis. Finally, an allowed 6,5% return on capital employed was included, calculated on basis of replacement costs of the assets.[2]

Although all network charges are calculated on a cost plus method following the same calculation rules, the resulting charges differ significantly (see figure 1). Accordingly, network charges have been subject to much debate when considering the German electricity market.

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1 See Annex 3 of the *Verbändevereinbarung über Kriterien zur Bestimmung von Netznutzungsentgelten für elektrische Energie und über Prinzipien der Netznutzung (VV2+)*, 13. Dezember 2001. The VDN (Association of Network Operators) also published a explanatory document Kommentarband Umsetzung der VV2+, Berlin, November 2001. Both documents are available on the VDN website www.vdn-berlin.de.

2 The system was changed July 2005 when the new Energy Act came into power.

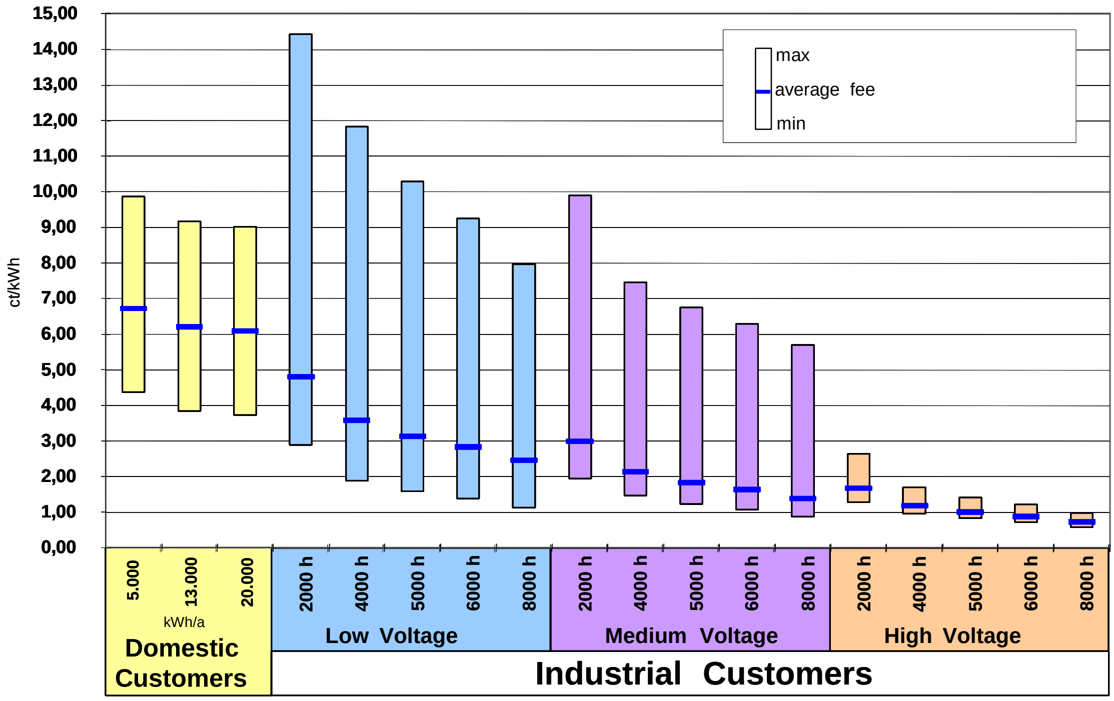

Figure 1: German network charges[3]

This article sets out to test whether German network charges are truly cost plus calculated by applying three basic tests. It should be noted that these tests are rough consistency checks at industry level, which do not aim to assess individual utilities. They build on certain circumstances and links that should hold true if network charges are cost plus calculated. There could be other reason for failure of these tests. Data problems being the first and obvious, as we are using published data only. Following the three tests this article discusses limits and conclusions of the three tests applied.

