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THE SOCIAL EFFICIENCY OF INSTRUMENTS FOR THE PROMOTION OF RENEWABLE ENERGIES IN THE LIBERALISED POWER INDUSTRY

by

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ABSTRACT:** *This paper compares the social efficiency of the two main regulatory instruments used to promote renewable energy sources in electricity generation (RES-E), taking into consideration their role in promoting the preservation of the climate. They are based on a purchase obligation and act either by price (feed-in tariffs) or by quantity (RES-E quotas). In their reference design, the instruments show different performances in several dimensions: market incentives intensity, control of the cost for consumers, safeguards of RES-E investments, and conformity with the new market regime of the electricity industry. The comparison shows that neither instrument offers an optimal solution in each of these dimensions. In particular, the intrinsic qualities of the quotas instrument that are put forward to mandate its adoption by the EU members are overestimated. A government will thus select an instrument in accordance with the relative importance of its objectives: environmental policy versus cost control by market pressure.*

The promotion of renewables started in Europe during the first half of the nineties in response to the objective of reducing greenhouse gas emissions in parallel with energy efficiency (policies). By drawing

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** *Résumé en fin d'article; Zusammenfassung am Ende des Artikels; resumen al fin del artículo.*

lessons from the subsidisation of the investment, for electricity these policies were initially based on two instruments giving support at the level of production: feed-in tariffs (FIT) and bidding systems for long-term contracts at guaranteed prices. The European Directive 2001/77/C on the promotion of renewable energy sources (RES) – which aims at an increase in their share from 14 to 22% of total generation – intervened in the context of deepening reforms for the liberalisation of the electricity sector. The preparation of this directive raised significant debates about the effectiveness of the regulatory instruments involved, and on their modes of financing. The FIT and bidding mechanisms were however criticised for the cost to the consumers for the first ones, lack of incentive to develop RES-E units for the second ones, or else for their incompatibility with the electricity market regime for the two instruments. It was therefore proposed to substitute a system of quotas for green electricity certificates that were to be imposed on the suppliers of electricity and associated with exchange mechanisms.

The introduction of competition into electricity industries in view of integration of the European markets has in fact modified the conditions under which support for the RES-E can take place. The consumers now having a free choice of the producers, they can exert their preferences for environmental protection by the purchase of green electricity from the RES-E producers. In coherence with the rules of electricity markets, the RES electricity could, for its electricity component, be traded on the electric markets, and for its environmental component, on the green certificates markets, that is completely coherent with the market principles. However, in order to have an effective RES-E development some countries adopt a different mechanism that is set up on an obligation to get a quota of RES electricity, this obligation being imposed on the electricity suppliers. Moreover, the adoption of this instrument of exchangeable quotas (EQ) in a harmonised way in the European Union would make possible the theoretical advantage to limit the cost of European policy by allowing the development of the RES-E in the countries endowed with the least cost RES resources. It is the reason for which the European Commission and some member-states seek to convince other member-states in the near future, despite disagreement and controversy around the efficiency of instruments (European Commission, 2004). There are two main policy options with respect to RES-E support in the future: continuous improvement of existing national schemes and EU-wide harmonisation of national support schemes by alignment on the EQ system.

We compare here the relative advantages of the two main regulatory instruments, the FIT which is used in Germany, Spain, France, Portugal and the EQ instrument that is used in the UK, Italy, Belgium and Sweden. One will first analyse the goals of the RES-E policies and the criteria that result from them in terms of environmental effectiveness, efficiency, equity and viability:

- The environmental effectiveness which results from the capacity of the instrument to incite investment in RES-E units which avoid gas emissions; it is related both to the level of the incentive and the foreseeability of revenues offered to the RES-E investor;
- The control of the collective cost; this criteria includes the dynamic efficiency, i.e. the capacity of the instrument to facilitate the innovation and the fall in costs by technological and institutional learning;
- The costs for the consumers and the equity in the limitation of rents that the instrument could let to the new RES-E producers;
- The viability that is ensured by the compatibility of the instruments with the market regimes of electricity industries and the degree of their liberalisation.

The approach in terms of social and economic efficiency is extended to the predisposition of the instrument to allow a European optimisation of RES-E development by the exploitation of the least expensive geographical resources.

