RECerT

The European Renewable Electricity Certificate Trading Project

Work Package 3:

Cost-Benefit Analysis

Final Report

Wolfgang Bräuer and Isabel Kühn

Zentrum für Europäische Wirtschaftsforschung (ZEW)
Center for European Economic Research
P.O. Box 10 34 43, D-68034 Mannheim, Germany
braeuer@zew.de, kuehn@zew.de, http://www.zew.de

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1 INTRODUCTION

This paper is the outcome of work package 3 within the RECerT project (The European Renewable Electricity Certificate Trading Project), a project partly funded by the European Commission. It is closely linked to RECerT work package 1.4 for which the authors came up with first rough estimates of the potential size and monetary value of a Tradable Green Certificates (TGC) market in the European Union (cf. Bräuer / Kühn 2000). The entire RECerT project has a focus on the instrument of green certificate trading as a means of accelerating the deployment and use of renewable sources of energy (RES) in the electricity sector. RECerT was designed to assess TGC_{el} policies and to disseminate the TGC_{el} idea in the EU.

The objective of this document is to elaborate on the costs and benefits of a European-wide TGC_{el} system in comparison to (isolated) national systems and alternative support schemes for RES – other things (as deployment targets etc.) being equal. In section 3, we make a quantitative cost-benefit analysis based on the model which was developed under Task 1.4. In sections 4 and 5, the cost-benefit analysis is qualitative only, as the cost and benefits discussed there are not quantifiable, are difficult to quantify or could not be quantified within the scope of the project. Section 2 briefly introduces the Task 1.4 model and the reference scenarios.

2 REFERENCE SCENARIOS AND METHODOLOGY

The basic data used for the calculations below has been derived from a small number of earlier surveys of estimates of the technical and market potential for different sources of renewable electricity (RES-E) in each EU-15 country. Electricity market projections for EU-15 have been taken from the Commission's Shared Analysis Project. Estimations of the price development for electricity have been drawn from Schlesinger/ Schulz (2000) as well as Dany et al. (2000). Based on the available information, TGC_{el} price-potential curves for each Member State as well as an aggregated curve for EU-15 have been developed. The base year is 1995.

For the TGC_{el} market modelling, we assume that there is only one generic green certificate product, i.e. only one single market develops. Further simplifying assumptions are that there are no trade barriers or other market distortions as e.g. additional promotion schemes for renewable electricity, or upper and lower price limits, i.e. we are in an ideal economic world. Moreover, only renewable energy plants (including large hydro, excluding waste) built after the base year 1995 are eligible for green certificates. Finally, the view we take is mainly static. Production cost effects due to economies of scale or technological progress have been integrated exogenously as averages in the periods 2001-2005 and 2006-2010. Also, the commodity prices are assumed to change in these two periods. Thus, the derived cost-potential curves change in the course of time.

For further details on the model data, assumptions and methodology, please, refer to RECerT Task 1.4 report (Bräuer / Kühn 2000).

For the following comparison of RES-E support policies, we assume that they are designed and implemented to fulfil the RES-E targets set in national legislation and energy pro grammes (cf. Table 1).

Table 1: National targets for RES-E in Austria, Germany, Spain and EU-5 (Status: 05/2000)

	RES-E share 1997 (in %)	**'National Targets' for RES-E by 2010 (in % and year)**	**(in TWh)**
Austria	72.7	3% in 2005	+2
		(non-large hydro)	(+0.11)
Belgium	1.1	Flanders: 3% in 2004	Fla.: 0.9
		5% in 2010	1.8
		Wallonia: 8% in 2010	
Denmark	8.7	20% in 2003	7.5
		30% in 2010	13
Germany	4.5	10-12% in 2010	61
Italy	16.0	+2% in 2002	+4.5
		Doubling until 2010	78
Netherlands	3.5	8.5% in 2010	11
		17% in 2020	
Spain	19.9	12% in 2010	62
		(non-large hydro)	
UK	1.7	5% in 2003	21
		10% in 2010	50
EU-15	13.9	About 17% in 2010	

Source: Task 1.4 report

3 ESTIMATES OF COST SAVINGS

Cost minimization, economic efficiency and market conformity are the most common arguments for implementing market-based environmental policies like TGC_{el} systems. In frictionless, fully competitive market scenarios, this should definitely be true. The following calculations based on the RECerT Task 1.4 model can give an idea of the order of magnitude of the possible cost savings.

