# The support schemes of renewable energy sources

*Meeting document for the Amsterdam Forum on 13 October 2005*

## 1. Introduction

- Accordingly to Article 4 of the Directive on the promotion of electricity from renewable energy sources 2001/77/EC:

  *The Commission shall not later than 27 October 2005, present a well-documented report on experience gained with the application and coexistence of the different mechanisms.*

- On 30 September 2005 the European Parliament adopted an amendment asking *that in the longer term, a harmonised European incentive system be created which fulfils the following criteria:*

  *(a) contribute to the achievement of both the current targets and more-ambitious future targets, taking into account an increased annual share of renewables for electricity, with the increase being at least as high as the average annual increase since adoption of Directive 2001/77/EC;*
  *(b) be compatible with the principles of the internal electricity market;*
  *(c) be part of a systemic approach towards the development of renewables which takes into account the characteristics of different sources of renewable energy, together with the different technologies, and geographical differences;*
  *(d) promote the use of renewable energy sources in an effective way, and be simple and, at the same time, as efficient as possible, particularly in terms of cost;*
  *(e) internalise the external costs of all energy sources;*
  *(f) include sufficient transitional periods for national support systems in order to maintain investor confidence; considers that, based on these criteria, uniform Community legislation on European feed-in systems could make sense in the long term, but that a quota or tendering model could also be taken into consideration provided that the current weaknesses of such models, which have come to light in a few Member States, can be eliminated;*

- This report serves two purposes:

  - The above formal report that the Commission is required to make under Article 4 of Directive 2001/77/EC, presenting the **experience gained** with the application and coexistence of the different mechanisms used in Member States for supporting electricity from renewable energy sources (RES-E).

  - The formal report that the Commission is required to make under Article 8 concerning **administrative barriers and grid issues** and the situation of implementation of the guarantee of origin on renewable electricity.

*For the purpose of the Amsterdam forum on the 13 October 2005, only the first issue of this report will be discussed.*

# 2. Inventory

## 2.1. The existing support systems

Currently there are in the EU a range of different support systems operational (Annex 1) that broadly can be classified into four groups: tendering systems, quota obligations (green certificates), tax incentives and feed-in tariffs.

- Pure tendering procedures existed in two Member States (IE and FR). France recently changed its system towards a REFIT and Ireland has just announced a similar move. Theoretically tendering systems use in a optimal way the market forces but they have a stop-and–go nature which may not create stable conditions. This support scheme presents also the risk that low bids result in non achieved projects.
- Green certificates (Tradable Green Certificates, TGC) are market based instruments and at least in theory, have the advantage of creating the best value per Euro invested, favouring a single European market and pose a lower risk of over-compensation. They exist in SE, UK, IT, BE and PL. Green certificates may create a higher risk for investors and long-term technologies are not easily developed under such schemes.
- Pure tax incentives are applied in Malta and Finland. However in most cases (e.g. Cyprus, UK and the Czech Republic) this instrument is used as an additional tool in the policy.
- Feed-in tariffs (Renewable feed-in tariff, REFIT) exist in the majority of the Member States and have the advantage of investment security, possible fine tuning as well as the promotion of mid- and long-term technologies. On the other hand, they are difficult to harmonise at EU-level, may be challenged by internal market principles and they contain a risk of over-funding.

  A more market oriented variant of the REFIT is the so called premium, where a fix amount is given on the top of the fluctuating electricity price. This system is implemented in Denmark and partially in Spain.

It should again be emphasised that the above distinction in four groups is a rather simple presentation of the situation. There are several systems that have mixed elements especially in combination with tax incentives.

## 2.2. Supported price level

In Annex 2, a detailed assessment has been made of the difference between the total money received for produced renewable energy as a result of the market price plus given support and the real generation cost.[1]

[1] Average level of 2003 and 2004 is used. In the REFIT system, the support price level is equal to the value of the tariff. The source for generation costs used in this Communication is Green-X.

The current level of support for RES-E differs significantly among the different EU member states. The duration of the support schemes also varies in the countries. Therefore, in the comparison, the support level under each instrument was normalised to a common duration of 15 years.

## 2.3. Effectiveness

Next to the cost also the effectiveness of the different support systems is an essential parameter in the assessment.

The effectiveness is understood as the capability of a support scheme to deliver green electricity. Two important issues should be taken into account when assessing the effectiveness:

- The first one is that some historical perspective is needed as the effects of more recent systems are difficult to judge. Notably the experience with green certificates is more limited than with feed in tariffs.

- The second one is that the amount of green electricity delivered needs to be assessed against the additional available green electricity generation potential[2] of the country (see Annex 2).

## 2.4. The investor's profits and effectiveness

In this section, a comparison of the profits from an investor perspective and the effectiveness has been made for a limited number of Member States and under assumption of current prices for a longer period.

Therefore the effectiveness indicator as defined in chapter 2.3 is presented versus the expected annuity (see Annex 3) for an investment into wind and biomass energy for each country. In this way one can correlate the effectiveness of a policy with the average annuity of expected profit. This gives an indication whether the success of a specific policy is primarily based on the high financial incentives, or whether other aspects have a crucial impact on the market diffusion in the considered countries.

### Wind energy

This analysis has only been carried out for a selection of countries in order to show the principal differences between the different policy schemes. Reference year for both effectiveness indicators and expected annuity is 2003. This analysis includes the country specific costs of generation and the duration of the payments.[3] Furthermore country specific wind yields are used to calculate the generated income during the lifetime of the plant. The methodology is further clarified in annex 3.

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2 The additional available electricity generation potential until 2020 represents the "realisable additional achievable potential assuming that all existing barriers can be overcome and all driving forces are active".

3 An extreme example is the Italian certificate price, which appears to be very high. However, considering the duration of the support, the high price partly is partly justified by the fact that Italian renewable electricity producers are only allowed to deal with green certificates during the first 8 years of the operation time of the plant.

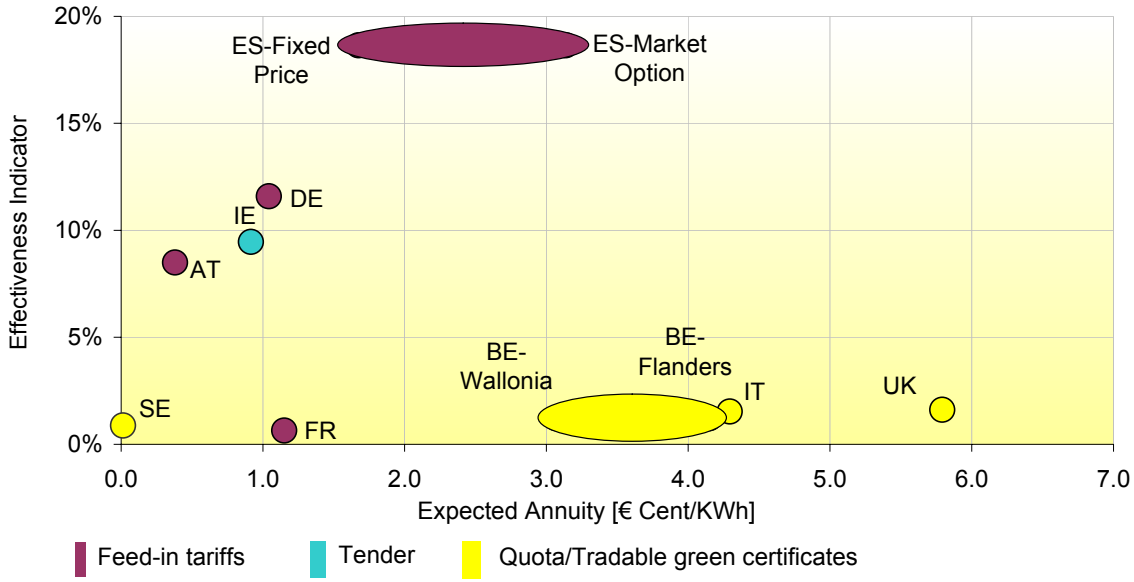


**Figure 1:**
**Historically observed efficiency of support: effectiveness indicator in relation to the annuity of expected profit. WIND.**

## Forestry Biomass

The same analysis has been pursued for electricity generation from biomass. However the biomass sector is influenced by other factors like secondary instruments[4], the combination of heat and electricity generation or an optimal forest management.

The final result of this exercise, carried out for the year 2003[5], is shown in the figure below.

4 Some Member States 'reinforce' the main instrument (normally REFIT or TGC) by a de-taxation or an investment support. These instruments are good elements of catalyses for the kicking of biomass. They also have the advantage of less interference with wood market.