It will be shown that, beyond the theoretical arguments in favour or against one or the other instrument, there is no clear-cut optimal instrument whose advantage emerges clearly along this set of criteria. In this perspective, the instrument of exchangeable quotas does not have such economic qualities that one attributes to it, in particular as regards incentives by the competition and the prospect of European certificates exchanges. Moreover, the FIT instrument presents a capacity for adaptation that makes it possible to correct its flaws that are the matter of collective cost and rent allocation to RES producers. Nevertheless, the instrument that will be prefered in a country will depend in any case upon the hierarchy of objectives of a government and the degree of beliefs in market virtues.

Before developing the argument, we shall make four observations. First, in order to simplify the comparison, we ignore the bidding instrument that has been used in the UK between 1990 and 2000,

France and Ireland in the nineties. Second only instruments based on obligation assigned to clearly designated agents (generally the distributors or the suppliers of electricity), and not on voluntary green purchases by suppliers, or final consumers to RES-E producers, are considered here. So we do not consider the so-called green marketing by which consumers and wholesalers voluntarily trade with any RES-E producer to buy their production with a price premium reflecting their willingness to pay the subjacent environmental goods. This market solution encounters the traditional difficulty of free riding. Indeed if, as the polls show, numbers of people appreciate green electricity as citizens, but they rather tend as consumers to buy 'grey electricity' which is cheaper, since they cannot appropriate the environmental benefit of the first (Wiser and Pickle, 1997).[1] So voluntary exchanges of green electricity can not be an effective means to frame investment in RES-E units and to reach the social optimum. RES-E purchase obligation creates clear property rights on an environmental good – the stability of the climate by avoidance of any incremental CO2 emissions of each new piece of RES-E equipment – and values them. They *de facto* create these clear property rights by the obligation of purchase. Third we underline also that the instrument-types considered here are only focused on the development of new installations and the support of their production by mandatory purchase. The exclusive focusing on the production of new RES-E units avoids the creation of undue rent on the production of existing RES-E equipments that is not well understood in a number of European countries. Fourth, noting a methodological difficulty: references to empirical observations are misguiding because we cannot isolate the influence of instruments from other factors that contribute to the development of RES-E.[2] Some factors create obstacles, such as planning permission procedures and relations to the grid operators for the recovery of connexion costs (not generally among the activists of the RES-E promotion). Conversely each instrument frequently benefits from other support measures such as investment subsidies, low-interest loans, tax credits, or exemption from ecological tax. We

1 Experiences show a very modest development of purchases of this type (2–3% of purchasers) which contradicts the results of investigations revealing that 20–30% of the consumers would be ready to pay an inflated price of 15–20% to profit from renewable electricity (Wustenhagen 2001).

2 There is an abundant literature discussing causal links between the diffusion of RES-E and variation in design and strength of the governmental policy. Some examples are Reiche 2002, 2005; Morthorst and Jorgensen 2005; van Djik et al. 2003; Sijm 2002; European Commission 2004; Haas 2001.

therefore do not refer to results of effective RES-E policies based on instruments as proof of intrinsic performance.

1. Objectives and criteria of the policies of promotion of the RES-E

Let us underline again the objective of the RES-E policies. The objective is focused on the contribution to climate protection and more generally environmental protection by avoiding future emissions in electricity generation. This remains the crucial objective without which RES policies would have never been revived in the nineties after their decline in the eighties. The RES-E technologies need support because they have three limitations: their high cost due to commercial immaturity, the combination of capital intensiveness given their limited size effects (with few exceptions), the weakly programmable production for some of them (wind, minihydraulic) and annual random production (biomass, wind) as the result of agricultural variations. They force the creation of a regulation which brings two advantages to investors: a complement of payment for production and, what is generally underestimated, the securitisation of revenues over the long period of amortisation of the equipment. To invest in RES-E units it is necessary to borrow a large part of the investment and to make it bankable by a guarantee of cash-flow in the project financing arrangement.

1.1 The necessity for a specific policy

The rationale of using a specific RES-E instrument in terms of social efficiency refers to the second best optimum according to the environmental benefits of the substitution of new RES-E production to fossil fuel electricity production which are put in balance with the high costs of RES-E production.[3] There would be one theoretical solution which would avoid the use of a specific instrument for the promotion of the RES-E: a high environmental tax on the pollutant emissions to correct market imperfections by internalisation of environmental externalities. It would be optimal to make the electricity producers pay for the environmental costs of fossil fuel generation, in particular

3 One must add the possible environmental effects of the RES-E (impacts on the landscape, environmental effects of the collection of biomass for the bioelectricity units, etc.).