We choose two different scenarios given the RES-E targets formulated by the national governments (cf. Table 1):

- In the first scenario, we compare the regulation costs of the national feed-in systems in Austria, Germany, and Spain[1] with the costs of (isolated) national TGC_{el} systems in these countries, and with the costs of national TGC_{el} systems in these Member States as part of an EU-wide trading scheme.
- In the second scenario, we estimate the cost savings derived from cross-border TGC_{el} trading in contrast to (isolated) national TGC_{el} systems in EU-5 – EU-5 being the countries most advanced with the design and implementation of a TGC_{el} system (Italy, Flanders, Denmark, the Netherlands, and the U.K.).

Regulation costs are defined here as the technology-based marginal costs of RES-E minus the commodity price times the kWh generated with RES. Under TGC_{el} systems the regulation costs equal the market value of all issued TGC_{el}s. For feed-in systems, the regulation costs come to the accumulated feed-in payments per kWh minus the average commodity value of

[1] See Annex for assumed development of tariffs.

RES-E from different technologies as assumed in the Task 1.4 model.

3.1 Regulation Costs of National Feed-in vs. National TGC_{el} systems

The model results in Table 2 tell three different stories. Obviously, the assumed Austrian national RES-E target for 2010 can be achieved by simply paying the RES-E producers the commodity price of electricity. Therefore, a national TGC_{el} system would see a TGC_{el} price of zero €, within our data and model framework. But the Austrian feed-in system generates regulation costs of 21 million €. This documents an inefficient regulation design compared to a national TGC_{el} system or – in other words – a national TGC_{el} system in Austria would reach the national RES-E target with lower regulation costs even if the transaction costs of the TGC_{el} system summed up to 20 million €. In an EU-wide TGC_{el} system based on national targets, Austria would face regulation costs since the TGC_{el} price of the European system is expected to be higher than in an isolated Austrian TGC_{el} market. This corresponds to the result in Task 1.4 where Austria would be a TGC_{el} seller under the EU-15, national targets scenario.

Table 2: Regulation costs of feed-in vs. TGC_{el} systems

Million €	Feed-in	National TGC_{el}	EU-wide TGC_{el}
Austria	21	0	6,1
Germany	1300	1200	260
Spain	840	54	35

In relative terms, the German feed-in system seems to be more efficient than the Austrian one. The regulation costs of the feed-in system are in the same order of magnitude as the expected costs of a national TGC_{el} system. However, Germany would benefit from an EU-wide TGC_{el} system. Under the EU-15, national targets scenario, the regulation costs in Germany would drop by about 1 billion € compared to any national support mechanism.

In contrast, the Spanish feed-in system seems to be extremely inefficient compared to a national TGC_{el} system. This is basically due to the fact that Spain guarantees a comparably high tariff for electricity production from photovoltaics which makes this technology economically viable between 2005 and 2010, in our model.

3.2 Regulation costs of EU-5, trade vs. EU-5, non-trade TGC_{el} System

The model results for the five most advanced European countries in TGC_{el} trade (Flanders, Denmark, Italy, the Netherlands, and the United Kingdom) clearly show that international co-operation is cost-efficient in total (cf. Table 3). Regulation costs can be reduced by 4 billion €. But there are winners and losers of international trade. Italy can profit the most, in particular from the assumed large wind offshore potentials of Denmark and the United Kingdom.

Table 3: Regulation costs in the EU-5, national targets scenario of international vs. national TGC_{el} trade

Million €	National TGC_{el} Trade	EU-5 Trade
Flanders	16	15
Denmark	22	97
Italy	4600	320
The Netherlands	108	85
United Kingdom	84	360
EU-5 Total	4830	877

3.3 Summary

We can conclude that the model runs support the most common arguments for implementing TGC_{el} schemes. As we assume frictionless, competitive markets, market prices are determined by the marginal production cost of the last RES-E kWh that manages to enter the market and the RES-E targets are fulfilled with the cheapest options available. Total regulation costs are minimized. The net gains get even larger, when cross-border trade is allowed.