2. First test: Network charge and Standard Tariff

Network charges are not the only cost-plus calculated price in the German electricity supply industry. Before the 1998 liberalisation domestic end customer prices were calculated according to the *Bundestarifordnung Elektrizität* (Federal decree for electricity tariffs, BTO). After liberalisation, (incumbent) suppliers were free to other additional products and prices, however, the BTO remained in power. The BTO price is always the default price if no other things have been agreed. Around 70% of all customers are still on a BTO tariff.[4]

The BTO itself delegate the price setting to the German states. Accordingly all states issued a calculation method for the standard tariff. All these calculation methods are a rate of return regulation in principle, but differ in detail as attempts for a unified calculation method did not succeed. The main differences are related to the calculation of depreciation and allowed profits.[5]

3 Source EnBW Energie Baden-Württemberg AG, data for summer 2004. The network charges included are all published data, typically available from the website of the network operators.

4 Cmp. VDEW, Strommarkt Deutschland 2005 – Frühjahr, Zahlen und Fakten zur Stromversorgung, April 2005.

5 An overview and comparisons of different calculation methods in the German electricity supply industry can be found in G. Sieben, H. Maltry, Kalkulationsgrundlagen in der Energiewirtschaft Vol. 3,

Obviously, the network charge is a component of the domestic end customer price. Network charge and taxes form 80% of the average German domestic electricity price.[6] This suggests that domestic tariffs and network charge should be highly correlated. Hence, the first test is a correlation analysis of the network charge and the standard tariff according to BTO.

Approach and data used

For the year 2005 the actual standard tariffs and network charges for a household with a consumption of 3.500kWh have been researched for 685 of the around 900 incumbent electricity suppliers in Germany. All taxes and levies have been deducted, i.e. VAT, energy tax, concession fee and the levies for CHP and renewables. To minimise the impact from differing calculation methods, the correlation is tested on a state by state basis.[7]

Results and discussion

The result of the correlation analysis is given in table 1:

federal state	number of grid operators	Pearson correlation coefficient	F-Test
Baden-Wuerttemberg	102	-0,23	5,4
Bavaria	176	0,21	8,1
Brandenburg	19	0,25	1,1
Hessen	44	0,27	3,4
Mecklenburg-Western Pomerania	9	0,65	5,1
Lower Saxony	57	0,24	3,3
North Rhine-Westphalia	100	0,21	4,8
Rhineland-Palatinate	51	0,30	4,9
Saarland	17	0,02	0,0
Saxony	33	0,56	14,5
Saxony-Anhalt	19	0,21	0,8
Schleswig-Holstein	34	-0,21	1,5
Thuringia	24	0,15	0,5

Table 1: Correlation of network charges and standard tariff for the federal states

The results do not confirm the assumption of a correlation between standard tariff and network charge. Only for two states, Saxony and Mecklenburg-Western Pomerania a recognizable correlation can be confirmed. All other states have little to no correlation and furthermore these correlation are mainly statistical insignificant. Especially the analysis of Bavaria, Baden-Wuerttemberg and North Rhine-Westphalia, three states with the highest number of incumbent electricity suppliers, did not bring up the expected high correlation.

The difference between the network charge and the standard tariffs are the costs of energy sourcing, cost of retail and differences in the calculation method. Differences in the

Netznutzungsentgelte für elektrische Energie, 2nd edition, Frankfurt, 2003 and W. Pfaffenberger, et. al., Vergleich der Arbeitsanleitung nach §12 BTOElt mit dem Kalkulationsleitfaden nach Anlage 3 der Verbändevereinbarung II+, Bremer Energie Institut, October 2002.

6 Cmp. VDEW, Strommarkt Deutschland 2005 – Frühjahr, Zahlen und Fakten zur Stromversorgung, April 2005.

7 We excluded the town states Berlin, Bremen and Hamburg. As these states have only one incumbent electricity supplier a correlation analysis becomes meaningless.

calculation method have at least partly been accounted for by the state by state approach. By far the largest remaining component is the energy sourcing cost.

