April 2000 ECN-C--00-032

OPTIONS FOR DESIGN OF TRADABLE GREEN CERTIFICATE SYSTEMS

G.J. Schaeffer	ECN
M.G. Boots	ECN
C. Mitchell	SPRU, University of Sussex
T. Anderson	Independent Energy Consultant
C. Timpe	Oeko-Institut
M. Cames	Oeko-Institut

Abstract
The main conclusions with regard to the design of Tradable Green Certificate (TGCs) systems for the penetration of renewable energy are as follows.

Any design of a national promotion system based on TGCs should:
- Provide substantial pressure to actors in the market without making it impossible to reach their goals.
- Provide sufficient security for investors; provide a stable and predictable growing market for renewables over time.
- Incorporate flexibility mechanisms such as banking, borrowing or compliance to targets averaged over several periods.
- Ensure liquidity and transparency of the TGC-market.
- Provide customers with sufficient information to allow them to make informed choices.
- Anticipate on international trade of green certificates in the future and on interaction with future Carbon Emission Trading schemes.

There are no major barriers foreseen for starting national TGC-systems. However, for international trade several issues remain to be solved. These include the procedure of international trade, how to deal with different levels of subsidies and the question what country will get the political credit if a certificate is not consumed in the country of production but elsewhere. These difficulties indicate that formalised EU-wide trade cannot be expected in the near future. However, it is expected that international trade based on voluntary demand will happen soon, because this is in principle possible without government interference. Furthermore, formal trade between a limited number of countries, forming 'TGC-trading bubbles' probably will already occur within the next two years. These trading bubbles will provide a good learning ground for international trade and will largely influence the evolution of a wider system. To ensure that the needs of later entrants in TGC-trading are reflected, we recommend the European Commission to set up an open discussion forum for policy makers from all Member States. The sharing of information in such a forum will allow 'first movers' to reflect other Member States' needs in their bilateral agreement so that entry in a later stage will be possible more easily.

Preface
This report is one of the publications of results of the Altener research project entitled 'The Implications of Tradable Green Certificates for the Deployment of Renewable Energy' (Altener Contract XVII/4.1030/Z/98-037). The Netherlands Energy Research Foundation ECN (co-ordinator), the Science and Technology Policy Research Unit (SPRU) of the University of Sussex and the Oeko-Institut of Freiburg/Berlin carried out this project between January 1999 and December 1999. The research project comprised four phases: Inventory, Analysis, Design and Dissemination. The results of the first two phases have been reported in the Mid-Term Report (ECN-C-99-072). The current report comprises the result of the Design phase. A preliminary draft of this report has been the basis for discussion in the Dissemination phase: A workshop for policy makers on the issue of international aspects of tradable green certificates, held in Brussels, 8 December 1999. The proceedings of the workshop as well as the other published results of the project are available via the green certificate website of ECN (http://www.ecn.nl/unit_bs/gr_cert/main.html).

The support from the European Commission for this project is sincerely acknowledged. Additional copies of this report can be ordered at the secretariat of ECN Policy Studies, tel.: +31-224 56 4469. The internal project number at ECN is 7.7212. Questions regarding this report can be addressed to the project co-ordinator, Gerrit Jan Schaeffer (schaeffer@ecn.nl).

The funding by the EU does by no means imply that this report contains EU-statements. The responsibility for the text, including its inevitable flaws, remains with the authors.

CONTENTS

1. INTRODUCTION

1.1 Renewable energy policy in a liberalising EU market

Two issues are dominating European renewable energy policy:
1. The liberalisation of energy markets.
2. The need to meet legally binding international agreements to avoid global climate change.

National Governments as well as the European Commission have decided that renewables are a credible tool to meet these environmental targets. Most Member States have put forward major targets for renewable energy deployment over the next 10 years. For example, the European Commission's White Paper on Renewable Energy states that 12% of the gross energy consumption in the European Union should come from renewable energy sources in 2010, a doubling compared to the 6% level of 1995. For electricity production, this means that the share of renewables have to expand from the current 14% to about 23% (European Commission, 1999).

However, as targets for renewable energy increase so the total cost of the programmes to the Member States have come under closer scrutiny and this, in combination with the move to a Single Energy Market, has led to a new era for renewable energy policy in Europe. One mechanism, which appears to act as useful facilitator towards both the liberalising goals and to provide an obligation for renewable deployment are tradable green certificates (TGCs).

1.2 Tradable green certificates as facilitators of RES-policy

What is a green certificate system? Most people take it as a 'quotum-based' system. This project aims to distance itself from such a definition. We take it to mean that the key feature of a green certificate system is the separation of the 'physical electricity market' from the 'greenness' that is produced along with the physical electricity by renewable electricity generation equipment.

In a system of green certificates, producers of renewable electricity receive a certificate for each pre-defined unit of electricity produced. Such a certificate represents the 'greenness' of the production of electricity from renewable sources. Defining this 'greenness' is an important first step. By issuing green certificates, two different markets are created for producers of renewable electricity: the market of physical electricity, on which they have to compete like any other electricity producer, and the market of green certificates.

Demand for green certificates can originate from several sources. There might be a voluntary demand of consumers (for instance by green pricing). Demand can also be imposed on consumers or other actors in the electricity supply chain (generators, distributors, or suppliers) by the Government via an obligation to generate, transmit, deliver or buy a certain amount of green certificates. In theory, the government, or another actor appointed by the government, can guarantee a minimum price or a fixed price at which green certificates can be sold. Finally, certificates can be taken out of the market by a tendering procedure (on certificates). In practice, combinations of these options might exist.

The main characteristic of green certificates is that they are 'facilitators' of trade in greenness. By separating the markets, the trade in greenness produced by renewable energy generation is de-coupled, as far as that is possible, from physical constraints linked to trade in electricity.

If a green certificate system wants to avoid the pitfalls of both feed-in systems and NFFO-like tendering systems, then it has to ensure that:

- it gives enough security for investors,
- it provides a cost-effective way of deploying renewables,
- it is non-discriminating and transparent to all actors.

1.3 International context

With regard to international green certificate trading there are several issues that need to be resolved. These issues are elaborated in the conclusions part of the final report. They include the question what country gets the credit for renewable energy production; how international trade in green certificates links up to the flexible Kyoto mechanisms; what to do with the different levels of financial and other support for renewables in the different Member States and how to enforce penalties internationally.

1.4 Design of TGC systems

In this report a wide range of options for designing TGC systems will be explored and assessed. This will be done in three steps, indicated by three report parts.

First, in Part A of this report, we will describe three possible scenarios for the future of European renewable energy policy: 'Maximum Harmonisation', 'Maximum Subsidiarity' and 'Harmonised Targets but Subsidiary Promotion Schemes'.

The second step, presented in Part B of this report, is an extensive description and assessment of possible variations for design of tradable green certificate systems. It should be regarded as a 'potential shopping list', from which a designer could choose.

The third step, Part C, is to describe 'ideal' designs per scenario. In the final chapter (Chapter 11) conclusions, recommendations and remaining issues will be presented.

PART A: CONTEXT

2. SCENARIOS

2.1 Why scenarios?

Currently, TGC design efforts are mainly focussed on national domestic systems (for instance Denmark, The Netherlands)[1]. In these design efforts not always the internationalisation of green certificate systems is anticipated. An example is the information content that should be linked to a certificate. From a domestic point of view it does not make sense to indicate whether the electricity that is represented by the certificate has been receiving other kinds of support, like tax rebates or investment subsidies, since this is equal for all the renewable production installations. However, from an international perspective this kind of information can be essential. If every country has, apart from green certificates, its own incentive measures for the production of green electricity, then it is very important for cross-border trade (for instance to determine 'exchange rates' or 'compensation fees') to know what kind and how much support has been received.

The example above also points out an important 'if': If every country has its own incentive measures. There could also be a future in which all incentive measures have been harmonised, and in that case not the same requirements apply.

The lesson of this example is that the design of TGC systems depends also on the possible future of the degree of harmonisation of incentive schemes for renewables in the EU. To cope with this, we have set up three scenarios for the future: one with maximum subsidiarity, one with maximum harmonisation and one medium scenario, in which targets for renewable energy production are agreed, but the way by which Member States reach these targets are left to subsidiarity.

2.2 Scenario descriptions

2.2.1 Scenario A – maximum subsidiarity

This Scenario assumes that Member States will not be willing to give up their own preferences on how to stimulate the increase of the share of renewables in their energy mix. They do not want to be forced to set targets, to introduce taxes or to change their current ways of stimulating renewables. They will only want to adapt their legislation as far as it is ruled to be not in line with current EU legislation. Some of the Member States might want to introduce green certificate systems others might not. Private actors, potentially from each of the Member States, might set up their own private system of green certificates without (direct) involvement from their Governments. Some Member States will rely on fixed feed-in systems, others on tenders, others on investment subsidies, and others on fiscal measures, etc.

2.2.2 Scenario B – agreed targets – no harmonisation of incentive schemes

This scenario differs with respect to Scenario A at one point: Based on the EU-wide target, each Member State adopts a target for their domestic share of renewable energy in their energy mix. This Scenario Also indicates that Member States are a bit more willing to harmonise parts of their policies, as long as they feel that enough room is left for their own way of policy making.

[1] An exception are the efforts in the Renewable Energy Certificate System (RECS)-group. The RECS group has been established during 1999 as an important forum of the electricity industry and some governmental representatives to discuss and test out international trade in green certificates.

2.2.3 Scenario C – maximum harmonisation

In this scenario, targets are allocated to each of the Member States and also the incentive schemes for renewables are harmonised. The main (and perhaps only) incentive scheme is a green certificate system. Member States do not care about subsidiarity with regard to renewables, since they all agree that the least-cost solution to reach a European-wide target is conditional on harmonisation.

This scenario might not be very realistic. However, it might be sensible to work it out, since it 'mirrors' the ideal of a 'pure' green certificate system.

PART B: OPTIONS FOR DESIGN FEATURES

INTRODUCTION TO PART B

TGC-systems can be designed in many ways. There is not one superior system, although some design choices make less sense than others do. In the following part of the Design Report, we have decided to give a broad overview of all the possible ways we could imagine in which a green certificate system can be designed. It aims to describe the options, not to make choices. In this sense, it is a 'shopping list' of design options. Each particular country that wants to develop a TGC system will have its own preferences depending on its climatic, physical circumstances and political views. This document can help them in assessing the options.

DEFINITIONS

Reference Period/Reference Year
The period (for instance a year) of which the necessary statistics are used to determine the number of certificates the obliged actors have to hand over during the Compliance Period.

Compliance Period/Compliance Year
The period (for instance a year) for which an obligation is set.

Reference Amount of Electricity
The amount of electricity consumed/supplied on the basis of which a percentage obligation is translated into an absolute amount obligation.

Time of Proof
The point in time when certificates must have been delivered to show that the obligation has been met.

Renewable Energy Declaration
A declaration filed by a generator of electricity with the Issuing Body for its accreditation.

Issuing Body
The nominated body responsible for the issuing of green certificates in the relevant geographical domain.

Control Body/Redeeming Body
The nominated body responsible for taking green certificates out of circulation and collecting the penalties in the relevant geographical domain.

Registration Body/Registrar
The nominated body to administrate the ownership registration of certificates and to carry out trade transactions.

Central Monitoring Office
An office established to monitor and control issuing, registration and redeeming of all certificates in the relevant geographical domain. There is only one Central Monitoring Office in the domain (for instance the EU or a bubble of countries or regions operating the same kind of TGC system).

3. DEMAND FOR TGCs

As indicated in Chapter 1, demand for tradable green certificates can be organised in different ways. In this Chapter we will deal with four variations, that is, demand by

1. an *obligation* on an actor in the electricity supply chain, to acquire a certain number of certificates within a certain period,
2. specifying a *fixed price* at which certificates can be sold to a certain actor,
3. a *tendering process* aiming at buying certificates,
4. *voluntary demand*.

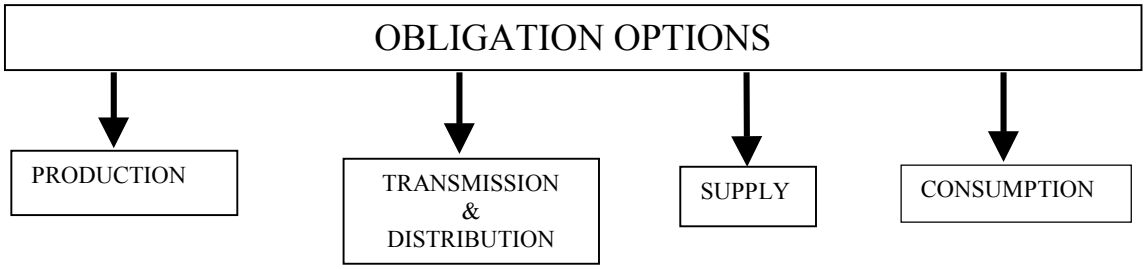
For each of these variations the necessary items for design will be discussed.

3.1 General obligation

3.1.1 Obliged Actor

An obligation to acquire a certain number of certificates can be put on various places of the electricity supply chain:

1. Producer.
2. Transmission or Distribution.
3. Supply Company.
4. Consumer.



Option 1: Producer

A consequence of putting the obligation on the producer is that, since certificates are awarded to producers, this means that the need to transfer certificates to other actors is reduced to a minimum. This has a positive effect on transaction costs, but might have a negative effect on the liquidity and transparency of the green certificate market. A clear advantage of an obligation on producers is that this particular position of the obligation could make interaction with Carbon Emissions Trading (CET) easier, as electricity producers may well be involved in CET. However, an obligation on producers must be supported by other actions, for instance an obligation on suppliers to purchase the production from Renewable Energy (RE) schemes, which then raises questions of which actor is then responsible for system balancing costs. This can give rise to 'indirect' support for RE in some countries. Another disadvantage of this option is that if producers in one country get this obligation, they will have a competitive disadvantage with regard to other producers in neighbouring countries that do not have such an obligation.

Option 2: Transmission or Distribution Companies
In this case, the Transmission System Operator, or the Distribution Companies will have to buy a certain number of certificates. This will lead to a higher electricity transport tariff. This might create a barrier for trade of electricity.

Option 3: Suppliers
If the obligation is put on domestic suppliers, they might be disadvantaged in competition with non-domestic suppliers that do not have an obligation. To avoid this, a condition to this option is that every actor that sells electricity, even if this is not its core business, should have a suppliers license for the specific Member State it is supplying in and/or to. Part of this license is the obligation. This condition might sound obvious. However, in some Member States not all 'suppliers' need a supplying license, for instance some large consumers might not buy their electricity from the supply companies, but buy it directly from the generators, or from their 'neighbour' at an industrial site. In order to avoid this problem the obligation should be put on the consumers (option 4) or the licensing procedures should be adapted (option 3). To include auto-generation also auto-generators should be included in the obligation.

Option 4: Consumers
Obliging the most down-stream level in the energy supply chain, that is, the final consumers, is, at least in theory, the best choice (see for instance Schaeffer et al. 1999a). Final consumers might fulfil their obligation themselves, but also might use the possibility, offered to them by suppliers, to pass on the obligation to their suppliers. Policy makers might want to point out this possibility explicitly to the industry and remove legal barriers for this, in order to avoid large bureaucracy and difficult controlling procedures. An obligation on consumers fits well with the 'polluter pays' principle.

3.1.2 Quantitative obligation

Three issues have to be dealt with:
- What is the character of the obligation (percentage or absolute amount) in the target period?
- How will the targets develop over time?
- Will there be technology diversity in the obligations (homogeneity of obligation)?

With regard to the first point, it should be noted that in the end every percentage obligation is translated into an absolute amount.

3.1.2.1 Character of obligation

Option 1a: A percentage obligation in kWh consumed/supplied
This option means that a certain percentage of the total amount of electricity produced/delivered/consumed/supplied by the actor obliged in the Reference Period should be covered by green certificates. Currently this is the option most popular in discussions on TGC designs. The possibilities for the exact translation from a percentage obligation to a absolute amount per obliged actor are discussed in Section 3.1.3.

Option 1b: A percentage obligation in MW installed capacity
This option means that green certificates will not represent kWhs, but MW installed. This option has been chosen by the authorities of Texas, US. The obliged actors will have to acquire their fair share of green certificates of a certain percentage of the total installed capacity in a country. The allocation of the obligation can be based on the electricity consumption/supply/production/distribution in the Reference Year. It requires complex calculations to translate MW certificates in kWhs.

This will be necessary if one wants to relate to systems in other countries. From an industrial-politics point of view, it might be preferred by some member states to have (domestic) MW-obligations instead of kWh-obligations.

Option 2a: An absolute-amount obligation in kWh
An absolute amount can be based on the assumption of a certain percentage to be reached and an expected development of demand. This is the route that has been chosen in the Australian TGC-design. The advantage is that the market is known long in advance. The disadvantage is that it is not sure whether the percentage foreseen will be reached.

Option 2b: An absolute-amount obligation in MW installed capacity
Comments are equivalent to those of option 2a and 1b.

3.1.2.2 Development of obligation over time

An important aspect for potential investors to assess whether renewables will be an interesting market (and thus for deployment) is the development of the obligation over time. The longer the period for which the market induced by the obligation is known, the higher is the investor security. For the deployment of renewables this is almost as important as the type of growth pattern selected. A tough target, rather than a range of target points might trigger a windlash that might be counterproductive in the long term. This has happened for instance with wind energy in the USA in the early 1980s as well as in the UK in the 1990s. It might be better to have a system that does not create time pressures. Flexibility in System Mechanics (for instance possibility of banking and borrowing) might help to relieve such pressures.

Option 1: Fixed growth rate of obligation
In this case, the (absolute or percentage) obligation, given for the starting Compliance Period, grows with a fixed growth rate over time. This is for instance the case in the Flemish proposal (Belgium). The growth rate can be adapted to reach a politically defined target in a given future year (for instance to reach 3% in 2010). The growth rate can be different in different periods (for instance 16% a year till 2010 and 5% a year after 2010).

By choosing this option a continued growth of the contribution of renewables is induced, without limiting this contribution in advance. Theoretically a year can be determined in which 100% is reached (for instance 75 years from now).

Option 2: Increasing path of obligations
For several future points in time, the obligation is fixed in advance. This is done for instance in the Danish proposal: 20% by 2003 and 80% by 2030. The intermediate path can be filled out in the same way. This option forces the policy maker to state explicit obligations for the far future. This can be regarded as an advantage as well as a disadvantage.

3.1.2.3 Homogeneity of obligation

Policy makers might want to promote not just one (or the cheapest) renewable energy technology, but are aiming at technology diversity in the renewable energy portfolio. For this policy aim, separate policy measures can be applied outside the green certificate system. However, this policy aim of technology diversity can also be incorporated within the green certificate system, for instance by reducing the homogeneity of the obligation. A general disadvantage of this option is that it will create a less homogeneous and transparent market.

Various options for varying the homogeneity of the obligation will be treated below. For each option, the impacts will be analysed, under the assumption that the rest of the system does not change along with and has been designed as optimal as possible.

Option 1: No technological differentiation of obligations
A homogenous obligation has the following impacts:

- It will create the most homogenous and transparent market.
- Overall costs of reaching the obligation will be minimal, at least in theory.
- In comparison with the other options, TGC prices will be the lowest.
- Every thing else being optimal, generation will take place where it is most economic (hot spots possible).
- International trading will be potentially large and easy to handle.
- Only the cheapest options will be stimulated. The number of technologies stimulated depends of course on the definition of renewable (for instance is large hydro included or not), and on the level of the obligation. However, very expensive options such as PV will not have a chance. New, at this moment unknown, options will not be stimulated by a TGC-system with an unbanded obligation, unless they appear to be cheap enough from the beginning. To counteract this negative side effect, while keeping an unbanded obligation, additional stimulation measures for PV and other expensive but promising options could be envisaged.

Option 2: Separate obligations for each renewable technology
The impacts of having a separate obligation for each renewable technology has the following implication:

- It will create a heterogeneous and not very transparent market. In fact, it will create as many markets with individual prices, as there are renewable technologies.
- Transaction costs are expected to be higher than in the case of option 1, since a lot of different obligations have to be calculated and checked.
- Overall costs of reaching the total renewable obligation will not be minimal. They might be minimal for reaching the policy target of technology diversity.
- Generation will take place where it is most economic (hot spots possible), but only per option/market.
- International trading will help to make the markets larger and more transparent/liquid.
- Diversification of renewable electricity sources will be ensured. Difficulty is on what basis to divide the overall obligation over the different options.

Variation on option 2: Separate obligations for 2 or 3 renewable energy 'classes'
Instead of having a separate obligation for each technology, also a number of technologies can be put together in a 'Class', and an obligation can be issued for this Class. This variation is chosen in some of the US States. For instance Class 1 = PV, Class 2 = tidal and wave energy, geothermal energy, solar thermal electric etc. Class 3 = rest. This will soften some of the disadvantages of option 2 mentioned above. It will introduce competition between technologies, but only within their technology class.

Option 3: Separate values for TGC
If separate values are given to TGC from different technologies, this can either be done on the supply side or on the demand side of TGC: On the supply side this will mean for instance that for the production of 1 kWh by PV 5 certificates will be given, while 1 kWh of wind gets 3 certificates and 1 kWh of hydro 1 certificate. On the demand side this will mean that an obligation of 5 certificates can be fulfilled either by handing over 5 hydro certificates, 3 wind certificates or 1 PV certificate.