In addition, the results of the model runs back two other issues emphasized in economic textbooks. First, the closer the regulator gets to real production costs and the market prices when setting feed-in tariffs, the more equal the total regulation costs of an (isolated) national TGC_{el} system and a national feed-in system can become. But it is very difficult for the regulator to obtain this information. Secondly, there are not only winners, but also losers of policy changes. In the U.K., it is the consumers, in Italy, it is the producers who earn a lower surplus under an EU-5, trade scenario in comparison to an EU-5, non-trade scenario. However, in total, the EU-5 societies are benefiting.

4 TRANSACTION COSTS OF RES-E SUPPORT SCHEMES

Market-based instruments, and more specific tradable permits, have been widely discussed on theoretical grounds. Their advantages are highlighted by many economists. However, up to now their implementation has remained poor at both the national and international levels. This fact is usually attributed to the problems of acceptability in administration and society, and more technically and broader speaking to transaction costs. Transaction costs accompany the implementation of all policy instruments and are involved in all market transactions. Model simulations (like the above) that neglect the existence and evaluation of transaction costs over-estimate the potential benefit from (international) trade. The primary economic tool for policy analysis, cost-benefit analysis (CBA), is deficient in its handling of transaction costs, so that CBA presents an incomplete view of the social welfare effects of policies.
In the following, we investigate the issue of transaction costs of TGC_{el} and feed-in systems in more detail.

4.1 General

Coase defined transaction costs to be the costs that arise from initiating and completing transactions, like finding partners, negotiating, consulting with lawyers and other experts, monitoring agreements, etc., or opportunity costs, like lost time and resources. The most obvious impact of transaction costs is that they raise the costs for the participants of the transaction and thereby lower the trading volume or even discourage some transactions from occurring. Transaction costs that fall under this definition can take many forms. Different authors have used different subcategories. They, for example, divide the so-called market transaction costs in:

- Search costs*:* costs of finding interested partners to the transaction as well as the costs of identifying one's own position and optimal strategy.
- Negotiation costs: the costs for coming to an agreement. Negotiating terms may for example take time, visits to the site of a project, and hiring lawyers to draft contracts.
- Approval costs arise when the negotiated exchange must be approved by a government agency. Modifications could be imposed on the deal.
- Monitoring costs are the efforts the participants must make to observe the transaction as it occurs, and to verify adherence to the terms of the transaction.
- Enforcement costs: the expenses to insist on compliance once discrepancies are discov

ered.

- Adjustment costs: costs of changing strategies, due to a change in regulations or new scientific discoveries.

These costs can occur with every transaction that is carried out; they are also called periodic transaction costs.

But there is also another category of transaction costs. They are those costs that arise in designing and implementing public policies. The so-called set up or institutional transaction costs are considered very relevant for TGC_{el} systems, and tradable environmental policy instruments in general, by many experts, market actors, and politicians. They include:

- Developing the instrument in question,
- Enacting it by legislature,
- Establishing of an administrative infrastructure,
- Implementing and enforcing the policy by administrative agencies and the courts,
- Fighting political opposition against the instrument; campaigning for social acceptance.

4.2 TGC_{el} Systems vs. Feed-in Systems

For the following discussion, we assume two alternative financing mechanism of feed-in tariff systems and two variants of tradable green certificate models, acknowledging that many additional design differences are possible. We highlight some subcategories of transaction costs that are very similar and some that are rather different.

One feed-in tariff system is modelled after the German feed-in tariff system where both, the grid and supply companies are responsible for purchasing and selling the eligible RES-E produced, as well as for the administration of the nation-wide balancing of qualified RES-E power and costs of the support scheme. We will refer to it as Feed-in System 1, in the following. Under *the other feed-in tariff scheme*, the government/ a ministry is involved as well, as it is to collect money from taxpayers and to redistribute it to the grid companies who transfer the respective tariffs per kWh to the RES-E generators (Feed-in System 2). The differentiation we make for the TGC_{el} system concerns the competition on the electricity market. Under *an "ideal" TGC_{el} scheme* in a liberalised market, the purchase of RES-E is not guaranteed at a minimum price, but subject to negotiations and competition (TGC_{el} System 1). Most of *the national TGC_{el} schemes* that have been designed so far do, however, include a purchase obligation for RES-E at a fixed minimum rate. This element makes the latter system more equal to a feed-in system and reduces the risks for renewable generators (TGC_{el} System 2).