Around 80% of generation is in the hand of the four large generators RWE, EON, EnBW and Vattenfall. Hence the vast majority of the electricity suppliers are on-suppliers with little to no own generation. Electricity prices for on-suppliers as large customers are strongly linked to the wholesale price.[8] So remaining bits of own generation and different sourcing times and strategies could be one reason for different sourcing costs. However, as 20% difference in the wholesale price make only about 5% in the standard tariff, it could be questioned whether sourcing costs can explain the non-existence of correlation between network charge and standard tariff.

So while there are explanations for a disconnection of network charge and standard tariff, the failure to show any significant degree of correlation is surprising.

3. Second test: network charges of the same network owner

A network operator typically differentiates its network charge for voltage level (i.e. low, medium, high, highest), customers' meter arrangements (i.e. real time metering or load profiling) and demand characteristics (i.e. utilisation hours – typically above or below 2500 utilisation hours per year).[9] As all these different network charges are for connection to the same network, one could assume some correlation between them. For example, if a network owner has a very low network charge for domestic load profiled customers, then this would imply comparatively low costs in the low voltage network. Accordingly one would expect that the network charge for a real metered customer connected to the low voltage network should also be comparatively low.

Approach and data used

The German Association of Network Operators (*Verband der Netzbetreiber* – VDN) publishes a collection of network charges for about 500 network owners for the different customer types.[10] We also calculated an average network charge for the four groups of profiled, real metered low voltage, medium voltage and high voltage customers. The correlation of each network charge against every other has been tested with the Pearson correlation coefficient and the Spearman correlation coefficient.[11]

Results and discussion

The results with all possible combinations are listed in table 2. For each combination two values are given. The upper value is the Pearson and the lower value the Spearman coefficient.

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8 For example, the electricity price for large customers published by VIK is a generic ("artificial") price. The network component is derived from the average network charges of seven large network operators. The energy component of the price is based on the wholesale market price for electricity.

9 As recommended by the VV2+ (sources see above).

10 These customer types are load profiled customers with an annual demand of 1700 kWh/a, 3500 kWh/a, 30.000 kWh/a; real metered low voltage customers with 1600, 2500 and 4000 utilisation hours; medium voltage customers with 1600, 2500 and 5000 utilisation hours and high voltage customers with 2500, 4000 and 6000 utilisation hours.

11 W. Pfaffenberger et.al undertake a similar analysis in Anwendung der Vergleichsmarktanalyse auf die Netzunutzungsentgelte in der Stromwirtschaft, Bremer Energie Institut, März 2002. Their analysis was only assessing the correlation of different tariffs for the low voltage level, no correlation was found.

The network charges within the four groups of profiled, real metered low voltage, medium voltage and high voltage customers are highly correlated, with the notable exception of the network charge for customers with an annual demand of 30.000 kWh/a. This was to be expected, as these prices are all calculated from the same (typically) two price components (fixed charge, capacity related for real metered customers, and per unit charge). The weak correlation for load profiled customers with 30.000 kWh/a can be explained by the fact that the fixed charge becomes insignificant at these demand levels.

Between the medium and high voltage network charges a significant correlation can be shown. Also, there is a strong correlation between network charges medium voltage and real metered low voltage customers. Between the network charges for high voltage and load profiled low voltage customers the correlation is recognisable lower. Especially the network charge for the high voltage demand of 2.500 h/a has statistically insignificant correlations with the low voltage network charges especially for the Spearman correlation coefficient. The network charge for load profiled low voltage show no significant correlation to other voltage groups. Even the correlations within the low voltage level (load profiled against real metered) are relatively low.

The analysis shows that there are indeed significant correlations. However, the weak correlation between load profiled and real metered low voltage customers comes as a surprise. As it is the same voltage level one would have assumed a strong correlation of these network charges. The insignificance of the high voltage charge for a demand of 2.500 h/a could be explained ba the lower number of high voltage grid owners. But on the other hand the results of other high voltage charges show no insignifiance.

