Supported by

Framework conditions for tracking electricity in Europe

E-TRACK WP2 report

A report prepared as part of the IEE project
„A European Tracking System for Electricity (E-TRACK)"

Supported by the European Commission

W. Lise, ECN
C. Timpe, Oeko Institut
M.G. Boots, ECN
J. de Joode, ECN
M. ten Donkelaar, ECN
C. Vrolijk, IT Power

ECN-C--06-014 March 2006

The project "A European Tracking System for Electricity (E-TRACK)" is supported by the European Commission through the IEE programme
(contract no. EIE/04/141/S07.38594).

Acknowledgement/Preface

This report is the result of a study provided within WP 2 (Framework conditions for tracking) of the project 'A European Tracking System for Electricity (E-TRACK)'. This project is supported by the European Commission under the Intelligent Energy - Europe Programme (Grant agreement no. EIE/04/141/S07.38594). We are grateful to the European Commission for part funding this work. The study is jointly conducted by the E-TRACK project team and is registered under ECN project number 7.7645. We are grateful for discussions with members of the E-TRACK research team and suggestions by Birgit Bodlund, Natacia Falcucci, Anne-Malorie Geron, Claes Hedenström, Edith Hofer, Nico van der Linden, Rickard Nilsson, Timo Riess, Herbert Ritter, Martin Scheepers and Martine Uyterlinde have been very helpful in establishing this report. We thank Jaap Jansen of ECN for carefully co-reading the report. Remaining errors are ours.

Abstract

The analysis of this report shows that context matters for tracking generation attributes. On the one hand, there are factors that enable the introduction of tracking, like previous experiences with green certificates. Some Member States have already gained experience with tracking generation attributes, which is required to disclose the generation mix to the consumer. On the other hand, there are factors that are making the introduction of tracking generation attributes in Europe more difficult, like the widely varying initiatives among Member States with respect to legislation on GOs and disclosure. Also the market conditions can be of influence. The varying degree of market opening matters, because the usefulness of tracking is lower in a market where a customer cannot switch among suppliers. The amount of electricity traded makes it difficult to link generation to consumption under contract-based tracking, while this is of no concern under certificate-based tracking. One of the ways towards overcoming the aforementioned barriers is harmonisation of schemes for tracking generation attributes.

Contents

List of tables

Summary

This report gives an overview of framework conditions for tracking generation attributes in Europe. Thereupon, this report focuses on the context in which a tracking system will function. Moreover, this report studies framework conditions and possible stakeholder positions for putting in place a harmonised tracking system. The status of the information presented in this report and in the Appendix is representative up to mid 2005.

This report provides a general analysis of the framework conditions in which a tracking system has to function. There are three major drivers for tracking generation attributes:

1. Support schemes for some generation technologies, such as electricity from renewable energy sources (RES-E) or high-efficiency cogeneration (HE-CHP).
2. Electricity disclosure requirement (Article 3 (6) of Directive 2003/54/EC) and Guarantees of Origin for RES-E and HE-CHP (Article 5 of Directive 2001/77/EC and Article 5 of Directive 2004/8/EC).
3. National indicative targets of Member States for the expansion of RES-E (Article 3 of Directive 2001/77/EC).

There can be various interactions between these drivers and other policies, including the interaction with the EU Carbon Emission Trading System.

The liberalisation of the European electricity market has introduced competition among electricity companies. Simultaneously, new opportunities have arisen where the market can start playing a role in sustainable generation of electricity. To stimulate sustainable generation, various European directives, national policies and initiatives have been introduced. Member States have put in place three main types of support policies to increase the share of renewable electricity (RES-E) and high efficiency cogeneration (HE-CHP), namely quota obligations, feed-in tariffs and fiscal measures.

The usefulness of tracking and the effectiveness of different tracking mechanisms depend to some extent on the electricity market conditions, which can vary considerably among Member States. Especially important are the level of market opening; market concentration, competition and regulation, domestic and cross border trade, power exchanges, harmonisation of the European electricity market and electricity disclosure.

With reliable disclosure of generation attributes, consumers can make a choice of electricity supplier based on price, quality, and generation characteristics. This new regulation, therefore, requires more information from the market players - not just the price of electricity, but also its ‘ingredients’, the generation attributes such as the fuel mix and environmental indicators. There are three major ways for tracking generation attributes, namely contract-based tracking, certificate-based tracking, which are both explicit tracking mechanisms and implicit tracking based on statistical averages.

The interests of stakeholders can differ considerably in relation to the different options and possible details of tracking schemes for generation attributes. These reservations are mostly based on assumptions about the purpose, the cost of tracking and on their impact on the electricity market. In this report we deal with the stakeholder requirements for a tracking system according to 1) electricity producers, 2) suppliers, 3) traders, 4) consumers, 5) transmission and distribution system operators (TSOs and DSOs), 6) Member State governments and regulators, and 7) exchanges and NGOs/label owners. This section concludes the second chapter.

The report also deals with the particular framework conditions in the so-called participating countries in the E-TRACK project, namely Austria, France, Germany, Italy, Lithuania, Netherlands, Poland, Switzerland and the UK. The focus is on the regulatory and policy conditions, i.e. whether a quota obligation or feed-in tariffs system is used, and on electricity market conditions, i.e. level of market opening, market concentration and cross border trade.

The analysis of this report shows that context matters for tracking generation attributes. On the one hand, there are factors that enable the introduction of tracking, like previous experiences with green certificates. Some Member States have already gained experience with tracking generation attributes, which is required to disclose the generation mix to the consumer. On the other hand, there are factors that are making the introduction of tracking generation attributes in Europe more difficult, like the widely varying initiatives among Member States with respect to legislation on GOs and disclosure. Also the market conditions can be of influence. The varying degree of market opening matters, because the usefulness of tracking is lower in a market where a customer cannot switch among suppliers. The amount of electricity traded makes it difficult to link generation to consumption under contract-based tracking, while this is of no concern under certificate-based tracking. One of the ways towards overcoming the aforementioned barriers is harmonisation of the schemes used for tracking generation attributes.

From the analysis in this report we can come to the following basic recommendations for tracking:

1. Experiences gained with partial tracking schemes used for feed-in tariffs, quota obligations or fiscal support measures can be useful for implementing more comprehensive tracking mechanisms.
2. There is great variation among Member States in market opening and the role of power exchanges varies. Due to the Electricity Market Directive there will be more harmonisation with respect to market opening and power exchanges. Tracking systems need to be flexible enough to be operational under the variable conditions now and in the future.
3. Explicit tracking via certificates and/or contracts should be prioritised over the use of statistical averages.
4. Where a default set of attributes is needed, a residual mix should be used instead of uncorrected generation statistics in order to minimise multiple counting. The residual mix is derived from statistical data on domestic generation, corrected by net imports or exports of electricity without explicit attributes and corrected for all attributes that have been tracked explicitly.

1. Introduction

1.1 E-TRACK project

The E-TRACK project investigates the feasibility of a harmonised standard for tracking generation attributes in Europe. The aim is to outline a comprehensive approach for all tracking requirements which are imposed by European and national legislation. The major benefits of such a tracking standard will be that electricity attributes (such as the fuel type used for generation and related environmental indicators) can easily be accounted for in the internal market; problems with multiple counting of attributes (e.g. from renewable energy sources) can be avoided; verification of tracking procedures can be simplified and cross-border trade of electricity and attributes will be facilitated. The tracking standard will be designed in such a way as to support European and Member State electricity policies. It will not predetermine policy decisions such as the design of support instruments for electricity from renewable energy sources or cogeneration or the relationship of cross-border transfers in RES electricity with the indicative targets set by Directive 2001/77/EC.

The project will provide a detailed insight into the requirements for the design and operation of tracking systems, which are set by European and Member States legislation as well as by market participants. A major result of the project will be a blueprint of a European standard for tracking electricity generation attributes, which will cover technical aspects (e.g. database and interface specifications) and non-technical issues, such as institutions and processes involved. The project involves partners with scientific expertise as well as electricity transmission system operators, regulators and market players, which will be able to work with the standard. This ensures that results from the project are oriented towards practical implementation and can easily be disseminated. An intensive consultation phase and several dissemination activities will support widespread communication of the project results.

1.2 This report

This report intends to give an overview of the framework conditions for tracking electricity generation attributes in Europe, and from these to derive recommendations for the design of such a system. The focus of this report (WP 2 of the E-TRACK project) is not on the design of the tracking system itself, which is the subject of investigations in WP 3 to 5, but on the context in which such a tracking system will function. Moreover, this report studies framework conditions and points out possible stakeholder positions for putting in place a harmonised tracking system. This report analyses general framework conditions, with a more detailed assessments of the framework conditions in participating countries[1] to support the main argument and a short comparison is made among all European countries. This report uses the results from the WP 1 report of the E-TRACK project, which analysed the existing tracking schemes for electricity generation attributes in Europe.

The outline of this report is as follows. Chapter 2 identifies framework conditions for tracking generation attributes in Europe. These framework conditions consist of drivers for tracking generation attributes and policies to support sustainable electricity generation, namely quota obligations and feed-in tariffs or fiscal measures. The influence of electricity market conditions is considered as well as various ways for implementing tracking of generation attributes. Furthermore, we study possible stakeholder positions for harmonising a tracking system by pointing out the

[1] The participating countries in the E-TRACK project are: Austria, France, Germany, Italy, Lithuania, Netherlands, Poland, Switzerland, and the UK.

possible differences of priorities among the main market actors, namely producers, suppliers/traders, consumers, system operators and regulators/Member State governments.

Chapter 3 links the general framework condition to actual experiences with tracking generation attributes in participating countries. Here the focus is on factors, which are highly variable among Member States, namely policy and electricity market conditions. The final chapter presents some general conclusions.

2. General analysis of framework conditions

This chapter provides a general analysis of framework conditions. This is done in three major steps, after giving a motivation for tracking by pointing out the main drivers. First, experiences with tracking related to policies mainly for stimulating renewable electricity are reviewed. Second, the current dynamics on the electricity market are pointed out. Third, possibilities of tracking are described. Finally, based on our assumptions, an overview is given of possible stakeholder positions towards the framework conditions of a tracking system.

2.1 Drivers for tracking generation attributes

There are multiple purposes for tracking generation attributes:[2]

1. Proof of generation for a specific *support* scheme, like feed-in tariffs and quota obligation schemes, as well as some fiscal measures.
2. Proof of generation in a reporting scheme, in particular *disclosure* of generation attributes to the consumer, but this may also include green quality labels.
3. Accounting for the national indicative *targets* for renewables in electricity generation (RES-E) as set out in Directive 2001/77/EC.[3]

These uses may also be interpreted wider, to assist more accurate accounting for general energy sector transparency. These three (or more) uses can be positive drivers for the introduction of an accurate tracking mechanism for electricity generation attributes.