Variation A: Supply-side differentiation
Within the issuing process, generated electricity from RE sources is converted into a pre-defined common base value, for instance hydro in the relation shown above. All certificates issued are homogenous.
This has the following impacts:

- The number of certificates issued will not be equivalent to the electricity generated from RE sources.
- The market will keep its transparency as there is only one type of certificates to be traded.
- Activities inducing transaction costs will be more or less equal to the first option.
- International trading will be complicated if the common base value and its exchange rates to different RE technologies are not harmonised among the Member States.

Variation B: Demand-side differentiation
The obligation is fixed on the basis of one pre-defined RE technology, for instance hydro in the relation shown above. It can be met either by showing the defined number of hydro certificates or a smaller number from other technologies with a higher value. This has the following impacts:

- The number of certificates issued will be equivalent to the electricity generated from RE sources.
- The market will be heterogeneous and not very transparent. In fact there will be as many markets with individual prices as there are renewable technologies.
- Activities inducing transaction costs will be more or less equal to the second option.
- International trading will only be influenced by the diversified demand for TGC from specific technologies.

Both variations have the following common impacts:

- The eventual contribution of renewables to the electricity supply/consumption depends heavily on the kind of technologies deployed. This means for instance that instead of a 10% target by sources like large hydro, only 2% of renewable electricity supply/consumption might be deployed from renewable sources in the case when only PV is chosen.
- Overall costs of reaching the total renewable obligation will not be minimal; they might be minimal for reaching the policy target of technology diversity.
- TGC prices will not be the lowest possible. The deviation from the optimal will depend on the basis on which the different values of technology-specific TGCs are allocated.
- Generation will not take place where it is most economic.
- Diversification of renewable electricity sources most probably will occur.

With regard to the significantly lower impact on the international TGC market, variation B is more suitable than variation A.

The determination of the different values under both variations can be based on different fundaments.

Base A: Cost price
The values of TGCs are attributed inversely proportional to cost price differences. For instance if the average kWh from PV is 10 times as expensive as the average kWh from wind in the Reference Period, PV solar certificates will have the same value as 10 wind certificates.

If well done, this will keep TGC-prices as low as possible and thus minimise the overall burden for the actors obliged. However, it will barely be an incentive for individual technologies to reduce cost. The actor setting the relative values has to have detailed knowledge on the costs of electricity from RE sources. However, these costs will be different in different countries, so from an international perspective this will lead to a very complex system.

Base B: Environmental benefits
This will allow taking 'grey' or indirect emissions into account. Hydro for instance has, on average, less CO_2 equivalent emissions than PV. Also the location of production plays an important role. A wind kWh produced in Denmark reduces more CO_2 than wind in Norway.

There are again several variations possible. One option is to try to quantify all benefits of renewables, and calculate the value of a renewable certificate on the basis of all the sub-scores per benefit category. This will result in a very complex and opaque market, also because environmental benefits differ between countries. Another option is to take just one environmental benefit, for instance CO_2 equivalent reduction. This is much easier, but will reduce the benefit of renewables to its CO_2 reduction potential.

Base C: Other considerations: For instance industrial policy
The obligation can be seen as a tool for policy makers to stimulate certain options more than other options. This introduces uncertainty for investors, since they cannot anticipate 'changing political moods'.

3.1.3 Reference of obligation

A reference is needed in the case of percentage obligations. It has three components:

- The length of the Reference Period.
- Which period.
- The Reference Amount of Electricity supplied or consumed in the Reference Period.

For the length of the Reference Period there are an infinite number of possibilities. However, the most obvious one is one year. Therefore, we assume that the length of the Reference Period is one year.

3.1.3.1 Reference Period

A Reference Period is needed if an obligation is given as a percentage of electricity consumption/supply/distribution/production. By taking the percentage of the electricity consumed/supplied in the Reference Period, the percentage obligation is translated into an absolute obligation.

Option 1: The Reference Period is the same for all current and future obligations
In this case only one Reference Year is chosen for all Compliance Periods. A consequence of this is that the percentage obligation is translated into an absolute obligation at an early stage. The advantage is that the market is known long in advance. The disadvantage is that it is not known what the percentage will be in the Compliance Period. If this option is chosen and as RE policy is likely to become increasingly linked with Climate Change Policy, it may be useful to use the same Reference Year as the Kyoto Protocol (that is, 1990).

Option 2: The Reference Period is the latest period of which statistics are available at the beginning of the Compliance Period
If the Compliance Period and the Reference Period are both a year this means for instance that in most countries the statistics of, say 2008 (Reference Year), will be available before the year 2010 (Compliance Year) starts. In that case the obligation for the year n is calculated on the basis of the statistics of the year n-2.

This option makes it probable that the percentage of renewables in the Target Year is close to that in the Reference Year. A disadvantage is that the total market is only known at the beginning of the Target Year.

In case the obligation is on consumers and not delegated to suppliers, this gives problems with regard to people moving around, new households and/or new houses.

Option 3: The Reference Period is the latest year for which statistics are available at the end of the Compliance Period
In most countries the statistics of, say 2009 (Reference Year) will be available before the end of the year 2010 (Compliance Year). In that case the obligation for the year n is calculated on the basis of statistics of the year n-1. This option has been chosen in the Flemish proposal.
The (dis-) advantages are similar to those of option 2.

Option 4: The Reference Period is the Compliance Period
The obligation for the year 2010 can also be calculated based on the statistics of 2010. This is the best way to ensure that the target for the Compliance Period is realised. Also for new suppliers (entrants on the market), it is straightforward what their obligation will be. In the case the obligation is on the consumers, it will be the easiest option to deal with new consumers and people moving around.

A disadvantage is that actors only know whether they have reached the target or not, after statistics become available, that is, after at least some months. One solution to this problem is that actors can balance their obligation with certificates until 1 month after the statistics have become available, for instance before the end of March, year n+1.

3.1.3.2 Reference amount of electricity supplied/consumed/distributed/produced

Option 1: Total amount of electricity
The most simple and straightforward option for the Reference Amount of Electricity is the total amount of electricity supplied, consumed, distributed or produced by the obliged actors.

Option 2: Total amount of electricity supplied/consumed/distributed/produced minus for instance large hydro or landfill gas electricity or CHP
Instead of taking all electricity as the Reference Amount, it could be decided to distract from the total amount the amount of electricity produced by sources such as large hydro, landfill gas (if not defined as renewable under the obligation) or Combined Heat and Power (CHP) production. This option is considered in several USA federal proposals and in the Flemish proposal. In this way, renewable sources that are not considered to deserve direct promotion (for instance because they are 'already competitive') are getting an indirect incentive. Instead of spending money to buy new certificates, an actor can also invest in cheap conventional renewables or CHP. In this way, the actor lowers his Reference Amount of Electricity and the actor can fulfil his obligation with less certificates. In this sense this option introduces a 'soft competition' between conventional renewables/CHP and new renewable electricity sources.

3.1.4 Compliance process

In a system with an obligation, the obliged actors should know how and when to comply with this obligation. This means that decisions should be made on the length of the Compliance Period, the Time of Proof for each Compliance Period and the process of compliance. These aspects will be treated in this section.

3.1.4.1 Length of compliance period

Option 1: 1 year

The most simple and straightforward option is to have a Compliance Period of one year. A disadvantage might be that because of circumstances unforeseen (a bad wind year, less solar irradiation than normal, or installations that break down unexpectedly) the actual supply/consumption of green certificates might be less than could be reasonably expected. This problem can be dealt with by choosing for longer Compliance Periods (option 2). Another possibility is to include flexibility in the System Mechanics for instance by allowing banking or borrowing of certificates (see Section 4.2.4).

Option 2: Several years (for instance 5 years)

Comment: This is equivalent to what has been chosen in the Kyoto-agreements on greenhouse gas emission reduction. Instead of one year, the compliance should be reached in a period of x years. The total obligation for that period = x times the yearly obligation. This allows some flexibility for the actors. This flexibility might also be reached by allowing banking and borrowing of certificates (see Section 4.2.4).

A disadvantage might be that actors have a tendency to postpone their investments to the latest date possible. TGC prices might become sub-valued in the earlier years and over-valued in the last year, just before the Compliance Period ends. This disadvantage can be dealt with by having a Time of Proof each year, based on the moving average of the last 5 years.

Option 3: Part of a year (for instance every month or every quarter)

The obligation per quarter (month) can be calculated as the yearly obligation divided by 4 (12). This will induce a continuous spot market and enhance market liquidity and transparency of market prices. It might have somewhat higher transaction costs than option 1.

This option has a very important disadvantage. TGC supply varies heavily during the year due to seasonal variations in climate. Therefore, in this case it is conditional that flexibility (by banking and borrowing) in fulfilling the obligation is allowed.

3.1.4.2 Time of proof

Option 1: At the end of the Compliance Period

The most simple and straightforward option is to have the Time of Proof at the end of each Compliance Period. A possible disadvantage is that if the Compliance Period is long, spot market trade will only occur at the end of the period, and transparency of the market is minimal.

Option 2: Several times during the Compliance Period

Having a check on whether obligations are met several times in a Compliance Period (for instance every month or every quarter) will positively influence the liquidity and transparency of the market. A Time of Proof every month does not effect the length of the Compliance Period. It only means that every month it is checked whether an obliged actor has fulfilled his obligation during the last 12 months (if the Compliance Period is a year). A disadvantage is that controlling costs can become very high.

A combination of Option 1 and Option 2 could be to have at least a check at the end of each Compliance Period. At any other time the Control Body will control randomly whether an actor has fulfilled his obligation calculated over the Compliance Period time reckoned from the time of control.

3.1.5 Compliance control

3.1.5.1 Control body

Option 1: Body especially set up for this purpose
A Body especially set up for controlling purposes could, for reasons of efficiency, be integrated with other functions in the green certificate system, such as verification, registration and issuance.

Option 2: Electricity Regulator
Since the basics of a green certificate system will be incorporated in the Member States' legislation and the Electricity Regulator has a function to look after the correct practice of such an Act, this task seems to fit well with the Regulator's task. Note: Not every Member State has a Regulator (for instance Germany).

Option 3: System Operator
If the obligation is not on the distributors of electricity, the system operator can be a well-suited body to perform controlling tasks, together with issuing and registration tasks. The system operator can have, by European Law, no interests in other potential obligation groups and therefore its independence is assured.

Option 4: Sub-department of existing General Inspection Body of Taxes
Since the penalties in the case of non-compliance can be treated in the same way as taxes, the existing organisational infrastructure of the tax body can be chosen to carry out this task. This would also link in with rebates of Eco/Environmental/Climate Change taxes and levies.

3.1.5.2 Control mechanism

Step 1: As soon as all the necessary data are available (if necessary) the Control Body will calculate the number of certificates required for each obliged actor, and inform the obliged actor concerned.

Step 2: Each obliged actor has to hand over, before the date of the Time of Proof, the number of certificates required for that Compliance Period. Transferring this number of certificates from the obliged actor's account to the Control Body's account can do this.

Step 3: The Control Body will compare the number of certificates transferred before the date of the Time of Proof by the obliged actor with the obligation allocated.

Step 4: Three possibilities:
1. The number of certificates handed over is equal to the number of certificates required. In this case, the Control Body will confirm to the obliged actor.
2. The number of certificates handed over is more than the number of certificates required. (This can only happen if the Reference Period is the same period as the Compliance Period).

In this case there are three options:
2.1 The surplus certificates are returned to the obliged actor
2.2 The surplus certificates are kept out of the market by the controlling body.
2.3 The surplus certificates are kept in stock on the account of the obliged actor concerned by the controlling body. These certificates will be used for a later obligation.

3. The number of certificates handed over is less than the number of certificates required. In this case, the Control Body will add the lacking certificates to the obligation for the next Compliance Period, that is, if borrowing (see Section 4.2.4) is allowed. If no borrowing is allowed, or if the number of certificates lacking is higher than the amount that is allowed for borrowing, the obliged actor has to pay a penalty.

3.1.5.3 Penalty

In a green certificate system in which demand is driven by an obligation, penalties are key elements. The level of the penalty might have several consequences. It might function as a maximum price. The level of the penalty could be looked upon as a degree of political willingness to keep actors to the target. Therefore, the height of penalties (together with the level of ambition of an obligation) will influence market expectations of potential investors in renewable energy.

The several options we envisage of fixing penalties will be treated.

Option 1: Penalty is a fixed price per certificate or per kWh.
This penalty will function as a maximum market price for the certificates. The desirability of a maximum price could be evaluated differently by different actors. In the Danish case, the penalty is very close to the market price expected, and will really act as a ceiling price. The danger is that the system will not really produce the market price and that targets are not reached. A very high penalty level (e.g. 1 Euro/kWh) will not easily have the distortive effect of creating a maximum price, since such a penalty will be far above the market price and will not be attained. If chosen for a very high penalty, it should be avoided that short-term shortages will lead to sky-high prices. That is why mechanisms of flexibility, such as banking, borrowing or long Compliance Periods are very important in the case of high penalty levels.

Option 2: Penalty is a factor above 1 times the average market price in the Compliance Period.
The effect of having a penalty that is $(1 + x) \times$ market price, would be that the penalty will always be higher than the market price, so it does not act as a distortive maximum price for the certificates. A condition to this option is that the body determining the penalty level should have access to market information to determine the average market price. Either this means that there should be a highly liquid and transparent stock market, or that the Control Body should have access to price information on every transaction. In the latter case, the Control Body can also publish an average market price each month in order to enhance price transparency.

3.1.5.4 Destination of penalty money

Option 1: General means of the state
Providing the penalty money to the general means of the State is the most simple and straightforward solution. It is part of the proposal for Flanders. Such a regulation might actually raise the tax burden in the country. Therefore in many proposals it is considered to recycle in one way or another the penalty money to the obliged actors.

Option 2: Renewable Energy Fund
If the money collected from the penalties is put in an Renewable Energy Fund, than this fund can for instance be used to finance new renewable installations. This will need an independent set of rules. Also, part of the transaction/system costs of the green certificate system could be

sustained by this Fund. Furthermore the Fund can function as a 'Market Stabilisator': by buying certificates when the price is low and selling when the price is high, it can influence the market. The penalties do not have to be the sole resource for this Fund.

Option 3: Contributes to income for the Control Body
The penalty money can also be used as an income for the Control Body. Such a regulation might form an incentive for the Control Body to be as strict as possible. In this case it will be necessary to have a good appeal procedure in order to avoid misuse of the Control Body's power.

Option 4: Complying Obliged Actors
The money can also be redistributed to obliged actors that have complied to their obligation. This is the case in the Dutch Green Label system. The penalty is structured in the form of an obligation to purchase certificates from complying suppliers at a price higher (fixed or multiplied by a factor above 1) than the market price during the Compliance Period. A disadvantage is that this might induce strategic behaviour on the part of complying obliged actors.

3.1.6 Continuity of the obligation

The continuity of the renewable energy obligation is important for potential investors in renewable energy production plants. They want to know whether the market for certificates, as far as it is derived from an obligation, will continue to exist during the whole period of exploitation of the production installations. This means that not only it is important that the obligation will last for a sufficient period of time (sunset date of the obligation) but also that in the meantime there is no gap between Compliance Periods.

3.1.6.1 Sunset date of the obligation

Option 1: A fixed sunset date
Several proposals in the US and at least one in Europe (UK) consider to indicate in their regulations a year that will be the last Compliance Period. In the case of the UK this will be 2025. By setting such a date, insecurity may arise among market players what will happen after the last year for which an obligation is known. This might scare off potential investors who will need a longer time horizon. This disadvantage decreases as the period until the specific year for which the obligation is known becomes longer. Politicians might not want to fix obligation long time in advance, to create some political flexibility.

Option 2: A self-sunsetting system
In a self-sunsetting system the obligation is, in principle, limitless in time. This option will avoid the disadvantages of option 1. However, the possibility that politicians will change the level of the obligations is higher, since over longer periods the political constellation of governments can change several times. Investors might take this into account as a risk. This risk will be far less in case of European rules. If Renewable Energy Sourced Electricity (RES-E) costs decrease due to economics of scale and technological development, the scheme may phase out automatically at the point at which RES-E production costs become competitive with conventional electricity production costs. It is a 'self-sunsetting' approach.

3.1.6.2 Intermediate continuity of obligations

Option 1: Not every year belongs to Compliance Period
In the case of the Dutch Green Label system only the year 2000 is a Compliance Period. The years 1998 and 1999 did not have a target to comply to. This option means that only penalties will be paid for lack of obligation in the Compliance Periods. An advantage might be that con-

trol activities by the controlling body could be minimised. A disadvantage is that spot market trading might only occur in the Compliance Period (possibly even restricted to the end of it) which will not contribute to a liquid or transparent market. Another disadvantage might exist with regard to international trade. Suppose Compliance Periods are not synchronous in different countries. In that case actors from countries that do not happen to live in a Compliance Period can temporarily help out obliged actors in other countries and a few years later it can be the other way around. This will not enhance the deployment of renewable energy as much as anticipated by policy makers.

Option 2: Every year belongs to a Compliance Period
If every year is a Compliance Year, or belongs to a longer Compliance Period, the disadvantages mentioned above are avoided. This means that besides final targets (for instance 10% in the year 2010), also intermediate targets for every year between the start of the system and 2010 have to be determined. A minor disadvantage of this approach will be that control activities by the Control Body will have to take place more often.

3.2 Voluntary demand

In the case of only voluntary demand, green certificates have to be handed over to the consumers together with their electricity as a proof of green electricity consumption. The big advantage of this approach is that all the complex issues related to obligations and mentioned in the foregoing sections do not have to be settled. It implies a far more simple system. However, from an equity point of view, only relying on voluntary demand conflicts heavily with the polluter-pays principle. From an international perspective, countries with a demand structured by an obligation might not want to accept certificates from countries with only a voluntary demand approach. Especially if voluntary demand in a given country is well below current production of renewable electricity in a certain country, this country might export many green certificates to other countries, without inducing an actual increase of the deployment of renewables.

In principle, policy makers do not necessarily have to set rules for voluntary demand. If a customer wants to buy a certain certificate and a supplier can offer that and both agree on the price, no interference of the government is needed. However, policy makers might want to stimulate voluntary demand of green certificates by fiscal measures. In that case, they will have to define what they mean by ‘green’.

Another role of the government might be to ensure that the customer gets enough information to decide whether he/she considers the certificate as green. This will also help labelling organisations to be able to give ‘Environmental Labels’ to green electricity products.

3.2.1 Combination with obligation

In the case of the combination of voluntary demand with an obligation of suppliers, there are two options:

Option 1: Voluntary demand is part of the obligation
If the obligation is put on suppliers, in principle it is up to them to find a way to comply with the obligation. They might be willing to do that by looking for customers that are willing to pay a premium for clean energy. However, this is not in line with the polluter-pays principle.

Option 2: Voluntary demand comes on top of the obligation
The obligation part then falls under the polluter-pays-principle, whereas those consumers that want to do more than the minimum, can buy extra green energy.

3.2.2 Withdrawal of certificates

In the case of voluntary demand, green certificates are handed over to consumers. However, if there is not an expiry date for these certificates, these consumers might bring the certificates back into the market, and sell them to others. This will mean that it will be very difficult to assess how many certificates have really been 'consumed', and how many are still 'in the market'. Therefore, a procedure is needed to make sure that the certificates are taken out of the market.

Two possibilities exist:
Option 1: Consumers hand over their certificates acquired to the Control Body
Handing over certificates to the Control Body can be coupled to possible tax rebates. It can be done for instance together with the normal yearly tax forms.

Option 2: Suppliers inform the Control Body on the certificates involved in an actual green electricity sale. The Control Body marks these certificates as being 'out of the market'
Instead of consumers handing over the certificates to the Control Body, the suppliers of green electricity can do this on behalf of the customers. This option is somewhat simpler than option 1. It involves final consumers less.

Also a combination of option 1 and 2 is possible.

3.3 Tender

Another form in which demand can be organised is by organising tenders for green certificates at a regular basis. In this case, the demand for TGCs is not driven by an obligation but by tenders. The tender is for TGCs and *not* directly for RES-E capacity or supply (as is the case in NFFO). The advantage is that verification and licensing of the RES-E project is already carried out when TGCs are awarded. In the tendering procedure only the content of the TGC has to be checked. A disadvantage of tendering for TGCs is that there is no guarantee that the (governmental) target for RES-E is met, if there is one. There is no penalty if the supply of TGCs is lower than demand by the tender. Another disadvantage is that there is no guarantee for a producer that the certificates will be sold at all, especially if the continuity of tenders and the timescale is not very clear. Especially this aspect is very important in tender-based green certificate systems.

Tenders can also be used in combination with other demand structures, for instance to stimulate certain technologies such as PV.

3.3.1 Aim of tender

Option 1: To finance a fixed quantity of renewables in each tender round (quota-based tenders)
In the case that a country has fixed a target, quota-based tenders on certificates gives the best guarantee (among the tendering options) that the target will be reached. If one tender round delivers not enough green electricity, the next tender round can be larger. The disadvantage is that the budget needed (and thus the levy, see 3.3.6) cannot be known in advance.