			low voltage / load profiled customers				low voltage				medium voltage				high voltage			
		Pearson / Spearman	1.700 kWh	3.500 kWh	30.000 kWh	Average	1.600 h	2.500 h	4000h	Average	1.600 h	2.500 h	5.000 h	Average	2.500 h	4.000 h	6.000 h	Average
low voltage / load profiled customers	1.700 kWh	Pearson	1	0,898	0,582	0,909	0,477	0,456	0,416	0,469	0,402	0,375	0,440	0,416	0,494	0,520	0,445	0,520
		Spearman	1	0,856	0,456	0,874	0,450	0,411	0,391	0,429	0,396	0,366	0,433	0,404	0,398	0,392	0,350	0,395
	3.500 kWh	Pearson	0,898	1	0,871	0,997	0,454	0,432	0,350	0,431	0,457	0,446	0,466	0,473	0,568	0,584	0,504	0,592
		Spearman	0,856	1	0,830	0,999	0,456	0,410	0,325	0,412	0,494	0,477	0,496	0,502	0,447	0,452	0,440	0,455
	30.000 kWh	Pearson	0,582	0,871	1	0,867	0,305	0,283	0,180	0,271	0,394	0,398	0,369	0,406	0,398	0,363	0,319*	0,394
		Spearman	0,456	0,830	1	0,809	0,345	0,305	0,169	0,288	0,460	0,461	0,415	0,464	0,501	0,480	0,428	0,504
	Average	Pearson	0,909	0,997	0,867	1	0,452	0,427	0,349	0,429	0,452	0,439	0,463	0,467	0,521	0,525	0,453	0,538
		Spearman	0,874	0,999	0,809	1	0,457	0,411	0,331	0,415	0,488	0,469	0,494	0,496	0,421	0,418	0,371	0,421
low voltage	1.600 h	Pearson					1	0,959	0,823	0,969	0,620	0,579	0,539	0,610	0,438	0,621	0,593	0,549
		Spearman					1	0,967	0,811	0,969	0,698	0,673	0,650	0,701	0,260**	0,555	0,513	0,391
	2.500 h	Pearson					0,959	1	0,889	0,988	0,590	0,597	0,558	0,608	0,405	0,592	0,559	0,516
		Spearman					0,967	1	0,872	0,987	0,654	0,663	0,641	0,676	0,227**	0,537	0,501	0,359
	4.000 h	Pearson					0,823	0,889	1	0,931	0,421	0,421	0,538	0,465	0,147**	0,445	0,407	0,297**
		Spearman					0,811	0,872	1	0,921	0,465	0,469	0,598	0,513	0,035**	0,424	0,384	0,191**
	Average	Pearson					0,969	0,988	0,931	1	0,572	0,559	0,566	0,588	0,347	0,570	0,537	0,473
		Spearman					0,969	0,907	0,921	1	0,640	0,635	0,654	0,662	0,191**	0,531	0,494	0,335*
medium voltage	1.600 h	Pearson									1	0,966	0,797	0,980	0,704	0,703	0,705	0,744
		Spearman									1	0,970	0,836	0,984	0,628	0,597	0,613	0,637
	2.500 h	Pearson									0,966	1	0,828	0,986	0,696	0,702	0,713	0,741
		Spearman									0,970	1	0,850	0,986	0,586	0,586	0,636	0,611
	5.000 h	Pearson									0,797	0,828	1	0,887	0,381	0,570	0,607	0,505
		Spearman									0,836	0,850	1	0,904	0,272*	0,521	0,578	0,393
	Average	Pearson									0,980	0,986	0,887	1	0,647	0,697	0,711	0,712
		Spearman									0,984	0,986	0,904	1	0,536	0,592	0,638	0,532
high voltage	2.500 h	Pearson													1	0,818	0,785	0,959
		Spearman													1	0,758	0,754	0,950
	4.000 h	Pearson													0,818	1	0,927	0,942
		Spearman													0,758	1	0,934	0,907
	6.000 h	Pearson													0,785	0,927	1	0,917
		Spearman													0,754	0,934	1	0,893
	Average	Pearson													0,959	0,942	0,917	1
		Spearman													0,950	0,907	0,893	1

r < 0,5 — 0,5 <= r <= 0,75 — r > 0,75 — ** not significant — * significant with α=0,0

Table 2: correlations of network charges at different voltage levels and utilisiation hours

4. Third test: network charges and network area parameters

The structure of a network has a significant influence on the costs of the network service. For example, the nature of electricity networks as natural monopolies would lead to the expectation that network costs and hence network charges are negatively correlated to population density. The question which parameters are significant cost drivers has gained some importance in Germany. These parameters should be included in efficiency benchmarks within an incentive regulation regime due to be introduced beginning 2007.[12]

The complexity of the question of parameters and their influence on network costs is severe. Hence we focus only on those parameters where a clear link to network costs can be made.