Ad 1 Claiming financial support
In order to provide support to specific types of electricity generation, it is usually necessary to account for the volume of electricity generated, which is eligible for support. Some support schemes require to allocate this volume to final suppliers or consumers of electricity, e.g. on a pro-rata basis or as a minimum quota. Therefore, many support schemes do already include some form of tracking. Similarly, if a comprehensive tracking system is introduced, then it must be designed in such a way as to facilitate the different support schemes in place in Member States.

The E-TRACK project intends not to predetermine the design of support mechanisms used by Member States through the tracking mechanism. Rather the tracking scheme should be designed in a way that different support schemes can be facilitated. However, the introduction of a tracking scheme might require some corrections to support schemes, mainly in order to avoid multiple counting of attributes.

Ad 2. Aiding accurate reporting of generation and disclosure
Proof of generation in a reporting scheme, in particular disclosure of generation attributes to the consumer can facilitate consumer choice. Hence, an improved transparency of the market, irrespective of the contents of disclosure, is a non-monetary benefit on its own, because it provides market participant with relevant information and it might also increase the confidence of a consumer into the sincerity of the supplier.

Ad 3. National indicative targets
Accurate accounting for the national indicative targets for RES-E (and potentially in the future also for HE-CHP) is useful and needed for Member States. However, since these targets are in-

[2] Here we have mentioned three purposes, but there are also other potential purposes. See, for instance, Jansen (2005a,b); Kristiansen et al. (2005); Van der Linden et al. (2004); Vrolijk et al. (2004).
[3] Potentially in the future also for high-efficiency cogeneration for heat and power (HE-CHP).

dicative only and there are no financial sanctions for non-compliance, accurate monitoring may be considered by some as less important.

In addition to these three drivers, it is also interesting to point out their interaction with the EU CO_2 Emission Trading System (ETS).[4] The ETS covers direct emissions only. The emitters, i.e. the operators of fossil-fuel power plants as well as certain other devices, which are subject to the ETS scheme, have to redeem a sufficient number of emission allowances to cover the actual emissions from their plants. Most Member States have already implemented procedures for monitoring emissions from power plants. With regard to CO_2 emissions, a European standard for monitoring has been introduced in the course of the EU Emissions Trading Scheme, which commenced on January 2005. This scheme requires fossil fuel power plants above a rated thermal input of 20 MW and other emitters to monitor and report on their fuel input and emissions and to meet certain emission targets.

In the course of disclosure of electricity generation attributes, the attribute of actual CO_2 emissions of electricity generation has to be tracked from the producer to the consumer in some way. The monitoring data from the EU ETS could be used by the electricity disclosure scheme.

The detailed interaction between CO_2 emission reduction targets and renewable energy support is hotly debated in the academic literature and falls outside the scope of this project. Interactions identified in the various studies carried out depend on the assumptions and models used, as well as on the various energy policies and issues studied. For example, the impacts are different in countries with carbon taxes than those with emission trading schemes, and the same is true for feed-in tariffs, premiums and obligation schemes.

To highlight a few possible interactions, Sijm (2003) highlights that once a CO_2 target has been set, a renewables obligation will no longer achieve further reductions, but only make the target easier to achieve and thus reduce the cost for the emitters. However, he adds that the diffusion of RES-E technologies will reduce costs for larger emission reductions in the long run.

Within E-TRACK we will use the interpretation explained in Vrolijk et al. (2004) on the relation of tracking of electricity and the ETS. Any tracking scheme, including Guarantees of Origin, TRECs or other forms of proof, cannot represent reductions of greenhouse gas emissions, because these are governed exclusively by the ETS scheme. This does not discount the roles GO, TRECs and electricity disclosure may play in helping achieve a low-emission electricity system, e.g. by expanding generation from low-emission energy sources and technologies.

2.2 Policies in place to stimulate ‘greener’ electricity generation

The liberalisation of the European electricity market has introduced competition among electricity companies. Simultaneously, new opportunities have arisen where the market can start playing a role in sustainable generation and marketing of sustainable electricity. To stimulate sustainable generation, various European directives, national policies and initiatives have been introduced. One of the most important regulations in this regard is the renewables directive (2001/77/EC), which aims at a share of renewables in electricity generation (RES-E) of 21% by 2010 for EU25 (SEC, 2004). In addition, the Cogeneration Directive (2004/8/EC) aims at increasing efficiency of electricity generation by encouraging the simultaneous generation of heat and power. These directives are not mutually exclusive, as there is generation with biomass, which can also be used for high-efficiency cogeneration for heat and power (HE-CHP). In addition, these directives do not yet make arrangements for a reduction of final energy consumption. Support mechanisms based on the upcoming white certificates for energy efficiency can possibly fill this gap.

[4] See also Van der Linden et al. (2004) for the interactions of EU-ETS with GOs for renewables.

Member States have put in place three main types of support policies to increase the share of RES-E and HE-CHP -quota obligations, feed-in tariffs (including fixed premiums on the market price) and fiscal measures as identified in the RE-GO project[5]- as well as a number of other targeted measures.

2.2.1 Quota obligations

A Member State government or regulator may oblige market players to generate (or to purchase) a certain amount of electricity from pre-defined sources or technologies. Such a quota obligation is usually put in place to support renewable energy sources, but it may also incorporate HE-CHP or other 'sources' such as energy saving. The obligation is normally allocated to supply companies and is defined as a percentage of the total electricity demand.[6]

For RES-E support, the obligation is usually administered through tradable renewable energy certificates (TRECs),[7] which are issued to producers for units of electricity generated from qualifying sources, and redeemed by the obliged parties to meet their quota obligation. Penalties are in place to encourage compliance with the targets.[8]

With regard to the interaction with tracking of electricity generation attributes, there are two different ways for designing an obligation:

1. A '*financial' obligation* requires the obliged actor to financially support generation from eligible power plants equivalent to the specified share of its electricity supply or consumption. This obligation would not include the actual purchase of the electricity. The TRECs used for this type of obligation scheme would only facilitate a financial support mechanism, and the generator would therefore be allowed to sell its generation including GOs that can be issued separately from TRECs to other parties in the market.[9] Accordingly, the obliged actor can only claim that it has supported eligible generation, but not that it has purchased or consumed the supported electricity. Any tracking scheme would therefore have to track two attributes separately: Firstly the allocation of a 'support attribute', which could be contained in the TREC, and secondly a GO, which would be used for purposes of electricity disclosure and green power labelling. In the case of RES-E, governments would have to decide how and where the attribute of accounting for the indicative targets would be allocated.[10]
2. A '*physical' obligation* requires the obliged actor to purchase the specified share of its electricity supply or consumption from eligible power plants. This obligation would include the transfer of the respective GO to the obliged party. Any tracking scheme would therefore have to allocate the respective generation attributes accordingly, meaning that no other party than the obliged actor can claim to have purchased the supported volumes of electricity generation. This means that under a physical obligation either the GOs are directly used as the certificates facilitating the quota obligation, or that TRECs for the support mechanism and GO are issued separately and are both transferred with the respective volume of electricity to the obliged actor.

---

5 See www.re-go.info.

6 It is also interesting to take note of the recent study by Van der Linden et al. (2005) on a comparison of quota obligation systems in Belgium, UK, US and Sweden. In that study, only the US system turned out to be effective in promoting RES-E investments, due to a longer-term commitment towards the investor and the fledgling stage of the European systems.

7 The names or TRECs differ from country to country, for instance, renewable obligation certificates (ROCs) in the UK and electricity certificates (Elcert) in Sweden, among others.

8 Van der Linden et al. (2005) argues that it is a major challenge to set the right level of penalty.

9 This is similar to the case of a fixed bonus, which can be paid to generators in addition to the market price. However, in this case the level of the bonus payment is determined on the TREC market.

10 The accounting of the respective volume of RES-E towards indicative targets could either be bundled to the TREC or to the GO (but not to both). In theory, the 'target attribute' could also be made transferable as a separate certificate. However, it is not clear how a market for such a separate attribute could be established.

It is important that governments and legislators make sure which type of obligation they intend to implement, in order to avoid multiple counting of generation attributes. More specifically, in the case of the financial-only obligation, it is also important to clearly distinguish the different attributes and their individual uses.

2.2.2 Feed-in tariffs

Feed-in tariffs (FITs) are provided in general by the state (e.g. via the TSO) to increase the share of RES-E in power generation, by investments in RES-E. Hence, this instrument usually concerns an obligation for a system operator to purchase eligible electricity generation and to pay a defined minimum price. The price guarantee is introduced to make RES-E technologies competitive in the market and to make investments in RES-E more attractive. Usually, the tariffs for new technologies (like most RES-E technologies except hydro power) are differentiated for the individual technologies and are reduced over time, in order to stimulate and reflect technology development which leads to reductions in generation cost and to avoid over-subsidisation. Again, similar systems can be used for the support of electricity from cogeneration.

Feed-in tariffs are easy to introduce and back-up legally, and they have proven to be effective in stimulating investments in renewable power generation. However, it is not easy to determine adequate levels for the feed-in tariffs.[11] While in quota obligations, it is not clear at which cost the target will be met, it is not certain in feed-in schemes what the volume of supported electricity generated will be.[12] Both policies need careful adjustments by regulatory bodies.

With regard to the interaction with tracking of electricity attributes, there are three different ways for designing a feed-in scheme:

1. The feed-in scheme can contain an allocation mechanism for the supported electricity to the final consumer. In this case, the system operator is obliged to purchase eligible electricity generation and it has the possibility to pass the electricity volumes (and usually also the related cost) on to the final consumers, e.g. on a pro-rata basis. If Guarantees of Origin were issued for the supported generation, then these would have to be passed on together with the electricity. Under this option (which is used in Germany), the tracking system would have to follow this allocation procedure, or it could even be used to facilitate it.
2. The feed-in scheme can contain a rule that the supported electricity is purchased by an obliged actor, usually a system operator, and that no further provisions are made as to where this electricity is allocated. In this case, the system operator would be free to sell the electricity and the related generation attributes to any other party in the market. If Guarantees of Origin are issued for the supported generation, then these should be passed on to the system operator and could then be used to prove the origin of the related electricity volume.[13] Any tracking system would have to facilitate this allocation.
3. Finally, the feed-in scheme can take the form of a fixed premium above the market price. The generator of eligible electricity would sell its generation on the market, including the related generation attributes. Based on the volumes generated, the generator would receive a fixed premium above the market price. If Guarantees of Origin were issued, then the generator would pass them on alongside with the electricity. Here, a tracking mechanism would also allocate the attributes to the buyer of the electricity.

Again, it is important that governments and legislators make sure which type of feed-in support they intend to implement, in order to avoid multiple counting and multiple uses of generation attributes.

---

[11] This is somewhat similar to the difficulty to set the right targets and penalties in quota obligation schemes.