5 Again, as in the case of wind, the reference year for both effectiveness indicators and expected annuity is 2003.

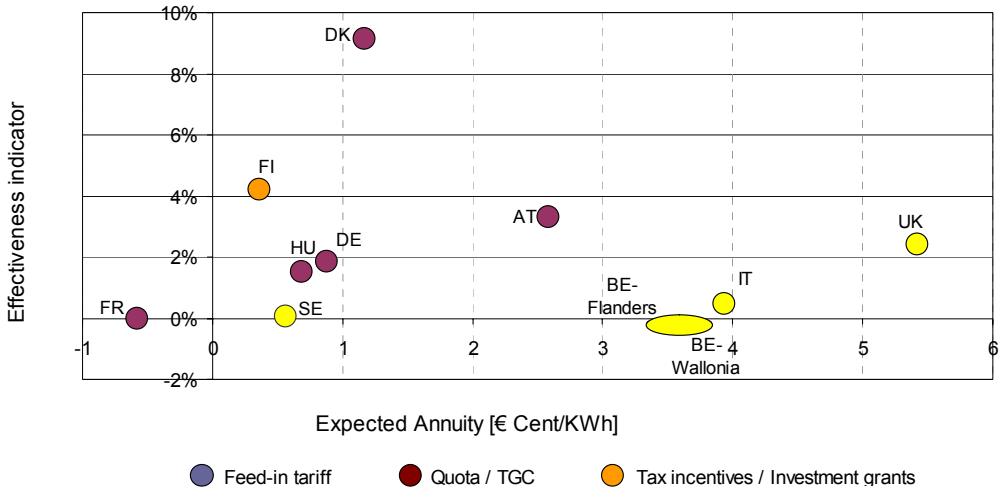


**Figure 2:**
**The economic data regarding investment costs and the operation and maintenance costs are based on biomass electricity generation using CHP[6] technologies. Therefore also the selling of heat as a by-product has been taken into account for the economic assessment.**

## 2.5. Main conclusions

**Wind energy:**

- The TGC systems present currently a significant higher support than the feed-in tariffs. This could be explained by the higher risk premium requested by investors, the administrative costs as well as a still immature TGC market. It should also be pointed out that the high annuity results from the extrapolation of the presently observed certificate prices.
- As it can be seen in the Annex 2 in many Member States support seems insufficient for any take off. In some countries with enough support the non take off might be explained by the existence of grid and administrative barriers.

**Biomass forestry**:

- Denmark with the REFIT centralised co-generation plants of straw combustion together with the Finish hybrid support (de-taxation and investment) clearly show the best performance, both in terms of effectiveness as well as economic efficiency of support. A long tradition in biomass use for energy purposes, stable planning conditions and a combination with CHP (combined heat and power) can be considered as key reasons for this development.

- Although in countries with TGC, the level of support seems appropriated, the investors risk seems to hamper the real take-off of the biomass sector.

[6] CHP Combined heat and electricity generation.

- Although in general REFIT shows better outcomes, the analysis is not as clear as in the wind sector. Other factors different than the choice of the instrument like infrastructural barriers, sizes of the installation, optimal forest management and the existence of secondary instruments, etc., influence considerably the effectiveness of a system.

Questions for debate:
When comparing the current data of performance of feed in tariffs and quota systems the assessment must be that at present feed in tariffs score better as regards effectiveness but also as regards costs.
What is the reason that market based instruments are (still) more expensive:
- risk perception of investors
- market barriers
- administrative costs
- markets are too small (would work in a EU wide market)

# 3. Internal market and trade aspects

## 3.1. Introduction

Internal electricity market and support of RES-E are intimately linked together. Renewable energies provide new installations contributing to security of supply and enlarging the energy mix of electricity generators. Vice-versa, internal market aspects, like free trade, transparency, unbundling, disclosure, inter-connectors, can accelerate the deployment of RES-E in the internal electricity market.

## 3.2. Unbundling, transparency and dominant players.

On an unbundled market, an independent Transmission System Operators (TSOs) is obliged to guarantee fair grid access to all producers and has to develop the transmission infrastructure according to a long-term strategy, taking account of the integration of renewable energy resources.

Some countries still have the dominance of one or a few power companies, often vertically integrated. This might imply a monopoly-like situation, which could hamper the development of RES-E.

For a good functioning of **all** the RES-E support systems, an independent TSO is an essential factor.

## 3.3. Intermittency in Production and Balancing power: a need for appropriated regulation to combine internal market and renewable regulation.

Wind power is not the only RES source but it is obviously an intermittent source of energy. The following issues are especially important when considering intermittency:

- Firstly the time of the gate closure[7].The closer the gate closure is on the operating hour, the better intermittent RES-E technologies can predict how much electricity they will be able to deliver.

- Secondly the prediction of wind. In countries like Denmark, United Kingdom and Spain, RES-E generators have to predict their production, just like other electricity producers. The more firm prediction the better we can rely on intermittent RES-E sources.

- Thirdly, the charging of the balancing costs. UK, DK and ES[8] have systems for charging for the deviation from the predicted production of electricity, whatever origin, including wind electricity.

A more detailed analysis on balancing cost can be found in the Annex 4.

In cases where power production from intermittent sources covers a high share of domestic power consumption, it might be important that the RES-E producers can react better on the power prices at the spot market. **Therefore integration of large shares of RES-E intermittent power in the system might be facilitated by a support system that includes a link to the spot power price**. This is the case in a premium system[9], under a TGC and in some feed-in systems like the one existing in Spain.[10]

### 3.4. Trade of Power

The impact of the different support schemes on trade is an important element of the compatibility of RES support measures with the internal market. One needs to differentiate between the trades of:

- the physical power (electricity)

- the green-value of the electricity

The trade of physical RES-E is limited by the same restrictions that apply to conventional electricity[11] but generally possible and it is taking place. The deployment of RES-E might be concentrated on some quite specific countries, and therefore, probably will increase the need for cross border trade of power and accordingly the need for stronger inter-connectors.

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7 The closing time for power markets for receiving bids from electricity producers.

8 UK has green certificates as main support scheme for renewables. DK and Spain have feed-in tariffs.

9 To recall, a premium system is normally classified as REFIT although there exist difference: a premium is applied to the RES generators on the top of the spot market. The final price paid to the RES-E fluctuates together with the normal electricity spot market.

10 REFIT system in Spain includes charges for the deviation in electricity production for RES generators –as for the rest of electricity generators.

11 Currently around 11% of electricity is subject to physical cross border trade in Europe.

It should also be considered that the disclosure[12] of the origin of electricity gives an added value to a generators portfolio with a higher RES share because of consumers preferences.

### 3.5. How is the cost of support systems reflected in the electricity tariff? A consumers point of view.

The transparency to the consumers of the different support systems depends almost entirely on the design of the system and especially on the flexibility of the market. The majority of the countries in the EU do not detail in the electricity bills the explicit cost of renewable energies as they do not detail nearly any issue.

The tradable green certificate system transfers the cost of support to renewable electricity to the consumer, making the support payment a direct part of the power payment, according with the set quota.

With the feed-in tariff the support is not necessarily seen directly by the electricity consumer, although the tariffs are publicly available and countries like Germany include a breakdown of the costs- depending on how the payment is transferred to the consumer.

The structure of the electricity market and the design aspects are very different in Europe, therefore the following graph should be considered an estimation of the integration of the RES support on the electricity prices.

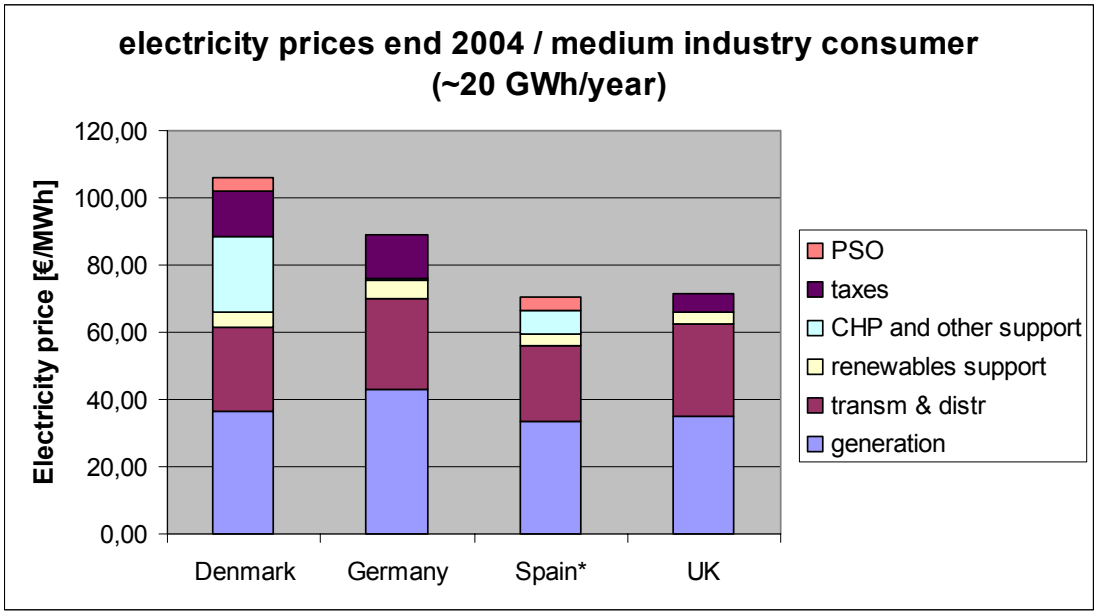



**Figure 4:**
**Approximated breakdown of electricity prices. European Commission, own estimation. * No tax is considered for Spain.**

**Main conclusion**

[12] Explain.

Compatibility of all different renewable energy support schemes and the development of the internal market of electricity is essential at medium and long term. The construction of an European internal market should be realised through adequate regulation including the characteristics for the development of RES-E. The influence the increased development of RES-E will have on the price and trade of power will strongly depend on how the power markets are designed.

### 3.6. Guarantees of origin

It seems that the guarantees of origin have a role to play in the trade of green electricity under ay support system. Article 5 of the Directive requires Member States to implement a guarantee of origin system (hereafter GO-system) by 27 October 2003 for EU15. For the 10 new Member States the deadline for implementing such a system was, in accordance with the Treaty of Accession of 2003, 1 May 2004. The main objectives of such a system are to facilitate trade in electricity from renewable energy sources and to increase consumer transparency between electricity from renewable and non-renewable energy sources. Annex 5 contains an overview of the different stages of GOs in Europe.