- Population density: Measured on basis of total network area and settlement area within the network area. Also we tested the correlation between the ration of settlement area to total network area against network charge.

- Wages paid in the industry: Labour is a significant cost factor of production for all network owners.

- Gross Domestic Product per citizen and per employee: A relatively larger gross domestic product per head implies more energy use and hence the larger economies of scale in electricity networks.

The analysis can be biased by correlation without causation and combined correlation of several factors.

Approach and data used

To avoid at least the bias caused by the differences in eastern and western Germany only the western network operators have been analysed. We used data published by the Federal Office for Building and Regional Planning (*Bundesamt für Bauwesen und Raumordnung*) that gives a number of data broken down on community level.[13] Based on a list that attributes communities to network areas, average figures for parameters of network owners could be calculated. The correlations of these parameters were then tested against the network charge of a domestic customer with an annual consumption of 3500 kWh/a.

Results and discussion

The analysis showed that there are significant but mainly weak correlations (table 3).

parameters	correlation	F-Test
population density	-0,25	38,6
population density of the settlement area	-0,17	17,9
settlement area to network area	-0,22	28,8
Wages in the industry	-0,14	11,6
GDP per citizen	-0,11	7,4
GDP per employee	-0,13	9,8
tax income per citizen	-0,15	13,3

Table 3: correlations network charges and structural parameters

[12] Cmp. Frontier Economics / Consentec, Netzpreisaufsicht in der Praxis – Gutachten für VIK und BDI, October 2003; W. Fritz, C. Zimmer, Bedeutung von Struktureinflüssen beim Netzbenchmarking, in Energiewirtschaftliche Tagesfragen, Vol. 54, Nr. 5, p. 320 – 323.

[13] Bundesamt für Bauwesen und Raumordnung, INKAR Datenbank 2004, CD-Rom.

All tested parameters show a weak, negative correlation with the “classical” population density being the highest one. This in itself supports the cost plus notion, however it comes as bit of a surprise as population density of the settlement area is generally regarded to be the “better” structural parameter.[14] But this assumption could not be affirmed with the data at hand. Also the proportion of settlement area has in comparison to the overall results a high correlation.

Economic parameters have an even lower correlation than structural ones. Figure 1 shows the correlation of wages and network charges, which is negative. This might be surprising as labour costs are a direct component of network charges and a positive correlation would have been more in line with expectation. However, as figure 1 shows the data has to be treated with care: Network operators at the observed borders, although they are no outliers, define the correlation. The main body of observations forms a great scatter plot without any noticeable correlation. The absence of a positive correlation could perhaps be explained by a combined correlation of several factors. The wages are correlated with the general economic efficiency of an area which in turn should be correlated to higher industrial demand and therefore a more efficient network operation. A combination of such dependences can lead to an unexpected correlation like the one observed, even though the correlation is too small to draw any secured assumptions.

