Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

Windfall profits of German electricity producers in the second phase of the EU Emissions Trading Scheme (2008-2012)

Briefing Paper

for

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Dr. Felix Chr. Matthes

Öko-Institut e.V.

Berlin Office
Novalisstraße 10
D-10115 Berlin
Tel.: +49-(0)30-280 486-80
Fax: +49-(0)30-280 486-88

Freiburg Head Office
Merzhauser Straße 173
D-79100 Freiburg i.Br.
Tel.: +49-(0)761-45 295-0
Fax: +49-(0)761-45 295-88

Darmstadt Office
Rheinstraße 95
D-64295 Darmstadt
Tel.: +49-(0)6151-81 91-0
Fax: +49-(0)6151-81 91-33

www.oeko.de

Contents

List of figures

List of tables

1 Introduction and background

With the introduction of the Emissions Trading Scheme for greenhouse gases in the European Union in 2005, the economic basic conditions for electricity production in the EU changed significantly. Alongside fossil fuels, capital, personnel, operation and maintenance as traditional cost items, the carbon dioxide (CO_2) emissions of electricity production plants also have to be taken into account in cost terms from now on. Within the scope of the EU ETS, the power plant operators have to surrender the corresponding amount of emission allowances (European Union Allowances – EUA) for their CO_2 emissions for the previous year to the responsible authority[1]. If the required amount of emission allowances for each previous year has not been submitted by the end of April of the following year at the latest, a fine has to be paid. In the case of a fine, however, the operators still have to hand in the required emission allowances.

The total quantity of available emission allowances for all of the European Union is limited; the emission allowances are tradable. If the quantity of the available emission allowances falls short of the expected demand, a shortage arises and the emission of CO_2 takes on a price within the emission allowance market. The pricing of CO_2 emissions for the energy industry and other energy-intensive industries that was intended during the introduction of the EU ETS is therefore taking place via a pricing process on the emission allowance market.

The EU ETS, which began in January 2005, is based on fixed trading periods; the key rules of the systems are laid down in the EU Emissions Trading Directive:

- In the first two periods of the EU ETS (2005-2007 and 2008-2012) the overall number of emission allowances that are to be allocated (and therefore the cap of the permissible CO_2 emissions) is established in the so-called National Allocation Plans (NAP) of the Member States, as are the rules according to which the emission certificates are to be allocated to the individual plants (the NAP has to be approved by the European Commission).
- In the first period, at least 95% - and in the second period at least 90% - of the emission allowances that are available in total have to be allocated for free, whereby the extent of free allocation to the individual industry branches or plants can vary.
- The fine that is due in the case of late surrender of the emission allowances amounts to 40 € per tonne CO_2 (t CO_2) in the first period and 100 €/t CO_2 in the second period.

With the introduction of the EU ETS (i.e. the market pricing of CO_2) and the predominantly free allocation of emission allowances, substantial windfall profits have arisen,

[1] In Germany, this is the German Emissions Trading Authority at the Federal Environment Agency (Deutsche Emissionshandelsstelle (DEHSt) im Umweltbundesamt (www.dehst.de)).

above all in the context of electricity production. This is because the CO_2 costs on the competitive electricity markets are passed through to the wholesale electricity price. The revenues from electricity production thereby increase although the required emission allowances are predominantly allocated to the operators for free.

In the scope of this brief analysis windfall profits are understood as those additional profits which arise from the difference between the (additional) electricity revenue induced by the EU ETS and the real costs for the purchase of emission allowances.

The objective of this short analysis is to provide an estimate of the windfall profits for a selection of German electricity producers for the second period of the EU ETS (2008-2012). After the pricing mechanisms on competitive electricity markets are addressed in Chapter 2, the basic data for the analysis will be compiled in Chapter 3. In Chapter 4 the calculation results of the windfall profits will then be presented and analysed.

The analysis covers the five largest German electricity production companies: E.ON, RWE, Vattenfall Europe, Energie Baden-Württemberg (EnBW) and Evonik Steag as well as the electricity production of these companies in Germany. The windfall profits of these companies on other European sub-markets are therefore not taken into account in the following analysis.