[12] Note that, depending upon the design, quota obligations provide the possibility for obliged actors to pay a buy-out price to the regulator instead of fulfilling the obligation. Therefore, it is not fully certain whether the set target will be met in obligation schemes.

[13] In this case, any compensation scheme for the cost of the system operator should take into account its revenues from selling the supported generation at a higher price, e.g. as green power.

2.2.3 Fiscal measures

Various fiscal measures may be introduced to stimulate renewable production. These are generally not in the form of actual subsidies, but in the form of tax rebates and tax exemptions. This tax instrument is very flexible as it can be targeted at producers, suppliers and consumers. Fiscal measures may be used to stimulate renewables, CHP, but also other preferred investments. The flexibility can also be a threat, as it is very difficult to avoid perverse subsidies/tax rebates where technologies are subsidised which could survive in the market without subsidy.

The difficulty is to identify technologies that are clean/green and to give them just the right push for just the right amount of time to make them competitive with conventional technologies and attractive enough to be invested in. Hence, there is a need for timing the incentive to such an extent that there is no oversubsidising, but also that the investment remains sufficiently attractive to be undertaken.

Some fiscal measures may also be directed at supporting R&D in renewable and other preferred technologies. This can be another driver for a continuous exploration into cost effective, energy efficient and sustainable generation.

With regard to the interaction with tracking of electricity attributes, there are two different ways how a fiscal support can be designed:

1. The support can be granted to the generator of eligible electricity. In this case, the generator will sell its generation just as any other generator and the support scheme does not require tracking of attributes (but it requires tracking of the generated volumes of eligible generation and support granted). If a tracking scheme is introduced, then supported generation will be treated just as any other type of generation.
2. Alternatively, support can be granted to the consumer of eligible electricity, as it was the case in the former electricity tax exemption for RES-E consumer in the Netherlands. In this case, a tracking scheme is indispensable in order to identify the share of electricity consumption from eligible sources for each customer (or group of customers served by a supplier).

2.2.4 Transparency about support granted

In addition to the discussion of individual support policies above, Member States might wish to create transparency for actors in the electricity market as well as regulatory bodies as to whether a certain instance of electricity has received support or not. For instance, a customer might give lower value to RES-E if it has already received funding through a support scheme. Also, many green power quality labels require information about the support granted in order to determine the degree of additionality in a green power product.

In order to create such transparency, earmarking of Guarantees of Origin or of any other proof of origin of electricity can be introduced. However, if support can be granted ex post, i.e. after the issuance of a GO or other proofs, then it is much more difficult to provide information to market participants, as earmarks would not work. In this case, it might be necessary to introduce ‘support certificates’ which are separate from GO, such as the TRECs discussed above.

2.3 Electricity market conditions

Past and ongoing experiences with regulatory and policy conditions can provide useful insights for the design of a tracking system. However, the effectiveness of different tracking mechanisms depends on the current electricity market conditions, which can vary considerably among Member States. Thereupon, this section deals with the level of market opening, market concentration, cross border trade, electricity exchanges, harmonisation of the European electricity market and its relation to tracking, electricity disclosures, and market regulation.

Market conditions can have an impact on the required design of the tracking scheme, because the mechanism must be able to cope with the current differences in the regional electricity markets and restricted capacities of interconnecting lines for imports and exports (Boardman et al., 2003, page 40), but similarly the system must be able to deal with changes that are taking place both in the physical networks, market structures and generation technologies.

The following quotation, from the liberalisation of electricity market progress report (EU 2005a), illustrates the current barriers towards full competition on the (gas and) electricity market among the EU Member States:

> *"Firstly, a key issue relates to the failure to fully integrate national energy supply into a wider European market. In this context it is vital for rules on cross border electricity exchanges to continue to be improved to ensure that existing infrastructure is utilised to its maximum possible extent. Likewise for gas, the adoption and implementation of the proposed Regulation is similarly important. New investment in infrastructure is also needed and progress in this regard remains slow, as was also noted in the Commission Communication on Energy Infrastructure and Security of Supply.*
>
> *Secondly, Member States are still failing to deal with the issue of market structure. As has been highlighted in previous reports, one or two companies dominate the gas and electricity markets in too many Member States, and there is often inadequate capacity for cross border competition. It is imperative that solutions are found to such problems.*
>
> *Thirdly, although much progress has already been made in terms of unbundling of network operators and the introduction of regulated third party access, there are still certain aspects, which remain unsatisfactory. A fully independent transmission system operator is crucial for a well functioning market. Likewise distribution system operators need to be adequately separated from supply companies to ensure cost reflective tariffs and the removal of any cross subsidies. The independence of regulators is crucial in this respect in order to ensure fair network access in terms of tariff levels and structure. In this respect the gas sector is measurably behind that for electricity.*
>
> *Finally, another obstacle to the internal market is the continued existence of regulated end user prices for electricity and gas alongside the competitive market and associated long-term power purchase arrangements (PPAs). Although such controls are a valuable transitional measure during the initial phase of market opening, there are risks that such an approach will stifle competition, constrain investment and confuse and contradict unbundling measures.*
>
> *Although many of the necessary measures to implement competition have been taken, or are in progress, the obstacles referred to above appear in many of the electricity markets of Europe as summarised below.*
> *a) No major issues: Denmark, Finland, Sweden, UK.*
> *b) Unbundling and Regulation: Austria, Germany, Luxemburg.*
> *c) Market Structure or Lack of Integration: Belgium, Czech Republic, France, Greece, Ireland, Italy, Latvia, Lithuania, Netherlands, Slovenia, Slovakia and Spain.*
> *d) Long term PPAs Regulated end-user prices: Estonia, Hungary, Poland and Portugal. In addition to this, the island states of Malta and Cyprus have limited scope for the development of competition for electricity."*

The first issue is related to harmonisation of electricity market and this is dealt with in Section 2.3.5. The second and third issue concerns with market concentration and competition, which is dealt with in Section 2.3.2. The fourth issue is related to the level of market opening, namely in

closed markets the end user prices are regulated, rather than determined by the market (Section 2.3.1).

2.3.1 Level of market opening

In a fully opened market a customer can switch supplier based on tracked information, while this is not possible in a closed market. The level of market opening varies considerably among the EU Member States, ranging from full opening in the Austrian, British, Dutch, German, Iberian and Nordic market to a partial opening in the market of other Member States. The electricity markets in the new Member States and Accession Countries are even more diverse.

In relation to market opening, it is mainly of interest to consider the amount of customer switching or contract renegotiation by consumers that occurred after opening the market. In a fully opened market the amount of switching/renegotiation is generally higher. The usefulness of tracking and the information on generation attributes is largely influenced by the level of market opening in Member States.

2.3.2 Market concentration, competition and regulation

A tracking system makes more sense under a liquid and perfectly competitive market, where consumers presumably can switch more easily among producers. However, opening up of the market has, for instance, led to mergers and acquisitions to such an extent that it influences competition. The Dutch and German wholesale markets, for example, have become oligopolistic in nature, possibly reducing the benefits of competition in a wave of mergers immediately after opening the wholesale market.

Concentration of market power can potentially lead to market distortions and imperfections for which the consumers have to pay a higher price. Hence, market opening does not automatically lead to more competitiveness and market liquidity. Nevertheless, the level of competition on the retail market is usually much higher, due to a higher number of retailers and the possibility of new entrants. However, competition at the wholesale level is an indispensable element of a functioning electricity market. Moreover, more competition also enhances the ability to switch for the consumer and the variability among the producers.

To sum up, aiming at perfect competition and a wider consumer choice increases the potential for trading including cross-border co-operation. Tracking can play a facilitating role for achieving this and could be one of the key objectives of electricity regulatory authorities in European countries.

2.3.3 Domestic and cross border trade

A fundamental feature of liberalised electricity markets is that large shares of the generated energy are traded between market participants. Sometimes, in the case of forwards and futures, the electricity is traded several times before it is produced and consumed. There are several patterns of energy trading, including in-house deals, long-term bilateral contracts, over the counter (OTC) transactions and power exchanges (PX). In addition to domestic trades, large volumes of electricity are traded across borders in Europe every day. Any system designed to track attributes therefore has to be able to take into account trading activity including such cross-border links.

The electricity grids of mainland Europe are interconnected through the UCTE network, and international exchanges have taken place through this channel for decades. Synchronous operation with neighbouring networks with, for instance, the UK and the NORDEL system is also aimed at. Moreover, the interconnected area is increasing even further as the result of the economic

and political transition of central and eastern European countries. Furthermore, interconnection capacity within the EU and to other regions outside the EU is increasing, and cross-border transfers are increasing rapidly with an increasing level of competition. Also, the liberalisation of the electricity markets has resulted in a few large multinational electricity companies, optimising their portfolio across Europe using the UCTE interconnection capacity.

The increasing volume of trade in the European electricity market necessitates the implementation of a reliable tracking system that can cope with cross-border trades and transfers. Moreover, cross-border trade in attributes of electricity production is already taking place on a large scale. Trade in attributes has been mostly restricted to tradable renewable energy certificates (TRECs), and more recently guarantees of origin for RES-E (RE-GO). The most active market has been the market in the Netherlands with some 2.5 mln households, as compared to 4 mln households European wide (www.greenprice.com July 2004 estimate). Much of this demand has been met from foreign green electricity sources. Figures presented by the Association of Issuing Bodies (AIB), which operates the RECS and EECS certificate schemes for RES-E, show cross-border transactions of certificates representing some 13 TWh in the first four months of the year 2005 alone. Hence, cross-border transfers of generation attributes are not just a possibility; they are a reality in the current market.

2.3.4 Power exchanges

A significant share of electricity is traded on the PX, of which a large number are in operation across Europe (an example of past recorded volumes is given in Section 3.10). On the PX, electricity is often bought and sold several times as part of the trading and hedging strategies of electricity companies. Repeated trade of electricity often breaks the link between generation attributes and electricity sales by aggregating volumes. In this case, contract-based tracking (see Section 2.4.1) would only be able to track aggregate generation attributes for the part of the electricity that is traded over the PX.

If the generation attributes are split from the underlying electricity (most likely through issuance of certificates) such a problem would not exist as the attributes could be transferred independently from the aggregated volumes from the exchange. Therefore, tracking systems based on certificates can work well with power exchanges.

2.3.5 Harmonisation of the European electricity market

The electricity markets are not fully harmonised or even liberalised to the same degree across Europe. With the exception of the Scandinavian region, most electricity markets operate almost exclusively on a national basis. However, in mainland Europe, the continued expansion and strengthening of the UCTE system, and the Florence process are working towards a greater integration of the wholesale markets. So far, regional harmonisation and integration of national electricity markets is taking place. For example, the markets of Spain and Portugal are merging into a single Iberian market and the national regulators of the Netherlands, Belgium and France have prepared a roadmap for the integration of the wholesale electricity markets (CRE et al., 2005).