Questions:
Is there any real or potential conflict of some support systems with the internal electricity market or with the general principles of the internal market?
Given the Guarantee of origin (GO) role in trade and consumer information, is there a need for a GO harmonized model in the EU?

## 4. Co-existence or harmonisation

### Potential advantages

Due to largely varying potentials and developments in different Member states regarding renewable energies, a harmonisation seems to be very difficult to achieve in the short and medium term. Nevertheless the advantages and disadvantages of harmonisation towards the different current systems have to be analysed and monitored also notably for the longer term development. The following key issues have to be taken into account:

- Theoretically, the trading in RES-E quotas could lead to an overall reduction in the cost of compliance. In fact, a number of studies suggest that the overall cost for complying with the RES-E target share in 2010 could have been substantially lower with harmonisation of TGC or REFIT than with a continuation and coexistence of present different national policies. However, a prerequisite would be a real liberalised market, where market distortions in form of support for conventional energy sources are eliminated and a higher interconnections and trade capacity. These pre-requirements are currently not yet met.

- A Europe-wide TGC scheme is likely to lead to a bigger and thus more liquid certificates market, which would result in more stable TGC prices compared to smaller (national) markets. However, the administrative costs for such a system are not yet calculated.

- A European wide common REFIT scheme which takes into account the availability of local resources could drive down the costs of all RES technologies in the different Member States as installations are not restricted to certain Member States. Such a REFIT system could either consist of fixed tariffs or "premium" tariffs on top of a base price bound to the average electricity price.

## Potential disadvantages

- A harmonised TGC scheme can only work if it results in the 'right' certificates price and penalties across the EU and thus the most efficient build-up of RES installations in various countries. Significant fluctuations in the TGC price can lead to increased investor uncertainty and reduced build-up of RES.

- Financial benefits from harmonisation would be biggest if marginal cost curves differed vastly between countries. If however these differences were smaller than assumed, benefits from trading between low- and high-cost countries would be much smaller. Graphs in the Annex showed the differences in the generation costs.

- Harmonisation through a TGC scheme without technology bands would be the effects this has on dynamic efficiency. Because of the emphasis that such a scheme would put on cost-efficiency, that is least cost deployment of RES, only the most competitive technologies would expand. While such an outcome would be beneficial in the short-run, investments in other promising technologies might not be sufficiently stimulated. "Low-hanging fruits" would be then harvested and the long term perspective missed.

- Employment and rural development, diversity and thus security of indigenous energy supplies and reduced local pollution are important effects of an active renewable policy. Member States that become importers of RES-E in a harmonised system may be unwilling to pay the bill if they do not profit of these local beneficial effects.

- On the other hand, even the exporting countries might be unwilling to have more RES capacity than needed for their own target, as this could create opposition (NIMBY-ism) within the population against future RES installations.

Questions:
Are the presented potential effects of harmonisation giving a realistic picture?
What would be a realistic time schedule for harmonisation?
How do you see the role of the regulators in such a process?

# Annex 1
# Inventory of current support systems

**Table 1: Overview of the main policies for renewable electricity in EU-15**

| Country | Main electricity support schemes | Comments |
|---|---|---|
| **Austria** | Feed-in tariffs (presently terminated) combined with regional investment incentives | Feed-in tariffs have been guaranteed for 13 years. The instrument was only effective for new installations with permission until December 2004. The active period of the system has not been extended nor has the instrument been replaced by an alternative one. |
| **Belgium** | Quota obligation system / TGC combined with minimum prices for electricity from RES | Federal government has set minimum prices for electricity from RES.<br><br>Flanders and Wallonia have introduced a quota obligation system (based on TGCs) with obligation on electricity suppliers. In Brussels no support scheme has been implemented yet. Wind off-shore is supported on the federal level. |
| **Denmark** | Premium feed-in tariffs (environmental adder) and tender schemes for wind off-shore | Settlement prices are valid for 10 years. The tariff level is generally rather low compared to the formerly high feed-in tariffs. |
| **Finland** | Energy tax exemption combined with investment incentives | Tax refund and investment incentives of up to 40% for wind, and up to 30% for electricity generation from other RES. |
| **France** | Feed-in tariffs | For power plants < 12 MW feed-in tariffs are guaranteed for 15 years or 20 years (hydro and PV).<br><br>For power plants > 12 MW a tendering scheme is in place. |
| **Germany** | Feed-in tariffs | Feed-in tariffs are guaranteed for 20 years (Renewable Energy Act). Furthermore soft loans and tax incentives are available. |
| **Greece** | Feed-in tariffs combined with investment incentives | Feed-in tariffs are guaranteed for 10 years. Investment incentives up to 40%. |
| **Ireland** | Tendering scheme<br><br>Annoucement has been made that tendering scheme will be replaced by a feed-in tariff scheme | Tendering schemes with technology bands and price caps. Also tax incentives for investments in electricity from RES. |
| **Italy** | Quota obligation system / TGC | Obligation (based on TGCs) on electricity suppliers. Certificates are only issued for new RES-E capacity during the first eight years of operation. |
| **Luxembourg** | Feed-in tariffs | Feed-in tariffs guaranteed for 10 years (for PV for 20 years). Also investment incentives available. |
| **Netherlands** | Feed-in tariffs | Feed-in tariffs guaranteed for 10 years. Fiscal incentives for investments in RES are available. The energy tax exemption on electricity from RES was finished on 1 January 2005. |
| **Portugal** | Feed-in tariffs combined with investment incentives | Investment incentives up to 40%. |

| Country | Main electricity support schemes | Comments |
|---|---|---|
| **Spain** | Feed-in tariffs | Electricity producers can choose between a fixed feed-in tariff or a premium on top of the conventional electricity price, both are available during the whole life time of the RES power plant. Soft loans, tax incentives and regional investment incentives are available. |
| **Sweden** | Quota obligation system / TGC | Obligation (based on TGCs) on electricity consumers. For wind energy investment incentive and a small environmental bonus available. |
| **UK** | Quota obligation system / TGC | Obligation (based on TGCs) on electricity suppliers. Electricity companies which do not comply with the obligation have to pay a buy-out penalty. Tax exemption for electricity generated from RES is available (Levy Exemption Certificates which give exemption from the Climate Change Levy) |

**Table 2: Overview of the main policies for renewable electricity in EU-10**

| Country | Main electricity support schemes | Comments |
|---|---|---|
| **Cyprus** | Grant scheme for promotion of RES (since Feb. 2004) financed through electricity consumption tax of 0.22 E/kWh (since Aug. 2003) | Promotion scheme is only fixed for 3-year period. |
| **Czech Republic** | Feed-in tariffs (since 2002), supported by investment grants Revision and improvement of the tariffs in February 2005. | Relatively high feed-in tariffs with 15 year guaranteed duration of support. Producer can choose between fixed feed-in tariff or premium tariff (green bonus). For biomass cogeneration only green bonus applies.. |
| **Estonia** | Feed-in tariff system with purchase obligation | Feed-in tariffs paid for max. 7 years for biomass and hydro and max. 12 years for wind and other technologies. All support schemes are scheduled to end in 2015. Together with relatively low feed-in tariffs this makes renewable investments very difficult. |
| **Hungary** | Feed in tariff (since Jan 2003) combined with purchase obligation and tenders for grants | Medium tariffs (6 to 6.8 ct/kWh) but no differentiation among technologies. Actions to support RES are not coordinated, and political support varies. All this results in high investment risks and low penetration.· |
| **Latvia** | Quota obligation system (since 2002) combined with feed-in tariffs | Frequent policy changes and short duration of guaranteed feed-in tariffs result in high investment uncertainty. High feed-in tariff scheme for wind and small hydropower plants (less than 2 MW) was phased out in Jan. 2003. |
| **Lithuania** | Relatively high feed-in tariffs combined with a purchase obligation. In addition good conditions for grid connections and investment programmes | Closure of Ignalina nuclear plant will strongly affect electricity prices and thus the competitive position of renewables as well as renewable support. Investment programmes limited to companies registered in Lithuania. |
| **Malta** | Low VAT rate for solar | Very little attention for RES so far. |
| **Poland** | Green power purchase obligation with targets specified until 2010. In addition renewables are exempted from the (small) excise tax | No penalties defined and lack of target enforcement. |
| **Slovak Republic** | Programme supporting RES and EE, including feed-in tariffs and tax incentives | Very little support for renewables. Main support programme runs from 2000, but no certainty on time frame or tariffs. Low support, lack of funding and lack of longer-term certainty make investors very reluctant. |
| **Slovenia** | Attractive feed-in system combined with long term guaranteed contracts, $CO_2$ | None |

| Country | Main electricity support schemes | Comments |
|---|---|---|
| | taxation and public funds for environmental investments | |

**Annex 2**
**Effectiveness and costs of current support systems**

## Wind energy

Figure 1 and figure 3 show the generation cost of wind energy and the level of the supported prices given in each country. Support schemes in wind vary importantly throughout Europe with values from 30 €/kWh in Slovakia to 110 € per kWh in UK. These differences – as seen in Figures 1 and 3 - are not justified by the differences in generation costs. Generation costs are shown in a range depending –in the case of wind - on the different bands of wind potential.