the cost of the CO2 emissions. It is an argument that some critics of the RES-E policy present by criticising the high opportunity cost of the policy by calculating the cost of the avoided CO2 emissions by RES-E development by these policies: it covers a range between 50 and 150 €/tCO2 which is much higher than the price of CO2 emissions permits.[4]

But the imposition of a high ecotax for boosting technological innovation and substitution encounters three difficulties. First there is a large uncertainty on the value of the damage avoided, which raises the theoretical problem of definition of tax level. In the second place, a tax involves redistributive effects and encounters problems of acceptability if one seeks to define the tax at a high level, demonstrated by the refusal of the European ecotax at the beginning of the nineties. The dual approach by quantity instrument such as CO2 quotas would lead to the same difficulties if the quotas are too severe. In third place nothing guarantees that a tax, even if high, leads to significant results in terms of technological substitution in energy production towards clean technologies in comparison with policies targeted on clean energy techniques, as show in the retrospective studies quoted by Jaffe et al. (2000). The principal reason is the entry barrier for new techniques raised by R&D and learning costs.

In any case climate policies have to do whatever they can, promotion of the RES being one of their main fields of action. The RES-E option is reinforced by the obstacles existing before the non-emitter nuclear technology, because of the social perception of its specific risks and the political obstacles to its revival. One must organise the direct and indirect subsidising of green electricity production beside the CO2 quotas imposed on the power producers at the same time as on other industrial emitters.

The RES-E promotion benefits from the successive 'learning by using' of the instruments, some of them have been given up because of their inefficiency or the significant drawbacks they pose.[5] The modes of subsidising are now focused on production; they are indirect in

4 See on the UK case Newbery (2003) and National Audit Office (2005). The critics argue that the social benefit in terms of avoided tons of CO2 (15–30 €/t which is the price on the market of permits) is much lower than the opportunity cost of tCO2 avoided by the marginal RES-E unit.

5 Such are the cases of the direct subsidies or the credit tax to investment in RES-E units which were largely used in the eighties, in particular in the United States (Gielecki et al. 2001; Sawin 2004). Experience shows

the sense that their costs are passed through the electricity price in specific ways. One 'socialises' the payment of the higher costs of new RES-E production by sharing it with all consumers of electricity, this affects electricity prices by an acceptable rise (between 0.1 to 0.3 c€/kWh presently in Europe to be compared to a wholesale price of 4.5 c€/kWh on average). A government can complement a RES-E instrument by a fiscal subsidy on the production to consolidate it, as it was done in the United States, the Netherlands and Denmark. But the political economy of the tax credit as a complementary instrument shows that its stability which is needed for investing is much more dubious than a specific regulatory instrument.

Now the governmental selection of an instrument of indirect subsidisation of RES-E production is supposed to depend upon its social efficiency. Its appreciation is made in several dimensions insofar as several objectives and criteria are jointly pursued with a possible change in their hierarchy. One thus acts by implicitly aiming a quantitative RES-E development target at a particular horizon and with an implicit level of the collective cost not to be overcome.

1.2 The criterion of environmental effectiveness

In the definition of environmental policy under uncertainty on the costs of the environmental damage, one cannot reason in simple term of cost-benefit and second best optimal tax, but in terms of cost-effectiveness with an objective of reduction of pollution which the government has to set (Baumol and Oates, 1988). Because of the impossibility of having a reliable value of the benefit related to the use of RES-E, i.e. the value of the avoided emissions, the policy is defined from this second point of view. The quantitative objective of development of RES-E capacities is defined in a discretionary way by the government because it is unable to define the second best optimum. The environmental effectiveness is appreciated according to the newly installed RES-E capacity and will depend on two parameters: the level of the economic incentive offered by the instrument and the securitisation of RES-E investment.

The first depends upon the additional remuneration of RES-E kWh and must cover all the cost and risks of production for

that the developers of RES-E units quickly neglect the maintenance and the improvement of units after their start-up and stop them at the first operational incident.

an effective development of capacity in various technologies. If a government wants to make progress, it will have to seek to share the effort of investment of the producers between varying techniques of different maturity.