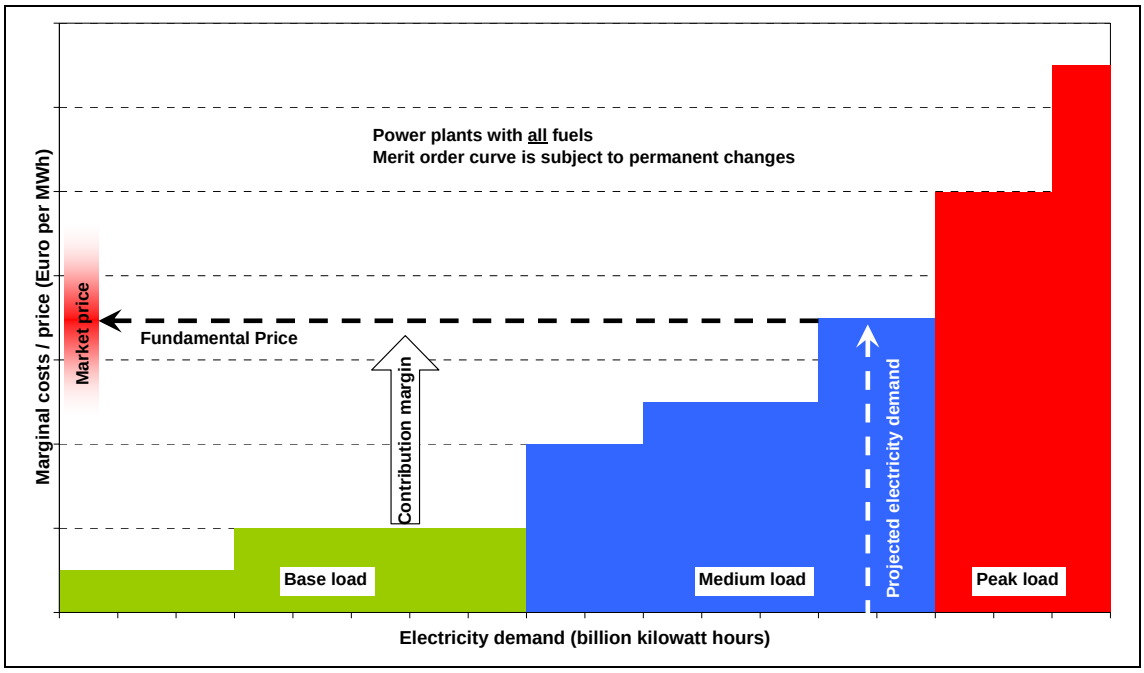
The goal of the analysis is, amongst other things, to determine the share of the total windfall profits that stems from the free allocation of emission allowances, the continuation of which for the time period after 2012 is currently being vehemently called for by German electricity producers (amongst others). In this way, the question of the scale of the profit orientation that lies behind the demand for free allocation of CO_2 allowances can also be pursued.

2 Pricing mechanism on competitive electricity markets

With the liberalisation of German electricity market, the pricing of electricity on the wholesale level has fundamentally changed. Whilst the prices were established on the basis of the average costs of electricity production in the regulated monopoly market, pricing in the liberalised electricity market takes place on the basis of the short-term marginal costs of electricity production.

The marginal costs denote those costs which would additionally arise if the electricity demand were to rise by one unit (marginal unit).

Figure 1 Pricing of marginal costs



Source: Öko-Institut

Figure 1 represents the principle of marginal cost pricing on the wholesale electricity market. In the case of a given (predicted) demand[2], the marginal costs of the generation unit that is next in line to be used in order to fulfil the demand make up the basic market price. The ranking of the power plants according to their marginal costs is referred to as the *merit order*.