Option 2: To allocate a fixed budget per tender round as cost-effective as possible (budget-based tenders)
Budget-based tenders have the advantage that the total budget needed (and thus the levy to finance the tender) can be fixed and will not change over time. The disadvantage is that it will not be known in advance how much renewable electricity will be supported.

3.3.2 Homogeneity of tender

Tendering for TGCs gives the opportunity to steer on certain types of RES-E. Each tender round could specify for instance the ingredients or the locations of the RES-E in the TGCs. The *options* to do so (for instance by *technology or region bands*, by *valuing some certificates higher* than others, either on the *basis of the relative cost prices*, or on *the basis of the contribution to reducing environmental harm)* are similar to the options for demand enforced by obligations (see 3.1.2.3), as are their advantages and disadvantages.

3.3.3 Actor calling for tenders

Option 1: An independent body.
If an independent body is set up to perform the role of the tendering actor, this body could best be integrated with other functions in the green certificate system, such as verification, registration and issuance. Such a body could also be linked to the body responsible for administering eco/environmental/climate change-type taxes and levies.

Option 2: The Electricity Regulator
Since the basics of a green certificate system will be incorporated in the Member States' legislation (for instance electricity acts) and the Electricity Regulator has the function to look after the correct practice of such an Act, this task seems to fit well with the Regulator's task. Note: Not every Member State has a Regulator (for instance Germany).

Option 3: The Transmission System Operator
If the Transmission System Operator is chosen as the actor calling for the tenders, this would combine well with a financing scheme in which the budget necessary is financed by a levy on electricity transmission. In that case, the burden of renewable electricity policy is borne by the same actor that can raise the income needed to finance this burden.

3.3.4 Frequency of tenders

It is important to ensure a long-term perspective for TGC suppliers. The timing of future tender rounds should be known in advance. Suppliers of TGC should have some demand security to ensure the continuity of RES-E deployment. Brokers could fulfil the intermediary task to buy up TGCs continuously (taking over the risk) and supply them when a tender is out. The involvement of brokers in a TGC system will introduce new actors in the game whose activities will add to transaction costs. If this goes along with higher volumes of trade, the transaction costs per volume might not be effected negatively too much. It should be noted that with higher volumes of trade needed, it will be more difficult for smaller players to participate in the market (entry barriers).

With respect to the frequency of tenders for certificates, there are two elements that influence investors' security:
- The period between the tenders.
- The period until the final tender.

3.3.4.1 The period between the tenders

The period between tenders has to be a balance between the transaction costs of each tendering procedure on the one hand and the avoidance of a 'stop and go'-market on the other hand. Since tendering is done on certificates, with the advantages mentioned and with a simple selection procedure, the transaction costs per tender might be far less than the transaction cost per tender on future kWhs (for instance NFFO).

Therefore the frequency of tenders can be rather high. This will help to avoid the stop-and-go character experienced in NFFO (with periods between tenders of about 2 years).

3.3.4.2 The period until the final tender

If there is insecurity about the duration of the tender system, that is, the time until the final tender, or if the period until the final tender is shorter than the depreciation period of renewable installations, this will add to the investors' insecurity. So, the date of the final tender should be known long in advance.

3.3.5 Scheme for selection of tenders: the lowest-price offer wins

The only sensible option for the selection of tenders on certificates is that the lowest-price offers win. There are however several possibilities on what price will be given to the winning offers.

Option 1: Every offer awarded gets the price asked for
If, for instance, the tender was for 500 000 kWh of wind power, first the cheapest offer will be awarded, then the next cheapest, etc., until a total of 500,000 has been reached (or, in case of a budget-based tender, until the total budget is reached). Each offer awarded, will get the price that was asked for. So the 500 000 kWh will be bought for different prices. This procedure is simple and could be automated easily. Actors might regard it as unfair.

Option 2: Every offer awarded gets highest price of the offers awarded
The second possibility is that the same offers win the tender, but the price paid is the highest price offered within the quantity/budget tendered for. This may induce strategic behaviour, for instance making the offers at higher prices than necessary. However, if your offered price is to high, your offer is not rewarded within the tender round. All offering actors will get the same price. However, the total costs of this procedure will be far higher than for option 1.

Option 3: Every offer awarded gets average price
The same offers win the tender, but the average price of the offers is paid to all the rewarded offers. The high-cost certificates might have to be sold at an economic price. This might lead to withdrawal of the offer (for instance to wait for a next round), and thus lead to less certificates than targeted.

3.3.6 Financing mechanisms

Option 1: A levy on consumption
A general levy applies to all consumers and the money is collected by the suppliers and put into a Fund that is available to the actor calling for the tender.

Option 2: A levy on the use of the transmission grid
A levy on the use of the transmission grid is a good option if the actor calling for tenders is the Transmission System Operator, since then the burden of green certificates as well as the benefits of the levy is going to the same actor. A possible disadvantage for industrial electricity consumers is that if other countries do not have such a system, the higher electricity price could be a competitive disadvantage.

Option 3 A levy on suppliers
A levy on suppliers will imply that the costs of the levy will be translated into higher consumer prices.

Option 4 A levy on generators
A levy on generators will make them less competitive with regard to foreign generators. This means that the levy should also apply to import of electricity.

3.3.6.1 Minimum price guarantee

Demand for TGCs could also be guaranteed by a minimum price for TGCs. The difference with the current prevailing feed-in systems for instance in Germany and Denmark is the separation between the market for electricity and the market for the societal benefits of electricity produced by green certificates.

A disadvantage of this system is that it does not guarantee a certain amount of RES-E, that is, the supply of TGCs might fall short (if there is a target) and there is no penalty for that. On the other hand, the supply of TGCs might be much higher than expected, but this also applies to the budget allocated to renewables.

Another disadvantage is that minimum price guarantees do not provide an incentive to produce renewable electricity production at the lowest price possible.

A very important issue for minimum price systems is the extent to which a minimum price system in one Member State is open for certificates from other Member States. This issue will be treated in 3.4.3.3

3.3.7 Actor guaranteeing the minimum price

Option 1: An independent body appointed by the Government
If an independent body is chosen to be the actor guaranteeing the minimum price, this body could be integrated with other functions in the green certificate system, such as verification, registration and issuance. It could also be linked to the body responsible for administering eco/environmental/climate change-type taxes and levies.

Option 2: The Electricity Regulator
Since the basics of a green certificate system will be incorporated in the Member States' legislation (for instance electricity acts) and the Electricity Regulator has the function to look after the correct practice of such an Act, this task seems to fit well with the Regulator's task.

Option 3: The Transmission System Operator
This option combines well with a financing scheme in which the budget necessary is financed by a levy on electricity transmission. In that case, the burden of renewable electricity policy is borne by the same actor that can raise the income needed to finance this burden.

Option 4: Fiscal Administration
The Fiscal Administration as the actor guaranteeing a minimum price is the choice of preference for instance in the case of an indirect minimum price guarantee via rebates on eco/environmental/climate change levies and taxes on the consumption of green electricity (= consumption of green certificates in a green certificate system). This is for instance the case in The Netherlands.

3.3.8 Homogeneity of minimum price setting

Minimum price setting for TGCs gives the opportunity to steer on certain types of RES-E. Each technology or class of technologies could be getting different minimum prices for their certificates.
The *options* to do so (for instance by *technology bands*, by *valuing some certificates higher* than others, either on the *basis of the relative cost prices*, or on *the basis of the contribution to reducing environmental harm*) are similar to the options for demand (see Section 3.1.2.3), as are their advantages and disadvantages.

3.3.9 Procedure of setting the minimum price

3.3.9.1 Determination of level of minimum price

Option 1: Percentage of average final consumer price minus average electricity market price
Calculating the level of the minimum price by relating it to the average final consumer price for electricity is an option is similar to the practice under the regime of the old feed-in law in Germany. A disadvantage is that in this option there is no relation to the cost price development of renewable technologies.

Option 2: Externally fixed price on the basis of technology costs
The calculation of minimum prices can be based on an estimation of the necessary price that will cover investor's costs and profit demands. It can be different for each technology. An officially acknowledged calculation method has to be constructed + the necessary information (for instance average wind speed) should be available. This option is very much like the practice under the new German feed-in law. The difference is that instead of a fixed price, a fixed premium would be calculated as the minimum price for certificates (and not for the electricity, which has to compete on the electricity market like any other form of electricity).

Option 3: Indirectly by eco-tax levels
If consumption of green certificates is exempted from eco-taxes, then the level of the tax automatically sets the level of the minimum price. The level of a tax is always an outcome of a political process. One of the prevailing rationales is the incorporation of external costs of energy consumption in the energy price.

3.3.9.2 Development of minimum prices over time

Minimum prices do not need to be stable over time. The dynamic efficiency (that is, the drive to reduce costs over the longer term) of minimum price systems can be improved by reducing the minimum prices steadily and predictably over time.

Option 1: Minimum prices for certificates are reduced over time according to an estimated learning curve of the technology considered
This option means that each doubling of world-wide installed capacity of a technology will lead to a reduction of the minimum price for electricity and certificates with a given percentage. The minimum price for the certificate can then be calculated by deducting an estimated average market value for the electricity produced by the specific technology. The learning curve percentage (learning ratio) can be based on historical analyses of technology process of each technology.

Option 2: Minimum prices for certificates are adapted to the year of installation according to a yearly declining percentage with regard to the start year
This is similar to the practice under the current German feed-in law. Historical cost trends can be taken as a starting point for negotiations.

Option 3: Minimum prices are fixed for longer period and revised periodically
If minimum prices are known well in advance, it will give more security in the market. The negotiation process at the end of each period will be laborious and unpredictable. It will create a large interest lobbying process and it might be difficult to reduce the minimum price over time.

Option 4: Minimum price linked to external benefits of the consumption of renewable energy
This option links up with the philosophy behind eco-taxes (and the exemptions/rebates for them on renewable electricity consumption).

3.3.9.3 International harmonisation of minimum prices

If minimum prices are not harmonised between countries, there are at least two possibilities. If there is an open international market for TGCs, all TGCs will be offered in the country with the highest minimum price guarantee. This will lead to an under-supply in other countries. Market prices in these countries (that do not necessarily have the same demand structure (that is, by minimum prices) as in the minimum price country) will go up and converge to the highest minimum price in all Member States.

Another possibility is that only certificates produced domestically will be receiving the minimum price (or only a certain percentage of certificates might be non-domestic). It is the question whether this will be in line with general EU internal market rules.

3.3.10 Financing mechanisms

Option 1: A general levy on each electricity consumer
In this option, a general levy applies to all consumers and the money is collected by the suppliers and put into a Fund that is available to the actor guaranteeing the minimum price. Possible disadvantage: If other countries do not have such a system, this could hamper the competitiveness of industrial consumers. This will put pressure on governments to shift the burden to smaller consumers.

Option 2: A levy on the use of the transmission grid
This is a good option if the actor guaranteeing minimum prices is the TSO. Possible disadvantage: If other countries do not have such a system, this could hamper competitiveness for industrial consumers. Furthermore, a balancing fund might be necessary if some TSOs in a country are offered more certificates than others.

Option 3 A levy on suppliers
The costs of the levy will be translated into higher consumer prices.

Option 4 A levy on generators
This will make generators less competitive with regard to foreign generators. This means that the levy should also apply to import of electricity.

4. TGC SYSTEM MECHANISMS

4.1 Issuing of TGCs

In all cases, TGCs issued will be given to the producer of RES-E, who is then able to sell them to anybody in the market.

4.1.1 Technologies included

The standard technology catalogue for RES technologies includes:

- Biomass (including waste and landfill gas).
- Hydro.
- Wind.
- Photovoltaics.
- Geothermal.
- Heat pumps.
- Other (solar thermal power, tidal power, ocean currents, wave power, hot dry rock, ocean thermal energy).

In some countries, promotional schemes for RES exclude some technologies for reasons of ecological problems or because they do not need financial support:

- Waste.
- Large hydro.

4.1.2 Reference of issue

The issue of TGCs can be based on the amount of RES-E generated or on the amount fed into the grid. If auto-producers of RES-E are not to be discriminated, the basis for issuing certificates should be the amount of RES-E generated. The generation should be measured by certified measurement devices.

4.1.3 Issuing body

The Issuing Body has to make sure that TGCs are issued correctly. Regarding the type of the Issuing Body, the following options exist:

1. Public body or authority.
2. Generators.
3. System operators.
4. Private associations, which can either be driven by:
   - Generators and/or utilities.
   - Independent bodies (environmental NGO etc.).

With exception of the first case, some Member States might regard public control over the issuing process to be necessary. Other countries might prefer a credible private body (such as RECS, or the APX) as long as they have agreement in the sector.

4.1.4 Time of issue

The certificates can be issued permanently or for specific periods. Those periods could be months, quarters of a year or years. A permanent issuing (that is, continuously) is possible only if the physical form of the certificates is an electronic record.

4.1.5 Physical form of TGC

All TGCs should have a standard value (certain number of RES-E kWh). If this is not the case, transactions will be more complex. In The Netherlands and in the RECS-proposal the standard value of a certificate is 10.000 kWh, in the Belgian proposal it is 1000 kWh.

In principle, there are two (non-excluding) physical forms possible for the certificates:
- Electronic record (as is proposed as a standard by the RECS group).
- Paper.

The handling of physical sheets of paper for executing transactions of certificates seems not to be a practical option. Therefore, the standard form of TGC should be an electronic record. Of course, in addition paper certificates based on the electronic records can be made.

4.1.6 Information content of TGCs

In general, there is a trade-off between homogeneity of the certificates (only the most important information on the certificates) and possibilities for differentiating demand. The more information is given on the certificates the more the market for TGCs may be differentiated into partial markets. This may increase transaction cost and decrease efficiency due to reduced competition between renewable electricity technologies, regions etc. However, as more information also facilitates compliance control and monitoring, the risk of market separation must be accepted.

If the TGCs are to be kept as electronic records in databases, there is a need for standardisation of the (maximum) information content of the TGC in order to define a standard design for the databases.

Certificates should at least include the following information:
- Unique identification number.
- Generator.
- Date of issuing and the period of production covered by the TGC.
- Unit, amount (if the value of TGCs is not standardised).
- Location (country and region) of the plant.
- RE Source (solar, hydro, wind etc.).
- Technology (type of unit, size, age etc.).
- Capacity of the plant.
- Expiration date of the certificate (could be infinity).
- Direct support received for the production of renewable electricity.
- Indirect support (for instance dispatch priority) received.

In order to quantify environmental benefits in international trade, the amount of pollutants avoided, such as
- CO_2
- SO_2
- NO_x
- nuclear waste.

could be added as information on the certificate.

The subsidy points have to be incorporated to be able to have an international trading system in which 'exchange rates' or 'compensation fees' can be incorporated.

Some of the information can be encrypted by numbered codes, if necessary.

4.1.7 Renewable generators

A generator of renewable electricity can be acknowledged as such if he files a Renewable Energy Declaration with the Issuing Body. This declaration includes data on the generator and the metering and on the date of commissioning the plant. The declaration should be verified and, if necessary, certified measurement devices should be installed.

4.2 Use of TGCs

4.2.1 Accounting rules

The system for accounting of the certificates and their handling should be kept as simple as possible. The design of this system and its rules depend on the physical form of the certificates.

If the certificates are kept as electronic records in a database, then the accounting system is very similar to bank accounts. This means that every participant in the TGC system has his own account and can receive bank statements. The main difference is that the certificates kept on the accounts are not homogenous, but are bearing individual information, which has to be kept during all transactions.

4.2.2 Lifetime/expiry date

The certificates can have a limited or an unlimited lifetime. If the lifetime of the certificates is limited, then the timing of generation of RES-E will be more closely related to the timing of demand for certificates (that is, the possibilities for the production of a large number of certificates for future demand is limited). If an expiry date is set, the lifetime of the certificates should be several compliance/target periods (for instance under a obligation).

4.2.3 Redemption

There has to be a clear procedure in how certificates, which are used to meet a demand are withdrawn from circulation. This avoids multiple use of certificates.

Besides this withdrawal there also has to be a mechanism to allow owners of certificates to make them void (for instance if NGOs or other bodies buy certificates to stimulate RES generation). If the lifetime of the certificates is limited, then the owner only has to keep the certificate until the expiry date. But if the certificates have an unlimited lifetime, a separate mechanism is necessary to make certificates void.

The 'use' of TGCs includes trading activities, but we deal with trading in other sections. This section examines other uses of TGCs, including:

- Redemption against an obligation.
- Matching voluntary demand for Green Electricity.
- Withdrawal from circulation.

In order to prevent the fraudulent use of TGCs, we propose that agencies or other bodies are established (or commissioned) to carry out the function of registering the ownership of TGCs, and that such agencies should be informed when trade, or any of the other uses listed above takes place. This is already done by the Registrar, auditing only requires files to be open for inspection by the controller.

Again, this function could be located in several different places or could reside with one central agency. One option is to establish a central agency that could license all other registration agencies (which could be national, or international, as in the section above) and stipulate the protocol for their activities.

4.2.3.1 Redemption against obligation

In the system we are proposing, any party using TGCs to meet an obligation must not only inform the central registration agency that certain TGCs have been taken out of circulation, they must also 'hand over' the TGCs to the appropriate government (or other) Redeeming Body.

The Redeeming Body may or may not be the same body that registers TGCs, but the two functions (registering TGCs and redeeming them against a quota) must be kept separate.

If TGCs from one country are used to meet a quota in another country, it is essential that the two countries enter into an agreement which ensures that there is no 'double counting', and that any imbalances between the support frameworks for RE in the two countries are taken into account. A condition is that the Redeeming Body agrees that TGCs from the other country are valid.

4.2.3.2 Matching voluntary demand for green electricity

Some suppliers may operate schemes in which they offer consumers the chance to voluntarily buy a certain fraction of their electricity from renewable sources. In these cases, TGCs can be used to demonstrate to consumers that the correct amount of Green Electricity has been supplied. It should be made sure that these certificates are not used for trade anymore. This can be done by informing the Central Monitoring Office, which can register them as being redeemed.

Depending on the type of demand from voluntary 'green consumers' and generally accepted practice of consumer protection in different countries, the supplier may also offer the consumer independent auditing of their Green Electricity supply etc. In some countries, this could be undertaken by the accreditation agency for TGCs, but the function could also be separate.

4.2.3.3 Withdrawal from circulation

It is possible that bodies outside the electricity industry may want to buy Green Certificates and 'retire' them from circulation in order to increase the total number that must be produced.

This has parallels with the market for pollution permits (such as SO_2 emission permits) where environmental groups have suggested that if they bought some of the available permits and effectively 'retired' them from the market then there would be less total pollution from the market actors.

However, this can only happen if it has been agreed that third parties have access to the market for Green Certificates and that those parties operate according to the rules of the TGC system.

Also in this case, the Central Monitoring Office have to be informed of the status of the green certificates, so that they can be officially taken out of the market.

4.2.4 Banking and borrowing

4.2.4.1 Rules

Here, 'banking' means that certificates that are not consumed/used in the current Compliance Period, can be kept in the account in order to use them in a later period.

It can be decided, too, that these certificates are earning interest. If for example a certificate for 10.000 kWh produced in year x is worth 10.500 kWh in year x+1, the RES-E generator has an incentive to generate more RES-E than is demanded today. This might lead to a faster development of RES-E generation than it is defined by the demand, for instance by the minimum obligation for a given year.

On the other hand one might want to avoid too much banking. If many certificates are banked in an early period, (for instance because, looking back, the obligation appears to have been set far to low in the early periods), this has a negative impact of deployment of renewables later on.

With regard to banking, the following options exist:
- No banking (which would mean a limited lifetime of TGCs).
- Banking without interest rate.
- Banking with interest rates.
- Banking with a 'levy' to discourage hoarding of certificates.

A combination of banking with interest rates and an unlimited lifetime of certificates might induce hoarding of certificates.

On the other hand, 'borrowing' means that a given demand today can, at least in part, be met by future generation of RES-E and certificates. Here, three options exist:
- No borrowing.
- Borrowing without interest rate.
- Borrowing with interest rates.
- Borrowing with a deposit sum to discourage too much banking.

If borrowing is allowed without interest rates, then there is an incentive to buy the certificates as late as possible. The reason for this is that the money the certificates would cost today will earn interest until it is used later. Therefore a combination of an unlimited lifetime of the certificates and borrowing of certificates without interest rates or deposit sums should be avoided.

Borrowing with interest rates means that, if somebody meets a demand of 10.000 kWh this year by using a certificate credit, then he has to show certificates equivalent to 10.500 kWh (if the interest rate is 5 %) in the following year. This leads to an incentive to produce the certificates as soon as possible (as long as the TGC interest rate is higher than the interest rates on the financial market). The interest rate should be higher than the average interest rate for RES-E investment loans. If it is lower, it would give an incentive to postpone RES-E investment.

Besides the interest rates, putting off of investments in RES-E generation can also be avoided by limiting the total share of certificate credits to a certain percentage of a given demand, for instance to 25 % of the obligation. To limit the total volume of borrowed certificates, a maximum time frame for credits can be set. This means, that the credit used in one year has to be paid back by showing certificates within for instance three years. It is sensible to correlate this maximum time frame for borrowing to the average planning and construction time for RE electricity plants.