The second depends upon the 'transactional efficiency' of the instrument in the relation between the public authority, the mandated purchaser and the producers in new RES-E units in the long term (Langniss and Wiser, 2003; Finon and Perez, 2006). The main aspect of the transactional efficiency is twofold. First the instrument must help the developers to contract long term with the obligated purchasers by securing their investment, and it will be shown that that is not defined as such in the exchangeable quotas mechanism. Second an instrument should offer credibility to investors in RES-E plants and to the manufacturers developing the RES-E technologies. It has to resist external shocks in its institutional environment as changes in the political balances of powers after elections, which expose the RES-E policy and its instrument to discretionary changes.

The RES-E investors must have guarantees on the stability of their cash-flow which is based on the revenues coming from the indirect subsidy allowed by each instrument. Even in the case of a change of policy, the long term commitment of the government as the relations between parties must stay along those existing at the moment of the investment in the RES-E unit. The existence of long term contracts between developers and mandated purchasers is a way of complementing the commitment of the regulatory contract established around RES-E promotion.

1.3 The criteria of control of collective cost and consumers cost

From the point of view of the social efficiency and collective surplus, one must examine the cost-benefit of the policy. But, on the side of the social benefits (environmental protection and as a side-effect, energy security), the uncertainty on their value is large. The assessment must focus on the control of the cost of the policy and so one must consider two aspects of efficiency: the collective cost of the policy (which results from the RES-E capacity development and the marginal cost curve) and the incentive mechanisms for limiting the costs of the RES-E projects. We must also have a look at the dynamic efficiency, in particular the effect of learning on the variety of RES-E technologies by each instrument in order to open

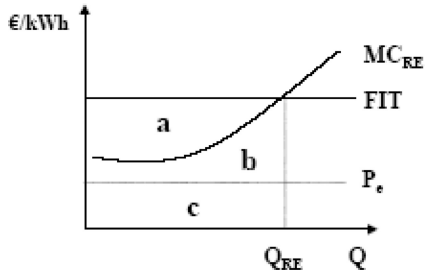

Figure 1 – The different types of costs of RES-E policy

the options for the future.

Before considering these issues, we must distinguish the costs for the consumers, i.e. the premium the obligated suppliers have to pay comparatively to the price of 'grey' electricity and which will be passed on through the retail prices from the collective cost of the policy. By referring to figure 1 which represents the case of feed-in tariffs (FIT) taken as an example, the collective cost is not the surface a + b + c below the horizontal straight line which represents the 'obligated demand' at the FIT price. The collective cost is the surfaces c + b at the cost of the RES-E production. If Pe is the 'grey' electricity price, the surface b is the extra cost of the whole of the RES-E production. The collective cost will thus depend on the shape of the curve of marginal cost MC, (which depends on the cost of technologies and on the politically accessible potential of RES projects) and capacities which are supposed to be installed by merit order. For the future this long run marginal cost curve integrates necessarily the effects of 'learning by doing' of the manufacturers and the 'learning by implementing' in particular in the costly preparation of projects.

The collective cost is increased in static when one seeks to diversify the support between technologies in order to take account of their difference of maturity so that the developers do not focus their investment on the most mature technologies; but this cost increase in the short term can be beneficial in a long-term perspective by opening the way to the large scale development of new technologies after the exhaustion of the cheap potential of the front runner technology (for instance the emergence of biomass units after the successful generations of windmills). So there are three aspects of social efficiency to be distinguished:

Incentives to control costs. One must identify the characters of the instrument which create incentives to control development costs and

operating costs. It can be by creating forms of competition which complement the upstream competition between manufacturers of RES-E units organised by the call for tenders of the developers. It is a bidding competition for the attribution of contracts. In the exchangeable quotas, the competition is established between RES-E producers at two levels: for winning long term supply contracts with obligated suppliers and for selling certificates on spot exchanges.

The control of the consumers cost and equity. The approach in terms of collective cost does not prevent the examination of redistributive effects of the rent left by the instrument to RES-E developers. This rent is paid indirectly by the consumers. The cost is passed on through the price of electricity. The rent could be used by the developers in a socially efficient way by their investment in R&D and payment for their project risk, but one does not have that guarantee. There is less incentive to control costs if the rent is large. A legitimate concern of the public authority is thus that the cost for the consumers does not become too high. This could create a problem of acceptability.

Dynamic efficiency. In a policy focused on the promotion of RES innovations, the RES-E capacity development through the support of an instrument which is focused on the short term efficiency by market incentives tends to stick with the most mature technology. In the long run this situation will create an increase of the long run marginal costs of RES-E because the least advanced technologies which are the most expensive at the beginning of RES-E policy will not have progressed by the time they are needed (after exhaustion of the cheap resources). In the design of some instruments this leads to the dissociation of support by technological band and by size of unit with specific conditions of incentives. Conversely the instrument which is criticised for allowing a high rent to RES-E developers and not encouraging their effectiveness can be efficient in terms of learning and incentives to technological improvement because of the effects of large capacity development.