Market Transaction Costs

Concerning the periodic transaction costs, we perceive key differences between the 4 selected support schemes in the two categories:

- Economic risks, and
- Search and negotiation costs.

Under both types of a feed-in tariff system, the investment risk for the renewable plant operator is very low compared to a "normal" market. He exactly knows what revenue to calculate with and does not need to worry about demand (fluctuations). Under TGC_{el} System 1, the renewable generator operates under "normal" market conditions, the future development of market prices of electricity and TGC_{el}s is uncertain. Demand is not guaranteed, although the minimum total market size is known. So an additional project risk which consists in the possibility that the ex-post realised net present value will differ from its ex-ante planned value exists under TGC_{el} System 1. As a result, the RES-E generator should include a risk premium in his calculations or diversify against the risk of failure by investing in a portfolio of projects with uncorrelated risks.[2] TGC_{el} System 2 leaves some uncertainty for the RES-E generator concerning the TGC_{el} price development. But the other critical parameters are fixed for the RES-E investor. The above deliberations lead us to the ranking of economic risk from the RES-E generator perspective as low, low, high, and middle, respectively (cf. Table 4).

From the perspective of the supply companies, there is an economic risk under Feed-in System 1 that the costs cannot be passed on to the consumers. As the retail power market is supposed to be competitive, the cost sharing between companies is an important feature of the Feed-in System 1 that impedes discrimination and helps to reduce economic risks. If the money is collected via taxes (Feed-in System 2), there is no price risk for the supply companies. The risk shifts to the public budget. Under both TGC_{el} systems, the supply companies who are the obliged parties under the renewable obligation have to cope with "normal" economic risks. This is also true in TGC_{el} System 2, as electricity prices are swinging while the minimum imbursement paid to the RES-E generators by the grid company is legally fixed. Thus, we suggest to categorize the economic risk from the supplier perspective as middle, low, high, and high, respectively (cf. Table 4).

With respect to search and negotiation costs, the main difference is that under Feed-in Systems it is only the grid and supply companies that have to sell power and find customers for their product on the market, not the RES-E generator (cf. Table 4).

Table 4: Main Differences in Transaction Costs of TGC_{el} and Feed-in Systems

	Feed-in System 1	Feed-in System 2	TGC_{el} System 1	TGC_{el} System 2
Market Transaction Costs				
Economic risk for				
▪ RES-E Generator	Low	Low	High (Normal)	Middle
▪ Grid/ Supply Companies	Middle	Low	High (Normal)	High
Search and Negotiation Costs for				
▪ RES-E Generator	Low	Low	High (Normal)	Middle
▪ Grid/ Supply Companies	Middle	Middle	High (Normal)	Middle
Institutional Transaction Costs				

Institutional Transaction Costs

In the ongoing discussion about TGC_{el} systems, the high transaction costs of enacting, implementing and monitoring such a scheme are often cited as a main disadvantage. Yet, hardly anybody has so far made a comprehensive attempt to list the affecting parameters and to quantify them. Furthermore, usually it is not mentioned that other renewable support schemes like feed-in tariff schemes and tax exemption policies also cause institutional transaction costs; nor are thorough qualitative or quantitative analyses made. A comprehensive (quantitative) comparison of the transaction costs of feed-in and TGC_{el} systems is neither possible within the scope of this paper.

[2] It should be added that it is very likely that a financial market will emerge in which TGC_{el}s for future delivery etc. will be traded. This financial market will contribute towards creating greater certainty to players with respect to future TGC_{el} prices.

In the PwC report to the Danish Energy Agency (PwC 1999, App. 10) and the KPMG report for the Dutch Ministry for Economic Affairs (KPMG 1999), transaction costs got some attention, but the thoughts and estimates remain rather general. The Danish Energy Agency report goes into somewhat more detail. On the basis of discussions with the system operators and possible candidates for operating the market place, the expenses of establishing and operating the system are assessed at DKK 12 million a year plus/ minus DKK 3 million. The specific costs for establishing and operating (from issuing to quota fulfilment) a TGC_{el} system in Denmark are estimated to amount to 10-17% of the maximum certificate price of 0.27 DKK/kWh in 2000 and to drop to 0.9-1.4% of this maximum price in 2003 (Energistyrelsen 1999, Annex 3). These estimates of course very much depend on the assumed market and trade volumes which are not expected to become very high under the Danish system for the years to come, mainly due to generous transition periods from the feed-in to the TGC_{el} system. For comparison, a number from the financial and asset markets: Depending on the size of the company, costs of Going Public are usually between 6 and 12% of the emission volume (Blättchen/ Jasper 1999).