A possible disadvantage of allowing borrowing is that the eventual production of RES-E is not guaranteed if companies go bankrupt in the meantime. This can be avoided if the obliged actor has to provide a deposit sum (for instance equal to the penalty), which he gets back as soon as he fulfils his obligation. In the case the certificate is not produced, at least the penalty is collected. In this case the interest paid for the deposit sum forms already a negative incentive to borrowing.

4.3 Trading

4.3.1 Participants

Concerning the participants in the trading activities there are several possibilities:

- No restriction for trade: anybody may buy and sell TGCs.
- Producers.
- Wholesalers and/or retailers.
- Brokers.
- NGOs.
- Entities with TGC obligations.
- Eligible entities: only some of the above groups or entities are allowed to take part in trading.
- No restriction, but registration or accreditation at a trading board or opening of a trading account is mandatory.

There is a correlation between the number of entities involved in trading and the ability to control trading and compliance with obligations. On the other hand, competition might be low if the number of entities involved in trading is too low. However, trading of TGCs is a risky business and to avoid losses it is necessary to accumulate a certain know-how about market perspectives etc. Therefore, only a restricted amount of entities will be interested to take part in national and/or international trading.

Whether registration of participants is needed depends on the physical form of certificates: in case of digital certificates physically traded through databases (see above), it is imperative to register participating entities. In case of certificates in paper form, it is ultimately impossible to control participants. However, if TGCs in paper form are traded internationally it might be mandatory to register such transactions.

As it is more likely that certificates will be issued in digital form it is absolutely necessary to register participating entities. But it is not necessary to exclude any entity or subject from trading of TGCs. Once registered or accredited for trading TGCs, anybody may take part.

4.3.2 Mechanism

TGCs may be traded bilaterally or at a TGC exchange. One possibility does not exclude the other, that is, if a TGC exchange will be opened it may also be possible to trade TGCs on a bilateral basis.

Transactions at the exchange may be automatically registered in the TGC database. Bilateral trades have to be reported to the TGC database.

An exchange is not necessary to create competition between suppliers of TGCs but it may increase market transparency and, thus, increase competition and efficiency in TGC generation (that is, generation of renewable electricity). Hence, it is highly welcome to have a TGC exchange. However, TGC trades may be carried out on a bilateral basis due to certain qualities of a specific TGC (that is, regional preferences) or due to long-term business co-operation etc.

Transactions at a TGC exchange may be more short-term orientated (spot market). They may be used to compensate short-term variations in TGC generation, supply and demand, whereas bilateral contracts may be more feasible for long-term contracts.

The existence of an exchange may also support the development of financial (futures etc.). These instruments may be used to reduce risk due to variations in supply and demand and, thus reduce price variations of TGCs.

4.3.3 Periodicity/frequency of trading

When should or could TGC be traded and when will be peaks of trading? Although this depends on some other design features of TGC three different options could be differentiated:

- Any time, permanently.
- Short period during the Compliance Period.
- At the end of the Compliance Period.

From a design perspective there is no need to restrict TGC trading to certain periods. Therefore trading should be possible at any time. Bilateral trade could be carried out any time although it must be guaranteed that these transactions will be registered (for instance retroactively). Trading hours at an exchange depend on turnover, that is, volume of supply and demand. At the beginning of a trading system, there may only be a few trading days (once a month). However, at the end of a commitment period, when compliance will be controlled, turnover probably will increase. The main reason for variation of TGC turnover is that at the beginning of a Compliance Period (for instance one year) the amount of TGC generated throughout the year is difficult to predict due to yearly climatic variations in wind, water and sun resources. At the end of the period, it is better predictable whether TGC obligations could be fulfilled or not. Thus demand for TGCs will increase or decrease and have its impact on supply of TGC.

4.4 Registration

The question of registration depends on the physical form of the certificates. If the certificates are kept as electronic records in databases it is necessary to record each step of the handling of certificates (issuing, trade, withdrawal) in the databases. This means that records representing certificates can be created, moved or deleted in the database. The database is an accounting tool as well as a means to execute trade and redemption at the same time.

The RECS propose that there can be several Trade Registrars who administrate the ownership registration of certificates and carry out the trade transactions for the owners. They have to be recognised by the Issuing Body. All transactions of certificates have to be reported to a Central Monitoring Office.

It would also be possible to create only one Trade Registrar for each region or country. If they are under independent control and their activities are checked by audits, then a Central Monitoring Office would not be necessary.

If TGCs have the physical form of paper, then registration will be much more complicated to execute. However, if the certificates on paper are protected against forgery a registration of transactions is not necessary. But then it is difficult to keep track of the certificates while they are in the market.

The following steps of registration are therefore described in brief only for the case that certificates are kept electronically in a database.

4.4.1 Registration body

Must be an independent body, not involved in trading. The same options (Special Independent Body, Regulator, System Operator) apply as for Issuance and Control.

Certificate accounts can be registered by a central organisations, or by banks (Registrars). In the latter case, the Registrars will have to report their transactions to the central registration institute (Central Monitoring Office).

4.4.2 Registration of issuing

The database record can be credited to the account of the generator as soon as the meter is read and the data is transferred to the database.

4.4.3 Registration of transactions

Trade of certificates leads to a transaction from one account to another. This can happen within the database of one Trade Registrar or between different Registrars. The RECS group proposes that all transactions are reported to a Central Monitoring Office, which has to confirm the transaction.

4.4.4 Registration of withdrawal

The consumption of certificates (if they are used to meet a demand, for instance an obligation) and the expiration of certificates (if they are not consumed) has to be executed by deleting the respective electronic records. This will be the responsibility of the Central Monitoring Office. For statistical reasons, it can be useful to record aggregated data (like the total number of certificates consumed at a given time and the type of RES-E technologies etc.).

4.5 Electricity system regime

4.5.1 System access

If a certificate is created when RES-E is fed into the grid, it is important that all RES-E gets easy access to the grid, otherwise the creation of certificates is hampered.

Guaranteed access to the grid should be part of the information on the certificate, since this is a crucial point which can determine the level of deployment of renewable energy (and hence its cost) within any country. However, it will be difficult to identify exactly to which level of support this translates.

4.5.2 Trade via bilateral contracts/pool/spot market/obligation to purchase for local utility

4.5.2.1 Bilateral contracts

So far in The Netherlands, most trades in Green Labels have been via (long-term) bilateral contracts. These type of contracts offer the most security for producers of green electricity and therefore for developers of RE installations. Security of contract for developers enhances the possibility to get RE schemes financed. Structuring the system of trade of TGCs to favour this type of contract is therefore likely to support deployment of RE. This has to be balanced with the need to create enough price transparency by spot market trading.

Bilateral contracts can operate in all three of the scenarios we. The way bilateral contracts are made must be left open to the market players. It is very well possible that suppliers will offer a 'total package contract' to the producer, including the electricity price and the certificate price. It is also possible that two different contracts for the electricity and the certificates are concluded.

Price information of bilateral contracts is in principle confidential. However, the Controlling Body might need all market information, to determine the penalty (see part on Penalties). The Controlling Body should keep the specific information confidential, but has to make public the average market price over the Compliance Period by setting the penalty. If the Controlling Body has all this information, it can publish average prices as a market indicator more often. This will reduce the need for enhancing price transparency by stimulating spot markets.

4.5.2.2 Pool trading

A 'Green Pool' trading system for electricity from RE schemes has been discussed in several EU Member States. Were a Green Pool to emerge, TGCs could be used within this to authenticate trades that occur in a 'settlement' process. It is also very well possible that existing exchanges, such as the NordPool or the Amsterdam Power Exchange, will set up a trading system for certificates along trading in electricity. This has happened already at the Californian Automated Power Exchange, where trade in 'Green Tickets' takes place.

4.5.2.3 Obligation to purchase renewable electricity on local utility

If a local utility has an obligation to purchase electricity output from a renewable energy scheme within its area, then TGCs can have a variety of roles:

- If no target for RE operates, it is unlikely that TGCs will be used, as the utility will merely pass on the cost of purchasing the RE-sourced electricity to its own consumers,
- Alternatively, if no target for RE is in force, TGCs might not be used if all utilities pass the cost of RE purchase to a central body which imposes a levy on all (or on certain types of) consumers to cover the extra outlay.
- If a target system operates (such as in The Netherlands), then the utility which is obliged to buy the RE scheme output also gains the TGCs, which it can then use either to meet its own obligation or to trade, as the target system allows.

4.5.3 Technical constraints

There are two main options to consider:

- Trading in TGCs alone.
- Trading in Green Electricity: that is, TGCs *and* electricity at the same time.

4.5.3.1 Trading in TGCs alone

This seems to be the most useful option in terms of the 'portability' of TGCs, as there are no technical constraints to the *trade* of TGCs.

The only technical constraint that seems important is the capacity of the grid to accept electricity from local RE schemes when there is insufficient demand for the physical electricity in the grid region or country.

4.5.3.2 Trading in green electricity

Coupling import of green certificates with import of green electricity is an option that is being considered in The Netherlands and a similar structure that seems to underlie thinking in Denmark on this subject at present. The Dutch government has made an implementation plan for reaching their Kyoto targets (-6% for NL). 50% (the EU maximum) will be reached outside The Netherlands. The remainder has to be reached domestically. For this purpose a detailed implementation plan has been made. The whole Dutch intermediate renewables target for 2010 (5%) is foreseen to contribute to the domestic Kyoto target. That means that all Dutch renewables have to reduce CO_2 domestically. The logical consequence is that if part of the renewables target is realised in other countries, the electricity has to be transported to The Netherlands, in order to reduce CO_2 domestically. In this framework, technical limitations of the grid (especially transport capacity) are important, as the TGC can only be transferred at the same time as the physical electricity.

It should also be noted that linking trade in green certificates with physical electricity trade will be a barrier to international trade. In some cases this barrier can be overcome by paying the necessary transport tariffs. In some cases it will be a prohibitive barrier, for instance for island states with no or barely any connection to other electricity systems (Ireland, UK).

Another remark that should be made that it is impossible to track the physical flows of electricity. Tracking can only be done by following the money flows or contracts. If actors from two countries want to exchange the 'greenness' without getting involved in physical transport they can make two contracts of the same amount of electricity that is delivered to each other. This is the same as just exchanging the 'greenness' and thus a form of green certificate trade.

4.6 National introduction and transition

The introduction of a TGC model alone (without an obligation) raises questions on the establishment of the methods and institutions mentioned above. To build up these institutions and to give time to the actors to get used with the instrument of TGC, an introduction period is necessary, before one can rely on the instrument of TGCs. The major problem during the introduction of a TGC system in combination with a minimum obligation is the transition from the current schemes for the promotion of RES-E to the new system.

Several options exist to make this transition easier:

- Limited time with coexistence of the old and new system (possibly with the additional right for generators, which have invested under the old system, to choose the supporting scheme they want during the transition phase).
- Specific guarantees for stabilising the TGC price (like upper and lower limits guaranteed by the state).
- Additional measures to improve the fair access of specific groups to the TGC system (like guarantees for system access for the generators).

5. INTERNATIONAL CONTEXT

5.1 Agreements on what is traded

Before international trade of certificates occurs, countries have to agree on what is traded. This means that they have to acknowledge each other's certificates and agree on their relative value with respect to a country's own certificates.

5.1.1 Conditions for mutual acknowledgement of certificates

Trading between countries requires some rules. The following are necessary conditions for mutual acknowledgement of certificates, if one wants to make sure that each certificate indeed leads to deployment of renewables.

- Demand for renewable electricity in the other country should also be accounted for by certificates (and not by the electricity itself).

If in one country the renewable target is accounted for by production and import statistics, and in another country this is done on the basis of certificates, than the possibility exists that renewable kWhs are double-counted. They are counted once in the country of production (by statistics) and once in the country of consumption (by certificates). Another solution might be that the country accounting in certificates requires from countries accounting in statistics, that the export of certificates is accompanied by the export of the renewable electricity as well. This is however in contradiction with the whole philosophy behind tradable green certificate systems. It also will make international trading with some of the Member States (Ireland, United Kingdom) very difficult, since their electricity grid is not or barely connected to other Member States.

- Demand for renewable electricity should be synchronous in both countries.

Demand is not synchronous if for instance actors in one of the trading countries have an obligation during the period of trade, while actors in the other country will have an obligation to fulfil only by the year after the period of trade. This will not lead to extra deployment of renewables in the latter country. This point is related to the discussion in Section 3.1.6.2

- The way certificates are issued and verified should be mutually acknowledged.

- Certificates from other countries should contain enough information to allow the potential importing country to decide unambiguously whether these certificates are acceptable or not. This might include the renewable energy source, the location of production, the date the installation started production, the level and kind of support the production of renewable electricity has got and the environmental emissions avoided by the production of the renewable kWh.

- There must be a guarantee from the participating countries that their domestic demand will increase compared to current levels of RE-deployment.

Assume a country such as Sweden wants to participate. If internal domestic demand for renewable electricity (whether coming from an obligation or not) is very low, than it might happen that a very large part of the overall target of all participating countries is complied by Swedish

RES-E from hydro-power plants. From this point of view, it might be that countries relying only on voluntary demand might have difficulty to be accepted by other countries as reliable partner countries in green certificate trading.

5.1.2 Validity area/geographical validity of TGCs issued in participating countries

Option 1: All certificates are equally valid
The most simple and straightforward option for geographical validity is that all certificates, wherever they are produced, are equally valid. This might create 'hot spots' (for instance Scotland) of areas that produce a large part of European renewable electricity. For a set of reasons (energy independence, industrial politics, etc.) governments might require that part of the demand is met by domestic certificates.

Option 2: The validity/value of certificates depends on the distance from the country
Another possibility is that the validity or value of a certificate depends on the distance from the location of production. This might be justified by the fact that many of the benefits of renewables are regional or local. Examples are the reduction of acid emissions, creation of jobs, reduction of local pollution etc. Only the climate change part and the contribution to global technology development can be considered as global benefits. A disadvantage of this approach is that the market becomes less transparent and liquid.

Option 3: Only certificates from within a certain country are valid
If only domestically produced certificates are valid, international trade in TGCs is prevented. Countries may want to do this for reasons of industrial politics or other reasons. The question is to what extent this will be possible with regard to internal EU market rules.

Option 4: Trading Bubbles
Trading 'bubbles' or 'green zones' can be established where standards are mutually agreed between members of the bubble. This could be similar to the 'Carbon Bubble' set up for the EU as a whole under the Kyoto protocol.

5.1.3 Acknowledgement of TGCs issued in non-participating countries

Countries complying with conditions mentioned above can form an international tradable green certificate system. The number and kind of countries included does not have to be the same as the complying countries. Other considerations, like being an EU-country or not (with an EU-wide target), can be decisive. Countries in other parts of the world (Eastern Europe, Australia, Asia, Africa, North America, and South America) might be busy to set up their own systems. The question is whether certificates from these other systems will be acknowledged or not, and if so, what part of the credits represented by the certificates will be allowed for trade.

Option 1: All certificates are equally valid
This would create a true world-wide market for renewable electricity. The burden (for instance on the landscape) and benefits of this market (for instance in terms of local jobs, reduction of acid emissions, reduction of local pollution etc.) might be unequally distributed.

Option 2: The validity/value of certificates depends on the distance from the participating countries
For instance for the EU, certificates issued in Eastern Europe will have some validity, since for instance acid rain in the EU is partly caused by Eastern Europe emissions. Furthermore, the EU is intending to expand towards Eastern Europe. Certificates from other parts of the world might only be valued with regard to their global beneficial impacts.

This includes greenhouse gas emission reduction (cf. CDM, Joint Implementation, Emission Trading) and the fact that large, cheap, markets in other parts of the world might induce a faster technological learning path for renewable technologies.

Option 3: Certificates from non-participating countries are not valid
To avoid all problems certificates from non-participating countries can just not be accepted as valid. However, this might reduce the size of the global market as well as global competition, which might put less pressure on cost-reduction.

Option 4: Validity of selected components within Trading Bubbles
Trading of different components of the 'value' of the certificates could be carried out with different partners. For instance the CO_2 reduction component is valuable on a global basis, so could be traded via Carbon Emission Trading systems, whereas the impact on security of supply to the EU or to individual Member States could not.

5.2 Process of international trading

5.2.1 Participants

There may be a differentiation between entities who are allowed to take part in national or in international trading in the sense that only some of the entities that are taking part in the national trading system may also buy or sell TGC to/from entities abroad. Such a regime may be necessary if eligible entities differ in countries taking part in international TGC trading. In this case, – most likely – only entities that are accepted for trade in all participating countries may take part in international TGC trade.

It seems possible that Trade Registrars that operate internationally may not be accountable to national bodies. This would suggest that there may be a need for an International body (such as the Central Monitoring Office) to which international traders are responsible. This need not be a top-down, centralised authority, but it must be (and be regarded as) credible in the eyes of all actors within the TGC system (including the final consumer).

International trade of TGCs could be highly complex because of the need to take into account national electricity supply system characteristics, differing levels and modes of support for RE, differing emphasis on Climate Change policy actions etc. The RECS system suggests that green electricity that has benefited from support at some stage of its production does not qualify for inclusion in the RECS system. However, the RECS system has not taken account of the *indirect* support that is given to RE production in some countries because of initiatives such as guaranteed grid access, favourable planning conditions etc.

Again, it may be necessary to establish a 'exchange rate', or 'compensation fee' which Trade Registrars must use when exchanging certificates from different countries.

Option 1: All owners of certificates
The most liberal option for cross-border trade is bilateral trade between individual owners of certificates. For reasons of transparency, it should be known which parties in each country are licensed to trade. And it is relevant to properly register transactions across borders, especially if compensation for differences in support systems has to be paid at the border.

Option 2: Via national trading institutes
If TGCs were tradable across country borders, you would want to know how many TGCs are traded. Therefore, it is recommended to streamline cross-border trade through national trading institutes, for instance one institute for each country. These national institutes can also refuse the exchange, for instance because a country does not want to accept TGCs from large hydro.

5.2.2 Issuing

It is clear that for international trade to take place in the RE sector, some internationally agreed procedures for issuing certificates must be put in place. The procedure can come from industry or government and must be acceptable to all actors within the sector.

A useful model for such a system is the certification of 'organic' agricultural products, which is carried out by accredited national agencies according to principles agreed for the EU as a whole. As might be expected, the EU standard has been regarded as a minimum level by some of these national agencies (for instance the UK's Soil Association, or the 'Demeter' biodynamic standard), who impose further, more stringent, conditions on top of the EU's requirements.

Under this model, therefore, there is a central EU body that sets out and oversees the basic TGC system. This is similar to a Central Monitoring Office that operates at an EU level. However, control for issuing TGCs themselves lies with agreed national (and possibly international) bodies.

There are several ways in which this can be done, including:
- Single national Issuing Body.
- Multiple national issuing bodies.
- International issuing bodies.

Option 1: Single Issuing Body for each Member State
This option is similar to the framework put forward by the RECS system, which proposes that there should be a single body within each member state that has responsibility for issuing Green Certificates. Such a body would also be responsible for auditing and validating the registration, trade and redeeming of Green Certificates.

This arrangement would have the advantage of simplicity and possibly reduce transaction costs for trade. However, it could have the disadvantage of being monopolistic, as the RECS participants propose that new Issuing Bodies would only be allowed to operate if they were accepted by an international alliance of all other Issuing Bodies. By disallowing competition between Issuing Bodies (for instance through geographical restricted areas), it is possible the transaction costs of TGC systems could be kept artificially high.

Another version of this option allows an EU Central Monitoring Office to empower national Issuing Bodies, with periodic competition for the post of National Issuing Body. (for instance an organisation could be granted the contract to operate as the National Issuing Body in a certain country for, say, three years, after which time there is a new competition for the contract). This could have the advantage of allowing competition to reduce transaction costs every few years.

Option 2: Multiple National Issuing Bodies
Under this option the EU Central Monitoring Office could grant permission to several Issuing Bodies within each member state. This is similar to the situation that currently operates for Organic food labelling (see above). Each Issuing Body would agree to issue Green Certificates in a specified way, but would also be able to add further criteria to its own accreditation process if it wished.

This would allow customer choice between several options. For example, some Issuing Bodies may decide that energy from waste is not acceptable to their target market, some may decide to accredit community-owned schemes only etc.

If there are several issuing bodies allowed to operate in one area, the problem of possible double-counting arises. This might be dealt with by having a central register of TGCs for the EU as a whole.

Option 3: International Issuing Bodies
International organisations could also be allowed to issue Green Certificates. One advantage of this would be a possible reduction in transaction costs in trade between countries. This option might also seem favoured in an increasingly international RE industry that contributes positively to international environmental issues.

A disadvantage could be that international bodies might be difficult to monitor and audit.

5.2.3 Registration of transaction

Option 1: International transactions are registered the same way as national transactions
This option can be chosen only in the case it is not necessary to keep track of the international flows of certificates, until the Time of Proof and the moment of redemption. This could only be possible in Scenario Maximum Harmonisation.

Option 2: International transactions will be notified to the national Central Monitoring Office
This option is necessary in case of different support mechanisms for renewable electricity. If, for instance, in one country a environmental tax rebate is rewarded to renewable electricity, and in another countries this is not the case (or in that country the level of the rebate is different), than the differences in support can be compensated for at the border. Also in the case one country does not have the same definition of 'renewable' as another country, this might be checked at the border.