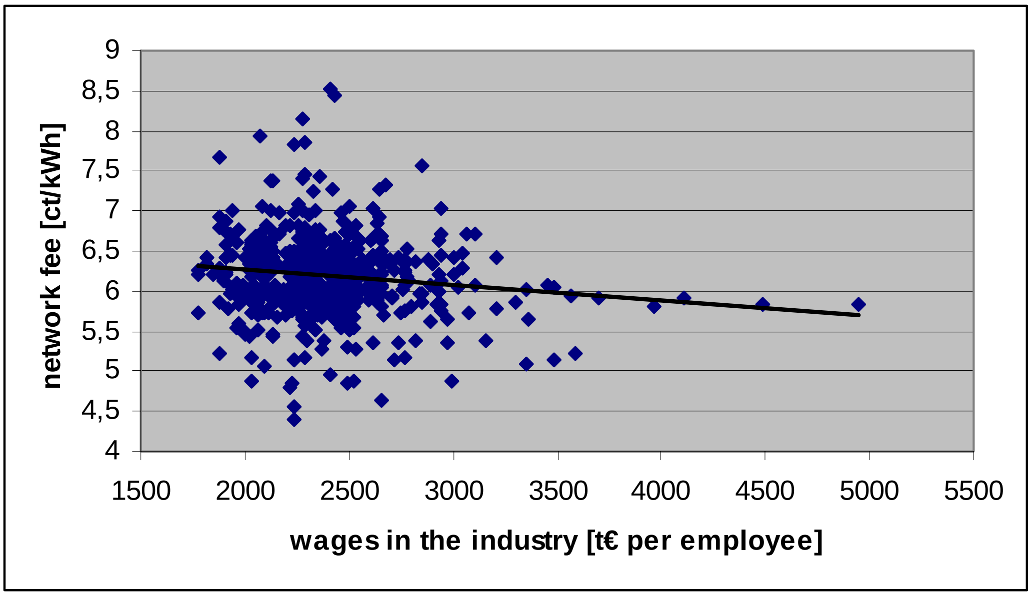

Figure 1: wages and network charge

Since the network charge is influenced by more than one parameter we also undertook multidimensional correlation analysis’s. None could yield significantly better results than the simple two-dimensional ones given in table 3.[15]

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14 For example, the Association Agreements as well as the new Decree for network charge calculation include population density on settlement area as one structural parameter to be considered when comparing network charges.

15 For example, the population density of the settlement area, the proportion of settlement area and the GDP per employee were chosen as three independent parameters. Since none of these factors has a correlation higher than 0,33 with any of the other factors, the assumption of independence is justifiable. The analysis resulted in a determination coefficient of 0,07, which is only slightly higher than the ones obtained in the

The conducted analysis shows that there is a very slight correlation of structural and economic parameters with network charges. Although a linear trend can be affirmed in most cases, the degree of correlation is close to zero, thus making it practically impossible to forecast any network charge with the structural parameters of the network area. For this reason the assumption of a correlation between network charges and cost influencing parameters seems to be week.

5. Conclusions

The three tests do not offer a straight-forward easy answer to question whether German network charge are cost plus calculated or not. The network charge does not show any correlation to standard tariffs, also cost plus calculated. Network charges for real metered customers show correlations, but the correlation between load profiled and real metered low voltage customers is weak, although both customers are connected to the same network. Structural and economic parameters show a weak correlation.

One obvious conclusion would be that the tests undertaken within this short discussion paper are too superficial and need to be more in-depth. The authors agree that this could be argued for the third test. However, the first and the second tests have comparatively little problems (data published by the incumbent supplier and network owner, i.e. the same company; in both cases the data can be applied without difficult adjustments; in both cases the data is only used for the same company). This makes these tests probably more telling and it is of particular interest that especially the first test failed completely.

Another explanation could be that the calculation method for network charges offers a considerable degree of freedom. Hence network charges are cost plus calculated in principle, but in effect streamlined for other purposes. This would explain the failure of test 1 – every network owner optimises its network charge for different purposes, the "just passed" of test 2 – within one network owner, the network calculation has some consistency and the weak correlations of test 3 – some weak cost dependency still shows up. If this reasoning holds, then "cost plus" only is the label, not the nature of German network charges.

The future of the German electricity supply industry is most likely to provide an answer: With the new Energy Act the calculation method is now defined by law with less degrees of freedom. Network charges are now controlled ex ante by the regulator. This should bring some standardisation into the network charge calculation. It remains to be seen whether it changes the overall picture.

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single case analysis. The explanatory potential of these combined factors is nearly as high as the potential of the population density alone.