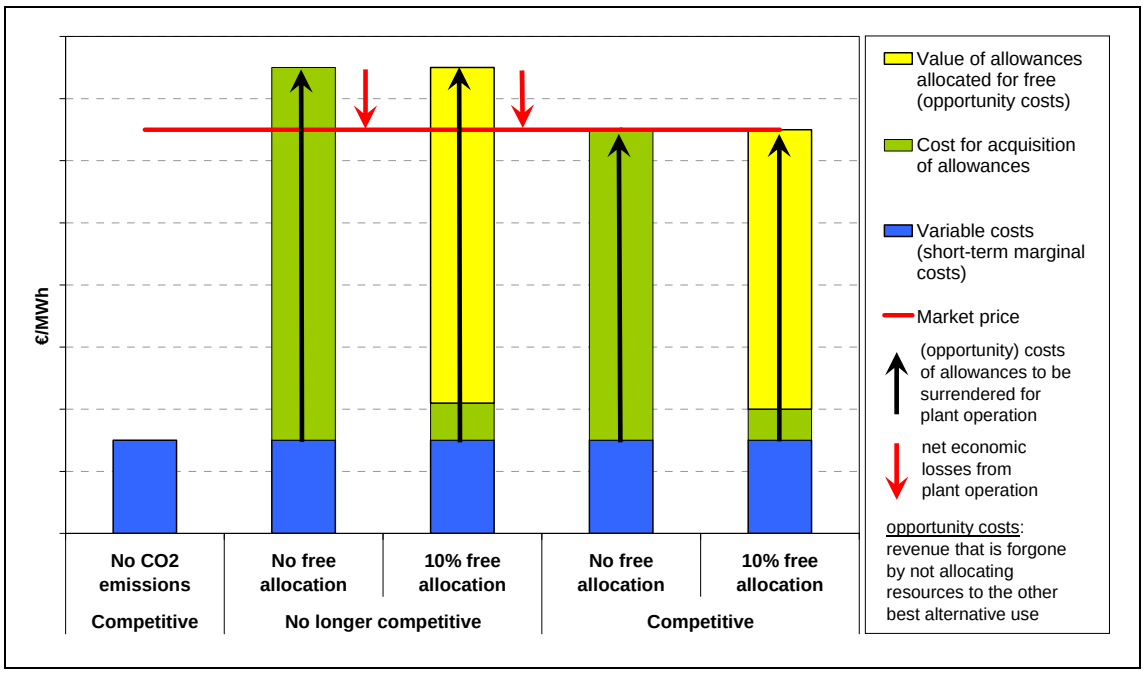
In principle pricing on the electricity markets is based on short-term marginal costs, i.e. the additional costs for the production of additional electricity. For the area of electricity production the short-term marginal costs up to the introduction of the EU Emissions

[2] The expected demand can also take into account the reaction of demand to the changed electricity price. The price elasticity of demand is not considered further in this analysis for simplification purposes.

Trading Scheme consisted above all of fuel costs. The last plant used (the so-called marginal generation unit) is thereby in a position to cover its fuel costs. If the market price lies below these costs, there would be no economically feasible reason for operating the power plant. Should the market price lie above the short-term marginal costs of a power plant, so-called contribution margins arise. These contribution margins can be used to cover fixed operation costs, to re-finance investments and to make profits.

With the introduction of EU Emissions Trading Scheme, an additional cost component arises for the short-term marginal costs of electricity production. Alongside the fuel costs, the costs for CO_2 emissions stemming from electricity production also have to be covered from now on. Therefore, if an electricity production plant cannot generate the costs for the required fuel and emission allowances via the market price for electricity, it will not be possible to operate it. Since this is of course also the case for the marginal generation unit that determines the market price, the market price for electricity increases through the introduction of the Emission Trading Scheme by the contribution that the marginal generation unit has to make for the emission allowances (pricing of CO_2 costs).

Figure 2 Consideration of opportunity costs for power plant operation and marginal cost pricing



Source: Öko-Institut

Against the background of the fact that a large share of the emission allowances are allocated for free in the first two periods of the EU Emissions Trading Scheme, the question arises as to what effect the emission allowances allocated for free have on electricity pricing (see also Figure 2):

- If no free emission allowances are available for the production of the marginal generation unit, the costs for the purchase of the necessary emission allowances have to be applied. The short-term marginal costs of electricity production thereby include the full market price for emission allowances. A plant which can realise its fuel costs as well as the (real) costs for the purchase of the required CO_2 allowances via the market price for electricity can be operated economically. If this plant sets the market priceas the marginal generation unit, the market price for electricity includes the full CO_2 costs (of the marginal generation unit).
- If free emission allowances are available for the production of the marginal generation unit, the question arises for the plant operator as to whether he uses the freely allocated CO_2 allowances for electricity production or rather does without the additional electricity production and sells the emission allowances on the market, thereby reaping additional revenue. The plant operator can then only economically operate his power plant when he obtains a price above the electricity price which also covers the market value of CO_2 allowances – even if emission allowances are allocated to him for free. Alongside the real costs for CO_2 allowances, the opportunity costs (i.e. lost revenue for alternative use) of the freely allocated emission allowances are also taken into account in the decision as to whether a power plant can be economically operated on the market or not. Since this is also the case for the marginal generation unit, the market price for electricity also includes the full CO_2 costs also in the case of the free allocation of emission allowances.[3]

In summary the full CO_2 costs have to be continually taken into account in the context of electricity pricing on the wholesale market, irrespectively of whether free emission allowances have been made available to the operator of the marginal generation unit or not.