The Electricity Regulatory Forum of Florence was set up in 1998 to discuss the creation of an internal electricity market. The participants are national regulatory authorities, Member States, European Commission, transmission system operators, electricity traders, consumers, network users, and power exchanges. The Forum convenes once or twice a year. The Forum currently addresses cross border trade of electricity, in particular the tariffs for cross border electricity exchanges and the management of scarce interconnection capacity.

2.3.6 Electricity disclosures

> *"The opening up of the electricity market in the European Union will gradually give all consumers a choice of supplier. This choice can be based on price, on quality and reliability of service, but can also relate to the generation characteristics of the electricity supplied. The Electricity Directive, therefore, introduces the obligation on suppliers to specify the fuel mix and its related environmental impact of the electricity they sell to final consumers."*[14]

This new obligation on suppliers -to specify the fuel mix and its related environmental impact- is the requirement of the so-called 'disclosure of electricity generation attributes'. To achieve this, there is a need for a well-working tracking system.

While mostly dealing with energy security and investments in the liberalised European markets for electricity, the Electricity Directive also requires the disclosure of generation attributes, namely the fuel mix and the environmental impact of the electricity sold by a supplier to final consumers. Once a system of disclosure of generation attributes is in place, consumers can make a choice among electricity suppliers based on price, quality, reliability of service, and generation characteristics. This new regulation, therefore, requires more information from the market players - not just the price and quality of the product electricity, but also its 'ingredients', namely the electricity attributes such as the fuel mix and environmental impacts.

A fundamental prerequisite of disclosure of generation attributes is the need for unambiguous links between power plants and electricity sold to final consumers. These links are used to transfer information about power generation attributes to electricity suppliers and finally to consumers. In an ex-post scheme, such as the EU disclosure requirement, the tracking system generates the information provided by the tracking system that will be accumulated to total figures over a previous period (usually a calendar year).[15]

2.4 Implementation of tracking of generation attributes

Tracking of generation attributes is required for a variety of EU and Member State policies, most obviously for electricity disclosure, but also for some support schemes for RES-E and HE-CHP.

Once a generation device has fed its electricity into the public grid, the flow of electrons to specific consumers can not be traced, because electricity in the grid is physically homogenous - there is no way of distinguishing 'brown', 'green' or 'yellow' electrons. Hence, electricity characteristics may be assigned to specific supplies using three alternative options: statistical averages, via electricity contracts, or by using transferable certificates.

Hybrid models using a combination of electricity contracts, certificates and statistics may also generate usable outcomes. Preferably the residual mix, which remains after contract-based and certificate-based tracking, should be minimised, because the use of national statistical averages will not help the end consumers in choosing their supplier. The difference in the electricity mix between suppliers remains insignificant in this case. Below we focus on the pros and cons of contract- and certificate-based tracking.

---

[14] Note of DG Energy & Transport on Directives 2003/54 and 2003/55 on the internal market in electricity and natural gas - Labelling provision in Directive 2003/54/EC.

[15] WP1 of the E-TRACK project (Lise et al., 2005) provides further information on disclosures, namely that disclosures are implemented differently across MS, while tracking requirements and the relation of disclosure to GO is not always clear.

2.4.1 Contract-based tracking

It is possible to assign generation attributes of specific power plants to specific suppliers and final consumers through contractual arrangements in the wholesale electricity market.

In some instances generation and supply is undertaken by the same company, namely a vertically integrated electricity company, and for those companies it is possible that supplies can be obtained from their own generation capacity and are not traded externally. However, while many vertically integrated electricity companies still exist across Europe, generation and supply need to be unbundled from network operations based on EU and Member State legislation. In addition to this, utilities often use external trade for their portfolio management.

Yet, the consideration of contracts is complex. In addition to the PX there are different types of contracts as already pointed out in Section 2.3.3, which are traded in the OTC, for instance bilateral contracts and forward contracts (futures). The 4CE study (Boardman et al., 2003) shows that forward contracts do not create any real problems with regards to contract-based tracking.

An additional complication is that not all electricity delivered is based on bilateral contracts. In the Nordic market about 42% of the electricity is traded through the Nord Pool where bilateral contractual linkages are absent. A similar system may also emerge throughout the UCTE area.

Also, there is always a need for backup capacity and other system services to balance the grid in real time for variations in demand and supply, which are typically not included in bilateral contracts between generators and suppliers, but is rather contracted by the TSO and/or DSO (SKM, 2002).

Hence, contract-based tracking could only work for that part of the market where sales are organised via unambiguous contracts, for various reasons including those above. Moreover, there are real concerns about liquidity in the market, as electricity generation attributes will differentiate the commodity and thus segment the market. Liquidity of the market is needed for a smooth negotiation of contracts. Without market liquidity, existing contractual arrangement are difficult to change and also costumers cannot use the disclosure of generation attributes in choosing the supplier they wish.

2.4.2 Certificate-based tracking

Based on experiences already gained, a tracking system could be designed where certificates are assigned to each generated MWh of electricity for each fuel or technology. Indeed certificates representing proof of generation already exist in all Member States in the form of guarantees of origin, but only for RES-E (and soon for HE-CHP). A number of Member States also have certificates in the form of TRECs, mainly for the purpose of obligation systems. Such certificates could be used for accounting in the electricity disclosure statement.

Certificate-based tracking can overcome many of the obstacles, which have been identified in a contract-based system, because attributes can be transferred independently from electricity trading arrangements. However, the unbundling of attributes and electricity can also have adverse effects, e.g. a regional mismatch between physical electricity volumes and attributes.

Also, there is little direct experience with such an all-encompassing tracking system, which would cover the whole electricity market. Nevertheless, the Austrian disclosure of generation attributes system is now based on certificates and Guarantees of Origin, which are to a big extent issued, transferred and redeemed electronically in a central registry, and further experience will accumulate over time.

In a disclosure scheme, which is fully based on certificates, it is not clear whether there will be demand for certificates of certain types of generation technologies, as the theoretical market value of certificates that are not asked for by the market could turn out to become negative (SKM, 2002). Such a comprehensive certificate-based system therefore would need to be mandatory to such an extent that even disliked attributes are linked to a particular consumption, e.g. by an obligation for all suppliers to cover their electricity sales with certificates, and a respective obligation for generators to sell their certificates even at a negative price.

Despite relatively little experience, certificate-based tracking is expected to be much easier than attempting to track attributes along the trading arrangements in the electricity market. Moreover, it is important to set up a system that rules out multiple counting. To achieve this, a system or register is needed to assign certificates to each generated MWh and redeem certificates for each consumed MWh (for a particular technology). At the same time it can also be desirable to have a system, which allows for multiple uses (e.g. financial support for renewables and accounting for the national indicative target). This is possible, but it needs to be pointed out in advance to make it transparent.

It should be added that existing certificate systems across Europe already cover a significant share of all plants, which will increase further when all new Member States have implemented the Renewables Directive and all the 25 Member States have fully implemented the Cogeneration Directive. While in most countries the renewables and CHP capacity is small, this does include the majority in terms of the number of plants. The additional administrative burden to add the other plants may be relatively small in comparison to the initial work on the GO/TREC systems.

2.5 Possible stakeholder positions

This section deals with possible stakeholder positions related to a tracking system according to 1) producers, 2) suppliers, 3) traders, 4) consumers, 5) transmission and distribution system operators (TSOs and DSOs), and 6) Member State governments and regulators. We have pointed out possible positions of stakeholders based on existing statements from different sources updated with opinions raised during stakeholder workshops organised in the framework of the E-TRACK project.

2.5.1 Electricity producers

Producer's attitude towards tracking schemes depends among others on the attractiveness of the attributes of generation. Producers that possess attractive (i.e. green) attributes would like to gain the full potential additional benefits and might support a fairly transparent tracking system. While producers with less attractive (i.e. carbon intensive) attributes would rather like to avoid having a 'negative label' attached to their product and might therefore prefer a tracking mechanism based on statistics.

Producers of supported electricity have an interest in continuity for a large number of years. This mainly means conserving existing benefits from certain support schemes (such as a system of feed-in tariffs). Especially, in the case of exploiting RES-E-based generation units with generation costs far above marketable revenue, this premium is necessary to stay profitable as a generation technology. RES-E technologies also need to be financially attractive, in order to meet (national) RES-E targets. In the German workshop, generators called for a proper integration of the support scheme with the tracking mechanisms.

Electricity Producers want to avoid unnecessary administrative burdens. A tracking scheme should remain simple enough as to prevent considerable efforts for declaration, monitoring, re-

porting, control, and verification. The Dutch energy producers also confirmed this during the first stakeholder workshop.

2.5.2 Suppliers

The position of suppliers is to a certain extent related to their direct contact with consumers. Electricity suppliers may be evaluated by consumers concerning their reliability, service and quality. Hence, to some extent suppliers share similar objectives with consumers. Suppliers also aim at clarity and transparency so that they can create consumer goodwill and trust. In addition, suppliers have a marketing interest in tracking (green) electricity attributes because it enables them to create new electricity products. In France, for example, stakeholders mentioned the idea that more information could be useful to devise specific green products, such as electricity coming from a given region of production.

In the Netherlands certificate based tracking of renewable electricity is already implemented, suppliers are satisfied with this system giving them the possibility to offer more than one product. They are, however, not certain whether explicit tracking beyond green has any added value to the consumer. Consumers can easily see the difference between green and 'grey' electricity, but may not be interested in more differentiation (e.g. between gas, coal or nuclear).

A reason why suppliers would not be in favour of a very advanced tracking system is that they currently compete mostly on price and want to avoid any additional costs, which could be incurred by the tracking system.

A potential disadvantage of the emergence of an electricity tracking system for suppliers is the additional work related to the handling of electricity portfolios, because they may have to acquire certificates to prove the origin of their electricity. Once consumers have stated their preference to electricity from a certain technology, suppliers must be able to meet consumers' demand for this type of electricity.

Suppliers will soon have to implement the provisions of Article 13 of the Directive on energy end-use efficiency and energy services (see below). Therefore, they are eager not to add more complexity in their relationship with their customers and not to bear additional costs incurred by the tracking scheme.