In fact, there are several categories of institutional transaction costs where the difference between Feed-in Systems and TGC_{el} Systems seems to be negligible. For example: RES plants are subject to an approval procedure prior to connection to the electricity grid, and checks are conducted and reported to the system operator regarding electricity production from RES plants. For delivery to the grid, information collection needs to take place. Institutional set up in both type of support schemes is concerned with auditing and measuring the amount of RES-E produced. Also, all RES-E kWh produced have to be recorded, the accounts of the grid and supply companies have to be managed and balanced. Overall electricity sales and consumption data need to be obtained.

Thus, the necessary functions for running RES-E support schemes are in fact more similar than discussions propose. The possibilities for the institutional set-up are plenty, however. Searching for efficient institutional arrangements that reduce transaction costs and share the risks are keys to the potential success of policy instruments. It is the transaction cost and risk sharing that is handled somewhat differently under our 4 systems.

The functioning of a TGC_{el} scheme is more responsive to transactions costs than feed-in tariffs schemes are. To maximize certificate-trading volumes, transaction costs will need to be as low as possible. The less liquid and less transparent the market, the higher the transactions cost per contract will be. If the transaction costs were to be high, trading might not get under way properly. Especially during the first stage of a TGC_{el} system, transaction costs may be an essential cost factor. However, they decline with the accumulated amount of trades. A cross-border or EU-wide trading scheme gives quite an advantage in this respect.

Finally, tradable instruments are rather new instruments in practice – not in theory. The different market players, administration and society as a whole have not come too far on the learning curve, yet. Therefore, it may take longer to solve issues, and to come to agreements. Resistance may as well as the investments in information distribution may be higher.

5 Non-Monetary Benefits of TGC systems

It is not only transactions costs but also non-monetary and other societal benefits cost-benefit analysis is deficient in handling. Some of these benefits are subject of section 5; we restrict our assessment to an EU-wide TGC_{el} system.

5.1 Common Market goals

In favour of international TGC_{el} systems it is argued that if such a market develops, (as compared to isolated Member State TGC_{el} markets operating without cross-border trading), it will deliver greater liquidity, greater volume of trade, more reliable price indicators, reduced investment risk, and ultimately faster investment in new renewable energy capacity. More politically speaking, TGC_{el} trading could promote European integration by linking companies and consumers across the EU. If the trading is based on the subsidiarity principle – a set of universal minimum criteria for TGC_{el}s – it gives maximum independence to Member States, and works in harmony with a liberalised energy sector and with different renewable energy support measures used in the EU. TGC_{el} trading promotes sustainable economic and environmental development for the EU, by maximising the cost-effectiveness of new renewables, and helping to accelerate their implementation. TGC_{el} trading can bring social benefits by giving greater choice to electricity consumers, and can help give consumers the power to influence the environmental performance of the EU electricity sector.

5.2 CO_2-reduction effects

One major goal of renewable energy support policies is the reduction of greenhouse gas (GHG) or CO_2 emissions. But as the carbon intensities of electricity production vary across Europe, the CO_2-emissions reduction potentials with RES are also not the same. In addition, the actual CO_2-emissions reduction under TGC_{el} trade and non-trade scenarios differ, since the geographical distribution of RES deployment is different. In order to estimate the annual CO_2-reductions in 2010 compared to a baseline scenario, we use the projected carbon intensities of electricity production from the Shared Analysis Project (c. second column in Table 5). Major shifts can be observed in Denmark, Germany, Ireland, Italy, Spain, and in the UK. However, the CO_2-intensity in these countries are very similar. Thus, no major difference between the trade and no trade scenario can be observed. Actually the trades scenario may generate more CO_2-reductions than the no-trade case. This is basically due to an expected increase in the Irish and Greek RES-E production compared to the no-trade case.