The process would look as follows:

Step 1: The potential trade partners notify the transaction anticipated to the Central Monitoring Bodies of both countries.

Step 2: The Central Monitoring Bodies confirm to each other the request for trade.

Step 3: After the confirmation being received, the Central Monitoring Bodies control whether there is an import or export barrier to the certificates subject of the transaction anticipated.

Step 4: The Central Monitoring Bodies notify each other whether there are such barriers and whether the request can be proceeded to the next step.
If there are no barriers, the Central Monitoring Bodies check whether the two countries have agreed on a procedure to determine and pay a compensation fee due to differences in level of subsidies.

Step 5: If this is the case, the Central Monitoring Bodies check whether there has been a difference in level of support for the electricity the certificates are representing.

Step 6: If there is a difference, the Central Monitoring Bodies determine a compensation fee.
Step 7: The Central Monitoring Body of the country that has to pay the compensation notifies the relevant government body of the compensation to be paid (this can be done aggregately and per period (for instance per month).
Step 8: After the compensation has been received, and this has been confirmed, the Central Monitoring Bodies notify the transaction partners that the transaction is allowed to take place.

Bilateral agreements between the Central Monitoring Offices will be necessary to allow mutual control and checks of accounts in order to make sure that no fraud occurs. An even better option would be to have an international body, be it an EU-institution or an international NGO that will check the registrations. One step further is to have an EU- Central Monitoring Office, to which all international transactions should be reported. This would add one step to the scheme above.

6. INTERACTION WITH OTHER INCENTIVE SCHEMES

6.1 RES-E promotion

To form an instrument for the promotion of RES-E, TGCs have to be combined with a system generating a demand for the certificates. In the analysis that follows, it is assumed that this demand will be created by a general obligation.

Interactions of this system with other policy instruments for the promotion of RES-E can occur

- In a national or international transition phase (if other instruments are kept for a limited time to ensure a smooth transition from one system to the other),
- In a permanent coexistence of instruments on the national level (if other instruments are used at the same time with the TGC/obligation system to create additional promotional effects),
- In a permanent coexistence of instruments on the international level (if actors in countries, which are using other instrument for the promotion of RES-E are allowed to sell certificates to countries with a TGC/obligation system).

Different types of interaction are possible:

- Other instruments have no effect on the TGC market and the national/international equilibrium price for TGC. This can happen for instance if a minimum price guarantee is given in one of the Member States, but if this minimum price is well below the international equilibrium price of trading.
- Other instruments and the TGC/obligation system are designed to have the minimum impact possible.
- The design of the TGC/obligation system and the other instruments are not matched and therefore strong impact occurs.

6.2 Subsidies and international trade

As indicated in the Mid-Term report (Schaeffer et al., 1999b), most current subsidy schemes will have market-distortion effects in the case of international trade in green certificates. This will not lead to the desired 'level-playing-field'. There are several options to deal with this problem:

Option 1: Do nothing and allow all trade, as long as subsidies comply with general state aid rules of the EU
There are several other sectors were state subsidies exist and where there still is free trade. Free trade will put pressure on actors to harmonise their support systems, otherwise tax-payers money from one Member State will flow to another Member State. Although this is true in theory, in practice the prospect of taxpayer money flowing to another country (for those Member States that export subsidised certificates) or the threatening of domestic production (for those countries that import certificates by other countries) will bring policy makers to the consideration not to accept foreign certificates. Such a trade barrier might be brought to the European Court, but before a verdict is given, many years might pass by.

Option 2: Abolish all other incentive schemes
This option is an 'idealistic' solution. It would fit in Scenario C but does not seem to be very realistic. Member States have a variety of energy policy targets and want to have enough flexibility in designing their own support systems for renewables.

Option 3: Compensate all subsidies at the border
This is possible in principle, although some support might be difficult to quantify (for instance priority dispatch). Furthermore trading countries should make agreements on how calculations are performed (for instance assumptions on life-time and discount rate).

Option 4 Allow only certificates that have not profited from subsidies
This is the solution proposed in the Basic Commitments of the RECS. In this proposed system for international trade, green certificates are 'earmarked' if they have received any support, and in these certificates will not be allowed for free international trade. This approach will initially limit the quantity of certificates that can be traded substantially. However, over a longer period of time, producers might be willing to choose for the international market, rather than for politically insecure support schemes.

Option 5: Come to constructive bilateral agreements between Member States
Except for option 2, all options seem possible to a certain extent. If someone goes to Court and gets a verdict that is favourable for EU-wide trade in all circumstances, option 1 might become a reality. Option 3 might be very difficult in principle. However, if Member States are not too perfectionist, they might find bilateral solutions that are not perfect but will work. One of the agreements could be option 4. If two or more Member States see enough interest in enhancing trade between those countries, they might voluntarily agree to harmonise their support systems.

What is essential for all workable solutions is that information with regard to subsidies and other support received be put as information on the certificate from the very start of national TGC-systems. Only on the basis of adequate information Member State governments can make agreements and market actors can determine the value of certificates adequately.

6.3 International introduction path

Here several options are possible, which correlate closely to the definition of the scenarios:
- Harmonisation of methods and institutions for TGC and targets on the EU level.
- Harmonisation of methods and institutions for TGC and targets within a few EU-countries, forming a 'trading bubble'.
- Harmonisation of targets, but not of methods of supporting TGC.
- Harmonisation of methods and institutions for TGC, but not of targets.
- No harmonisation.

A situation very likely to occur is that the trade of green certificates is developed by the industry in a group of countries first, which is then extending to other countries (like the development of the RECS group). A separate question is whether national governments accept this instrument as a tool for accounting for targets set by the state (like a minimum obligation) or whether national governments (or the EU) will press for changes in methods and institutions of the system developed by the industry.

In general, it can be expected that a TGC-system will be established as an evolutionary process, where the rules will be changed over time with regard to the experiences so far.

As the TGC system will be developed gradually, decisions will have to be made, who can join the system. This decision will depend on whether a set of minimum criteria for participants in the system is met. This can be done similar to the Schengen treaty, where some EU countries agreed on common standards for dealing with immigration and border control to the 'outside

world' and therefore reduced border control within the Schengen countries. The Schengen treaty started only with a few countries and others could join this group over time when they reached the standards of the treaty.

A similar development is possible for the TGC system. Two developments are possible:

- The TGC system is developed rather independently of national governments. Then national processes might not have first priority for the development of the system. The standards might be set by the industry and they decide who can join the system. Still, there is the question, whether governments will accept the TGC instrument.
- The TGC system is developed mainly on the level of national governments (with different roles of the EU possible). Then national governments may decide, which countries can join the system.

If formal trade between a few countries happens, then the rules and standards for international trade in TGCs set by these few countries will strongly influence the eventual international regulatory framework for TGC-trading. This regulatory framework will strongly reflect the needs and particular contingent circumstances of the 'early movers' and not necessarily reflect the needs of later entrants. Therefore, it would be wise for those countries that consider it possible that they might enter international trade in TGCs later, to already exert influence on the process and decisions of the early movers. These countries should be given a forum (with open access) in which they can ventilate their views, which can be taken into account by the early moving countries. The European Commission might want to play a facilitating role in this process.

7. INTERACTION WITH CLIMATE CHANGE POLICY

The most important issue surrounding the interaction of TGCs with CET appears to be the 'greenness' value of RE and the way in which this varies between Member States.

It can include factors such as:
- Climate Change
- Acid Rain
- Particulates
- Decentralised generation
- Avoidance of Nuclear Waste
- Impacts on national energy profile
- Security of supply
- Local employment impacts
- National energy industries etc.

The first difficulty arises from the fact that the Climate Change issue is of global relevance whereas all the other issues are mainly of national or even local relevance. Given that TGCs are currently considered to incorporate cover all the 'greenness' value of electricity from RE sources, international trade will have controversial effects on the several values. With regard to Climate Change, trade in TGCs may contribute to more efficiency in GHG mitigation. With regard to other values, however, it may be counter-productive.

To give an example: Ireland is keen to improve its security of supply, that is, it wants to reduce its dependency from energy imports through the deployment of RE sources. Here, we assume that electricity generation from RE source is much cheaper in Great Britain and that both countries participate in a TGC trading scheme which creates a substantial demand for TGCs in both countries. In this situation, there will be a significant import of TGCs to Ireland. The joint GHG mitigation of both countries will be achieved with lower cost. However, there will be no change in the energy trade balance in Ireland. Ireland's initial goal – to reduce energy imports – will not be achieved. The same applies to the other local or national goals for RE sources.

This example shows that international trade of TGC may be counter-productive to the national or local goals that could be addressed through the deployment of RE sources. National, regional or local benefits of RE sources can not be imported. They can only be developed domestically. If these benefits of RE sources are the priority, then international trade of TGCs is the wrong way to achieve them.

This leads to the conclusion that the main or even the only driving force for the development of an international TGC system is the capability of RE sources to reduce GHG emissions. The other values of RE sources can not be addressed by this instrument. They have to be addressed by other instruments such as standards and (indirect) subsidies.

However, if economically efficient GHG mitigation is the main motivation (driving force) for the development of an international or TGC trading system, two other basic problems emerge immediately:

Problem 1: RE is not currently the most cost-effective way of reducing GHG emissions
Compared to other GHG mitigation strategies most RE sources are and will not be economically efficient at all. Strategies like increasing energy efficiency, switching form coal to gas, co-generation etc. are much cheaper. If RE sources would have to compete with these strategies they will not be applied in the near future. On the contrary, it would give a strong disincentive to new investment in electricity from RE sources and possibly also give disincentives on some of the existing RE installations.

Not only does this argument apply to an international TGC system but also to the deployment of RE sources as strategy to reduce GHG emissions in general. In other words, taking this argument seriously, all national promotion schemes should be stopped immediately. Yet, this is not only contradictory to the recent RE policies of all EU countries but also to broad public support to such strategy in all EU countries regardless of the higher overall costs induced through this strategy.

The rationale behind this position is that RE sources are considered as the energy sources of the future and they should, therefore, be supported and developed now and with high priority although they are not cost effective in the near future. The real motivation for the broad support to the deployment of RE source is not their capability to reduce GHG emissions now, but the expectation that they could be the GHG-free energy source of the future[2]. RE sources do, therefore, not actually compete with other GHG mitigation measures in national frameworks. The driving force for the recent deployment of RE sources in EU Member States is not short-term GHG mitigation policy but R&D and/or industry policy with a real long-term orientation.

However, these policies have been implemented only on a national basis so far. They could be developed in a more cost-effective manner if they were to be developed on an international basis. If wind power is developed in regions with a high wind potential and biomass-fired gas turbines where wood is easily accessible, the overall cost would be lower then if every country relied only on its own RE resources. Thus, there are some reasons to carry out the promotion of RE sources on an international or EU-wide base. But as it could not compete with other GHG mitigation strategies, RE promotion should be set aside from these options. An international approach for the promotion of RE could be considered as a joint implementation of common R&D and/or industrial policy in the field of RE sources. However, this implies that TGCs should be traded separately from other GHG mitigation strategies, first of all because they are currently not competitive; and secondly because the real motivation behind RE deployment is not today's GHG mitigation but future energy supplies. An international TGC trading system in combination with substantial demand for TGC for instance through minimum quota requirements would be an efficient instrument to comply with these goals.

If we assume that just such an international TGC trading system has been implemented, in isolation from the other strategies of GHG mitigation we believe that although its main intention may not be to reduce current GHG emissions, in fact it does contribute to this. In other words, a TGC system is intertwined with other GHG mitigation strategies anyway. Although the demand for TGC may be created separately, its effects on GHG mitigation overlap with other GHG mitigation policies, for instance emissions trading (ET). It is at this point another basic problem emerges. Although the GHG mitigation effect of electricity from RE sources is one of the main drivers for the development of an international TGC trading system, it is at the same time also one of the biggest obstacles to international trade in TGCs.

[2] The expectation that RE will be the energy source of the future is another topic that could be added to the list of issues that explain the value of RE sources and TGCs.

Problem 2: RE generates GHG 'credits' but trading is likely to deal with 'allowances'
Electricity generation from RE sources does not emit GHG[3]. Deployment of RE sources therefore will create GHG credits whereas ET is based on assigned amounts, that is, allowances. This fundamental difference induces basic problems with regard to the compatibility of both approaches which, to date, have not been solved.

This could be explained best with an example: In this example we assume that Country A has distributed a share of its assigned amounts (AA) to the electricity industry according to the grandfathering principle[4]. A utility that builds up its own capacity for electricity generation from RE sources in order to replace some fossil generation capacities could gain extra assigned amounts (PAA) that could easily be traded domestically or internationally. The revenue of this trade could then be used for financing this RE generation capacity.

Any new, independent power producers would – in contrast – not receive any PAA according to the grandfathering principle. By building up electricity generation capacity from RE sources, IPPs will therefore create extra PAA, although they would not have access to the ET market. In this case, only entities that participate in the ET scheme could apply RE sources in their GHG mitigation strategy. All other entities would be excluded from this scheme.

However, the intention of TGC schemes is to overcome this obstacle. If a TGC schemes in combination with a minimum quota were be set up, all entities, that is, already existing ones as well as new entities, could then participate in the trading scheme. However, problems would arise again if these TGCs were to be traded internationally.

For example, if a country A exports TGCs to Country B, which has also set up a TGC scheme, country B has then financed the deployment of electricity generation from RE sources in country A. This would reduce GHG emission in Country A at zero cost and country B would spend money without any effect on its GHG inventory. Several strategies have been discussed to overcome this problem:

1. *TGCs and physical electricity should be imported jointly*[5]*:* In this case, TGC imports would replace electricity generation in country B and thus reduce its GHG emissions. The country that finances RE deployment therefore also gets the credits for this. However, international TGC trade would be only possible on a bilateral basis. In addition to this, first experiments have shown that it is almost impossible to control whether these electricity imports are real imports or in fact only virtual exchange contracts that are immediately compensated by electricity exports of the same amount. In fact, it is not very likely that such a strategy could be implemented.

2. *'Burden sharing':* In this strategy, minimum quotas are distributed between participating countries in such a way that the net TGC trade balance between these countries is more or less balanced. This will be the case if the marginal cost of the last option needed to reach the target is equal in each country. Countries with a greater and more cost-effective RE potential should, in theory, accept higher minimum quotas then countries with a smaller and more expensive RE potential. Although this approach may reduce the interference with GHG inventories, it has a major disadvantage: It is hardly possible to identify the RE potential and the resulting cost curves for RE deployment in each country in a firm manner. The necessary information could not be identified as it depends on the decisions of the entities that apply RE

[3] Neglecting incorporated or grey emissions as well as GHG emissions from Biomass, which could be considered as GHG neutral.
[4] Every participating entity gets a share of PAA equal to the share of GHG emissions in the base year.
[5] This was proposed by The Netherlands.

sources. Only a market process could identify it. Hence, the adequate shares could not be determined in advance. In addition, it is not very likely that the economic burden of RE deployment is simultaneously balanced with the balance of TGC trade (for instance equal costs per capita or equal costs per unit GDP). This would result in inadequate cost distribution between participating countries. This approach, therefore, also seems is impracticable.

3. *Distribution of PAA to producers of electricity from RE sources:* If Annex B countries allow private entities to participate in ET, it is most likely that only large actors (that is, big industry) will be involved. In other words, only a share of the assigned amounts of GHG would be distributed throughout the country. The remaining PAA could be distributed to producers of electricity from RE sources according to their average mitigation potential[6]. In this case, producers of electricity from RE sources would get their revenues from electricity sales, sales of PAA and sales of TGC. The value of the GHG mitigation potential of RE sources would be covered by the PAA whereas the TGC would cover all the other values (see above) of RE sources. However, approaches to the distribution of PAA to non-emitters of GHG are still unclear, so it is not possible to tell if this strategy will be compatible with rules for ET.

4. *TGC as a Joint Implementation (JI) project of all participating countries:* JI differs from ET in that it is not based on assigned amounts but on Certified Emission Reductions (CER), which are GHG credits rather than allowances. They are therefore much more compatible with TGC trading than with ET. Using a JI approach, all participating countries could agree to offset TGC exports with a transfer of an adequate amount of CER to the purchasing country. The difficulty with this is determining the correct amount of CER to transfer. In some countries the carbon offset of a TGC is higher than in others. For example, countries with a higher share of electricity generation from hydro plants replace less GHG gas emissions through the deployment of RE sources than countries, which rely mostly on coal, fired power plants. Three options might be considered to address this problem:

   1. the GHG mitigation value is set by the country where the TGC is generated,
   2. the GHG mitigation value is set by the purchasing country and
   3. application of an average GHG mitigation value for all participating countries.

   The first option applies where the TGC is transferred without a link to the transfer of physical electricity, that is, there is no displacement of generation in the purchasing country. However, this may not be politically acceptable for countries with a high carbon intensity in electricity generation. If they import a substantial share of their TGC demand from countries with less carbon intensive electricity generation, the contribution of their RE deployment to the Kyoto targets would be much smaller as if they would have deployed these RE sources domestically.

   The second option applies where there is physical transfer of electricity that matches the transfer of TGCs (although there are problems with this, as we indicate above). In this case, the electricity displaces generation in the country of consumption.

   However, this may be not acceptable for countries with low carbon intensity in electricity generation. If they export a large proportion of the TGCs generated in their country to countries with a higher carbon intensity they would also have to transfer an amount of CER higher than the GHG mitigation achieved through the deployment of RE in their own country.

6 For instance average GHG emission factor of the total electricity system.

To take the average GHG mitigation value for all international TGC trades might be a compromise that could overcome these differences. However, as there are substantial differences in the GHG mitigation values of TGCs between the participating countries this is problematic[7].

5. *TGC as proof for GHG mitigation measures of private entities that participate in ET:*
   In this approach, private entities that participate in ET can only do so if they accept a quantified emission target. GHG emissions that exceed this target might be offset through the provision of an adequate amount of domestic TGCs[8]. The 'GHG value' of TGCs might be determined in the same way as mentioned previously. In such a case, TGCs are not used in international ET directly but they do have an indirect effect. However, if a TGC is used to compensate GHG emissions for private entities participating in ET, they can not then be used also as proof for a minimum quota unless each TGC has two segments: one representing the GHG mitigation value (TGC-A) and the other representing all other values (TGC-B). The latter could be traded within all countries participating in the TGC scheme whereas the former (TGC-A) could be only sold to domestic entities participating in the ET scheme.

In this approach the GHG mitigation value of RE sources (TGC-A) is clearly differentiated from all other values. Electricity from RE sources has to compete directly with other domestic mitigation options and indirectly with mitigation options world-wide (for instance the shift to less carbon intensive fossil fuels, efficiency improvements). As there are lots of more economically efficient options than electricity generation from RE sources, the revenues from TGC-A are likely to be small. Therefore, at the beginning most of the generation cost of electricity from RE sources has to be covered by the revenues of TGC-B. However, with increasing deployment of RE sources, these technologies will achieve competitive convergence due to economies of scale. In the long run, the contribution of TGC-A to the overall cost of electricity generation from RE sources might increase and, finally, become important than the contribution of TGC-B.

[7] Carbon intensity of electricity generation in Austria or France was 1994 more than two thirds below the EU average whereas in Denmark it was more than two thirds above the average.

[8] TGC from other countries would not reduce domestic GHG emissions and hence not solve the problem they were intended to overcome.

PART C:
RECOMMENDATIONS AND CONCLUSIONS

8. SCENARIO A – MAXIMUM SUBSIDIARITY

Scenario A assumes maximum subsidiarity with regard to RES-E policies, that is, no harmonisation of target or incentive schemes. With other words, EU countries as a whole will not agree on a joint target for RES-E and will continue to apply different promotion schemes for RES-E. Anyhow, some EU countries – for instance The Netherlands, United Kingdom, Denmark and possibly Italy – may agree on a joint approach to RES-E promotion based on a TGC scheme. This joint approach of only some countries could be developed with or without support of the EU administration. Considering the maximum subsidiarity assumption for this scenario, we assume that the joint approach of some countries will be developed with minimum involvement of EU administration.

In a second step, we will discuss which design features would be affected if an interaction of TGC and trading of GHG emissions will occur simultaneously. Hereafter, we will discuss the prerequisites for an effective functioning of such a joint approach of some countries, along the main dimensions of design features of a TGC scheme. The basic question of this debate is which of the design features have to be agreed between the participating countries, and which features may be decided individually by each country. The features may be differentiated into three categories:

- features where an agreement is compelling,
- features where an agreement may support the development of international TGC trade (that is, increase efficiency of achieving the RES-E goals) or the deployment of RES-E, and
- features where an agreement is not necessary (each country could set its own rules and these rules may diverge between countries).

In a third step, we will analyse where and how the EU administration could support the approach of the group of countries and which impacts this support may have on development and regional extension within the EU.