> *"Article 13 (extract):*
>
> *2. Member States shall ensure that, where appropriate, billing performed by energy distributors, distribution system operators and retail energy sales companies is based on actual energy consumption, and is presented in clear and understandable terms. Appropriate information shall be made available with the bill to provide final customers with a comprehensive account of current energy costs. Billing on the basis of actual consumption shall be performed frequently enough to enable customers to regulate their own energy consumption.*
>
> *3. Member States shall ensure that, where appropriate, the following information is made available to final customers in clear and understandable terms by energy distributors, distribution system operators or retail energy sales companies in or with their bills, contracts, transactions, and/or receipts at distribution stations:*
> *a) Current actual prices and actual consumption of energy.*
> *b) Comparisons of the final customer's current energy consumption with consumption for the same period in the previous year, preferably in graphical form.*
> *c) Wherever possible and useful, comparisons with an average normalised or benchmarked user of energy of the same user category.*

d) Contact information for consumers' organisations, energy agencies or similar bodies, including website addresses, from which information may be obtained on available energy efficiency improvement measures, comparative end-user profiles and/or objective technical specifications for energy-using equipment."

2.5.3 Traders

Traders thrive on a liquid market with low transaction costs, where they can find ample trading opportunities. Like suppliers the traders attitude towards tracking is mixed. On the one hand, traders would welcome a tradable certificate system, preferably with cross-border linkages to maximise arbitrage opportunities. On the other hand, like for some suppliers, they could benefit from a less complex tracking system as well, e.g. a system based on statistics.

Traders are generally against contract based tracking, because this provides an incentive for reducing the amount of electricity traded on the power exchanges and reduces the liquidity of the market.

2.5.4 Consumers

The emergence of tracking, and specifically the disclosure of generation attributes, basically means that more information is gained about the supplier's portfolio. Due to the increase in information, customers will be able to make a motivated choice among supplier according to their preferences.

Consumers are in the first place interested in a secure supply of electricity at low cost. The whole process from production to distribution and retail does not matter much to them. Transparency, credibility, reliability (these may require independent verification of tracking results), low additional costs of the generation technology could help the consumer in making an articulate choice for the appropriate supplier.

Experience from the Netherlands, with about 2.5 mln households choosing green power, shows that a specific type of electricity generation is marketable to consumers. It requires, however, that 1) costs for green power are not or only little higher than for regular grey power and 2) that it is easy to understand why green power has (environmental) advantages over regular power. The difference between e.g. coal or gas based electricity is more difficult to understand, which makes that (until now) little interest is shown in disclosure of power generation from those sources among consumers.

Customers need information to make an articulate choice, but it is doubtful whether this information has to reach a high level of accuracy. Customers usually consider many components, not the least price and service quality, to make their choice. The recent European Commission Report (SEC(2005)1781) also indicates that the present situation is satisfactory:

"As regards the quality of services of general economic interest, EU25 consumers are satisfied by and large, with the highest level of satisfaction recorded for electricity and gas (94%)." (SEC(2005) 1781, Chapter 4.1)

and:

"For electricity, satisfaction with information provided by service providers sets a 74%." (SEC(2005) 1781, Annex, Table 12)

2.5.5 Transmission and Distribution System Operators (TSOs/DSOs)

The TSO/DSOs are responsible for balancing demand and supply. The emergence of a tracking system also leads to new opportunities for the TSOs namely by taking responsibility by becoming the issuing body.

2.5.6 Regulators and Member State governments

Governments and regulators have among their first priorities to support functioning, liquid and secure electricity markets. They will also consider the integration of tracking with existing policies and they are required to set up reliable tracking systems for disclosure (following EU Directives).

In addition, governments will seek to fulfil any obligations regarding greenhouse gas emissions or RES-goals. They also have other policy goals, including employment, technology development, security of supply, and rural electrification, among others. However, the willingness of Member States to implement a certain tracking system will, for instance depend on the energy system characteristics (imports/export, power exchange, etc) and whether other tracking systems are already in place, the position of market players and their political influence. For example, a country with high RES-penetration (such as Norway) might pose a different attitude towards certificate trading than countries with a lower share of RES-E.

The Member State governments (with the assistance of regulators) ideally maximise societal welfare, balancing the interests of producers, consumers and other parties. Furthermore, they have to adhere to regulation coming from the EU level, which puts an additional challenge to those interests.

The opinion of the Austrian regulator was that the European Commission should specify in more detail the function and use of the GO system. E.g. is the GO tradable, separated from the electricity, should the GO be the basis for disclosure. It is also unclear whether there should be GO for balancing energy as well.

2.5.7 Exchanges and NGOs/label owners

Most likely the exchanges will see contract-based tracking as a threat to the exchanges being liquid trading platforms for electricity. A certificate system might be more attractive, and might be an opportunity for operators of power exchanges to set up a new trading place.

For NGOs/label owners most likely the reliability and credibility of the process transferring the label to end-use customers are in focus, avoiding double selling. Anything that threatens this is most probably the concern of them.

3. Framework conditions in participating countries

In this chapter we deal with the particular framework conditions in the so-called participating countries in the E-TRACK project, namely Austria, France, Germany, Italy, Lithuania, Netherlands, Poland, Switzerland, and the UK. The focus is on the regulatory and policy conditions, i.e. whether a quota obligation of feed-in tariffs system is used for supporting in particular electricity generated by renewable electricity sources (RES-E), and on electricity market conditions, i.e. level of market opening, market concentration measured as the Hirschman-Herfindahl Index (HHI),[16] and cross border trade. The issues of the implementation of tracking, drivers for tracking generation attributes and stakeholder positions are more general at the EU level and, therefore, not further worked out at the Member State level.

3.1 Austria

3.1.1 Regulatory and policy conditions

The Austrian electricity generation system is characterised by a high share of RES-E. About 70% of the electricity generation is based on RES-E, mainly on hydropower; the rest is being generated by thermal power plants, mainly gas (16%). The total installed capacity is about 17,800 MW, of which 11,500 MW is based on hydropower. Nevertheless Austrian energy policy is very active in promoting RES-E and in exploiting additional renewable potential beside hydropower for electricity generation. The target for 2010 is to increase the share of RES-E to 78%.

In July 2002, the Austrian Parliament approved the so-called Ökostromgesetz (Eco-electricity Act), which is the current legal basis for promoting RES-E and CHP plants. By this act a nationwide harmonised RES-E support scheme based on feed-in tariffs (FITs) was set up starting in January 2003, when the Act came into force. The levels for feed-in tariffs are defined by ordinance of the Minister of Economic and Labour. Current FITs are only valid for small hydro plants approved until the end of 2005 and all other RES plants approved until June 2006. A new ordinance, defining new FITs has been proposed but not yet enacted. Furthermore, this new law also introduced a CHP bonus for existing or modernised CHP plants, a harmonised disclosure system in Austria and a GO system based on the requirements of the Renewable Directive 2001/77/EG.

3.1.2 Electricity market conditions

The Austrian electricity market is entirely open to competition since 1 October 2001 (based on the Electricity Liberalisation Act 2000 - ELWOG, 2000).

Due to geographic conditions, Austria is divided into three control areas, namely Vorarlberg, Tirol and the rest of Austria. The transmission system operators for these regions are VKW, TIWAG and Verbund-APG, respectively. In addition, the Austrian electricity sector is traditionally strongly integrated with the German and Swiss markets. Moreover, due to a strong, non-congested interconnection with Germany, the Austrian electricity market is already highly integrated with the German wholesale market.

[16] A widely used index for market concentration in the Hirschman-Herfindahl Index (HHI) which is the sum of the squares of the percental shares in production capacity of the largest producers in the country, were the total level of generation capacity also accounts for auto production. The value of this index lies between 0 and 10,000, where a value below 1000 is considered unconcentrated, a value between 1000 and 1800 moderately concentrated and a value above 1800 as highly concentrated. See, for instance, Boisseleau (2004) and Matthes et al. (2005).

There are three main producers in Austria, namely Verbund (48%), EVN (8%) and Wienstrom (7%). This leads to a highly concentrated market with an HHI of 2400 (Boisseleau, 2004).

3.2 France

3.2.1 Regulatory and policy conditions

The development of renewable electricity is supported in France through a system of feed-in tariffs. The law of the 10th February 2000 and its subsequent decrees of 2001 have established the level of tariffs. This law also reinforces the fact that independent producers (cogeneration, renewable energies and energy produced from waste) benefit from a purchase obligation that is placed on EdF and the non-public distributors. Certain RES-E plants do not benefit from the FIT instrument. For example, wind parks have to bid in calls for tender to secure preferential access to the grid and preferential tariffs.[17]

The same law also sets up a framework for action, namely the multi-annual programming of investments for electrical production (the PPI: *programmation pluriannuelle des investissements de la production électrique*). It foresees that if production capacities do not correspond to the objectives of the PPI, authorities can launch a call for tenders for the creation of new production capacities. The first PPI was published in 2003 with objectives for targeted installed capacities in 2007. Several calls for tenders were also launched in 2003-2004: offshore and onshore wind power, biomass and biogas.

Since 2001 the RECS system is available to French renewable energy actors. Oberv'ER, the observatory of renewable energies, is the issuing body. The system supports green offers from all suppliers that have created green offers (EdF, Poweo, Direct Energie, Gaz Electricité de Grenoble, part of CNR's offer). A framework law for energy is now (June 2005) under consideration by the French parliament. Paragraph B.1.2 of the annex plans the assessment of national and European experiences of support schemes in three years time after the adoption of the law and states the possibility that a market of green certificates can be created.

French GOs are foreseen to be neither tradable nor redeemable. Hence, the register will not lead to exchanges of GOs. GOs are not recognised to have a commercial value, which is, effectively, embodied by green certificates under RECS.

3.2.2 Electricity market conditions

The French electricity market has experienced several phases of opening in recent years:

- In June 2000, all sites consuming more than 16 GWh annually became eligible.
- In February 2003, this eligibility threshold was lowered to all sites consuming more than 7 GWh annually.
- Since July 2004, all companies and local authorities have also been considered as eligible clients.

At present this opening has reached a level of 70%. 100% will be achieved when all households will be able to choose their supplier, and this is scheduled for July 2007.

Competition between suppliers is biased because of the persistence of regulated end-user prices. Eligible customers can choose between two types of contracts:

[17] FITs apply to wind projects up to 12 MW in France, while a EOLE 2005 tender system applies to projects beyond 12 MW (De Vries et al., 2003).

- Contracts with regulated prices (which are offered only by incumbent suppliers).
- Contracts with market prices (which are offered by both incumbent suppliers and their competitors).

At the end of May 2005, the energy regulator (CRE) has issued a report with an analysis of the French electricity market. It shows that a request for eligibility in this context has been asked by only 3.2% of all sites. This share goes up to 15.7% in the case of large sites, which have been eligible for the longest time. Others have renegotiated with the incumbent supplier. One market segment appears to be less sensitive to competition (8% penetration only), namely medium-sized clients (site on high voltage under 250 kW or on low voltage over 36 kVA). In terms of consumption, the share of alternative suppliers represents 12.6% in February 2005. It increases relatively slowly (from 9.5% in July 2004).