Table 5: Assumed CO_2 intensities & CO_2-emissions under the EU-15, EC-targets scenario

	t CO_2/MWh 2010*	Mt CO_2 2010 no trade	Mt CO_2 2010 trade
Austria	0.13	2.1	0.6
Belgium	0.22	1.3	0.7
Denmark	0.29	3.3	14.0
Finland	0.21	3.0	0.9
France	0.09	3.5	3.7
Germany	0.38	21	12
Greece	0.68	7.9	12
Ireland	0.42	1.6	10
Italy	0.35	18	6.4
Luxembourg	0.31	0.1	0.0
Netherlands	0.31	4.7	5.2
Portugal	0.38	7.2	3.3
Spain	0.31	16	7.6
Sweden	0.07	1.7	0.8
United Kingdom	0.33	15	36
EU15		106	112.8

* CEC DG TREN (1999)

The following Table summarises the CO_2-effects in the scenarios of Task 1.4. In all of these scenarios we do not find any major CO_2-effect of trade vs. no trade cases, although on a national level substantial differences can be observed. If e.g. Germany was interested in renewables only from a CO_2-perspective it would hesitate to support an EU-wide TGC_{el} trading system since the domestic CO_2-reductions would decrease from annual 21 Mt CO_2 in 2010 to 12 Mt of CO_2. Countries like the United Kingdom, Ireland or Denmark on the other hand would benefit from an EU-wide TGC_{el}-system with respect to CO_2-reductions.

Table 6: CO_2-reductions in different trade scenarios compared to non-trade scenarios

CO_2-reductions	National Targets		EC Targets	
Mt CO2	EU5	EU15	EU5	EU15
Trade	34.65	64.89	41.01	112.82
No-Trade	35.82	65.34	42.14	105.68

5.3 Impact on Cohesion Countries

Under the assumption that a country can benefit from additional investments into renewable energy technologies with respect to domestic CO_2-reductions, employment and welfare, the cohesion countries exporting TGC_{el}s get additional benefits from a European-wide system. In the scenarios of Task 1.4 Greece and Ireland are expected to export TGC_{el}s whereas Portugal and Spain would import TGC_{el}s and thus do not benefit from a European TGC_{el} system with respect to the additional goals of employment and CO_2 reductions. The latter countries do, however, achieve their RES-E target cost-efficiently and have the possibility to allocate their saved resources towards the goals of employment and CO_2 reduction.

6 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions can be drawn from the above analysis:

- Under the assumption of frictionless, competitive markets, a TGC_{el} system is a cost-efficient and effective support scheme for achieving the RES-E targets set by the EU Member States. The costs to fulfil the RES-E targets are minimised, and society can allocate the cost savings towards other ends. Thus, TGC_{el} trading promotes both, economic and environmental sustainable development for the EU.
- The net cost savings as well as other benefits of a TGC_{el} system are greater, when a cross-border or EU-wide certificate trading scheme is established.
- However, a cross-border or EU-wide TGC_{el} system cannot be recommended to potential TGC_{el} importing Member States without further investigation, if their main goals are domestic CO_2 reduction, and the creation of employment and a RES industry at home. Further analysis may come to the conclusion that other and separate policies than a RES-E output subsidies policy should be implemented to achieve these main goals effectively and cost-efficiently.
  If the objective of potential TGC_{el} importing Member States is to increase the domestic deployment of RES power generation plants at home, then a cross-border TGC_{el} scheme cannot be recommended, at least until the targets are met.
  But if the European Union aims at developing a common electricity market, national interests and perspectives of this type should be ruled out in the longer run.
- TGC_{el} trading can help promoting European integration better than other RES-E support policies, as it is made for EU-wide trade, and works in harmony with a liberalised energy

sector. On the other hand, it can be based on the subsidiarity principle – a set of universal minimum criteria for the TGC_{el} market to work gives enough room to Member States for additional RES policies.

- Searching for efficient institutional arrangements that reduce transaction costs and share the risk are a key to the potential success of all renewable support policies, but in particular of the TGC_{el} instrument.
  The higher the liquidity and transparency of the TGC_{el} market, that is the lower the transaction costs, the higher the benefits of a market-based system like the TGC_{el} system.
- Under a feed-in system transaction cost can also be high. Their influence on the functioning of the system is rather low, however, since the RES generator will not be affected by it. The price is fixed. Transaction costs of the system are paid by the other players, either grid and supply companies as well as consumers or the government and taxpayers.