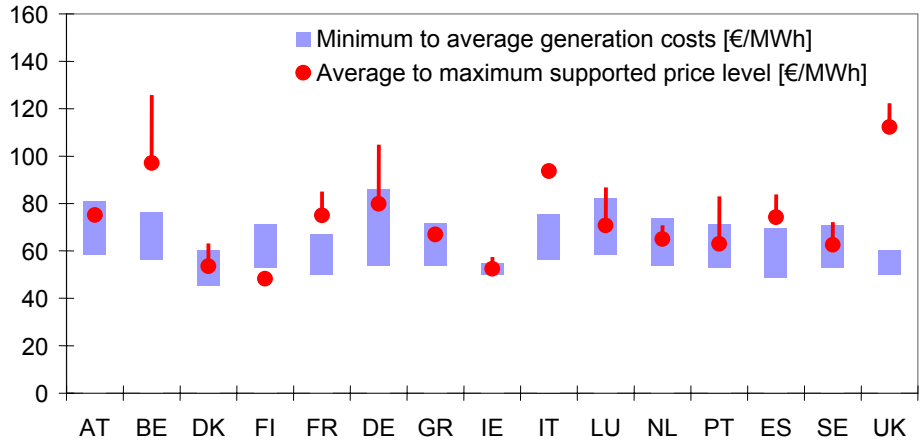



**Figure 1:**
**Price ranges (average to maximum support) for direct support of wind onshore in EU-15 member states (average tariffs are indicative) compared to the long term marginal generation costs (minimum to average costs). Support schemes are normalised to 15 years.**

How effective are these support schemes? The definition of the effectiveness has been taken as the electricity delivered in GWh compared to the potential of the country for each technology[13].

[13] The effectiveness indicator for the sectors wind on-shore, solid biomass, biogas and photovoltaic electricity generation are calculated for the period 1997-2003.

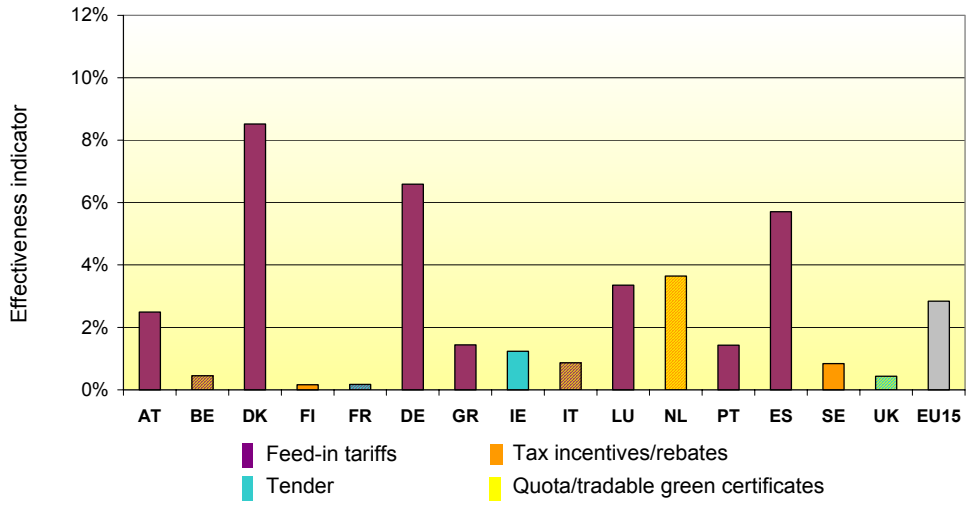



**Figure 2:**
**Effectiveness indicator for wind on-shore electricity in the period 1997-2003. The relevant policy schemes during this period are shown in different colour codes**

The three countries which are most effective in delivering wind energy are Denmark, Germany and Spain as it can be seen in Figure 2.

Germany applies a stepped tariff with different values depending on the wind resources. France uses the same system. This stepped support scheme –although polemic as it does not use only the best potentials, it is justified at national level with the purpose of extending the potential resources in the country and for avoiding concentration in one region and NIMBY phenomena. The values used in Figure 2 considered the maximum tariff for Germany[14].

It is commonly stated that the high level of the feed-in tariffs is the main driver for investments in wind energy especially in Spain and Germany. As it can be seen, it is not the case. A long term and stable policy environment seems to be a key criterion for the success for developing RES markets especially in the first stage.

The three quota systems in Belgium, Italy and the UK, present currently a higher support level than the feed-in tariff. The reason for the higher support level as reflected in the presently observed green certificate prices can be found in the fact of a higher risk premium requested by investors, the administrative costs as well as a still immature TGC market. The question is how the price level will develop at the medium and long term.

Figure 1 shows three countries with the lowest support: FI, DK and IR. Situations in this countries are very different. DK has a very mature market with the highest rate per capita of wind installations in the world[15], IR has the best potential of Europe in

[14] Germany wind on-shore: tariff 8.7 € cents/kWh (maximum tariff). Duration of the support 20 years. interest rate: 4.8% (considering the soft loans granted by the German federal government). Wind conditions: 1750 full load hours (country specific average).

[15] DK system is now concentrated in re-powering (replacement of old turbines by more efficient ones) and off-shore which is not included in this text.

wind and only 200 MW as installed capacity. Finland has chosen a policy of biomass promotion and support is too low to initiate a stable growth in wind.

For the EU-10 the comparison of costs and prices for wind onshore as shown in Figure 3 leads to the conclusion that the supported price level is clearly insufficient in Slovakia, Latvia, Estonia and Slovenia, as the level is below marginal generation costs.

It seems to be sufficient in at least Cyprus and Czech Republic. For countries like Hungary and Lithuania support is just on the edge to stimulate investments[16].

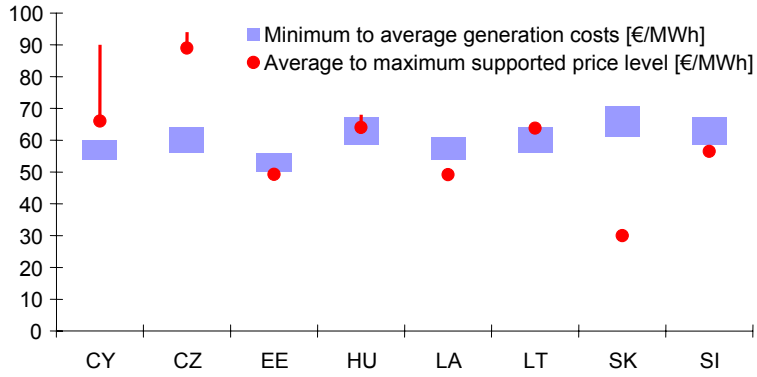
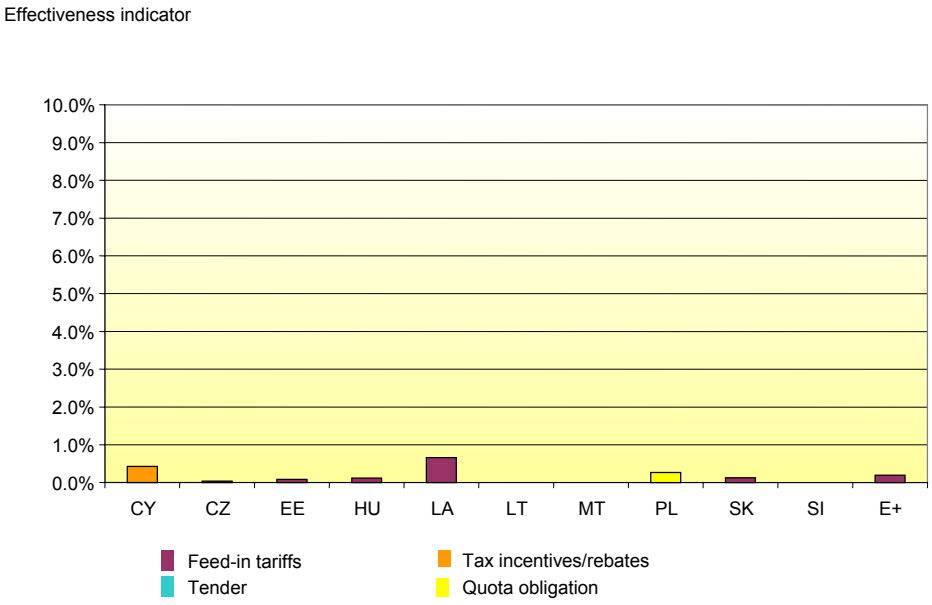



**Figure 3:**
**Price ranges (average to maximum support) for supported wind onshore in EU-10 member states (average tariffs are indicative) compared to the long term marginal generation costs (minimum to average costs)**




16 For Poland no figures are shown since a TGC price can not be given yet.

**Figure 4:**
**Effectiveness indicator for wind on-shore electricity in the period 1997-2003. The relevant policy schemes during this period are shown in different colour codes**

## Biogas[17]

To compare apples and pears seems sometimes easier than to analyse the biomass sector - as this latter is more about to compare cows and trees. Biomass is very complex sector as it considers wastes, products and residues of very different sources: agriculture, forest, cities, animals…The analyses of the support schemes becomes even more complex when the conclusions should cover 25 countries.

This paper intends to give an overview of two main sectors of biomass in Europe: biogas and forest residues.

The different level of support scheme is shown for agricultural biogas electricity generation in Figure 5 for EU-15 and Figure 7 for EU-10. The effectiveness indicators are depicted in Figures 6 and 8.

At EU-15 level, in France and Sweden the level of promotion appears to be insufficient when compared to the long run marginal generation costs. Finland clearly does not promote specifically this technology. For Greece, Ireland, and Portugal the support level is at the lower end of the cost range. In Austria the tariffs[18] are relatively high with a policy aim to support small scale agricultural applications (average range of 70-100 kW) as compared to large centralised plants. Germany also promotes small scale installations with a higher effectiveness (Figure 6). UK has a rather high support (TGC + de-taxation of the CCL)[19], resulting in a high effectiveness. Denmark shows a medium support with a rather high effectiveness. The Danish support scheme has prioritised the large central power plants. The Swedish and the Finish tax rebates have been unable to trigger relevant investments into biogas plants. Similarly the Irish tender rounds seem to have ignored biogas as an option for increasing RES-E generation capacity. It should be noted here that the high growth in Italy and the UK was mainly based on the extension of landfill gas capacity, whereas in Austria, Denmark, and Germany agricultural biogas had a significant share on the observed growth.