Market concentration in the French market is very high with an HHI of 7800, due to the dominance of EdF (88%) and small shares for CNR (3%) and SNET (2%) (Boisseleau, 2004). In the same report from CRE, market concentration is analysed in more detail. When considering injections to the grid, the HHI reaches 9078, which shows the lack of alternative producers, while a low HHI figure of only 883 is found for imports. When considering demand, HHI is 8401 regarding consumption of final consumers and 4663 regarding exports, which demonstrates the dominance of EdF, noticeably because of its-long term contracts.

Main exporting and importing partners were Italy, Germany and Spain in the first four months of 2005 and imports follow a rising trend. Volumes traded on the wholesale market are more and more important (a confirmed rising trend from 2002 onwards).

3.3 Germany

3.3.1 Regulatory and policy conditions

Germany operates a support scheme for RES-E based on a feed-in tariff, which includes an obligation for distribution system operators to buy electricity from RES at a minimum price defined in the law. The law also specifies how this electricity is distributed equally on a pro rata basis to all suppliers of electricity. Almost all renewable energy generation in Germany is covered by this regulation, with the exception of large hydro power plants.

Shortly after the formal liberalisation of the electricity market in Germany in 1998, several private initiatives for quality labels for ‘green power’ have emerged in Germany. The largest market share (within the niche market for green power in Germany) was soon held by the TÜVs (Technische Überwachungsvereine), which are well-established technical verification bodies.[18] The TÜVs established several certification standards, one of which can be seen as a Guarantee of Origin for electricity from hydropower, which at that time was the most important renewable energy source for electricity generation.[19]

In addition to this, the RECS system was introduced in Germany in 2001. The Issuing Body is Öko-Institut, an environmental research and consultancy organisation, and two TÜVs are involved in this as Production Registrars. However, due to the strong feed-in support scheme, issuing activity in Germany remained low.

[18] The TÜVs are organised in several regional branches. The most active branch in green power labelling is TÜV Süddeutschland, which is also active in several other European countries.

[19] All other standards include specific requirements on the electricity products, which go beyond the plain Guarantee of Origin. These usually aim at ensuring that green power products contribute to the expansion of RES-E generation and limiting environmental impact of RES-E plants.

3.3.2 Electricity market conditions

Market concentration in the German market is moderate (HHI is 1500), due to the presence of four main producers, namely RWE (28%), E.ON (22%), Vattenfall (15%) and EnBW (4%) (Boisseleau, 2004).

3.4 Italy

3.4.1 Regulatory and policy conditions

In order to promote the use of renewable sources of energy, a quota obligation system on the production side, based on a Green Certificate (GC) market has been put in place since the 1st of January 2001, according to article 11 of the Legislative Decree 16/03/1999 n. 79 that implemented European Directive 96/92/EC. In the GC market, demand is defined by the producers' and importers' obligation to inject into the power grid a certain proportion of RES-E. In particular, the support scheme covers energy produced by power stations, which entered into operation or were refurbished after 1 April 1999. The set minimum level is equal to 2% of the conventional electricity that producers and importers have generated or imported in the previous year. The proportion has been recently revised by the Legislative Decree n. 387 of 2003: the initial 2% is increased by 0.35% each year from 2004 to 2006.

Another support that was created for promoting 'green' production is still in place in Italy, namely the CIP6/92 mechanism based on a feed-in tariff system. Currently, only those plants that have the appropriate legal rights can continue to apply for it. Basically they are fed by renewable sources or by other sources considered 'similar' to renewable ones. The CIP6/92 mechanism is an alternative to Green Certificates. The producer cannot receive both of them for the same energy.

There are also other forms of certification, such as the RECS system, which are a voluntary and tradable instrument. The Italian Independent System Operator (GRTN) is responsible for admitting plants to RECS, issuing RECS certificates and managing the specific trading and redemption platform.

Based on Directive 2001/77/CE and in compliance with the Legislative Decree n. 387, GRTN also issues GOs to plants having a yearly generation above 100 MWh. This instrument, which has no commercial value at the moment, is used for:

1. Certifying the Italian production from renewables.
2. Verifying if energy that is imported is actually of renewable origin.
3. Facilitating the definition of common rules for the trading of electricity from renewables between European countries. Under special conditions, to be defined by the competent authorities in each case, Italy might recognise GOs or similar certificates issued by countries, which are not members of the European Union.

Since GOs have no commercial value, they coexist with RECS and GCs, but are not issued for the same generated MWh to avoid double counting.

3.4.2 Electricity market conditions

The Italian electricity generation system is characterised by a high share, 75%, of electricity produced by thermal power plants while 15% of generation is from big hydroelectric plants and 2.3% of generation is from wind, sun and geothermal sources. A considerable proportion of energy is imported from foreign countries (about 14.5% according to preliminary data of 2004). In 2004 the total production was about 300 TWh of which 56 TWh from renewable sources including large-scale hydro.

Although the legislative provisions for the liberalisation of the electricity sector have been implemented, the current structure of the market is still highly concentrated. The HHI index, in fact, is equal to 4300, because of the dominance of ENEL, which holds a share of nearly 50% of all generation capacity. According to the Investigation of the Energy Regulator and Antitrust Authority released in February 2005, the six first Italian producers (ENEL, EDISON, EDIPOWER, ENDESA, TIRRENO POWER and ENIPOWER) all together cover almost 80% of domestic production.

Concerning the restructuring of the Italian electricity sector, other measures have been put in place in order to favour the process of liberalisation. For example, in order to strengthen unbundling it was decided that after the transfer of the GRTN core business to Terna, which is the company that currently owns the 94% of the transmission grid, the ENEL quota in that company should be no higher than 20%.

The IPEX (Italian power exchange) has entered into operation in April 2004 and the Gestore del Mercato Elettrico (GME), a daughter company of GRTN, is in charge of organizing and managing the Electricity Market. This market is composed of the energy market, which itself consists of the Day-Ahead Market and the Adjustment Market - and the market of the Dispatching Services. In the Day-Ahead and in the Adjustment market GME is responsible for organizing the scheduling of production power plants, on the basis of generation costs and the grid constraints foreseen by GRTN.

3.5 Lithuania

3.5.1 Regulatory and policy conditions

Lithuania has been in transition from a centrally planned economy to a free market economy. During five decades since 1940, Lithuania was fully integrated into the economy of the Former Soviet Union (FSU). Production capacities of many enterprises of manufacturing and energy sector, inherited from its Soviet past, were planned taking into account not only internal country's needs but also requirements of the large FSU North-Western region. However, the share of indigenous energy resources in the country's primary energy balance was decreasing consistently - from 11.4% in 1970 to 2.4% in 1990, and primary energy supply was dominated by imports from Russia. The Seimas (Parliament) and the Government of Lithuania have started a policy for reforms in all sectors of economy and energy since 1991, the first days of regained independence.

Since May 2004 Lithuania is member of the enlarged EU. Thus, the energy sector should comply with requirements of the EU directives. All these obligations require from new Member States to start with implementation of policies supporting the use of renewable energy sources and high-efficiency cogeneration in the internal market for electricity.

The National Energy Strategy, which was adopted by the Seimas in October 2002, sets the main strategic priorities of the State energy policy and Lithuanian energy sector development. One of the main strategic priorities is striving to achieve a share of renewable energy sources in the total primary energy balance of 12% by 2010.

3.5.2 Electricity market conditions

Since 1 January 2002, radical changes in the Lithuanian power system have been introduced. The Law on Electricity entered into force, creating new and innovative relationships and providing for gradual liberalization of the electricity sector. Since 1 April 2002, the Lithuanian electricity market has started operating. The National Control Commission for Prices and Energy

granted the status of eligible customers to 12 companies (consuming more than 20 GWh of electricity) with a right to choose the supplier and to purchase electricity from the selected producer. In addition trading of electricity at auctions was launched.

The implementation of a competitive market has been started in the sectors of electricity generation and supply, where prices are set in auctions or determined by bilateral agreements between market parties. The National Control Commission regulates the activities of the transmission network operator by setting price caps for transmission services. The Market Operator organizes trade in electricity according to the Electricity Trading Rules. Distribution companies perform two functions: they are both distribution network operators and public suppliers. The National Control Commission sets price caps for distribution services for a three-year period. For the year 2003 the status of eligible customers was granted to 25 consumers (consuming more than 9 GWh each). Their share was about 26% of the total electricity consumption. Eligible consumers may freely conclude electricity contracts with any licensed producer or supplier and pay a set price for the electricity transmission and distribution. In 2003, the electricity trading balance was: 70% by bilateral contracts, 12% at auction and 18% as Public Service Obligations.

Since January 2004, the Government set a new consumption margin (3 GWh per year) for eligible customers. Also hour-to-hour balancing was implemented for electricity transport and the automatic electricity accounting system was implemented. From the beginning of 2004, opening of the electricity market has increased to 40%. And since July 2004 all non-residential customers are eligible. Thus, about 70% of customers (according to their share in the country's electricity balance) can choose their supplier. The electricity market will be open by 100% in 2007.

3.6 Netherlands

3.6.1 Regulatory and policy conditions

There is a broad level of experiences with tracking of generation attributes in the Netherlands, as the Netherlands has been one of the first countries to allow for Tradable Renewable Energy Certificates (TREC). The Dutch Transmission System Operator TenneT has been operating a system of TREC since the introduction of an ecotax exemption for consumers of RES-E in 2000. Suppliers of green electricity had to redeem certificates in this system in order to prove that they have acquired the proofs of origin for a certain volume of RES-E and for this volume their customers were exempt from the ecotax. As a result about 2 mln Dutch consumers have switched to green electricity. There is however not enough production capacity in the short term to meet demand of green electricity and consequentially the Netherlands has been a net importer of green certificates from abroad. The ecotax exemption per kWh consumed has subsequently been reduced (in January 2004) and abandoned completely in January 2005, because it was recognised that the Dutch tax rebate to generators abroad leads to an expenditure by the Dutch government, which will not lead to additional green electricity production capacity in the Netherlands. Thereupon, the Netherlands relies on feed-in tariff since 2004 to provide incentives for new RES-E generation capacity on Dutch soil. Feed-in tariffs available in the Netherlands are known as 'milieukwaliteit van elektriciteitsproductie' (MEP - environmental quality of electricity production) tariffs.[20, 21]

The Netherlands is also one of the pioneers in the current GO market for RES-E and HE-CHP as well. There is considerable interest in trading GO and setting up such a system. The share of wind power is still relatively low in the Netherlands as compared to the EU average; there are no great system balancing challenges. However, the planned offshore wind park in Germany

[20] There are many studies available about the level of efficiency of the MEP (e.g. http://www.renewable-energy-policy.info/mep/index.html) in the Netherlands.