[3] This only exception is in the case when the free CO_2 allowances are allocated on the condition that the plant is operated and the allowances are acquired in another way. The alternative use of emission allowances is not possible in this case (selling them on the market); the opportunity costs are therefore zero. However, these so-called *ex-post* adjustments eliminate the intended steering effect of the Emissions Trading Scheme (see Öko-Institut et al. 2005), have not therefore been approved by the European Commission, for example for Germany, and are currently no longer being pursued.

3 Basic data for the analysis

For the analysis of the windfall profits for electricity producers arising on the one hand from the full pricing of CO_2 costs in the electricity price and on the other hand from the substantial free allocation of emission allowances, the following data and assumptions are necessary:

- data on electricity production of the different companies (in Germany) differentiated according to electricity production based on fossil fuels (lignite, hard coal, mineral oil products, natural gas) and carbon-free electricity production based on nuclear energy, hydroelectric power (as well as other renewables);
- data on the CO_2 emissions from fossil fuel-based electricity production;
- assumptions on the free allocation of emission allowances;
- assumptions on the price development of emission allowances in the EU; and
- assumptions on the pricing of CO_2 costs on the wholesale electricity market.

Table 1 Electricity production and CO_2 emissions of German electricity producers, 2006

	Electricity generation								CO_2 emissions
	Total	Nuclear	Hydro	Fossil fuels				others	
				total	Lignite	Hard coal	Gas / oil		
	TWh								mln t
E.ON	121	63	7	46	9	33	5	4	54
RWE	148	47	3	98	68	20	10	-	118
Vattenfall Europe	93	16	4	72	59	9	4	1	77
EnBW	60	35	4	20	---------- 20 ----------			-	19
Evonik Steag	33	-	-	33	-	32	1	-	32
Total	456	161	19	270	155	95	19	6	301
Note: Owing to rounding, the values and totals may not always correspond.									

Source: Company data, calculations and estimations by Öko-Institut

In Table 1 the data for the different electricity producers in terms of electricity production in Germany and the corresponding CO_2 emissions available for the present analysis are compiled. The following data sources were used:

- The data on E.ON were drawn from the “Strategy & Key Figures 2007” (E.ON 2007); the CO_2 emissions were calculated based on data for the total electricity production in Germany and on the specific CO_2 emissions of the total electricity production.
- The data on RWE are taken from “Facts & Figures 2007 (October 2007 update)” (RWE 2007); all data refer solely to RWE’s own power plants and not the electricity delivery from contracted plants.
- All data regarding the German electricity production of Vattenfall Europe are extracted from the “Corporate Social Responsibility Report 2006” (Vattenfall 2007).

- The data on electricity production or on its structure are partly contradictory in the different publications of EnBW and its parent corporation, EdF. The data on electricity production are based on the known electricity production of the power plants of EnBW (BfS 2008); the corresponding production volume was re-calculated using additional company data on the structure of electricity production in Germany (Zimmer 2008). The data on CO_2 emissions were taken from the Sustainability Report (EnBW 2007).
- For the electricity production plants of Evonik Steag, the electricity production data for 2006 are based on the plant-specific company data (Evonik Steag 2008); the CO_2 emission data were determined on the basis of the emissions data in the Community Independent Transaction Log (CITL) of the EU in which the verified operator data for the EU ETS are summarised.

In total the electricity producers considered here cover more than 80% of the German electricity production as well as more than 80% of the CO_2 emissions from electricity production plants in Germany.

The structure of the electricity production is very varied. Whilst E.ON and EnBW realise the predominant share of their electricity production by using nuclear power plants, the electricity production of RWE, Vattenfall Europe and Evonik Steag is predominantly (although with different shares) based on fossil fuels, i.e. coal-fired power plants.

With regard to the degree of free allocation, only exploratory estimates could be undertaken to date[4]:

- RWE has stated that approx. 50% of the necessary emission allowances in the second period of the EU ETS are allocated for free (RWE 2007).
- For E.ON, EnBW and Evonik Steag, an average share of free allocation amounting to 65% (a conservative estimate[5]) can be derived on the basis of the power plant park – which is dominated by hard coal-fired power plants – and the aggregated data of the German Emissions Trading Authority on the results of the allocation process for the second period of the EU ETS (DEHSt 2008).