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17 Biogas includes all the fermentation processes of biomass: biogas with Co-fermentation, sewage and landfill gas

18 Paid for new installations until December 2004. The system is now stopped.

19 The total level of support in UK is about: 110 €/MWh =68€/ MWh certificate price + 6.9 €/ MWh CCL+36 € /MWh market price. UK had before 2002, different tender rounds for biogas applications.

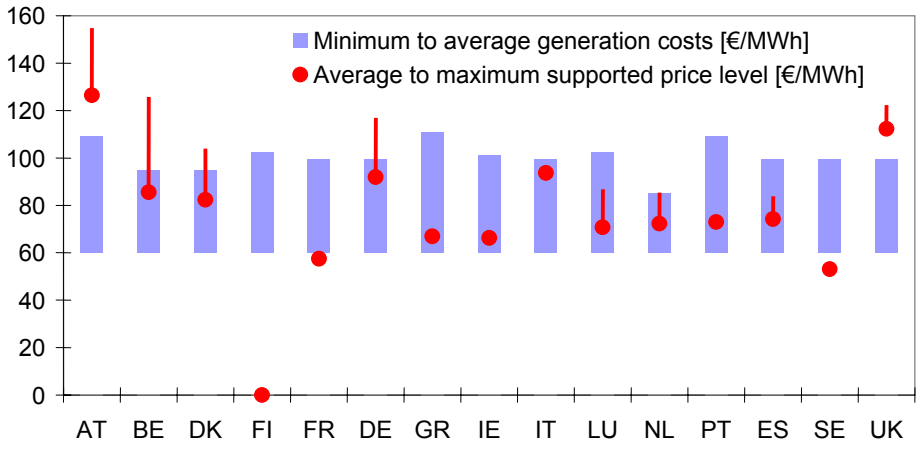


**Figure 5:**
**Price ranges (average to maximum support) for direct support of agricultural biogas in EU-15 member states (average tariffs are indicative) compared to the long term marginal generation costs (minimum to average costs).**

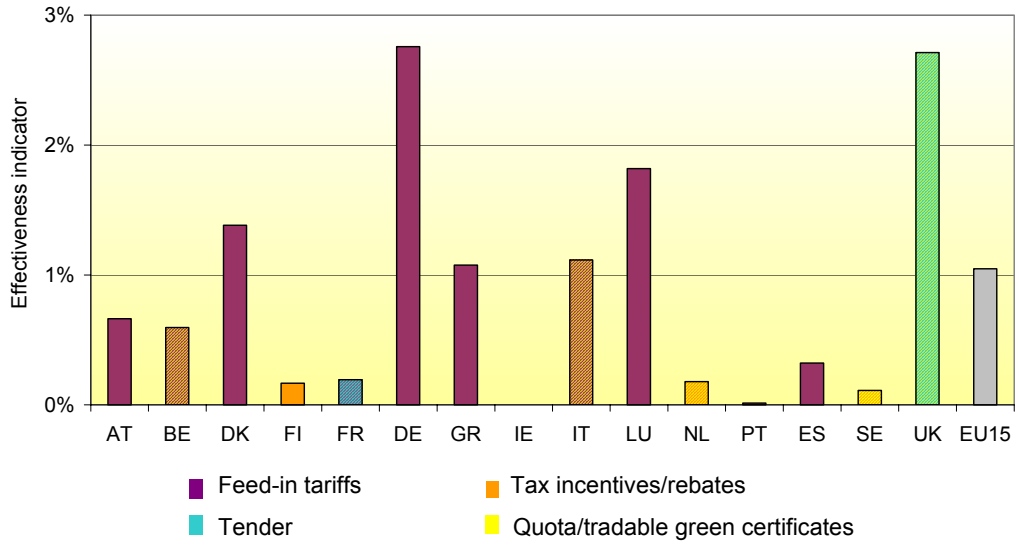


**Figure 6:**
**Effectiveness indicator for biogas electricity in the period 1997-2003. The relevant policy schemes during this period are shown in different colour codes**

The effectiveness of the biogas support level is influence by the following factors, different than the choice of the support scheme:

- The choice of small or large plants: large plants give a higher effectiveness. Small plants are important for agriculture policy but the cost is higher.

- The existence of a complementary support scheme. The biogas sector is intimately linked to the environmental policy of waste treatment. Countries

like UK support biogas with a secondary instrument as de-taxation (CCL)[20]. A complementary investment aid is a good catalyser for this technology.

- If a country supports agricultural biogas, generation costs are higher but environmental benefits also. While supporting landfill gas, the cost is 'cheaper' but the environmental benefit is reduced.

- The existence of district heating networks proved to be an important aspect for a successful development of the biogas sector, e.g. Denmark.

The EU-15 figures lead to the conclusion that , when the feed-in tariff are set up correctly, the support scheme is able to start a market development. The green certificate systems seem to need a secondary instrument (based on environmental benefits) for a real market effect.

The picture for the new member states looks rather different from the EU-15. For most EU-10 countries the supported price level shows to be low compared to the long run marginal generation costs. Except for the Czech Republic, the financial support is insufficient for triggering significant investments into biogas technology. Effectiveness is nearly zero as a lack of sufficient support.

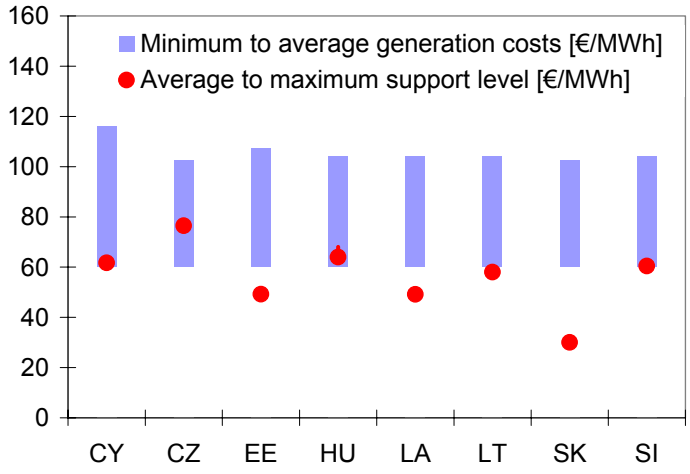


**Figure 7:**
**Price ranges (average to maximum support) for supported agricultural biogas in selected EU-10 member states (average tariffs are indicative) compared to the long term marginal generation costs (minimum to average costs)**

[20] Currently 68 €/MWh TGC price and secondary instrument 6 €/MWh of Climate Change Levy (CCL de-taxation). Figure 5 shows a support level of 110 €/MWh, this is due to the normalisation of 15 years.

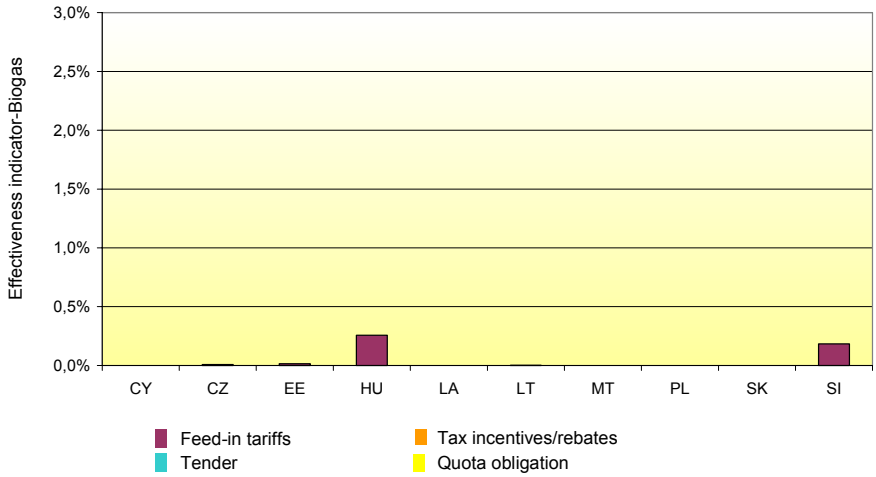


**Figure 8:**
**Effectiveness indicator for biogas electricity in the period 1997-2003. The relevant policy schemes during this period are shown in different colour codes**

## Biomass/forestry residues

Before any analysis is done, the complexity of this sector should be reminded as it includes small CHP system, big pulp and paper industry, co-firing of wood residues…

Figure 9 shows the variations of support schemes around EU15 and also the variations in generation costs.