1.4 Viability and compatibility with the market regime

The theory of New Institutional Economics clearly highlights the importance of the compatibility of a regulation with its institutional environment. The RES-E instrument must be compatible with the electricity industry regime. The introduction of competition upsets the traditional regulation of the monopoly and the public service obligations which were an important element of it. With

regard to RES-E policy, its rules should be coherent with the market principles, as it is frequently argued to promote the exchangeable quotas instrument. It concerns first of all the assignment of the RES-E purchase obligation and the recovery of the RES-E costs for the obligated purchasers. Otherwise they are in competition and have no legal monopoly of supply in their area of service where non-mandated electricity sellers compete with them. However it is not of primary importance that the design of the instrument could be inspired by the market principles in a liberalised industry for one reason: a policy can always be carried out on the basis of principles different from those of the organisation of the sector, providing that it does not disturb the functioning of this organisation. So in the electricity market regime it will be sufficient that the burden of the RES-E policy will be equitably shared between market-players.

2. The social efficiency of the feed-in tariffs

The feed-in tariffs instrument has two main characters: an obligation of purchase and a high purchase price guaranteed over a long period. It imposes the obligation to buy the production of all new RES-E units by the distributor-supplier in its service area at a tariff fixed by the public authority and guaranteed over a long period (at least 10 years, 15 years in France, 20 years in Germany for example). These prices are different according to technologies in order to diversify the RES-E development. They are calculated by reference to the cost prices of RES-E units with some risk premium, and not to the costs avoided by the electricity companies subjected to the obligation of purchase, as was the case before these policies.

The recovery of the RES-E premium by the mandated companies can be organised in two ways: either a rise in the price of every kWh sold by the distributors subject to the obligation of purchase (as was the case in Germany until 2000 under the regime of distribution monopoly), or a reimbursement by a fund financed by a tax on all kWh carried by the national grid (as in France). An alternative solution is to limit the level of the feed-in tariff and to make RES-E production the beneficiary of a large tax exemption (ecological tax, VAT) as in the Netherlands and Denmark, or a tax credit on RES-E production as in the United States. The premium is thus paid by all electricity consumers in the two first cases and by the taxpayers in the last. To allow the stability of the instrument by limiting the increasing opposition of the mandated buyers in the future, a limit on the RES-E

expenses of the local company (e.g. a certain percentage of its total turnover) and the increase of tariffs for their clients can complement the design of the FIT system.[6] Another option is to include in the regulation a rule of revision of the tariffs from a given installed capacity target.

2.1 Environmental effectiveness

Environmental effectiveness is reflected by the performance of the new RES-E capacity development under the weak control of the total cost. According to this criterion, the FIT instrument is effective because it grants high financial support, while minimising the costs of transaction for the developers in their relation with the obliged purchasers and by limiting quantity risk and price risks for them. Guaranteed over the long term, the prices are sufficiently high to make the new installations profitable by covering the costs and preparation risk of the projects. Banks easily agree to lend when cash-flow is guaranteed.

The transactional efficiency is good because the combination of the obligation of purchase and the price guarantee in the long term is the ideal framework for a producer-investor in search of a guaranteed cash-flow. The transaction costs of the relation between producer and purchaser are minimal, a simple technical convention being necessary to regulate 'secondary duties'. With this instrument it is possible to avoid the establishment of any contract between developers and mandated purchasers, except technical conventions concerning the secondary duties of producer (upper limit of yearly production covered by the tariff, conditions of connection, technical tuning, etc).

The principal risk for the investor is set at the level of political commitment in the long run. The obligation of purchase can be revised. It has been for instance the case in France. (The Energy Law passed in July 2005 the abandonment of the upper limit of 20 MW for the RES-E projects benefiting from the obligation and its unfavourable replacement by a regional authority's discretionary decision.) Guaranteed prices can also be modified by decree. The passing of a new law could provoke the shift from the FIT mechanism to another instrument without guaranteeing the preservation of the

6 Note that, beyond this limit, the upper cost of the obligation could be transferred to the upstream companies. Such a rule has been defined in Germany to wheedle opposition of local companies in the area in which the majority of wind power units have been installed.

conditions of the preceding support for the RES-E units which have been developed in this previous framework. The policies based on a mix of FIT and tax subsidisation are more vulnerable because of the limited duration of public commitment on the fiscal subsidy (e.g. in the United States the system of long term credit tax for the new RES-E units is valid only for the new units built during a period of three years and needs a vote by Congress to be extended for the next RES-E units).