[21] In detail, the MEP is a premium paid in addition to the market price. This means that the generator has to market its production on its own.

could pose considerable balancing challenges for the Netherlands. Also the share of (HE-)CHP is relatively large and the Netherlands has quite some experience with this technology. Moreover, the Netherlands has also introduced a system of CHP certificates by July 2003. The sole attribute of this CHP certificate is to obtain the MEP subsidy. It is not possible to use the CHP certificate for proving greenness of production to the consumer, which would otherwise have resulted in a 'double subsidy' for the same MWh of production. This is because the main purpose of the CHP certificate is to prove a reduction in CO_2 emissions and in this way is directly used in the EU-ETS as CO_2 emission permits.

3.6.2 Electricity market conditions

The Dutch electricity market has been fully opened by July 2004. Since then also the small consumers are allowed to switch supplier. Competition on the wholesale market consists of four main producers, namely Electrabel (23%), Essent (20%), NUON (17%) and E.ON (9%) in addition to a considerable amount of (mainly CHP and some wind) fringe producers. Hence, the market concentration is medium with an HHI index of about 1300. The Dutch market is quite open and has Belgium (also France with transmission through Belgium) and Germany as the main trading partners. Moreover, foreign companies own two of the main generation companies. The price level in the Netherlands is generally higher than in the bordering markets and this makes the Dutch market a particularly attractive trading partner.

3.7 Poland

3.7.1 Regulatory and policy conditions

Polish Energy Law includes, inter alia, the obligation of purchasing electricity generated by renewable sources imposed on energy undertakings, which hold licenses to trade electricity. This is the basic instrument to stimulate development of the 'green' energy sector. A more detailed version of the legal provisions is the regulation of the Minister of Economy from 30 May 2003, where the mandatory minimum shares for 'green' energy sales by undertakings dealing with trade in electricity were laid down. The minimum shares have been defined as the percentage of renewable energy sold to customers using energy for their own use in relation to total sales of energy to those customers, and they are increasing from 2.65% in 2003 to 7.5% in 2010.[22]

3.7.2 Electricity market conditions

Market concentration is quite low in Poland with an HHI value below 1000, where the main market shares are by the BOT group, PKE and ZE PAK (Elektrim). In addition there are also shares of foreign firms in generation capacity, namely EdF, Electrabel and Vattenfall.

3.8 Switzerland

3.8.1 Regulatory and policy conditions

The Swiss electricity generation system is characterised by a high share of electricity generated by renewable electricity sources (RES-E). About 60% of the electricity generation is based on RES-E mainly on hydropower; the rest is being generated by thermal, mainly nuclear (37%). The totally installed capacity is about 16,000 MW, of which 12,300 MW based on hydropower.

[22] Although the European target for Poland is also 7.5%, the national target is actually smaller, as it refers to electricity turnover in distribution companies and not to gross electricity consumption as in the Directive. The difference is approximately 38 TWh per year (Zowsik, 2005).

The EU Directive 2001/77 on guarantees of Origin (GO) does not apply for Switzerland, as Switzerland is not a member of the EU. However the Swiss parliament has passed a legislation (Swiss Energy Regulation EnV), which enables the government to introduce a GO scheme. Currently, no such scheme is in place but a task force has been set up, in which government officials, utility representatives, the future Swiss TSO and experts from other organizations like the association 'Energy Certificate System ECS Switzerland' (ECS CH) work towards a blueprint of a GO system.

3.8.2 Electricity market conditions

The Swiss electricity market has, as yet, not been liberalised and is in essence still operating similar to the German market before liberalisation. The Swiss grid is part of the UCTE and is running synchronously to support exchanges among neighbouring markets.

3.9 United Kingdom

3.9.1 Regulatory and policy conditions

The UK has provided support for renewable energy developments for many years. In 1990, the government launched several rounds of competitive bidding for renewable energy contracts, known in England & Wales as the Non Fossil Fuel Obligation (NFFO). Structured as a tender to receive a fixed FIT, tracking the generation attributes was not required. However, this support mechanism only showed limited success and was replaced.

The government decided to introduce a new, more market-driven support mechanism. This places an obligation on electricity suppliers to ensure that a minimum percentage of the power they sell comes from renewable energy sources. This obligation system is known in England & Wales as the Renewables Obligation (RO) and in Scotland as the Renewables Obligation Scotland (ROS). From 1 April 2005 a Northern Ireland Renewables Obligation (NIRO) has also started. There was fungibility between the obligation systems across Great Britain (GB)[23] from the launch, on 1 April 2002, and from 1 April 2005 there is likely to be full recognition and tradability under the obligation systems across all three UK markets. Compliance with the obligation is achieved by surrendering Renewable Obligation Certificates (ROCs),[24] which are freely tradable.[25] Current prices for ROCs are in the £45-50/MWh range, with the buy-out price at £32.33 for April 2005 - March 2006.[26]

A year before the introduction of the renewables obligation, the government also introduced the climate change levy (CCL) on business energy use. The current rate is 0.43p/kWh, or about equivalent to £10/t CO_2eq, close to the current EU-ETS range. This tax requires tracking of generation attributes, as it exempts consumption of energy from certain sources and technologies from the tax. To administer the exemption, levy exempt certificates (LECs) were introduced. As a result, LECs have become the default 'proof of green' for both business and household tariffs. Because of the value of the exemption and demand for green, LECs have become a regularly traded commodity. Initially, LECs were not intended to be separable from the power, but market ingenuity significantly loosened the link.

In compliance with the EU Directives, the UK has also introduced Renewable Energy Guarantees of Origin (REGO) and is preparing for the introduction of CHP GOs. REGOs will record *eligibility* of the plant for ROCs and LECs (i.e. not whether these have actually been issued).

[23] England & Wales and Scotland.
[24] SROCs for Scotland, NIROCs for Northern Ireland.
[25] But of course, many smaller renewable generators trade the power and ROCs at the same time.
[26] Note that the ROC price is higher than the buyout price. This is due to the fact that buyout payments are redistributed to those obliged parties, which have met the obligation without paying the buyout price.

Electricity Disclosure regulation is also being finalised, requiring just 'generator declarations' initially, but REGOs from the second year.

Further schemes in existence are energy efficiency certificates, the UK-ETS and of course the EU-ETS, which all present some interactions.

As a result of the introduction of this raft of policies over the last few years and the discontinuation of the Future Energy green labelling scheme, Ofgem is currently consulting on updating regulation for green supply offerings.

The integration of the Northern Irish and Republic of Ireland's electricity markets will introduce significant complications with regards to tracking electricity attributes and potential for double counting, on the basis of the current systems.

3.9.2 Electricity market conditions

The electricity market for the UK has currently three distinct parts: 1) England and Wales, 2) Scotland, and 3) Northern Ireland. The interconnection between these three distinct markets has traditionally been limited, but the UK government and the energy regulator are working to integrate the markets in the British mainland (England and Wales, and Scotland) as interconnection capacity has increased. Betta, the British Electricity Trading and Transmission Arrangements, effectively unifies the markets on the British mainland from 1 April 2005. Interconnection with Northern Ireland is still very limited, but is likely to be expanded. Additionally, interconnection with the Republic of Ireland is also expected to increase significantly, and the all-Island electricity market (combining the Northern Irish and Republic of Ireland's electricity markets) is imminent.

The UK market is not concentrated. Using Department for Trade and Industry statistics for May 2004, only one generator holds capacity over 10% of the total, British Energy. RWE Innogy and PowerGen (now E.ON UK) have capacities of 9-10%. Five other generators each have around 5%, and all others have 3% or less. 'Other' plants, including most renewables and small CHP account to 8.2%, while interconnection with France and Ireland are 3.7% (DTI, 2005). This results in a lowly concentrated market with a HHI of about 500.

3.10 Comparison

The following table provides a summary of all EU Member States related to the regulatory and policy conditions and electricity market conditions.

Table 3.1 shows that in most Member States Feed-In Tariffs (FITs) are used to stimulate the share of RES-E in the electricity generation mix. Obligation schemes are only found in Belgium, Italy, Poland, Sweden and UK. The presence of natural resources in the form of the possibility to generate electricity from hydro or wind power varies considerably among Member States. The ambition to increase the share of RES-E also varies. Most Member States have a moderate market concentration, while high market concentrations are found in Cyprus, Estonia, Greece, France, Ireland, Latvia, Lithuania and Malta; low market concentrations are found in the Nordic market, Poland and the UK. Most Member States are connected to the network of the UCTE.

Table 3.1 *Regulatory, policy and electricity market conditions in the current 25 EU member states*

Country	Feed-in tariffs	Obligation scheme	RES-E[a] [%]	RES-E[b] [%]	Market opening [%]	Market concentration	Coordinated operation through
Austria	*yes*		*70.0*	*78.1*	*100*	*high*	*UCTE*
Belgium		yes	1.1	6.0	90	medium	UCTE
Cyprus	yes		0.1	6.0	35	high	Cyprus
Czech Republic	yes		3.8	8.0	47	medium	UCTE
Denmark	yes		8.7	29.0	100	low	UCTE/Nordel
Estonia	yes		0.2	5.1	10	high	Russia
Finland	yes		24.7	31.5	100	low	Nordel
France	*yes*		*15.0*	*21.0*	*70*	*high*	*UCTE*
Germany	*yes*		*4.5*	*12.5*	*100*	*medium*	*UCTE*
Greece	yes		8.6	20.1	62	high	UCTE
Hungary	yes		0.7	3.6	67	medium	UCTE
Ireland	yes		3.6	13.2	56	high	Ireland
Italy	*yes*	*yes*	*16.0*	*25.0*	*79*	*medium*	*UCTE*
Latvia	yes		42.4	49.3	76	high	Russia
Lithuania	*yes*		*3.3*	*7.0*	*70*	*high*	*Russia*
Luxemburg	yes		2.1	5.7	57	medium	UCTE
Malta	yes		0.0	5.0	0	high	Malta
Netherlands	*yes*		*3.5*	*9.0*	*100*	*medium*	*UCTE*
Poland		*yes*	*1.6*	*7.5*	*52*	*low*	*UCTE*
Portugal	yes		38.5	39.0	100	medium	UCTE
Slovakia	yes		17.9	31.0	66	medium	UCTE
Slovenia	yes		29.9	33.6	75	medium	UCTE
Spain	yes		19.9	29.4	100	medium	UCTE
Sweden		yes	49.1	60.0	100	low	Nordel
Switzerland			*60.0*		*0*	*low*	*UCTE*
UK		*yes*	*1.7*	*10.0*	*100*	*low*	*UK*

Source: EU (2004).
[a] 1997 level.
[b] 2010 target.

As mentioned in Section 2.3.4, there is a wide variation in the exchange of electricity among various Member States. Table 3.2 provides an overview of those Member States where some trading takes place in the power exchange.