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8 ANNEX

Table 7: Assumed development of feed-in tariffs in Austria

Subsidies (c€/kWh)	2000 low	2000 high	2005 Low	2005 high	2010 low	2010 high
Wind: onshore						
7,5m/s	3,34	8,97	3,34	8,97	3,34	8,97
6,5m/s	3,34	8,97	3,34	8,97	3,34	8,97
5,5m/s	3,34	8,97	3,34	8,97	3,34	8,97
4,5m/s	3,34	8,97	3,34	8,97	3,34	8,97
Wind: offshore						
10m	3,34	8,97	3,34	8,97	3,34	8,97
20m	3,34	8,97	3,34	8,97	3,34	8,97
30m	3,34	8,97	3,34	8,97	3,34	8,97
40m	3,34	8,97	3,34	8,97	3,34	8,97
Large Hydro	0	0	0	0	0	0
Small Hydro	0	0	0	0	0	0
Photovoltaics						
	3,34	8,97	3,34	8,97	3,34	8,97
Biomass electricity						
Fuel switch	0	0	0	0	0	0
Wood	2,99	8,03	2,99	8,03	2,99	8,03
Biogas	2,99	8,03	2,99	8,03	2,99	8,03
Crops	2,99	8,03	2,99	8,03	2,99	8,03

Source: BMU (1999)

Table 8: Assumed development of feed-in tariffs in Germany

Subsidies (c€/kWh)	2000 low	2000 High	2005 Low	2005 high	2010 low	2010 high
Wind: onshore						
7,5m/s	5,6	6,2	5,2	5,7	4,8	5,3
6,5m/s	6,7	7,2	6,2	6,6	5,7	6,2
5,5m/s	7,7	8,1	7,1	7,5	6,6	7,0
4,5m/s	8,7	9,1	8,1	8,4	7,5	7,8
Wind: offshore						
10m	7,5	9,1	7,0	8,4	6,4	7,8
20m	7,5	9,1	7,0	8,4	6,4	7,8
30m	7,5	9,1	7,0	8,4	6,4	7,8
40m	7,5	9,1	7,0	8,4	6,4	7,8
Large Hydro	0	0	0	0	0	0
	20MW	*500kW*	*20MW*	*500kW*	*20MW*	*500kW*
Small Hydro	0,38	7,67	0,38	7,67	0,38	7,67
Photovoltaics						
	50,62	50,62	39,17	39,17	30,31	30,31
Biomass electricity	*20MW*	*500kW*	*20MW*	*500kW*	*20MW*	*500kW*
Fuel switch	0,22	10,23	0,21	9,73	0,20	9,25
Wood	0,22	10,23	0,21	9,73	0,20	9,25
Biogas	0,22	10,23	0,21	9,73	0,20	9,25
Crops	0,22	10,23	0,21	9,73	0,20	9,25

Source: BMU (1999)

Table 9: Assumed development of feed-in tariffs in Spain

Subsidies (c€/kWh)	2000 low	2000 high	2005 low	2005 high	2010 low	2010 high
Wind: onshore						
7,5m/s	3,2	3,2	3,2	3,2	3,2	3,2
6,5m/s	3,2	3,2	3,2	3,2	3,2	3,2
5,5m/s	3,2	3,2	3,2	3,2	3,2	3,2
4,5m/s	3,2	3,2	3,2	3,2	3,2	3,2
Wind: offshore						
10m	3,2	3,2	3,2	3,2	3,2	3,2
20m	3,2	3,2	3,2	3,2	3,2	3,2
30m	3,2	3,2	3,2	3,2	3,2	3,2
40m	3,2	3,2	3,2	3,2	3,2	3,2
Large Hydro						
Small Hydro	3,3	3,3	3,3	3,3	3,3	3,3
Photovoltaics						
	18	36	18	36	18	36
Biomass electricity						
Fuel switch						
Wood	2,82	3	2,82	3	2,82	3
Biogas	2,82	3	2,82	3	2,82	3
Crops	2,82	3	2,82	3	2,82	3

Source: BMU (1999)