Protection concerning the stability of the FIT for the RES-E units could be increased by private contracts between producers and mandated purchasers as has been organised by the FIT instrument in Spain. However sufficient protection is generally offered by the legal guarantees of the institutional environment. It results from the definition process of the instrument: the passing of a law and the details of the rules on the feed-in tariffs constitute solid protection compared to a ministerial decision by decree.[7]

Whatever it may be, the performance of installation under the FIT instrument are best among the RES-E instruments; this is explained by the fact that governments which adopt the FIT instrument give priority to the performance of installations. When this performance is mediocre, or weak, as in France up to 2006, it does not result from intrinsic flaws but from administrative obstacles which counter the effectiveness of the instruments.

2.2 Control of collective cost and producers' rent

The FIT instrument is criticised by the proponents of market instruments with three economic arguments: it lacks market incentive to reduce development cost; high tariffs lead to an installed RES-E capacity which is sub-optimal; and it leaves too much rent to the RES-E producers. Let us take each argument.

7 In Germany where the system is backed by two successive laws (EFL law of 1990, and EEG law of April 2000 corrected in 2004 by the RESA decree). The Administrative Law opens the possibility of appealing according to legal and constitutional principles which protect investors from regulatory change. The constitutional principle of the 'protection of legitimate expectations' reinforced by a jurisprudence which developed from the cases of changes of other regulations, constitute efficient protection (Langniss and Wiser 2003). In France the protection of the FIT for the developers is less assured because its implementation is a matter of decree and not of law (decree of the 6.12.2000).

First, the FIT instrument would carry higher production costs compared with other instruments which introduce more market incentives to cost efficiency. But contrary to this common idea, there exists for developers an incentive to reduce their costs and to enhance operational efficiency of the RES-E equipment in order to increase their profit margin. The feed-in tariff for a technology has the same function as a minimum standard price: every benefit coming from cost improvement is kept by the developer-producer. In particular the investment cost can be reduced by the developers' calls for tender, as Butler and Neuhoff (2004) clearly show in the case of German developers. Moreover the financing charges of the projects are lower than those of the projects developed in the framework of the two other instruments because the banks give better financing conditions. The configuration of the FIT instrument is very favourable: it guarantees the net cash flow of the projects and brings a significant risk premium with high guaranteed prices which compensate for the different risks of preparation costs, technological performance and annual variations in production as in the cases of windpower, minihydraulic and biofuel units.

However the FIT mechanism tends to amplify the collective cost for another reason than lack of market pressures. They are defined at a level which leads developers to go beyond the explicit or implicit governmental capacity target.[8] If the regulator defines the feed-in tariffs with a pessimistic anticipation of the long run marginal cost curve of RES-E, the FIT instrument leads to an excess of installed capacities and gives an excessive rent to all developers. In the case of excess capacity development the only feed-back mechanism comes from the reactions of mandated utilities who have to pass on the cost of their obligation in the tariffs and from those of consumers, in particular the large ones.[9]

8 This argument is rather a matter of fact than a general point. The feed-in tariffs for some technologies could be fixed at a level which does not allow it cover all costs and risks of the projects, implying a low performance of the instrument in this technological band.

9 To illustrate this increasing cost in the case of the German FIT, we can quote different sources: Fischedik et al. (2001) provide an estimation of the total cost of the German FIT in 2001 of €0.9 billion; Jacobsson and Lauber (2005) estimate the total costs of RES-E production at €1.45 billion in 2002 and an E.ON's expert provides an estimation of €3.4 billion for an installed capacity of 18000 MW reached in 2005 (Schneider, 2005). The impact on the retail price of kWh increases from 0.15 c€/kWh in 2001 to around 0.3 c€/kWh in 2005. For Spain, Delas (2003) estimates the additional cost at €330 million for production of 18.5 TWh, i.e. a total cost of around €800 million which impacts the final retail price of 0.2 c€/kWh.