8.1 Demand for TGC

8.1.1 Compatibility of various demand schemes

In general, all TGC demand mechanisms are compatible to each other. With other words, although the demand for TGC may be created in one country by a general obligation and in another country by a tender system or a minimum price guarantee[9]. TGC might be traded internationally and contribute to the demand in foreign countries. However, different demand schemes can have impact on the TGC price. For example, if a country with a minimum price guarantee is involved in the joint approach, the minimum price of this country would set the lower bound of the market price for TGC in all participating countries[10]. If the minimum price is higher than the equilibrium price in all other countries it would increase the TGC price and, thus, cause higher cost in the other countries. If the minimum price is lower than the equilibrium price in the other countries, it would create no additional demand and hence not increase the deployment of RES-E.

[9] Up to now voluntary demand for TGC has been much lower than national targets. Due to that special role of voluntary demand it is not discussed more in detail. Besides it could be easily integrated into a variety of TGC schemes, sometimes without any additional regulation. Therefor voluntary demand for TGC will be neglected hereafter.

[10] Here, it is assumed, that the minimum price applies for all TGC offered in this country, not only for TGC produced from domestic generators.

If several countries with minimum prices schemes are involved, it is sensible to agree on a common minimum price because otherwise TGC would be sold only in the country with the highest minimum price and the other minimum price schemes would have no effect.

If only countries with a general obligation and a tender system are involved, the situation is much easier. Both instruments apply a competitive process with flexible prices between RES-E producers. In case of an obligation, there is a fixed demand for TGC. The competitive process between producers will evolve the price for TGC and, thus, the overall expenditure for electricity from renewables. In case of a tender system with a certain maximum budget, the overall expenditure is fixed. The price competition of RES-E produces will determine the amount of renewable electricity that could be generated with this fixed budget. Although different, both instrument induce a price competition between RES-E producers and are quite compatible therefor. TGC could be traded between these countries. If both instruments are involved, neither the overall expenditure nor the overall RES-E generation is determined in advance. However, countries with a general obligation will achieve their goal and countries with a tender scheme will not exceed their planned overall expenditure for RES-E generation.

As a summary of this discussion, we can conclude that it is highly recommendable to integrate only countries with general obligations, voluntary demand or tender systems into the joint approach. Countries with a minimum price guarantee could influence the price competition and thus reduce the efficiency of the TGC trading for all participating countries.

8.1.2 Periodicity of demand

Basically, it is not necessary that all participating countries agree on the same periodicity of their demand systems. If for instance one country's commitment period is one year, the other country's is two years and in a third country tenders are carried out every three months, the turnover for TGC might have little peaks every three months, a medium peak after a year and the highest peak after two years. However, as obliged subjects or RES-E investors integrate expectation about future demands into their plans and long-term contracts, TGC turnover is not only determined by actual but also by future demand. Additionally, TGC derivates (for instance futures) may emerge and contribute to risk reduction.

Although differences in periodicity are in general compatible, big differences (for instance from quarterly to a 5 year commitment period) should be avoided as they reduce market transparency. The more the relevant periods in the participating countries are adjusted to each other the more transparency and hence efficiency will be in the TGC market.

8.1.3 Homogeneity or differentiation of certificates

For a functioning international trade of TGCs it is necessary to agree on a common definition of the certificates to be traded. Problems would arise if some countries are issuing homogenous certificates for all RES-E technologies, but others use separate values for different generation sources. But if certificates are issued homogeneously, it makes sense to include the information of the technology used for their production in the certificates (see Section 1.2.1). This would offer different options of demand schemes in different countries: The demand could be a RES-E target regardless of the technologies used or different targets (or tenders) could be set for different generation sources. It would also be possible to set a general target, but to give different value to the certificates with regard to their generation technology and RES source. In this way, targeted promotion of specific technologies is possible.

However, the complexity of international trade will rise substantially if several demand patterns exist.

8.1.4 Continuity of TGC demand scheme

As investment in most RES-E generation capacities does not pay back with three or four years RES-E promotions schemes need a long-term perspective. Governments should highlight that promotion of RES-E will be continuously. If these basic conditions are guaranteed in all participating countries, it is not necessary to harmonise time horizons for current targets or other demand schemes, that is, agree on a joint time horizon for all participating countries. However, it will probably not be difficult to agree on the year 2010 as a joint mid-term horizon for all participating countries, as the European Commission did in the White Paper on Renewable Energy. In any case, this would increase the homogeneity and transparency of the whole system although it is not essentially.

8.1.5 Conclusions

- With regard to the demand schemes, it would support international TGC trading if participating countries would agree only to apply general obligations, tender systems and voluntary demand.
- A common periodicity would increase transparency of international TGC markets but is not absolutely necessary.
- It is essential that all participating countries agree on a common standard for issuing TGC. It is recommended to include information on the RES-E source and technology in the certificates. This allows differentiated demand schemes. To reduce the complexity of trade, the demand schemes should be as simple as possible.
- There is no need to harmonise time horizons of TGC demand schemes at the beginning. However, if time horizons are different this may cause problems at the end of the schemes.

8.2 TGC system mechanics

8.2.1 Physical form and information content of TGC

With regard to the physical form of the certificates, it is essential to achieve an agreement between all participating countries. But as this is mainly a technological question, it is very likely that an agreement could be easily achieved (c.f. the example of the RECS system). A standard value and a minimum set of information given on the TGC has to be agreed. But individual countries may decide to give more information on TGC than others do. If so, they still might have to accept TGC from other countries with less information content.

Which information belongs to the minimum set depends on other design features of the TGC trading scheme and on the demand patterns. Basically, the necessity of information given is negatively correlated to the level of agreement between participating countries. For instance if TGC are accepted without any differentiation with regard to regional origin, it is not necessary to give information on this issues on the TGC. However, a comprehensive set of information makes the TGC system more flexible to meet future demand needs and enables additional possibilities for control and monitoring.

8.2.2 Technologies included

If information on renewable source and type of technology is given on the TGC, it is basically not necessary to achieve a joint agreement on technologies included. Each participating country may decide to not accept TGC for instance from waste or large hydro issued in another country if those technologies do not generate TGC at home. However, differences in technological extension of the scheme between participating countries would reduce the transparency of the international TGC market and probably reduce TGC turnover compared to more homogeneous solutions.

However, in the case of a RES-E target the question, which RES-E sources, and technologies are included in that target is very important for the setting of the target. If there is a common rule for the RES-E source and technology portfolio for the issue of TGC in all participating countries, it would spur international TGC trade and reduce barriers to a minimum. With other words, an agreement on technologies included is not absolutely necessary but very helpful for an effective functioning of an international TGC trading scheme.

8.2.3 Issuing and monitoring bodies

If the issuing and monitoring bodies differ between participating countries, it is essential that all participating counties accept the TGC issued and controlled by the bodies from all other countries. It is essential to achieve an agreement on the mutual acceptance of these bodies by all participating countries. This can be fostered by common standards for issuing and monitoring processes in all participating countries, which have to be met by all issuing and monitoring bodies. The creation and maintenance of joint bodies for TGC issuing and monitoring is not necessary but this would also possibly spur international trade.

8.2.4 Life time of TGC, banking and borrowing

Basically, it might be possible to trade TGC between countries that restrict TGC life time to one period and countries that allow banking, that is, accept life times of several periods or do not restrict life time at all. The same applies for TGC borrowing. However, such differences might cause market distortions: The market flexibility necessary to cope with variations of TGC demand and supply in countries with very restricted TGC schemes would be guaranteed to a large extent through the flexibility in other countries and through international TGC trade. This may reduce the transparency of the whole system and, thus, reduce the efficiency in all participating countries.

Differences in banking and borrowing regulations would also induce market distortions, although they might not hinder international trade at all. Therefore, it would be recommendable for an effective TGC trading system to set up common rules for lifetime, banking and borrowing.

8.2.5 Trading

The type of actors allowed to take part in the trading scheme may differ between the participating countries. If countries restrict participation in trading to a certain group of actors (for instance brokers), they will apply the same rules to foreign actors too. International trade in this case could be carried out only via the actors that are allowed to participate in both countries. Although variations in allowed actors would not hamper international trade totally it might reduce the transparency of the scheme. Therefore, an agreement on this is not necessary but it would increase transparency.

If an agreement about complete tracking and registration (see below) of (international) TGC trade is agreed TGC transactions do not have be controlled additionally. National or international trade may be bilateral between two (allowed) actors or via a TGC exchange. If one country requires transactions at a TGC exchange – for instance because that may reduce tracking and control efforts –, foreign actors will have to comply with that condition too. However, international TGC trade will be possible and will not be hampered. Therefore, there is no need for harmonisation with regard to trading mechanisms.

8.2.6 Registration, monitoring and control

Registration is an instrument to monitor and control the TGC trading scheme. If registration rules (issuing, trade, withdrawal) differ substantially between countries, it would hamper international trade because international transactions are not compatible. The participating countries should set up common standards for registration rules. National bodies for registration, monitoring and control should be mutually accepted by all participating countries.

8.2.7 Electricity trading regime

Different *conditions for system access* of RES-E producers will have influence on the price of certificates. If, for example, a RES-E generator has to bear high transaction cost for his system access (for instance for extensive negotiations with system operators under a negotiated TPA system like in Germany), then he needs a higher TGC price to recover his total cost than another generator in another country who has the same generation cost but has lower transaction cost for system access. In the case of negotiated TPA with high transaction costs for system access, the local or regional utility could be obliged to buy electricity from RES at prices at least equal to the avoided cost of conventional electricity in order to ensure electricity sales from RES. On the other hand, regulated system access and the existence of a spot market for electricity could foster the trade of electricity generated from RES and therefore reduce the total cost of RES-E production.

The ideal case would be equal (minimum) standards for system access in all countries participating in the TGC system. But under a maximum subsidiarity scenario, it is very likely that no common standards apply for system access. This leads to market distortions, as for a given market price for RES-E power (for instance from wind), generators in countries with higher transaction cost have a disadvantage in comparison with other generators. Therefore, the participating countries should at least try to agree on minimum standards for system access.

If easy system access is ensured, the existence of a pool system for electricity can give extra opportunities to the generators to sell their electricity very easily. At the pool, they could offer their electricity at the price of zero to ensure to be able to sell electricity at all[11]. If those 'zero offers' do not offer enough electricity to meet the demand, then the pool price will be higher than zero. The generator will try to cover the difference between his total cost and the pool price with TGC sales.

8.2.8 Conclusions

- An agreement on the physical form and a minimum information content of the TGC is necessary for an international trading scheme.
- It is not essential to agree on technologies included in the system. However, an agreement would increase the transparency of the whole scheme and spur effective TGC trading.
- All participating countries may set up their own bodies for issuing and monitoring. It is essential that they apply the same rules and are mutually accepted by all participating countries.
- Although differences with regard to life time, banking and borrowing might not hinder international trade, it is recommended to achieve an agreement on these issues as they are essential for an effective functioning of the international TGC trading scheme.
- With regard to participants and trading mechanisms, a joint approach is not necessary. However, if both issues are regulated similarly in all participating countries it would spur international trading.

[11] This is very important for the generator, because if he cannot sell his electricity, he will not produce certificates.

- Probably every country will set up its own control and monitoring body. It is essential that these bodies apply the same rules with regard to registration, monitoring and control.
- Different conditions for system access may create distortions on the TGC market. Therefore, minimum standards for system access of RES-E should be realised by all participating countries.

8.3 International Context

8.3.1 Regional extent

All participating countries should agree on a joint regional extent of the scheme. This can be shown with an example: Assumed all countries except one wish to restricted the scheme to the participating countries (reciprocity principle). But one country does not bother about this, that is, accepts TGC form for instance Eastern European countries too. Via the latter country TGC from Eastern European countries could infiltrate the whole scheme and, thus, violate the rules set by the other countries. This example shows, that it is absolutely necessary to achieve an agreement between participating countries about regional extension of the scheme.

If TGCs contain information about the region where they are created, it may be sufficient if all participating countries accept that each participant could set up its own rules with regard to the origin of certificates.

8.4 Remaining issues

8.4.1 Trading of GHG or carbon emissions

In this section we assume that countries participating in TGC schemes apply different strategies to involve producers of electricity from RE sources in Emissions Trading (ET). Some allow TGCs to be used as an offset for excess emissions, others distribute PAA to producers. Others do not participate in ET and therefore do not involve producers of electricity from RE sources.

TGC trade might be possible in this situation but TGC prices would be affected substantially by interaction with the different CET frameworks. For example, if producers are involved in ET in some way, they can cover a share of their costs with the revenue they obtain from ET. Their TGCs would therefore be systematically cheaper than the TGCs of producers in countries where they are not involved in ET.

Producers of electricity from RE sources, who are not involved in ET, would therefore have disadvantages with regard to their competitiveness. Despite this, such a situation would not prevent international TGC trade in general. RE capacities in countries without involvement in ET, which are economically very efficient, might compete with TGC from other countries and might be even exported to these countries. Thus, an agreement on the involvement in ET is not absolutely necessary, although it would promote fair competition between producers of electricity from RE sources in the participating countries.

8.4.2 Transition regimes

Under a maximum subsidiarity scenario, the participating countries will be able to introduce the TGC in different periods of time and with different regimes for the transition from ‘old’ instruments for RES-E promotion to the TGC system. It can be expected that some countries will use ‘old’ instruments (tenders, feed-in regulation, subsidies, and so on) parallel to TGC systems for a long period of time or even permanently. These instruments should have minimum interference with the TGC market. The number of participating countries may rise over time. Without a

harmonised EU strategy on the introduction of a TGC system, the development may follow the example of the Schengen treaty: that is, A group of countries define a common standard and establish a common TGC system. The members of the group decide whether other countries are allowed to join the group. A precondition for joining the group is that the new country has to fulfil the common standards. This may raise the issue that the 'First Movers' define the system in a way that benefits their interests, and disadvantage subsequent entrants.

In order to develop common standards for a TGC system, two scenarios are possible:

- The TGC system is developed independently of national governments. In this case, national processes might not have first priority for the development of the system. The standards would probably be set by the industry and they then decide who can join the system. Still there is the question, whether the TGC instrument will be accepted by governments, for instance to meet general obligations.
- The TGC system is developed mainly on the level of national governments (with different roles of the EU possible). In this case, national governments decide which countries can join the system.

Even under the first scenario, the definition of the TGC system should not be left to the industry alone. National and EU bodies should take an active role in defining a TGC system, which is able to meet the requirements of national instruments for RES-E promotion and where the minimum standards of harmonisation are met to make the system work on the international level.

9. SCENARIO B – AGREED TARGETS – NO HARMONISATION OF MEANS OF ACHIEVING TARGETS

Under Scenario B, targets are set in each EU Member State, but RE support schemes are not harmonised.

Member States agree a target for RE which can be:
1. set by multilateral negotiation across the EU, or
2. left to Member States to decide for themselves under the principle of subsidiarity.

Under Scenario B, the lack of harmonisation of support mechanisms in Member States can affect whether trade occurs or not. Countries can agree to trade TGCs in order to meet their targets, or they can choose to meet them in other ways.

As for Scenario A, it is possible that some countries may reach joint agreements on ways to achieve their RE targets, and that these may also link with their Greenhouse Gas (GHG) reduction actions (see later).

Under this scenario, any international trade in TGCs (or 'green electricity'[12]) can be carried out on a bilateral basis, as long as all parties are confident that the electricity is from renewable sources. However, it is also possible that a more general 'trading' framework (probably based on TGCs) could emerge.

This chapter examines such a framework, referring to options that could occur outside the framework where these appear relevant.

9.1 Demand for TGC

TGCs can be used to meet 'voluntary' demand for green electricity (that is, to certify that physical electricity comes from RE sources) or to meet compulsory demand which is created by the State (or another body) via targets for RE deployment, use etc. It is this second option which we examine in this section, examining the interaction between this and different methods for promoting increased deployment of RE.

9.1.1 Point at which demand is placed on the supply chain.

Under Scenario B, trade between different countries can take place in a non-harmonised way. This means that countries with the obligation placed at different points in the supply chain (for instance Denmark, with the obligation placed on consumers and The Netherlands, with the obligation placed on Supply Companies) might be trading with one another. This may require some negotiation to take into account 'indirect' means of support such as rebates on 'Eco' or 'Climate Change' - type levies and taxes (see later for points on interaction with Carbon Emissions Trading).

[12] 'Green Electricity' refers to physical electricity which is certified to be from Renewable Sources, either by TGCs or by another method of accreditation.

9.1.2 Obligation type

International trading in a non-harmonised system may take place between countries (or entities such as power suppliers etc) that are subject to different types of obligation. For example, a country that has a target framed in terms of a certain RE capacity might trade with another country that has a target framed in terms of RE production (that is, a certain number of kWh/year). This may give rise to 'double counting'. Because of this, trade must therefore be accompanied by the requirement that installations that contribute to capacity targets are not allowed to trade TGCs resulting from their output with other countries.

9.1.3 Development of obligation over time

If countries have obligations that develop differently over time, this gives varying emphasis to development in some states rather than others and might introduce market distortions.

9.1.4 Influence of other factors on demand for RE

Demand for TGCs (and therefore the impact of using TGCs on the deployment of RE in the EU) will vary depending on the interaction of several factors.

The most important factors are:
1. setting minimum price levels,
2. setting upper price levels,
3. 'indirect' support levels (including ease of obtaining planning, grid access, non-hostile attitude to the intermittency of RE sources),
4. perceived environmental benefit of different RE technologies.

9.1.4.1 Setting minimum price levels

Sellers of TGCs will obviously be drawn to countries in which the guaranteed minimum price for TGCs is higher than in others. However, it is assumed that, given equal access to this price for all players, the market will smooth this imbalance.

If access is not equal, however, it is possible that one group of actors (for instance local TGC producers, producers of TGCs from Wind power, any producer or TGCs except those producing from large hydro,etc) could benefit over others.

This may be used as a tool to promote domestic deployment, but may also affect the 'level playing field' for trade between Member States.

9.1.4.2 Setting upper price levels

Setting upper price levels which are far in excess of the expected equilibrium trading price for TGCs will have little impact on the trade of TGCs, at least in the short term.

However, strict upper price levels in one country (which could be set via penalty levels) which are close to the equilibrium price could limit exchanges of TGCs with this country. Of course, this can also be used as a way of directing the market, but it is possible that a country with a low upper price level could find all domestic capacity being dedicated to producing TGCs for external trade with other countries.

9.1.4.3 'Indirect' support levels (including ease of obtaining planning, grid access, non-hostile attitude to the intermittency of RE sources)

'Indirect' support to the deployment of RE can have as strong an effect as direct support mechanisms. One problem with examining indirect support is that it is difficult to quantify, particularly when it is linked to the cultural and social approach to RE or to the provision of electricity (for example) in different Member States. Indirect support is by its nature offered (almost always) only to domestic production.

Quantifying the effect of this support on demand levels is outside the scope of this project.

9.1.4.4 Perceived environmental benefit of different RE technologies

Under Scenario B, it is possible, if TGCs are traded without distinction, that those from one country would be regarded as 'non-renewable' by others (for instance TGCs produced in the UK could include a large proportion of those from waste combustion plants). Conversely, labelling TGCs with full RE and country source information (as we have recommended elsewhere) may result in a range of prices for TGCs from different technologies and countries.

9.1.5 Homogeneity or differentiation of certificates

As for Scenario A, international trade of TGCs can only take place if a common definition of certificates is agreed. In practice, it is likely that a range of certificates will emerge, as has happened already with accreditation systems for 'Green' electricity. This will introduce an extra stage in transactions involving TGCs (and therefore transaction costs) where 'exchange rates' are agreed between trading partners. It is also possible, however, that a dominant trading system (such as RECS) will emerge and that players will opt to use this system because of the ease this gives them in trading.

If the dominant trading system involves 'classes' of certificates (for instance PV, Wind, biomass in Class 1, waste, hydro in Class 2 etc) then there are likely to be differences between the way some technologies are classed in different countries. Under Scenario B, this might then require some harmonisation of classes between international trading partners. As this seems unlikely it seems that this will not be a suitable option for international TGC exchanges.

The 'Ingredient Labelling' option proposed by RECS seems to be the most workable option under Scenario B.

9.1.6 Continuity of TGC demand scheme

Under Scenario B, there will be no guaranteed continuity in demand for TGCs on an international basis. However, as most EU Member States are likely to opt for increasing their capacity of RE deployment, it is likely that the demand for TGCs can be 'smoothed' if international trading takes place between countries.

9.1.7 Conclusions for scenario B

- Demand for TGCs will be affected by factors other than the target levels set in each Member State.
- Certificates should contain the maximum amount of information, including, if possible, some indication of the level of 'indirect' support received in certificate production.

9.2 TGC system mechanics

9.2.1 Legal framework

Under Scenario B, it becomes more important that the legal framework for trade in TGCs is agreed clearly between trading partners. In particular, some examination should take place of whether trade in TGCs alone constitute a exchange of a financial instrument rather than of RE as such, and therefore is subject to EU financial services legislation rather than the legal framework surrounding trade in electricity and the support of RE.

Where there is a non-harmonised trading system, it is essential that bureaucratic delays (such as the 'late arrival' of certificates or 'gazumping' – that is, the last minute withdrawal of certificates from sale because a better price has appeared on the spot market, for example) do not result in actors being able to meet their obligations. This is a clear point where there is a need for an agreed arbitration body which can resolve conflict in a resolute manner.

9.2.2 Physical form and information content of TGC

As we stated above, certificates should contain the maximum amount of information, including, an indication of the level of direct and 'indirect' support received in certificate production.