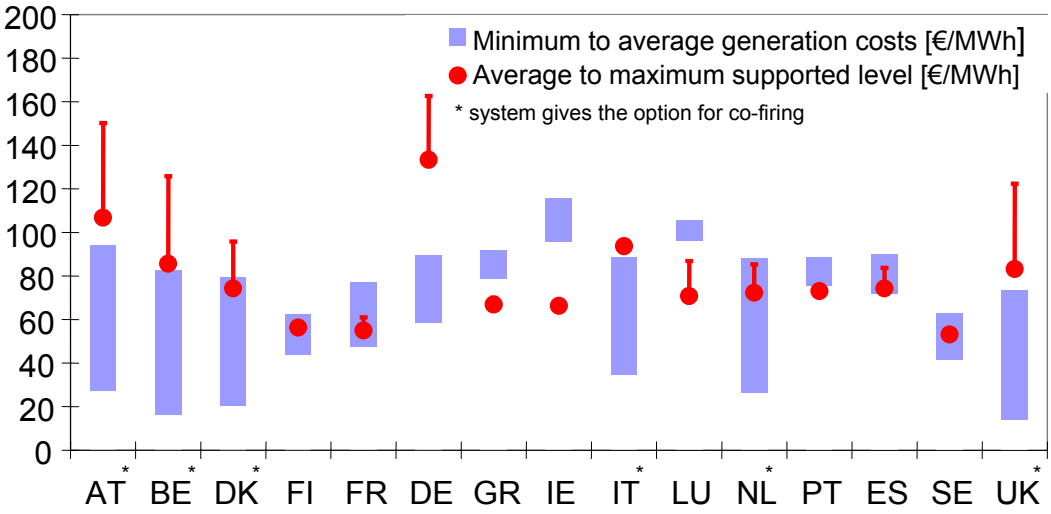


**Figure 9:**
**Price ranges (average to maximum support) for supported biomass electricity production from forestry residues in EU-15 member states (average tariffs are indicative) compared to the long term marginal generation costs (minimum to average costs).**
*** = countries with a co-firing.**

Figure 10 shows the effectiveness indicator for RES support in the sector of electricity from **solid biomass**. First conclusion is that at EU-15 level, only a small part of the available potential is being exploited on an annual basis during the period 1997-2003. The effectiveness indicator in solid biomass electricity is significantly lower, as compared with wind exploitation[21]. This confirms the conclusion of the Communication of May 2004 that the development of biomass electricity is lagging behind expectations on EU level.

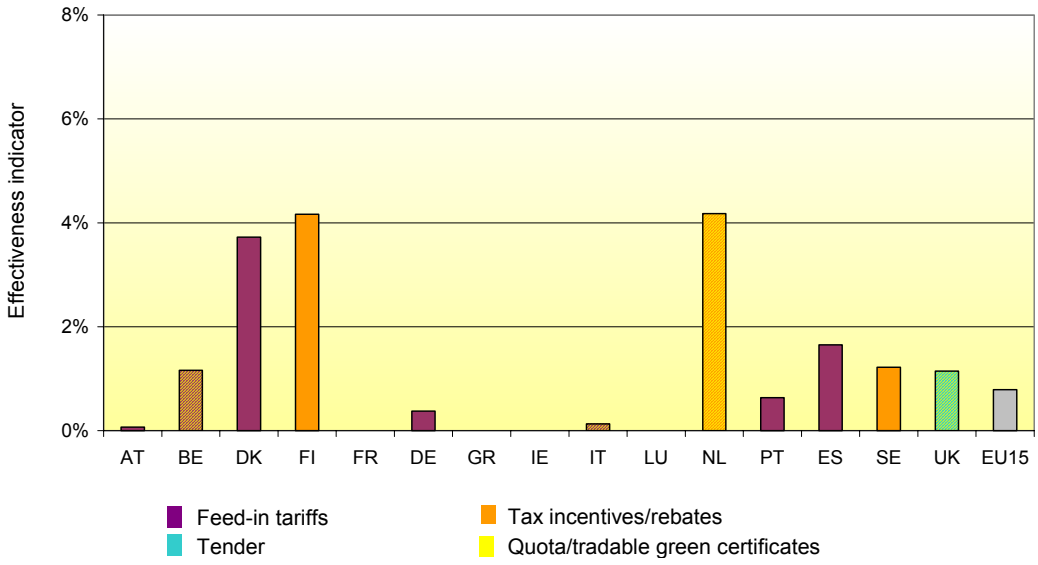


**Figure 10:**
**Effectiveness indicator for solid biomass electricity in the period 1997-2003. The relevant policy schemes during this period are shown in different colour codes.**

It must be clarified that Figure 10 includes, for the case of Denmark, apart from forest residues, also the straw- combustion plant, which represent half of their solid biomass market. The Netherlands also includes the co-firing of palm oil which represented in 2003 a 3% of the total solid biomass market.

Denmark has seen a strong growth of biomass until 2001 with CHP large centralised plants, initiated by the relatively high feed-in tariffs and a stable policy framework.

In the Netherlands, the partial tax exemption passed in July 2003 to a feed-in tariff system. Additional support was given by investment grants. Co-firing is the main technology in NL. It is highly likely that The Netherlands will reach the 9% target due by 2010 already in 2006.

In Finland, the tax refund for forestry chips was the main driver for the market growth in recent years. An additional 25% investment incentive is available for CHP plants based on wood fuels. The main key element of the success of mix de-taxation and 25% investment incentive in the context of an important traditional wood and paper industry.

[21] Countries showing high effectiveness in wind energy reach an indicator between 6-8%. On biomass, the top figures are around 4%.

Sweden, passed from investment grants to the TGC system and tax-refunds in 2002.

Austria and Germany have chosen a policy of medium and small size biomass installation, which present higher costs but it is driven not only by an energy policy but also by environment and rural development.

The new German support system shows the larger gap between support and generation costs. This new value has been adopted in August 2004. Effectiveness in the biomass forest sector need still to be demonstrated in this country.

The main barriers for the development of this RES-E source are both economical and infrastructural. Denmark, Finland and NL present the best effectiveness and the smaller gap between support and generation costs. Denmark and the Netherlands have implemented feed in tariffs and Finland has de-taxation as a main support scheme. There is a common characteristic in these three countries centralised power stations of solid biomass attracts the largest share of RES-E investment.

Nevertheless, biomass presents a large band of options, uses and costs. The promotion of large biomass installations should not ignore promising technology options with significant potential for technology learning.

For concluding this sector:

- In UK, BE, IT and to some extent SE, the level of support is just enough. Nevertheless, it looks like that the biomass sector is not yet able to cope to the risk of the green certificate schemes.

- Denmark, Finland and NL present the best effectiveness and the smallest gap between support and generation costs. Denmark and the Netherlands have implemented feed in tariffs and Finland has de-taxation and 25% investment support. The centralised power stations of solid biomass attracts the largest share of RES-E investment

- In FR, Greece, Ireland, Luxembourg, Portugal and Spain, the feed-in tariff support is not enough for a real take off of the biomass sector.

- Secondary instruments especially small investment-plant support and de-taxation are good elements of catalyses for the kicking of biomass. They also have the advantage of less interference with wood market.

- CHP support is a very good friend of the biomass development, adding higher energy efficiency.

- It is not an affair of demand, the good management of agriculture and forest residues is an important parameter for good biomass exploitation.

## Hydropower

As a third example we show the same analysis for the case of **small scale hydropower**. In this case the country specific costs show very large differences and the technology is especially relevant for some of the new member states. Again it can be seen that the existing feed-in tariffs are quiet well adjusted to the costs of generation, with the Austrian and the Portuguese tariffs ranging at the lower end of the cost spectrum. The Finish tax measure is again unable to cover the costs needed to stimulate investments into new generation capacity. Very good financial conditions for small hydropower exist in France and in Slovenia. Again for Cyprus the support level might be higher than shown in the figure, since additional investment grants are not considered.

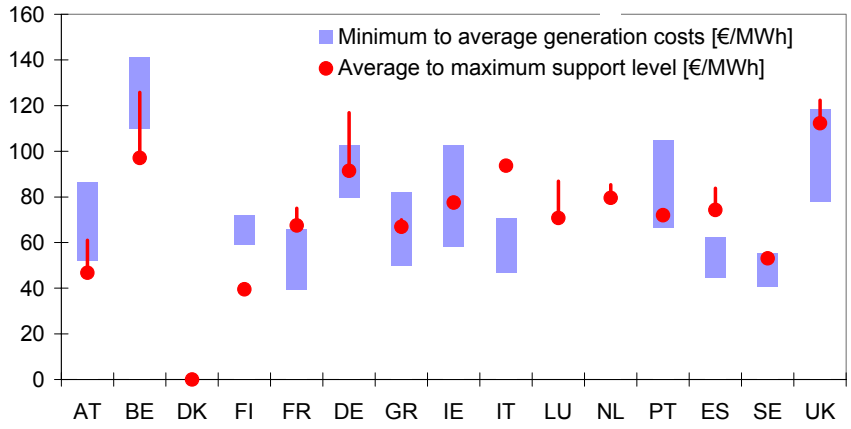


**Figure 11:**
**Price ranges (average to maximum support) for direct support of small scale hydro in EU-15 member states (average tariffs are indicative) compared to the long term marginal generation costs (minimum to average costs)**