In the second place, the difficulty arises from the excessive redistributive effect in favour of the RES-E producers. They would benefit from abusive rents, either because they have access to cheap resources compared to the marginal producers, or because the feed-in tariffs do not drop in proportion to the cost decrease due to learning by doing and incremental innovations. It is criticised as a transfer of surplus from consumers to RES-E producers. These limits must be balanced by two advantages. On the one hand high feed-in tariffs make it possible to take *de facto* account of the differentiated desaminities of RES-E units on the landscapes reflected in the degree of acceptance by local populations. In the case of the wind power high tariffs allowed the installation of windmills in areas with less resource potential and higher production cost than in regions with large wind resource but where they met opposition for reason of landscape protection.

On the other hand the instrument which is criticised for releasing too much rent for RES-E producers is the one which most encourages technical progress in RES technologies. The rent incites RES-E development which induces a higher learning effect than with the other two instruments. Moreover, because of this development, the rent can also be used to finance some R&D costs by allowing a partnership between developers and manufacturers, because market pressures are less important than with the other instrument.

In addition the induced effects on the development of a local RES manufacturing industry and the effect of energy security which add to the social benefit can reinforce the rationale for high tariffs. But this advantage weakens when an international industry has developed beyond the first stage of a life cycle of a technology, as shown by the positions of German, Danish or Spanish manufacturers who became leaders of the world industry thanks to their outlets in their local market stimulated by the FIT instrument.

Whatever it may be, the effect of rent creates a problem of political acceptability, in particular when the instrument is successful in terms of RES-E installation. It leads ex-ante to a definition of adaptable tariffs in time and space in order to reduce the producers' rent, as shown by figure 2. These flexible tariffs are defined to hold account of three traits: fast payback of the RES-E assets, differences in the quality of accessible resources (decrease of the tariffs according to the resource potential of the sites in order to reduce the 'differential' rent), and technical progress (decreased tariffs for the new units in order to reduce the technological rent). These refinements were initially introduced into the new German tariffs resulting from the

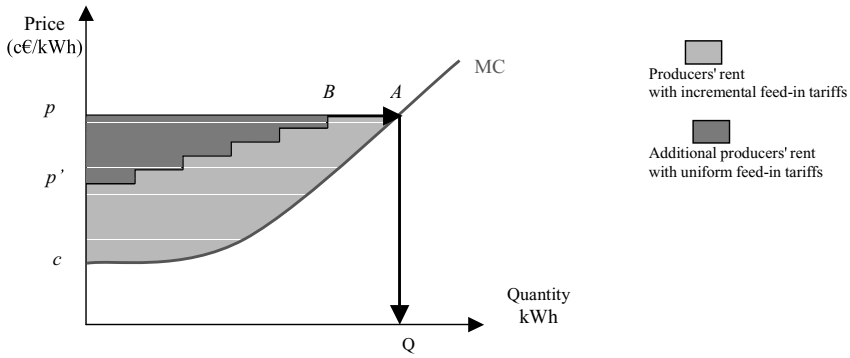

Figure 2 – Reduction of RES-producers' rent by adoption of flexible tariffs

EEG law of 2000, in the French tariffs of 2001 inspired by the previous ones, as in the Portuguese tariffs. The ex-ante flexibility of FIT limits the rent of the RES-E producer and so the costs for the consumer.

2.3 Compatibility with the market regime of the electricity industry

This system is criticised in terms of equity while carrying the burden of the premium of the RES-E mandated purchases by the companies in the service area of which units RES-E are established. The difficulty appeared in Germany before the liberalisation of the electricity industry because it was made to carry the burden of this national policy by only regional or local companies in the areas in which RES-E installations are developed, that involved significant tariff rises for their customers. This problem shed light on the problem created by electricity market reforms because the incumbents which remain subject to the purchase obligation would undergo a premium that their competitors do not have to bear.

Several answers are brought to this problem. The German answer, endorsed in 2000 by the Direction of Competition of the European Commission, is to carry in an equitable way the financing of the obligation on all suppliers by arranging a complex system of compensation between companies. The other solution adopted in France, Portugal and implicitly in Spain consists in refunding the cost borne by the mandated operators by special funds financed by a tax on all kWhs carried by the grid.