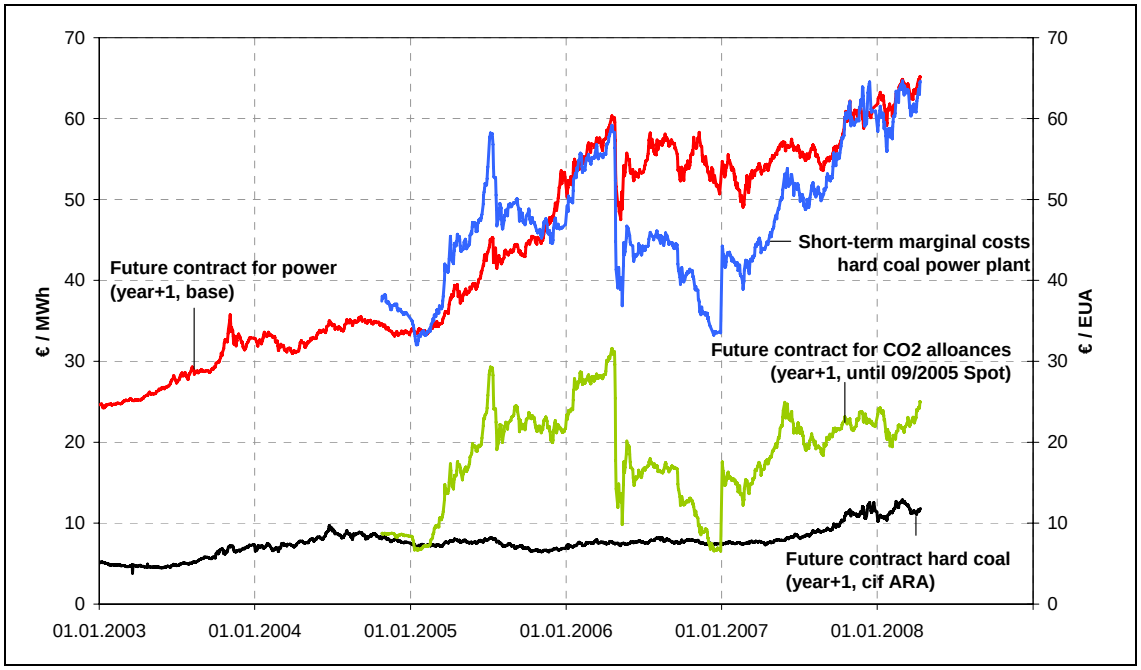
[4] The mentioned scope of free allocation differs from that which encompasses all plants covered by emissions trading, being 90% and 95% overall respectively (see Chapter 1). This is because the industry sectors that are not to be classified under electricity production enjoy very extensive free allocation; the overall emission reductions and the necessary provisions for new entrant allocations as well as the allowances earmarked for auctioning are to a large extent carried by the free allocations for the electricity producers. The differences between the individual companies arise from the different allocation rules (relating to fuel, age and previous performance) for the individual power plants.

[5] An assumption of the share of free allocation on the lower margins of the estimable range tends to lead to a lower estimate of the windfall profits; against this background it is regarded as “conservative” for the purposes of this brief analysis.

- For Vattenfall Europe, a conservative estimate for the average free allocation of 60% results from the inventory of comparatively modern lignite-fired power plants and the known overall results of allocation for the 2008-2012 period.

Figure 3 shows the path of the forward prices for electricity, hard coal and CO_2 allowances in the period from 2003 to 2008. Since a multitude of short-term influences (outside temperature, wind, short-term market trend in the trans-European electricity trade, etc.) underlie the spot markets, all price developments for the delivery in each following year are shown since the short-term "disturbances" only play a secondary role.

Figure 3 *Development of forward prices for base load electricity delivery, hard coal, CO_2 allowances and the electricity production of a representative marginal generation unit, 2003 to 2008.*



Source: European Energy Exchange (EEX), McCloskey Coal, European Central Bank, calculations by Öko-Institut

The overview first of all makes clear that the prices for emission allowances are currently developing towards a level of 25 €/EUA. The calculations presented in the following are based on this level.

Furthermore, the summary shows that, at least for the period from the beginning of 2005 to April 2006 and since September 2007, the short-term marginal costs of a hard coal-fired power plant with a capacity utilisation (load factor) of approx. 34% (i.e. spe-

cific emission sof 995 g CO_2/kWh) describe the path of base load electricity prices relatively well.[6]

A basic explanation for the substantial deviations between the price development for electricity and other price-determining factors (also for natural gas, etc.) is not identifiable. As a consequence it is assumed in this context that it was apparently possible, following the strong price fluctuations on the markets for CO_2 allowances, for the electricity producers to make basically unsubstantiated windfall profits in a transitional period.