Table 3.2 *Volume traded in the national power exchanges and total consumption*

Country	Total consumption [TWh]	Volume traded [TWh]	Percentage [%]	Exchange
Austria	54	1	1.9	EXAA
France	393	14	3.6	Powernext
Germany	499	59	11.8	EEX
Italy	282	15	5.3	GME
Lithuania	8	1.5	18.8	LPC
Netherlands	100	15	15.0	APX
Denmark, Finland, Norway, Sweden	391	166	42.5	Nord Pool
Poland	103	1	1.0	Gielda
Slovenia	12	0.4	3.3	E-borzen
Spain	241	203	84.2	OMEL
UK	333	35	10.5	NETA, UKPX

Source: EU (2004, page 18), EU (2005c), OMEL (2005) and updated with best guesses.

Table 3.2 shows that trading over central exchanges takes place in 13 Member States. Most trade takes place on the OMEL in Spain (representing 84% of all generation/supply, this is because of the single-buyer system), followed by the Nord Pool in the Nordic countries (42% of generation/supply, which is currently the most advanced spot market), while substantial shares in total volume are traded in the German and UK power exchanges. These traded electricity volumes are transferred on an anonymous basis without direct relations between individual sellers and buyers. Therefore it is impossible to track the original generation mix based on electricity contracts. However, trades on power exchanges can either be tracked by using certificates or, alternatively, average attributes of all electricity sold into the exchange over certain periods of time could be determined by the exchange (Boardman, 2003).

In addition, tax incentives can vary greatly among member states, which may be high, either on a national or on a regional basis. As a result the market distortions among member states after the introduction of different renewable schemes also vary considerably.

4. Conclusions and lessons learnt

This report gives overview of the key elements of the framework conditions for tracking generation attributes in Europe.

The analysis of this report shows that context matters for tracking generation attributes. *On the national level*, there are factors, which make the introduction of a tracking system more easy and others which make it more difficult, and these vary among Member States:

- Experiences in tracking of at least part of the market can be used as a basis for creating tracking systems.
- Existing regulations on GO and disclosure need to be taken into account, and might need to be adapted in order to create a consistent tracking system.
- The detailed design of the tracking system might depend on features of the electricity market, such as patterns of generation and trade (and the share of imports and exports).

There are additional factors *on the European level* which influence the chances to introduce a harmonised tracking system across Europe, such as

- The wide variations among Member States with respect to details of the implementation of GOs and disclosure.
- Also the market conditions can be of influence. The varying degree of market opening matters, because the usefulness of tracking is lower in a market where a customer cannot switch among suppliers.
- The amount of electricity traded makes it difficult to link generation to consumption under contract-based tracking, while this is of no concern under certificate-based tracking.
- The increasing cross-border trade of electricity and the establishment of regional electricity markets cause that the national electricity systems become more and more related.

The abovementioned developments are strong reasons to evolve towards harmonisation of tracking systems in Europe.

The key for overcoming the barriers towards a harmonised tracking is the need for cross-border co-ordination of policies and their implementation. To achieve cross-border recognition of electricity attributes there is a need for setting some common standards. The further activities of the E-TRACK project will be concentrating on this.

From the analysis in this report we can come to the following basic recommendations for tracking on which the consecutive work packages can be based:

1. Experiences gained with partial tracking schemes used for feed-in tariffs, quota obligations or fiscal support measures can be useful for implementing more comprehensive tracking mechanisms.
2. There is great variation among Member States in market opening and the role of power exchanges varies. Due to the Electricity Market Directive there will be more harmonisation with respect to market opening and power exchanges. Tracking systems need to be flexible enough to be operational under the variable conditions now and in the future.
3. Explicit tracking via certificates and/or contracts should be prioritised over the use of statistical averages.
4. Where a default set of attributes is needed, a residual mix should be used instead of uncorrected generation statistics in order to minimise multiple counting. The residual mix is derived from statistical data on domestic generation, corrected by net imports or exports of electricity without explicit attributes and corrected for all attributes that have been tracked explicitly

When it comes to the design of an explicit tracking system, we can draw a clear conclusion that a comprehensive contract based tracking system is unworkable in a properly competitive market which may have a large volume going through exchanges, and which may have large cross-border transfers. Contract based tracking would reduce liquidity to the detriment of the market.

Certificate systems have been implemented for RES-E and experience with these systems - while still limited to a few countries and a few years at this moment- will grow rapidly. Experience shows that the implementation of certificates systems is quite easy. Expansion of existing certificate schemes to other sources of generation is likely to be relatively easy and to incur only low additional cost. However, concerns against the introduction of explicit tracking can be expected from some stakeholders who believe that this will influence the electricity market and cause higher costs.

Certificate based tracking seems to be the best option, because it minimises the impact on the electricity market while delivering highly accurate results. Certificate schemes can be designed in a way that they incur low cost and high reliability and accuracy and minimise the possibility for double counting. If required, certificates can also be used for tracking bilateral electricity contracts by ‘tagging’ certificates onto the contract, which is an example of a hybrid tracking system.

The use of uncorrected statistics, such as the UCTE generation mix, should be avoided. A residual mix that is corrected for separately traded attributes can be used as a default set of attributes for electricity with unknown origin. However, a residual mix, which covers a large share of the market, should be avoided as well, because it would deteriorate the differentiation of information for consumers.

References

Boardman, B., J. Palmer, A. Arvidson, V. Buerger, J. Green, K. Lane, J. Lipp, M. Nordstrom, H. Ritter, C. Timpe, D. Urge-Vorsatz (2003): *4CE Final Report*, Prepared as part of the ALTENER project 'Consumer Choice and Carbon Consciousness for Electricity (4CE)'. http://www.electricitylabels.com/downloads/4CE_Final_Report.pdf.

Boisseleau, F. (2004): *The role of power exchanges for the creation of a single European electricity market: market design and market regulation*, PhD thesis, Delft University of Technology /Paris IX Dauphine University, Delft University Press, Chapter 7, http://www.dauphine.fr/cgemp/Publications/Theses/theseboisseleau/07%20Chapter%207.pdf.

CRE, CREG, Dte (2005): *Regional market integration between the wholesale electricity markets of Belgium, France and the Netherlands* - A roadmap prepared by CRE, CREG and Dte, December 2005, http://www.dte.nl/images/20051223%20fb%20roadmap%20final_tcm7-82780.pdf.

De Vries, H.J., C.J. Roos, L.W.M. Beurskens, A.L. Kooijman-van Dijk, M.A. Uyterlinde (2003): *Renewable electricity policies in Europe, Country fact sheets 2003*. ECN-C--03-071. http://www.ecn.nl/docs/library/report/2003/c03071.pdf.

DTI (2005): *Power Stations in the United Kingdom* (operational at the end of May 2004), DUKES Table 5.11.

EU (2004): *Commission Staff Working Document, Technical Annexes to the Report from the Commission on the Implementation of the Gas and Electricity Internal Market.* http://europa.eu.int/comm/energy/electricity/benchmarking/doc/4/sec_2004_1720_en.pdf.

EU (2005a): *Report from the commission, Annual Report on the Implementation of the Gas and Electricity Internal Market.* http://europa.eu.int/comm/energy/electricity/benchmarking/doc/4/com_2004_0863_en.pdf.

EU (2005b): *Information of the 15 Member States on legislature put in place to implement GoO's*: http://europa.eu.int/comm/energy/res/legislation/electricity_member_states_en.htm.

EU (2005c): *Power exchange prices*: http://www.europa.eu.int/comm/energy/electricity/links/index_en.htm.

Jansen, J. (2003): *A green jewel box?* Environmental Finance, March, pp 27.

Jansen, J. (2005a): *Spreading best practice.* Environmental Finance, May, pp 18-20.

Jansen, J. (2005b): *Transfer and use of generation attributes*, North American Windpower, June, 4 pp.

Kristiansen, K.O., R. Jørgensen and J. Lauritzen (2005): *Energy source disclosure, renewable energy targets and guarantees of origin a multi-certificate response to multiple regulatory requirements, Joule AS and Statnett SF* http://www.statnett.no/Resources/Filer/Dokumenter/pdf/Multi-certificate_model_-_final_version.pdf.

Leahy, P. and A. Hathaway (2004): *Renewable energy certificates and air emissions benefits developing an appropriate definition for a REC, Environmental Resources Trust, Pioneering Markets to Improve the Environment.* http://www.eere.energy.gov/greenpower/resources/pdfs/0404_ert_rec_position.pdf.

Lise, W., M.G. Boots, J. de Joode, M. ten Donkelaar, C. Timpe (2005): *Existing tracking schemes for electricity generation attributes in Europe.* E-TRACK WP1 report, ECN-C--05-063.

Matthes, F.C., S. Poetzsch and K. Grashoff (2005): *Power Generation Market Concentration in Europe 1996-2004*. An Empirical Analysis. Öko-Institut e.V., Berlin.

OMEL (2005): *Electricity market 2004.* http://www.omel.es/en/pdfs/Memoria2004EN.pdf.

SEC(2004)547: Commission staff working document. *The share of renewable energy in the EU*. Country profiles. Brussels, 26 May 2004. http://europa.eu.int/comm/energy/res/documents/country_profiles/2004_0547_sec_country_profiles_en.pdf.

SEC(2005)1781: *Evaluation of the Performance of Network Industries Providing Services of General Economic Interest Power exchange prices.* http://europa.eu.int/comm/economy_finance/publications/structural_policies/2005/horizontalevaluation4_en.pdf.

Sijm, J.P.M. (2003): *Interaction of the EU emissions trading directive with climate policy instruments in the Netherlands.* Policy Brief, ECN report ECN-C--03-096.

SKM (2002): *Electricity labelling, Requirements for establishing a reliable well functioning system within the EU*. http://www.gpx.nl/pdf/SKM_1.pdf.

Van der Linden, N.H., V. Bürger, F. Rivero Garcia, J. Green, J.C. Jansen, C. Timpe, M.A. Uyterlinde, C. Vrolijk, S. White, G.P. Yerro (2004): *Guarantees of origin as a tool for renewable energy policy formulation.* ECN report ECN-C--04-078. http://www.re-go.info/downloads/policy_interactions.pdf.

Van der Linden, N.H., M.A. Uyterlinde, C. Vrolijk, L.J. Nilsson, J. Khan, K. Åstrand, K. Ericsson, R. Wiser (2005): *Review of international experience with renewable energy obligation support mechanisms*. ECN report ECN-C--05-025.

Vrolijk, C., J. Green, C. Timpe, V. Bürger, N.H. van der Linden, J.C. Jansen, M.A. Uyterlinde, F. Rivero Garcia, G.P. Yerro (2004): *Renewable Energy Guarantees of Origin: implementation, interaction and utilisation, Summary of the RE-GO project.* http://www.re-go.info/downloads/summary.pdf.

Zowsik, M. (2005): Poland, EC Baltic Renwable Energy Centre, EC BREC, http://www.ecbrec.pl/pl/sektor_energetyki/Poland%20raport.pdf.