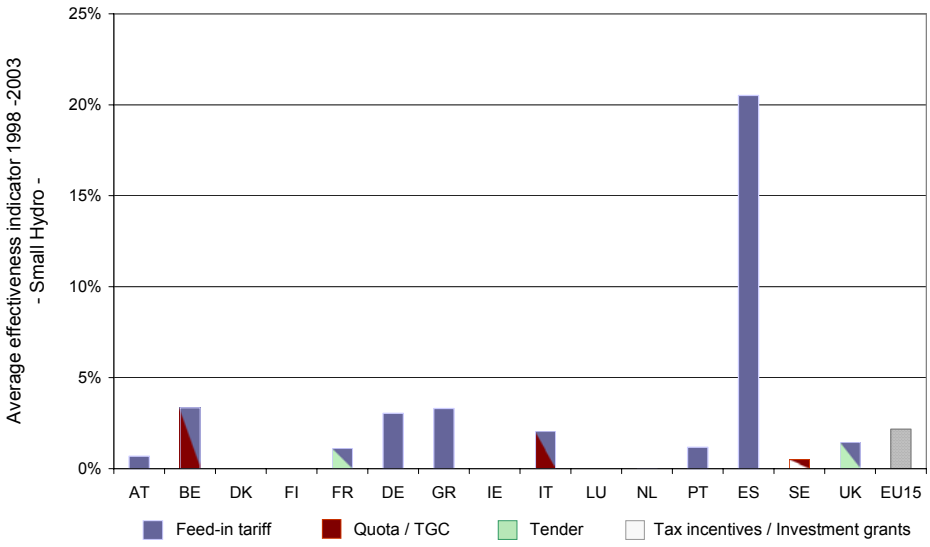


**Figure 12:**
**Effectiveness indicator for small hydro electricity in the period 1997-2003. The relevant policy schemes during this period are shown in different colour codes.**

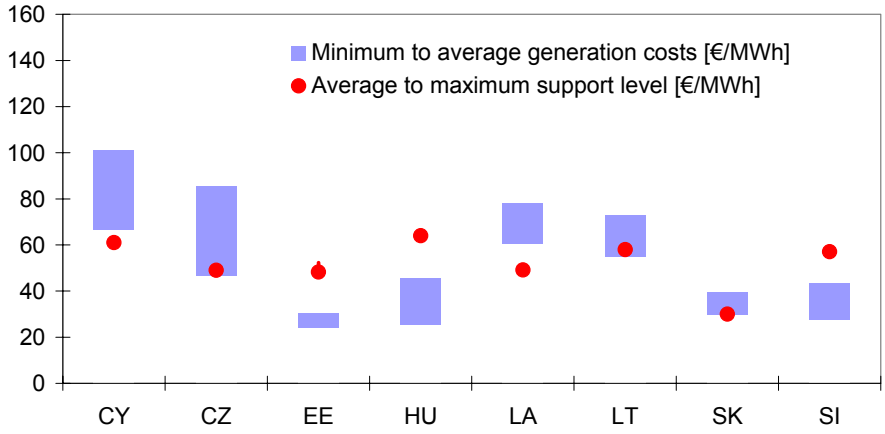


**Figure 13:**
**Price ranges (average to maximum support) for direct support of small scale hydro in EU-10 member states (average tariffs are indicative) compared to the long term marginal generation costs (minimum to average costs)**

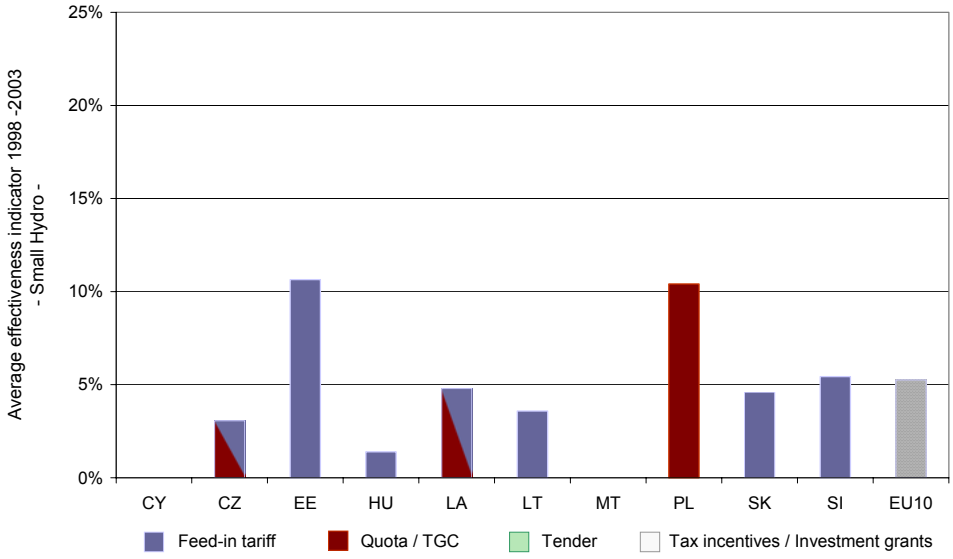


**Figure 14:**
**Effectiveness indicator for small hydro electricity in the period 1997-2003. The relevant policy schemes during this period are shown in different colour codes.**

## Photovoltaic solar energy

As presented in Figure _ the sector of photovoltaic electricity generation has shown the strongest growth in Germany followed by the Netherlands and Austria during the considered period. The support system in these three countries consisted of fixed feed-in tariffs supplemented by additional mechanisms like soft loans in Germany. As expected from the theory quota obligations and tax measures give only very little incentives for the investments in PV technology, since these schemes generally

promote only the cheapest available technology. The implementation of the PV support scheme in DE[22], NL, ES and AU is on the base of establishing a long term policy for the market development of this technology.

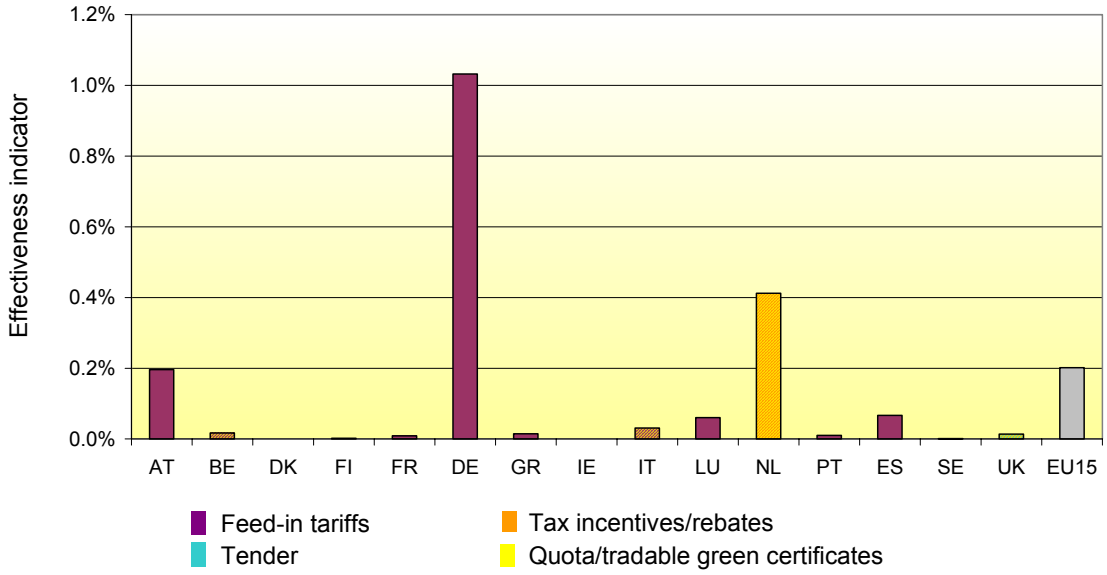


**Figure15:**
**Effectiveness indicator for photovoltaic electricity in the period 1997-2003. The relevant policy schemes during this period are shown in different colour codes**

22 DE has just become the world leader over taking Japan.

## Annex 3
## Methodology on the investor's perspective

We define the effectiveness of a member state policy in the following as the ratio of the change of the electricity generation potential during a given period of time and the additional realisable mid-term potential until 2020 for a specific technology, where the exact definition of the effectiveness reads as follows:

$$E_n^i = \frac{G_n^i - G_{n-1}^i}{ADD - POT_{n-1}^i}$$

$E_n^i$ Effectiveness Indicator for RES technology i for the year n

$G_n^i$ Electricity generation potential by RES technology i in year n

$ADD - POT_n^i$ Additional generation potential of RES technology i in year n until 2020

### – Annuity

One possible approach to calculate the actual support during the entire lifetime from an investor's perspective is to determine **the average expected annuity of the renewable investment.** The annuity calculates the specific discounted average return on every produced kWh by taking into account income and expenditure throughout the entire lifetime of a technology.

$$A = \frac{i}{(1-(1+i)^{-n})} * \sum_{t=1}^{n} \frac{Income_t - Expenditure_t}{(1+i)^t}$$

**A= annuity; i=interest rate; t=year; n=technical lifetime**

The average expected annuity of wind energy investments for Germany, Spain, France, Austria, Belgium, Italy, Sweden, the UK and Ireland has been calculated based on the expected support level during the period the promotion is given. The level of support in the German system is annually adjusted according to the digressive implemented in the German EEG. For the four countries using quota obligation systems the certificate prices of the year 2004 were extrapolated for the entire active period of the support.[23] Furthermore an interest rate of 6.6% was assumed[24] and country specific prices of wind technology were used according to the average market prices of wind turbines in those countries in 2004. Therefore the annuity of expected profit considers the country specific wind resources, the duration the support is given as well as additional promotion instruments like soft loans and investment incentives. An important limitation of this approach concerns the fact that an estimate of the future evolution of certificate prices in quota systems is needed. Such an estimate

[23] This assumption might be questionable because certificate prices might reduce as the certificate markets in those countries mature. However, only very little knowledge exists about the temporal development of prices in these markets.

[24] Only for Germany an interest rate of 4% was used based on the granted soft loans.

does typically not exist. We assumed therefore that TGC prices remain constant at 2004 levels.

## Annex 4
## Intermittency in Production and Balancing power: a need for appropriated regulation to combine internal market and renewable regulation

As previously said in chapter 3.3, balancing cost will of course depend on the volume of intermittent power that has to be balanced, which again depends on the prediction of renewable production, gate closure etc. Moreover, the cost will depend on the availability of balancing power, which will depend on the generating system (energy mix) and inter-connectors to other countries. As said before, an appropriated prediction-forecast of the wind generation minimizing deviations will optimize the system costs and the regulation services.