There are several ways of accrediting RE already in existence in the EU and not all of them are in harmony with the system listed above.

For example, in the UK only suppliers of green electricity are accredited, whereas in Sweden the accreditation system is based on ISO 14000 Type III declarations. Many countries have no accreditation system at all. There must therefore be some transition period for these systems or methodology developed for harmonising the systems with the proposed TGC system.

9.2.3 Issuing and monitoring bodies

As we proposed in the main design paper, it would ease trade in TGCs if there were to be some Central Monitoring Office for the EU in general, which could register all TGC transactions. This could be either a public or private body, as long as it has the confidence of all actors in the sector (including NGOs and the public).

9.2.4 Life time of TGC, banking and borrowing

Under Scenario B, banking and borrowing is left to agreement between those trading. It may be that one country will accept 'banked' or 'borrowed' certificates where another will not. This will be left to subsidiarity under this Scenario.

Countries that agree different lifetimes for certificates might find that certificates which become invalid in one country (that is, past their expiry date) may still be valid for sale to another country. Again, this is a matter for agreement between parties involved in the trade (or those in a trading system, if a dominant system emerges).

9.2.5 Trading

9.2.5.1 Qualifying levels

It may be that countries will want to set 'Qualifying levels' of RE deployment or use in their own countries before they allow trading of TGCs (into or out of the country). This is similar to the '5%' capping level set for RES support in the current proposed draft directive on RE support.

'Qualifying levels' can be imposed on a country as a whole or on any actors which may be participate in TGC trading.

9.2.5.2 'Level Playing Field'

In order for trade to be fair, we suggest that any support given to a TGC before it 'crosses the border' between the selling and the purchasing country should be ''cleaned' or 'stripped' of the support as it is traded. By this, we mean that the support should be 'refunded' at the border, in the same way that VAT is refunded in some instances.

Of course, under Scenario B this is in fact left to the actors themselves to decide. It may be that some actors would rather buy certificates that have already received support (perhaps because they are cheaper) and that the country that has provided the support is happy that another country benefits from this. It is left to the actors to decide this between them. However, we suggest that any dominant international trading system (for instance RECS) should include a means by which (direct and indirect) support can be refunded so that TGCs qualify for trading.

9.2.5.3 Trading actors

A range of actors can be allowed trade under Scenario B. In fact, any trading system can allow any trader that meets its basic requirements to operate.

9.2.6 Electricity trading regime

9.2.6.1 Trading TGCs alone

Under Scenario B, TGCs can be used to meet either voluntary or compulsory demand (that is, a target) in any Member State involved in any trading system. Under this system, access to electricity grids limits only the producer of electricity (that is, the level of access represents a certain level of support – good access being a high level of indirect support, poor access being a low level of support). Grid capacity, however, is not an issue as the physical electricity is not moved between states.

9.2.6.2 Trading green electricity

In this trade, the 'whole package' of 'renewable electricity' is supplied to the purchaser. TGCs are used in this framework merely to certify that the electricity came from a renewable source (which is similar to the accreditation system for green electricity suppliers in the UK) and not to transfer the 'greenness' between actors. TGCs used in this way probably are not subject to EU financial services law, but will be governed by the new RE directive. It is under this framework that grid limitations become significant, that is, to the extent that trade in TGCs between some Member States (for instance The Netherlands or Denmark with the UK or Ireland) seems unlikely. Under Scenario B, there is no guarantee that a harmonised approach to this issue will be taken.

9.3 International Context

9.3.1 Qualifying levels

Again, as we proposed earlier under Scenario B, actors could be allowed (by their Member States, or perhaps by the EC or by their agreed trading body) to bank or borrow (or in fact trade) certificates only when they have reached a certain 'qualifying level' of RE deployment (or production) in a certain Compliance Period (or in their own region or area in the case of trading).

9.3.2 Regional extent

Under this scenario, the regional extent of trading is left to the participants in TGC trades. There is no harmonisation of the extent of validity of TGCs in terms of geographical extent. However, it may be that public confidence in TGCs will be threatened if TGCs are used in such a way that it does not appropriately reflect their regional environmental benefits.

9.3.3 Arbitration

As we proposed earlier, international trade in TGCs will be easier if all actors agree to a common legal framework and to a common arbitration body in case of dispute.

9.3.4 Penalties

It seems unlikely that there will be any penalties imposed on Member States (by the EC) under Scenario B. National penalty levels will remain in place as long as Member States wish to keep them in place.

9.4 Interaction with climate change policies

The interaction of support for RE with Climate Change policy is emerging as a key issue for the RE industry. Under Scenario B, it is likely that various different types of support for both these sectors will have strong impacts on each other.

In the UK, for instance, it appears likely that electricity produced from RE source will be exempt from the Climate Change levy which will be imposed on the use of electricity by (some) business). However, some of the larger energy users have negotiated a level of exemption from this levy in return for voluntary actions on energy efficiency. Many of the same large energy users have also proposed a Carbon Emissions Trading scheme to the UK government.
This situation is reflected in many Member States, and under Scenario B, there is no requirement for this interaction to be factored into a TGC scheme.

So far, we have proposed that any support, whether direct or indirect, should be refunded at national borders and the TGC owner applies for a appropriate levels of support on newly purchased TGCs brought into the country 'cleaned' of previous minimum price support.

10. SCENARIO C – MAXIMUM HARMONISATION

In Scenario C a RES-E target, derived from the overall EU target, is allocated to each Member State. Moreover, the incentive scheme of Tradable Green Certificates is harmonised in the EU-15 in order to create a level playing field. Besides this scheme, there are no other instruments in effect supporting RES-E. This scenario represents an ideal EU with a strong EU government and political agreement between the Member States and with a complete internal market. It is assumed that an EU target for RES-E exists and that this target is translated into national targets for the Member States (which is the result of political negotiations). Thus, national target may be different between countries (for instance Germany 10% in 2010 and France 12%).

In a variant of this scenario, additional to international (within EU) trade of green certificates, also international carbon trade occurs.

In the European arena, a minimum set of guidelines are necessary to make sure that certificates are issued in a uniform way in all Member States. Certificates should be reliable and exchangeable. The guidelines also have to prevent fraud, for instance multiple sale of certificates. However, guidelines should be kept at the minimum.

10.1 Demand for TGCs

10.1.1 Obligations on suppliers

Demand for green certificates typically originates from the obligated actors, that is, those actors that are subject to an obligation. European wide tendering for TGCs or a minimum price would also be possible, but seems to involve more co-ordination and problems in raising the budgets necessary for tendering and minimum prices. Besides the obligation, voluntary demand for TGCs is possible, however this voluntary demand should not count for the obligation. The obligation part then falls under the polluter-pays-principle, whereas those consumers that want to do more than the minimum, can buy extra green energy.

In a fully harmonised and liberalised Europe, it would be possible to put the obligation on the end-consumers of electricity. However, because of the enormous amount of consumers, registration and monitoring of the system would be costly. Moreover, it is likely for consumers to pass over their obligation to their supplier. Therefore, it is recommended to oblige the suppliers of electricity with a target for TGCs. A certain percentage of the total amount of electricity supplied (in kWh) in the Reference Period should be covered by green certificates. The level of the percentage may be different between suppliers in different countries because national targets may differ (see introduction). This will be an extra incentive to reduce the difference between supply and consumption, that is, the losses, of electricity. A problem here is what to count as ‘supplied electricity’, that is, how to deal with actions behind the meter. If auto-production/consumption is not included, the reference amount for determining the obligation would be smaller, which is an advantage for the supplier (because his obligation will be smaller). It would be natural to just take the actual supplied electricity as reference, so excluding including auto-production (since it is not supplied by the obligated supplier).

Long-term demand for TGCs is only guaranteed if obligations are set for subsequent future years. Therefore, a growth rate for the obligation over time would be appropriate. Refer for instance to the Flemish proposal, where the growth rate is adapted to reach a politically defined target in a given future year (for instance to reach 3% in 2010).

The growth rate can be different in different periods (for instance 16% a year till 2010 and 5% a year after 2010). Here, a continued growth of the contribution of renewables is induced, without limiting this contribution in advance. Theoretically a year can be determined in which 100% is reached (for instance 75 years from now).

10.1.2 Homogeneity of certificates

For the obligated parties, the obligations should be kept as simple as possible. Therefore, it is recommended not to specify differentiated obligations for different technologies of RES-E. However, in order to be able to stimulate the promising but still costly technologies, separate obligations for 2 or 3 renewable energy 'classes' could be specified. This option is chosen in some of the US States. For instance Class 1 = PV, Class 2 = tidal and wave energy, geothermal energy, solar thermal electric etc. Class 3 = remainder. It will introduce competition between technologies, but only within their technology class. Since a large and liquid market for TGCs will emerge in a European wide system with obligations, it would not be a problem to distinguish between obligations for different classes of RE.

10.1.3 Reference of obligation

A Reference Period has to be identified in order to determine the level of the obligation for each supplier. We assume that the length of the Reference Period is one year. In order to keep it simple, only one Reference Period could be identified (some historic year, for instance 1996) to determine all subsequent future obligations with a growth percentage. In order to account for anomalous circumstances, the average over a period of 4 or 5 years should be taken as the Reference Amount. The advantage of taking a historic Reference Period is that the market is known long in advance. The disadvantage is that the percentage in the Compliance Period and the foreseen total obligation will not exactly match. Moreover, for new suppliers in the market (which did not exist in the Reference Period), the obligation should be determined differently, for instance a percentage (the percentage that holds for the specific year) of their expected annual supply. Afterwards, corrections can be made.

The system may account for other beneficial actions taken in the past (other than the renewable production falling in the TGC system). In that case, the Reference Amount of Electricity supplied should be the total amount of electricity supplied minus for instance large hydro, landfill gas electricity or CHP. In this way, renewable sources that are not considered to deserve direct promotion (for instance because they are 'already competitive') are getting an indirect incentive. Instead of spending money to buy new certificates, an actor can also invest in cheap conventional renewables or CHP. In this way, he lowers the Reference Amount of Electricity and he can fulfil his obligation with less certificates. In this sense, this option introduces a 'soft competition' between conventional renewables/CHP and new renewable electricity sources.

10.1.4 Compliance period

The most simple and straightforward length of the Compliance Period is one year. A disadvantage might be that because of circumstances unforeseen (a bad wind year, less solar irradiation than normal, or installations that break down unexpectedly) the actual supply of green certificates might be less than could be reasonably expected. This problem can be dealt with by including flexibility in the system mechanics for instance by allowing banking or borrowing of certificates. As mentioned earlier, long-term demand for certificates is only guaranteed if obligations of future are known well in advance. This will be achieved for instance in the case where the development of obligations over time is set by growth rates and no final year is mentioned (for instance the Belgian case). A self-sunsetting approach is preferred over the introduction of a artificial sunset date. We recommend that at the end of each Compliance Period suppliers have to prove that they fulfil their obligation. To avoid the disadvantage that spot market

trade will only occur at the end of the period, and transparency of the market is minimal, during the Compliance Period the Control Body will perform random checks on whether suppliers have fulfilled their obligation over the length of the Compliance Period ending at the time of the check.

10.1.5 Conclusions

- Demand for TGCs is driven by an annual obligation on suppliers of electricity. Voluntary demand for RES-E is possible but has to be additional to the obligation.
- The obligation will be differentiated into 3 technology classes.
- Obligations are determined as a percentage of the supplied amount of kWhs, that is, the Reference Amount. The level of the percentage depends on the national target.
- The percentage is subject to a fixed growth rate.
- The Reference Amount for determining the obligation will exclude auto-production and prespecified other beneficial production such as CHP.
- The Reference Amount will be based on the average annual supply over a five year historic period, for instance the Reference Period 1994-1998.
- The obligation for new suppliers will be based on their expected supply.

10.2 TGC system mechanics

10.2.1 Issuing TGCs

In a fully harmonised Europe, we assume there is agreement on the RES-E technologies eligible for receiving TGCs. If auto-producers of RES-E are not to be discriminated, the basis for issuing certificates should be the amount of RES-E generated (and not the amount fed into the grid). The Issuing Body has to make sure that TGCs are issued correctly. In Scenario C it is relevant to appoint one independent public Issuing Body in each Member State. The Bodies then co-operate and co-ordinate their work at the European level in a Central Green Certificates Office.

Certificates will be issued and administered as an electronic record. No paper versions are issued. The certificates should preferably be issued on a continuous basis, implying on-line metering and recording of production and transfer of this information to the Issuing Body. If continuous on-line issuing is technically impossible or difficult, discrete issuing with preferably small lags (for instance every week) is necessary. It is not necessary for TGCs to have a standard value of for instance 10 000 RES-E kWh since we assume on-line issuing of TGCs as electronic records. Each kWh counts for the obligation of suppliers, so an obligation of 834 kWh can exactly be reached. However, since each certificate contains its own information, it would mean an enormous amount of data to be handled and stored if one certificate equals 1 kWh. Therefore, certificates with a standard representation in 1000 kWh would be preferred. In that case, the obligation for a supplier is also rounded to 1000 kWh and continuous issuing would mean issuing a certificate after each 1000^{th} kWh recorded.

The information content of TGCs kept as electronic records in databases is standardised and at least includes the following information:

- Serial number.
- Identification of the generator.
- Location (country and region) of the plant.
- Capacity of the plant.
- In case of discrete issuing: date of issuing and the period of production covered by the TGC; in case of continuous system: year of issuing.
- RE source (solar, hydro, wind etc.).
- The class of RE (class 1, 2 or 3).
- Amount of emissions reduced (CO_2, SO_2, NO_X, nuclear waste).

For statistical reasons, all kinds of other information such as the technology used, type of unit, size and age of the plant may also be included.

In order for the generator to be recognised as an eligible RE producer, the generator has to file a Renewable Energy Declaration with the Issuing Body in the country where the plant is located. This declaration includes data on the generator, the metering and the date of commissioning the plant. Plants that already existed when the TGC system was introduced or that received support from other promotional schemes in the past will receive certificates for their RE production from the date that the TGCs system is introduced. These certificates may be earmarked, that is, stating that it already profited from earlier support, giving the possibility to exclude or reduce their use in meeting an obligation.

10.2.2 Use of TGCs

The accounting system for TGCs is very similar to bank accounts. This means that every participant in the TGC system has his own account and can receive bank statements. The main difference is that the certificates kept on the accounts are not homogenous, but are bearing individual information, which has to be kept during all transactions.

It is important to allow for the possibility of 'banking' certificates in order to provide some flexibility for the obligated suppliers. The lifetime of the certificates could then be unlimited, that is, there is no expiry date defined for the certificates and the certificates can be used to fulfil any future obligation. Banking with interest rates would perhaps lead to a faster deployment of RE sources, but it complicates the system (for instance interest rates have to be determined and adapted). A faster deployment is more easily reached with stricter obligations.

Again for reasons of flexibility, 'borrowing' should be made possible, although it should be limited to a small percentage of the obligation each year. Moreover, it should be guaranteed that over a period of for instance 5 years (a moving average of 5 years) the obligations is met. This is necessary to ensure that borrowing will not become structural and that eventually the obligation is met. A disadvantage of allowing borrowing is that the eventual production of RES-E is not fully guaranteed if companies go bankrupt in the meantime. In order to discourage borrowing and avoid the 'bankruptcy' problem, the obliged actor should provide a deposit sum equal to the penalty for the part of the obligation that is not fulfilled. He gets the deposit back as soon as he fulfils his credit. In case the certificate is not produced, at least the penalty is already collected.

10.2.3 Registration

It is necessary to record each step of the handling of certificates (issuing, trade, withdrawal) in the certificate accounts. This means that records representing certificates can be created, moved or deleted in the database. The database is an accounting tool as well as a means to execute trade and redemption at the same time. It has to be ensured that each obliged supplier only has one certificate account. There can be one independent public Registration Body in each Member State, which administrates the ownership registration of certificates and carries out the trade transactions for the owners. The functions of national Issuing Body and national Registration Body is easily combined in one national body. All transactions of certificates have to be reported to the European Central Green Certificates Office.

The database record can be credited to the account of the generator as soon as the meter is read and the data is transferred to the database. On-line issuing of certificates would be ideal here. Trade of certificates leads to a transaction from one account to another. This can happen within the database of one national Registration Body or between different Registration Bodies. The

consumption of certificates if they are used to meet an obligation has to be executed by deleting the respective electronic records. This will also be the responsibility of the Registration Body. Guaranteed access to the grid does not play a role here, because we assumed that all RES-E generated is liable for receiving certificates, that is, it is independent from being fed into the grid.

10.2.4 Compliance control

The Electricity Regulator can operate as compliance controller, that is, the Control Body for the TGC system. The basics of a green certificate system will probably be incorporated in the Member States' legislation and the Electricity Regulator has a function to look after the correct practice of such legislation. However, not every Member State has a Regulator and the control function easily combines with the issuing and registration. Therefore, we recommend that the national Issuing and Registration Body also is the compliance controller.

If the number of certificates handed over by the supplier is less than the number of certificates required, the supplier has to pay a penalty. The penalty should be higher than the market price in the Compliance Period and could be based on the average market price in the Compliance Period, for instance 130% of the average market price. The advantage is that the penalty will not act as a maximum price for the certificates, because the market price fluctuates. The Control Body should have access to market information to determine the average market price and the penalty.

It seems fair to deposit the penalties paid in a Renewable Energy Fund. This Fund can for instance be used to finance new renewable installations. This will need an independent set of rules. Also part of the transaction/system costs of the green certificate system could be sustained by this Fund. Furthermore, the Fund can function as a 'market stabiliser': by buying certificates when the price is low, and selling when the price is high, it can influence the market. The penalties do not have to be the sole resource for this Fund.

10.2.5 Conclusions

- Each Member State has an independent Green Certificate Body, incorporating the different functions of issuing, registration and controlling. The national bodies deliver information to and justify their actions in a European Central Green Certificate Office.
- One certificate equals 1 MWh of RES-E produced.
- Certificates are represented by electronic records with the Green Certificate Bodies.
- Certificates will be issued on-line and continuously.
- A RE-producer has to be registered in order to be eligible for receiving certificates.
- Existing plants will receive certificates relative to their age.
- Unlimited banking of certificates is allowed.
- Limited (5% of the annual obligation over a horizon of 5 years) borrowing of certificates is allowed. For the borrowed part, deposit payments are obliged.
- The penalty will be 1.3 times the average market price of certificates.

10.3 Trading

In Scenario C it is assumed that generators of RES-E that received certificates will only sell those certificates. Generators are not allowed to buy certificates. The obliged suppliers are allowed to buy and sell certificates. TGCs may be traded bilaterally or at a TGC exchange. One possibility does not exclude the other, that is, if a TGC exchange will be opened it may also be possible to trade TGCs on a bilateral basis. Transactions at the exchange or bilateral are automatically registered with the national Registration Body. Trading should be possible continu-

ously. Bilateral trade could be carried out any time. Trading hours at an exchange depend on turnover, that is, volume of supply and demand. At the beginning of a trading system, there may only be a few trading days (once a month). However, at the end of a Compliance Period, turnover probably will increase. The way bilateral contracts are made must be left open to the market players. It is very well possible that suppliers will offer a 'total package contract' to the producer, including the electricity price and the certificate price. It is also possible that two different contracts for the electricity and the certificates are concluded. Beforehand, it is not necessary to actively stimulate the emergence of an exchange.

For each transfer of certificates between accounts, the price of the certificates should be made available to the Registration Body. Price information of bilateral contracts is in principle confidential. However, the Registration Body can hand over the information to the Control Body to determine the penalty (see part on penalties). The Control Body should keep the specific information confidential, but has to make public the average market price over the Compliance Period by setting the penalty. If the Control Body has all this information, it can publish average prices as a market indicator more often. This will reduce the need for enhancing price transparency by stimulating spot markets.

10.3.1 International context

In Scenario C the TGC system is fully harmonised by definition. Therefore, demand for renewable electricity in every Member State is accounted for by certificates (and not by the electricity itself). Demand for certificates is synchronous in all Member States, that is, the Compliance Periods are synchronous. The issuance and verification of certificates is mutually acknowledged and fixed by the Central Green Certificates Office. Certificates from non-EU countries should contain enough information to allow the potential importing Member State to decide unambiguously whether these certificates are acceptable or not. This includes the same information as in the EU certificates and the level and kind of support the production of renewable electricity has got. All certificates originating within the EU are equally valid. This might create 'hot spots' (for instance Scotland) of areas that produce a large part of European renewable electricity. For a set of reasons (energy independence, industrial politics, etc.), Member States might require that part of the demand is met by domestic certificates.

10.4 Interaction with RES-E promotion

Interactions of a TGC system in Scenario C with other policy instruments for the promotion of RES-E can occur in a transition phase, if other instruments are kept for a limited time to ensure a smooth transition from one system to the other. In Scenario C, it is assumed that the other instruments and the TGC/obligation system are designed to have the minimum impact possible.