If it is assumed that for base load deliveries in the next 5 years a CO_2 price share that corresponds to a power plant with specific emissions of 995 g CO_2/kWh is to be applied; and that the electricity production of the companies considered here is also assumed to cover the base load segment up to approx. 80%[7]; and that in the peak load segment the CO_2 price share is predominantly based on the specific emissions or a natural gas turbine[8], it can be roughly assumed that a CO_2 component is included in the relevant mix of the wholesale price for electricity. In this regard, an electricity production of approx. 900 g CO_2/kWh can be considered representative.

The development of electricity prices on the wholesale market in Germany is strongly influenced – at least for the segment of electricity producers considered in this analysis and for the years ahead – by the development of the short-term marginal costs of the conversion of hard coal into electricity. Higher prices for hard coal and higher prices for CO_2 allowances – as well as a development in the other direction – will have significant effects on the development of electricity prices for the consumers as well as on the revenues of the electricity producers.

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[6] Alongside the above-mentioned price paths for CO_2 allowances and hard coal deliveries to the ARA harbours (Amsterdam, Rotterdam, Antwerp), average transport costs for the delivery of hard coal to the power plant, amounting to 1.71 €/MWh, are also assumed, as are average specific CO_2 emissions for hard coal of 94 t CO_2/TJ.

[7] This exploratory assumption is a rough estimate, drawn from the share of electricity production from nuclear energy, hydropower and lignite as well as a third of the electricity production in hard coal-fired power plants.

[8] For a gas turbine used for peak load coverage, a capacity utilisation (load factor) of 38% is applied, resulting in a specific CO_2 emission of approx. 530 g CO_2/kWh.

4 Windfall profits of German electricity producers in the scope of the second period of the EU ETS

In Table 2 the estimates are shown regarding the total requirement of emission allowances, the necessary purchase of CO_2 allowances, additional revenue accrued through the pricing of CO_2 costs on the wholesale market as well as additional profits that thereby arise for the electricity producers under consideration in this analysis.

For the second period of the EU ETS (2008-2012) annual average additional profits of approx. 7 billion € arise. As a result of the predominantly free allocation of CO_2 allowances, additional profits of around 3 billion € arise annually; windfall profits of approx. 4 billion € come about annually by means of the additional electricity revenue of CO_2-free electricity production plants that already exist (above all nuclear and hydro power plants). E.ON reaps the lion's share of these additional profits, taking almost a third of the windfall profits; RWE acquires in this case a little more than a quarter. Vattenfall Europe, EnBW and Evonik Steag account for shares of 19%, 17% and 7% respectively.

Table 2 Estimation of annual windfall profits in the scope of emissions trading, 2008-2012

	Allowance needs	Necessary purchase of CO_2 allowances		CO_2-costs pass-through	Annual windfall profit	
						of this CO_2-free sources
			at 25.00 €/EUA	at 0.9 kg CO2/kWh		
	mln EUA/a		mln €/a	mln €/a		
E.ON	54	19	471	2,718	2,247	1,575
RWE	118	59	1,475	3,335	1,860	1,141
Vattenfall Europe	77	31	775	2,102	1,327	442
EnBW	19	7	166	1,358	1,192	881
Evonik Steag	32	11	284	751	467	0
Total	301	127	3,171	10,263	7,092	4,039
Note: Owing to rounding, the values and totals may not always correspond.						

Source: Calculations by Öko-Institut

On the basis of these annual levels the total volume of windfall profits amounts to approx. 35.5 billion € in the 2008-2012 period for the electricity producers considered here. Of this total, E.ON reaps approx. 11 billion €, RWE approx. 9 billion € and Vattenfall Europe 6.6 billion €. For EnBW the expected windfall profits in the 2008-2012 period amount to almost 6 billion € and for Evonik Steag approx. 2.3 billion €.[9]

[9] Against the background of the fact that a considerable share of the windfall profits is accounted for by the additional revenue from electricity production in nuclear power plants, the question arises as to what effect the closure of nuclear power plants necessitated by the German Federal Atomic Energy Act (Atomgesetz) of 2002 in the scope of the scheme for nuclear phase-out will have. For E.ON windfall profits amounting to approx. 550 million € would be cancelled out for the overall 2008-2012 period on the basis of the expected shut-

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downs of nuclear power plants. For RWE approx. 560 million € and for Vattenfall Europe approx. 315 million € and for EnBW almost 130 million € would disappear. The total windfall profits would only be slightly reduced by the planned German scheme for the closure of nuclear power plants in the 2008-2012 period.