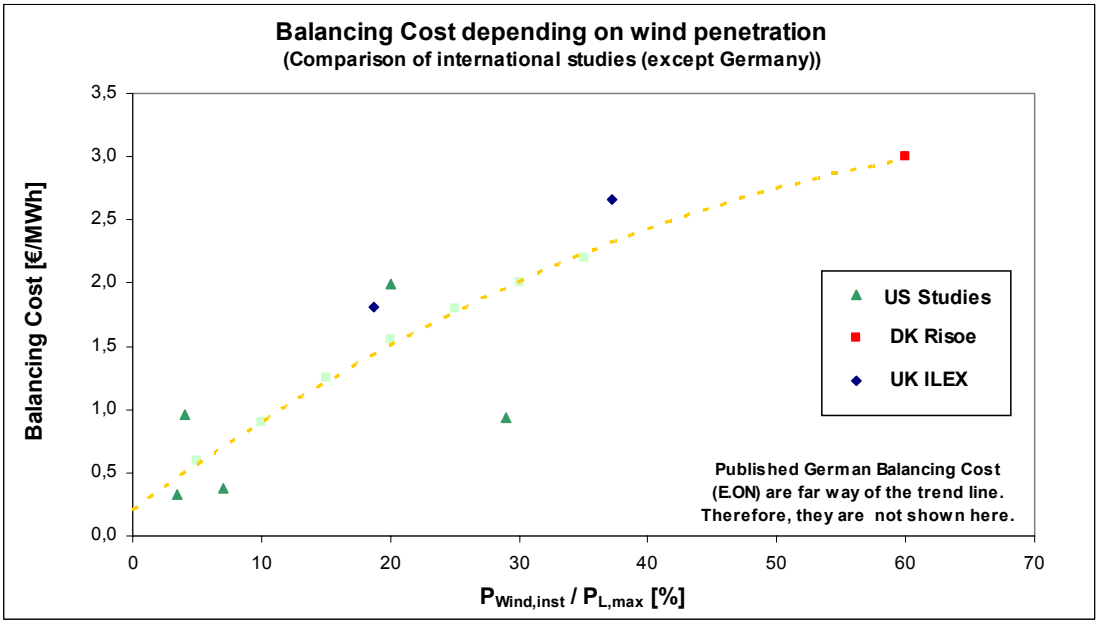


**Figure 1:**
**Comparison of international studies on additional balancing cost due to large-scale intermittent wind integration.**

It should be stressed that most of the existing power markets are designed according to the needs of conventional thermal and hydropower, and therefore, only to a very limited degree take into account the needs of new renewables. Thus, in an EU-context the need of rules and other measures for integrating intermittent RES-E technologies should be considered.

The influence of wind power on cross-border bottlenecks between Germany, have created some disturbance in the Netherlands and Poland. Arrangements for power plant scheduling, possible rigidity of the structure of electricity market, reserve capacity at cross-border transmission and congestion management seem determinant points which should be further analysed.

If developed in a more intensive manner than today, also the flexibility in demand can handle some of the fluctuations in power production from intermittent sources. At the same time this flexible demand may not only be an advantage in integrating RES-E

capacity, but also advantageous in the general operation of a liberalised power market as a whole, ensuring a better balance between supply and demand of power.

## Annex 5
## Guarantees of origin

Article 5 of the Directive requires Member States to implement a guarantee of origin system (hereafter GO-system) by 27 October 2003 for EU15. For the 10 new Member States the deadline for implementing such a system was, in accordance with the Treaty of Accession of 2003, 1 May 2004. The main objectives of such a system are to facilitate trade in electricity from renewable energy sources and to increase consumer transparency between electricity from renewable and non-renewable energy sources. Annex contains an overview of the different stages of GOs in Europe.

The most appropriate stages of the implementation of a GO-system are:

- implementing legislation,
- appointing an issuing body,
- setting up an operational system for issuing guarantee of origins which is accurate and reliable.

In accordance with Article 5 of the Directive, the guarantee of origin is issued on request. It is not an obligation to all the renewable electricity.

Based on national reports and supplementary information, the situation in September 2005 is the following:

| | **Legislation** | **Issuing body** | **Ready to GO** |
|---|---|---|---|
| ***EU15*** | | | |
| Austria | Passed | DSO | Operational |
| Belgium | Passed | Regulator | Operational |
| Denmark | Passed | TSO | Operational |
| Finland | Passed | TSO | Operational |
| France | In process | TSO | In process |
| Germany | Passed | Auditors | Operational |
| Greece | In process | TSO | In process |
| Ireland | Passed | Regulator | In process |
| Italy | Passed | TSO | Operational |
| Luxembourg | Passed | Regulator | In process |
| Netherlands | Passed | TSO | Operational |
| Portugal | In process | TSO | In process |
| Spain | In process | Regulator | In process |
| Sweden | Passed | TSO | Operational |
| UK | Passed | Regulator | Operational |

| ***EU10*** | | | |
|---|---|---|---|
| Cyprus | In process | Not appointed | In process |
| Czech Republic | Passed | Government organization | In process |
| Estonia | Passed | Not appointed | Not started |
| Hungary | In process | Not appointed | Not started |
| Latvia | Not started | Not appointed | Not started |
| Lithuania | In process | TSO | In process |
| Malta | Passed | Regulator | In process |
| Poland | Passed | Regulator | In process |
| Slovenia | Passed | Regulator | In process |
| Slovakia | In process | Regulator | In process |

In total only 9 of the 25 Member States have fully transposed this article into national legislation and put in place an operational system which issues guarantee of origins At present none of the new Member States have an operational system issuing guarantees of origin.

All EU15 have passed legislation concerning a system of guarantee of origins, with the exception of France, Greece, Portugal and Spain *(checking)*. However, these countries are in the process of adopting legislation. Of the new Member States only Czech Republic, Estonia, Malta, Poland and Slovakia have passed legislation regarding a system of guarantee of origins. The remaining new Member States, with the exception of Latvia, are in the process of preparing or have proposed legislation.

All together 21countries have pointed out an issuing body. The majority of countries have appointed either TSO (9 countries) or regulator (8 countries) as the issuing body. The exceptions are Austria, Germany and Czech Republic which have opted for DSO, a group of auditors and a governmental organisation respectively. The tasks assigned to the issuing body also vary from country to country. In some countries issuing bodies are assigned to maintain a national register for guarantee of origins; some are also responsible for accrediting the power generating plants. However, the task of plant accreditation and verification of eligibility is more often assigned to another institution than the issuing body. All 9 countries with operational system in place, with the exception of Germany, have established a national registry for keeping track of ownership of guarantee of origins and to facilitate redemption, if required. Only 3 countries; Austria, Belgium and the Netherlands have introduced redemption. Registry and redemption requirements help reduce problems of multiple counting.

Other design features, as well as the applications of the guarantee of origin vary greatly from country to country. All countries with a fully operation system in place, with the exception of Italy and Germany, allow for transferability of the guarantee of origins. Italy requires the transferability to be linked with the physical electricity, whereas Germany does not allow the transfer of guarantee of origins issued to

production eligible to the German feed in system. A few countries have introduced earmarking of guarantees of origin. In addition to Germany, Austria, Denmark and the Netherlands require that the guarantee of origin is earmarked for support received or tax benefits.

According to Article 5 of the directive, the Commission shall consider the desirability of proposing common rules for guarantees of origin. At present the Commission does not see the need for proposing common rules. There are several reasons for this. Firstly, on the objective of facilitating trade, a necessary clarification was made in COM (2004) 366 on the role of the guarantee of origin and under what conditions a Member State can consider that imported renewable electricity can contribute to the achievement of the RES-E targets. In the Communication it was stated that Member States can only count imported electricity towards its target achievement if exporting state agrees explicitly and accepts that this electricity can be counted towards the importing Member State's target. This agreement should be included in a mutually recognised guarantee of origin. Currently, it seems there is no transfer of guarantee of origins between Member States for the purpose of target achievement.

Secondly, Directive 2003/54/EC[25] has been adopted after the adoption of Directive 2001/77/EC. In accordance with Article 6 of Directive 2003/54/EC, Member States are required to implement a scheme for disclosure of the fuel mix and selected environmental indicators of electricity sold to final consumers. The Commission regards this provision as an important measure for fulfilling the objective of consumer transparency as it covers the whole electricity sector and not only electricity from renewable energy sources. Several countries with legislation on disclosure of generation attributes have already indicated that the will use the guarantee of origin to track information on renewable electricity generation. The guarantee of origin can therefore facilitate the implementation of electricity disclosure. A further development of disclosure could clearly increase consumer transparency.

Thirdly, a few countries have chosen a mandatory renewable energy quota obligation as the main support mechanism for renewable electricity. The quota obligation is administered by a system of tradable renewable energy certificates and there can be significant similarities between the guarantee of origin and tradable green certificates.

Nevertheless, the majority of Member States have chosen feed-in tariffs as the main instrument for promoting renewable electricity. Although there may be similar tasks required for the feed in tariff system as for the issuance of a guarantee of origin, such as accreditation and verification procedures for renewable electricity production, the issuance of a guarantee of origin is not strictly necessary to facilitate feed-in tariff system.

The Commission considers that for the moment, a further development of disclosure could clearly increase consumer transparency.

[25] Directive 2003/54/EC concerning common rules for the internal market in electricity and repealing Directive 96/92/EC.