10.5 Carbon emissions trading

The most important issue surrounding the interaction of TGCs with CET appears to be the 'greenness' value of RE and the way in which this value varies between Member States. It can include factors such as climate change, decentralised generation, local employment impacts, impacts on national energy profile, etc. It would of course be much easier if it were possible to separate the CO_2 portion of the TGC from the 'green' other attributes. However, it is very important that the value of a TGC is understood as a whole. There is also the question of how to account for the fact that some impacts of RE use (such as reduction in SO_2 levels) are local to the EU, and can probably be traded within the Union, but that others (that is, CO_2 emissions reductions) have global impacts and can therefore be traded via, for example, CET systems which operate world-wide.

If TGCs are to interact with CET systems, it is necessary to identify the climate change benefits of RE. This is clearly extremely difficult, nevertheless theoretically there are 'double benefits' of using RE (that is, the CO_2 reduction, which can be traded within the CET market and other greenness) and that TGCs should therefore benefit from both systems.

10.6 Transition regimes

The introduction of a TGC model alone (without an obligation) raises questions on the establishment of the methods and institutions mentioned above. To build up these and to give time to the actors to get used to the instrument of TGCs, an introduction period (around 3 years) is necessary. During the introduction of a TGC system in combination with a minimum obligation involves the transition from the current schemes for the promotion of RES-E to the new system. For Scenario C, it is essential to harmonise the methods and institutions for TGCs and targets on the EU level. In Scenario C, the TGC system is developed rather independently of national governments. Then national processes might not have first priority for the development of the system.

11. CONCLUSIONS, RECOMMENDATIONS AND REMAINING ISSUES

This Chapter is divided in four parts. First, general conclusions will be presented about promotion systems for renewables based on Tradable Green Certificates. Conclusions and recommendations with regard to design questions of *national* systems will follow. The third section treats issues regarding the international trade aspect of TGCs. The last section is dedicated to remaining issues and areas for further research.

11.1 General

In four Member States of the EU plans are made to set up a promotion system for renewables based on TGCs in the near future. These Member States are Denmark, The Netherlands, Italy and Belgium (the region of Flanders). Interest in other Member States for this incentive scheme is rising. The insights gained during the course of this project might be helpful in the further development of this process.

During this project, we have come to understand Tradable Green Certificates primarily as a good facilitator for national and possibly international trade of the external benefits related to the deployment of renewable energy sources. In principle*, TGCs form a sound basis for market-conform promotion schemes for renewable energy*. One of the main advantages, especially if combined with an obligation to stimulate demand, is that it allows flexibility in meeting ambitious targets in a cost-effective way.

Although a promotion system for renewables based on TGCs has this potential of enhancing the deployment of renewable energy sources in a cost-efficient way, this does not at all need to be the case in practice. *The success of a TGC-based promotion system depends largely on the way it is designed*. A good design is the key to success.

If sound design principles are taken into account, there are no major obstacles or difficulties foreseen for *national* systems of Tradable Green Certificates. Even though the system as a whole may turn out to be rather complex, the role of each actor can be made relatively simple and clear.

Setting up an *international* system of Tradable Green Certificates is very complex and still contains a lot of unresolved issues. These issues include the interaction with climate change policy and Carbon Emission Trading, the question on whether the country of production or the country of consumption gets the political credits and the question how to deal with different levels of subsidies for renewable energy production in different countries.

Another important aspect of Tradable Green Certificates is that it allows for the separation of the 'green' aspect of the production of renewable electricity from the physical electricity itself. This is a very positive aspect in a liberalised market. If promotion schemes for renewables are applied only to the green aspect, that is, the certificate in a TGC-system, instead of to the production of physical electricity, the producer of green electricity will have an incentive to act as a rational player on the liberalised electricity market, just as any other player. At times of low demand, his electricity will have a low value, at times of peak demand, it will have a high value. So, just by the separation of the two markets, which becomes possible by issuing green certificates, the *conformity to the liberalised electricity market is enhanced*.

11.2 Design at the national level

If a country wants to implement a promotion system for renewables based on Tradable Green Certificates, the following principles are recommended to be taken into account in the design of such a system. The design should

1. Ensure that the pressure on the market actors to deploy more renewables is increased. On the other hand, it should not frustrate these actors by demanding the impossible.

2. Provide to investors a long-term and secure view of the renewable energy market by ensuring a sustainable and orderly increasing rate of deployment of renewables into the future.

3. Incorporate mechanisms that increase the flexibility of actors that have to fulfil a demand. This is needed since supply is less flexible than demand since it depends on climatic factors and because in small markets the coming on-line of large projects have a significant influence on the market price of certificates.

4. Ensure that the liquidity and transparency of the market of tradable green certificates is not unnecessarily disturbed. Transparency and liquidity will enhance the cost-efficiency of the system.

5. Provide customers with enough information in order to enable them to make an informed choice on what renewable resources to support.

6. Anticipate on future international trade of green certificates.

7. Anticipate on future interaction with Carbon Emission Trading or other Kyoto flexible mechanisms.

These design principles have led us to draw the following conclusions for design.

The green certificate should contain as much information as possible
This is especially important with regard to the aspects of customer choice, anticipation on future international trade and anticipation on future interaction with flexible mechanisms of the Kyoto protocol. In the first place, customers should know what they are buying. This is obvious in the case of voluntary demand. However, also if the demand for tradable green certificates comes mainly from an obligation put on suppliers, customer pressure might influence the suppliers' choices. This is especially true in a liberalised market.

Information that might be relevant for potential customers includes the location of production, the kind of renewable energy source, the year of production, and possibly the maximum power output of the installation.

In anticipation on international trade, information should be given with regard to the maximum power of the installation and the number, kind and amount of subsidies that the production of the renewable energy represented by the certificates has received.

In anticipation on the interaction with carbon emission trading, the amount of CO_2 equivalents that are offset by the production of the amount of renewable electricity represented by the certificate must be included. Ideally, all factors that constitute the total 'greenness' represented by the certificate should be quantified and included as information.

Furthermore, some information will be needed for the system as a whole, for instance the validity period (or expiry date) of the certificate.

The validity period of the certificate needs to be several years, but does not need to be eternal.
To allow banking and enhance the flexibility of suppliers of green certificates to follow demand, it is convenient to use certificates produced in a year of abundant production to fulfil demand in a later, less-abundant year. To maximise this flexibility, certificates should be eternally valid. On the other hand, a process of expiry forms an easy way to redeem certificates and avoids that certificates will linger around for many years and come suddenly onto the market at an unexpected and inconvenient moment. To accommodate for both advantages, a validity period of 5 to 10 years could be taken, long enough to cope with climatic variations and short enough to clean up the market regularly.

Green certificates can be issued for a broader range of renewables than government-led demand will prescribe
A national government may decide to only stimulate a certain part of renewable electricity production, for instance by a tax rebate on consumption or by putting an obligation. It may want to exclude some sources because they are already competitive and are considered not to need any support, or because they are not seen as important enough for the relevant country's energy portfolio. However, customers may decide otherwise (and choose for instance not to benefit from tax rebates), or other countries may have decided to include those sources in their national TGC schemes. To facilitate customer choice and in anticipation on future international trade, national governments might want to decide to issue also certificates for the production of renewable electricity from sources that are excluded from its own promotion schemes.

The preferable form of demand for tradable green certificates is an obligation
The Design Report included in the Final Report has described four options how demand can be structured. The research team concludes that the preferable form of demand for tradable green certificates is an obligation.

An obligation is the only form of demand that can combine a stable and orderly growth of the deployment of renewables with a competitive element leading to cost-effectiveness and to technological development aimed at cost-reduction. Furthermore it has the advantage of being 'self-sun-setting', which means that as costs for producing renewable energy reduces over time and equal the cost of production from fossil fuels, the price of certificates automatically reduces to zero and the support system automatically fades out.

At first sight, voluntary demand might seems an attractive option from a purely economic point of view. It might also lead to cost-efficiency and cost-reduction. However, it will not ensure a stable increase in the share of renewables in the energy mix, since we do not expect that a substantial number of people will be prepared to pay the extra costs of renewable energy production. Another disadvantage of relying on voluntary demand is that it conflicts with the polluter-pays principle. Both disadvantages could be tackled by heavily subsidising renewable energy consumption, for instance by a high tax rebate. However, this will turn the voluntary system into a minimum price system, although in an indirect way.

A system of minimum prices for green certificates might considerably contribute to the deployment of renewable energy, provided that the minimum price is high enough. However, it will not stimulate that renewable energy is deployed where it is most cost-effective.

We do not see many advantages to choose for a tendering system for green certificates instead of an obligation. The big disadvantage is that it adds substantially to the insecurity of potential investors. One advantage from a policy maker's point of view might be that instead of a price or a quantity a certain budget can be fixed. In our view, a tendering procedure could be used as an additional form of demand, especially aimed at technologies that will not profit from a general obligation, because they are currently far too expensive. The best example of this would be electricity generated by PV-systems.

An obligation can best be put on suppliers or consumers, that is, on the lowest level of the energy supply chain that is possible
An obligation to cover a certain percentage of the electricity transported over the grid by green certificates could be put on system operators. The extra costs could be translated into the transmission and distribution tariffs. Although such a construction is not impossible in principle, it conflicts with the idea of system operators as 'neutral' facilitators of the electricity market. The whole idea of unbundling is that the commercial activities of buying and selling electricity is separated from the service of transmission and distribution. An obligation to become a trading partner in green certificates, a product related to the production of electricity, is not in line with this idea.

An obligation put on domestic producers implies a disadvantage for them with regard to foreign producers. Suppliers and customers can choose to buy their electricity from non-obliged non-domestic producers, unless they are obliged to buy at least the renewable part from the domestic producers. Therefore, it is better to oblige suppliers or consumers directly. The same reasoning is true for the relation between suppliers and 'free' consumers. This means that ideally the obligation should be put on the lowest level of liberalisation, that is, the final consumers in a fully liberalised market. However, this might be difficult to control. Therefore, some countries are considering putting the obligation on those suppliers that have a license to supply in their country. This includes foreign companies with a domestic supply license. The obligation will be incorporated in the license.

The obligation should be determined for each year and increase steadily and predictably over a substantially long period of time
Since the cost of producing renewable electricity for most technologies is mainly based on capital costs, enough security for investors that there will be a market during the whole period of exploitation is key to their investment decision. Therefore, the development of the obligation should be known well in advance (investment decisions are often made on prospects of at least 15 years). To keep the market liquid and transparent, there should be a constant demand, which means that there should be intermediate targets periodically (for instance each year). To avoid a stop-and-go character of demand, the intermediate obligations to start with should not be too strict. The obligation should therefore rise gradually over time to the desired level.

The obligation should preferably be without distinction between different renewable energy sources
Governments might want to distinguish between different technologies. However, the different ways to incorporate this wish into the design of a TGC system leads to several complexities. By introducing several obligations instead of one, a market that is already small, is split up in several other markets. To ease this disadvantage the general obligation might be split up in a very limited number of tiers (for instance Class 1 = PV and Class 2 = the rest).

If certificates are given different values (for instance 1 PV certificate counts for 5 wind certificates), the whole idea of competition and cost-efficiency is challenged. Furthermore, in that case, it would be insecure whether the overall target for renewables will be met. Mechanisms to correct for this will substantially increase the complexity of the system. Also it will be difficult to set and adapt the relative values of the certificates. In the case a government still wants to attribute different values to electricity from different resources, the distinction should be made on the demand side of the obligation and not on the supply side of issuing.

Our conclusion is that the obligation should preferably be without distinction between different renewable energy sources. If governments wish to stimulate certain technologies, it should preferably be done by additional stimulation measures, which do not influence the TGC market.

Flexibility should be incorporated by extending the Compliance Period to several years, or by allowing enough possibilities for banking
Flexibility to fulfil obligations is needed due to the dependency of production of green certificates on climatic variations as well as to the relative inflexibility on the supply side in a small market that has to cope with time-consuming planning procedures. To increase flexibility for actors that have to fulfil an obligation, there are several possibilities. One of them is a Compliance Period that is longer than one year. This solution will allow that obliged actors are not penalised for failing to meet their target in one specific year (which might be due to external factors such as climatic variations or planning permission procedures). They will be only held responsible if they fail to comply to fulfil their obligation on the average over a period of several years. This is similar to the approach in the Kyoto Protocol, for which the first 'Budget Period' is between 2008 and 2012 and not simply the year 2010. This solution might not be needed if there are enough possibilities for banking of certificates. The possibilities for banking can be increased by allowing a long validity period of certificates and by making sure that the obligation set in the earliest years covered by the TGC-system are not too strict and allow for banking. The possibilities of borrowing should be limited in time. If borrowing is allowed infinitively, it might lead to substantial postponement of fulfilling of obligations, which might frustrate the production and deployment of renewables. Demanding a deposit sum equal to the penalty can discourage borrowing. The obliged actor will then lose interest on this sum. Furthermore, a government might decide to allow borrowing only for a few years.

Penalty fees should be substantially higher than the expected market value of certificates
In order to enforce compliance to an obligation, a strict penalty should apply. If a choice is made for a penalty fee, this fee will function as a maximum price for the market value of renewables. If the penalty is too low, the market price can easily become the penalty price, and the market volume for renewables will decrease.

11.3 International trade

11.3.1 International trade possible in principal in the near future

In the year 2001 promotion schemes for renewables based on TGCs will be implemented in several Member States of the European Union. Before that date, TGC systems will be functioning in The Netherlands and possibly in the form of a pilot phase also in the Flanders region of Belgium. Furthermore, voluntary demand for green electricity is on the rise in Germany and the UK, as well as in The Netherlands, and suppliers might decide to cover their sales by buying green certificates from the TGC countries. Also voluntary customers in the TGC countries might be willing to accept green energy covered by green certificates from non-TGC countries, as long as it can be assured that the same green kWh is not sold twice. This all means that international trade of green certificates might occur in the near future.

11.3.2 Key issues of international trade

There are however a substantial number of issues to be solved before Governments of Member States will be willing to accept each other's certificates as valid for the fulfilment of the domestic obligations. Following is a list of these key issues, in some cases followed by preliminary analyses and recommendations.

- What country will get the political credit (for instance in terms of targets for renewables or CO_2 emission reduction) if the certificate is traded and/or consumed outside the country of production?

- What is traded? Are all the credits traded, or just a part of them, for instance the renewables part is traded, but the CO_2 emission reduction is not?

The proposal of the project team is to quantify all the constituents of greenness of the certificate, and to trade all the credits with the certificate. This is the most simple, straightforward and fair solution. The country of production will, of course, get the economic benefits that go along with producing goods for an international market. This proposal means that the political credits go to the country of consumption. A country will only possess the credits at the moment the certificates are consumed and redeemed in that country. If more certificates are redeemed than a country needs for fulfilling its political targets, redeemed credits might be sold to another country that is in need of those credits. In this sense 'two levels of trade' might exist.

- How will the political credits be traded? For instance, if the CO_2 emission reduction credit is traded, how can that be done exactly within the framework of the flexible mechanisms of the Kyoto protocol?

In Chapter 7 several possibilities with regard to CO_2 credits have been considered. Each of the options seems to have its advantages and disadvantages. It is clear that more work needs to be done on this topic.

- How should different levels of subsidies for renewables be dealt with in international trade of renewables?

In the Mid-term Report (Schaeffer et al. 1999b) we concluded that current subsidy regulations would have substantial influence on an international TGC-market. There are two 'ideal' solutions to this. The first one is to abolish all other promotion schemes for renewables. The second one is that when trade occurs between two countries the difference in subsidies per kWh is exactly calculated and refunded at the border. Both solutions cannot be expected in the near future. The former cannot be expected because of the wish of individual Member States to pursue their own targets for renewables in their own way (subsidiarity). The latter cannot be expected to occur soon, because it would need the development of a complex calculation tool, based on principles and assumptions (for instance on discount rates) that are generally shared. What can be expected is that Member States will sort these questions out bilaterally and start trading in 'TGC-trading bubbles'. In anticipation on these bilateral agreements, it is essential that the information that might be needed be linked to the green certificate from the start, even if it is not needed for the domestic functioning of the system.

It should be kept in mind that some subsidy schemes do not have an impact on TGC-markets. A first example is a subsidy for expensive technologies like PV-systems which output in kWh cannot be used for fulfilling an obligation. Since PV-systems are too expensive to be stimulated by a TGC-based system anyway, subsidising such a technology will not influence the TGC-market. Another example that would have barely any influence on a TGC-market is a tax rebate on the consumption of green certificates that is well below the market price for TGCs. Such a tax rebate will indirectly function as a 'floor price' for TGCs, and as long as this floor price is substantially below the market value of TGCs in the international market, the market price nor the trade flows will be affected.

- What will be the legal status of a TGC in an international context? Will it be a financial product, a bond or a service?

- How comparable are the certificates issued in different Member States under different conditions?

- How can Member States be ensured that once a green certificate is traded outside the country of production that the same certificate is not sold in the domestic market as well?

At this point, there might be a role for an EU-wide Control Body, appointed by the Commission.

- How can one Member State be sure that the certification and verification procedure in another Member State meets the same requirements?

Also at this point, the Commission might want to play a role in guiding and facilitating the process to get to EU-wide standards for certification of renewable energy production.

11.3.3 When and how will international trade occur?

Trade in TGCs related to voluntary demand is most likely to occur first. Voluntary demand is on the rise in The Netherlands, the United Kingdom and Germany and might be expected to kick-off in other countries as electricity market liberalisation proceeds. For voluntary customers, the political-credit aspect might not be of importance in their choice for a green electricity product. For the voluntary market, international trade in green certificates can occur in principle without the interference of the governments of the trading countries.

Formalised EU-wide trade between Member States might not occur in the near future, because of all the political issues to be sorted out. We expect that the political credit issues might be solved between a limited set of Member States first. By bilateral agreements between a few Member States TGC 'trading bubbles' might come into existence. This will certainly be helpful to get experience with international trading. In a later period, other Member States might join these trading bubbles.

11.3.4 The possible role of the European Commission in international trade in TGCs

Because the extension of the TGC trading bubble will be based on agreements that reflect the interest of the 'first movers', the needs of later-entry Member States might not be fully acknowledged. It is, therefore, very important that the first movers will be able to anticipate on the needs of other Member States when the first bilateral agreements are made, in order to avoid extension problems in a later stage. Therefore, other Member States should be able to participate in the discussion of the first movers. It might be a task for the European Commission to guide and facilitate this discussion, by creating a forum for policy makers on this issue. A first step has been taken during the workshop on Tradable Green Certificates in the framework of this Altener project, which was indirectly facilitated by the Commission.

If international trade occurs, certain EU-wide standards will be needed. An example is the procedure of international acknowledgement of certification procedures. For the control of registration of international trade, an EU body might be needed.

11.4 Remaining issues

Several remaining issues have already been mentioned, such as *the key issues of international trade*, mentioned in Section 11.3.2. These include questions concerning the *legal status* of TGCs and what that means in an international context. In particular, we would like to emphasise that more work will be needed on the ways in which TGC-systems will be able to interact with climate change policy and especially the interaction with the *flexibility mechanisms of the Kyoto-protocol*. Another issue that has not been treated in this study is the possibilities and challenges of extending the TGC concept to *other forms of energy* than electricity alone. These aspects will be subject of studies in the Fifth Framework Programme in the near future. A last topic that deserves further attention is how *broader energy policy objectives* can be pursued within or against the background of a promotion scheme for renewables based on TGCs.

LIST OF ABBREVIATIONS

AER	Alternative Energy Requirement (in Ireland)
APX	Automated Power Exchange (in the USA) or Amsterdam Power Exchange (in The Netherlands)
BAT	Best Available Techniques
CDM	Clean Development Mechanism
CET	Carbon Emissions Trading
CHP	Combined Heath and Power
EPA	Environmental Protection Agency (in the USA)
EU	European Union
FFL	Fossil Fuel Levy (in the UK)
GC	Green Certificate
GHG	Green House Gas
GWP	Global Warming Potential
IPCC	Inter-governmental Panel on Climate Change
IPP	Independent Power Producer
JI	Joint Implementation
MS	Member State
NFFO	Non-Fossil Fuel Obligation
NFPA	Non-Fossil Purchasing Agency (in the UK)
NGO	Non-Governmental Organisation
PAA	Parts of Assigned Amount
PV	Photo Voltaic
RE	Renewable Energy
REB	'Regulerende Energiebelasting', that is, the Dutch eco-tax
RECLAIM	Regional Clean Air Incentives Market
RECS	Renewable Energy Certificate System
RECs	Regional Electricity Companies (in the UK)
RES-E	Renewable Energy Sourced Electricity
SEP	Association of Electricity Producers (in The Netherlands)
TGC	Tradable Green Certificate
TPA	Third Party Access
TSO	Transmission System Operator
UCPTE	Union for the Co-ordination of Production and Transmission of Electricity
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value Added Tax

REFERENCES

European Commission (1999): *Electricity from renewable energy sources and the internal electricity market*. Working Paper. Brussels, 1999.

Schaeffer, G.J., M.G. Boots, J.W. Martens and M.H. Voogt (1999a): *Tradable Green Certificates – A New Market-based Incentive Scheme for Renewable Energy: Introduction and Analysis*. Report ECN-I--99-004. Petten, The Netherlands, 1999.

Schaeffer, G.J., M.G. Boots, C. Mitchell, T. Anderson, Ch. Timpe, M. Cames (1999b), *The implication of Tradable Green Certificates for the Deployment of Renewable Energy; Mid-Term Report*. Petten, The Netherlands, October 1999.