The FIT instrument becomes less and less compatible with the market regime of an electricity industry as this one goes

in-depth into the liberalisation process with a high degree of vertical and horizontal de-integration, in particular up to a total unbundling between network activities and supply business. The principal problem comes from the assignment of the obligation of purchase where there is a complete unbundling between network and supply activities in distribution, as is the case in the United Kingdom. Where the local, regional or national companies carry out a moderate unbundling, the geographical obligation of RES-E purchase can remain simple as in France or Spain in 2005. In the case of in-depth liberalisation, it is necessary to entrust an agency with the responsibility for buying RES-E electricity at the guaranteed tariffs and then auctioning it or sharing it between the suppliers in proportion to their market share. The British did this for the RES-E productions previously developed within the new framework of the Renewables Obligation implemented in 2002.

To sum up, the FIT instrument a priori is not disqualified by the introduction of competition, provided that the instrument respects the competitive game. For a government strongly engaged in the promotion of the RES-E, the instrument preserves its attractiveness because of its great effectiveness in stimulating the development of the production of RES-E and for allowing the achievement of ambitious objectives like those of the voluntary engagements defined by the European directive of 2001. Its drawback is its high cost for the consumers when the RES-E development exceeds a certain level. But the problem is the same for the quantity-instrument if it has ambitious quantitative targets.

3. Social efficiency of exchangeable quotas

The experience with this instrument is still limited, given that was is implemented in 2002 in the United Kingdom, Belgium and Italy, and 2003 in Sweden.[10] This instrument monitors the RES-E development by quantity and not price. It imposes quotas of renewable energy certificates on the suppliers and creates flexibility for respecting the quota by certificate exchanges. The imposition of

10 In the United States, the 20 states had adopted a regulation known under the generic name of Renewables Portofolio Standards between 1999 and 2005, but only one third have organised a system of exchangeable quotas. Another group of states uses the bidding instrument and a last group use voluntary agreements of the utilities. For an economic analysis of this instrument which is mainly focused on the certificates market, see Schaeffer et al. (2000), van Djik et al. (2003) and Skytte and Jensen (2004).

increasing quotas of renewable electricity to suppliers is made in proportion to their sales. So the marketing of RES-E production is developed in two distinct ways, the ordinary sale of electricity on the wholesale markets and the sale of certificates by the producers to the actors subject to the quotas. The sale of the certificates acts like a premium on the value of green electricity in the respect of the competitive game between participants in the electricity market. The three principal rules in the design of the instrument (see box 1) are the increasing quota of certificates imposed on similar types of agent (the suppliers),[11] the penalty for non-compliance of the quota and the list of eligible technologies. The function of the penalty is also to limit the cost in respect of the quotas by the mandated agents, what in the UK mechanism is reflected in its name: the 'buy-out price'.

Compared with the previous instrument, the regulation is much less developed to organise the relation between the mandated purchasers of certificates and the developers. It imposes a quota of green certificates and programmes its progressive reduction over the next 10 to 15 years, but it does not impose a contractual arrangement on price and quantity between RES-E producers and their obliged purchasers contrarily to the FIT and the bidding instruments. The operators subject to the quotas have the choice between three types of arrangement to respect their quota: to buy each year the certificates corresponding to the quotas, to build the units in order to produce themselves the obliged quantity of renewable electricity, to negotiate long-term contracts with specialised producers who thereafter will decide to invest in a RES-E. They could also choose to pay the penalty for a part of their quota, or the overall. (Box 1)

The functioning of the instrument requires a great number of rules and institutions which create high administrative costs and ex-post negotiation cost for the assessment of the instrument and its adjustment by the public authority, in comparison with the FIT system. The definition of the rules must be carefully designed in order to avoid unexpected effects. Again one underlines the role of the penalty which de facto will act as a ceiling price for the certificates in the event of tension on the certificate market. If it is defined at a too low level compared to the long run marginal cost of the RES-E capacity development, it could be used as means of escaping the obligation. Conversely one will note the importance of defining the

11 It might be the consumers but in fact they delegate their obligation to the distributor-suppliers as in Sweden. A last possibility is to impose the quotas obligation on the producers and importers as in Italy.

Box 1 – Rules and institutions of RES-E exchangeable quotas

The instrument rests on a whole complex of rules and institutions:

- Clear designation of the agents subject to the quotas of green electricity: they are generally the suppliers or the distributors-retailers; in Sweden they are the consumers, but they delegate (except opposition) their duties to their supplier of electricity; in Italy, they are the producers and importers;
- Designation of eligible technologies, with exclusion of existing installations (at the exception of the Flemish system; exclusion of great hydraulic plants and waste incineration,) and exclusion of those located in foreign countries;
- Installation of a system of certification and control;
- Definition of a penalty for non-compliance of the quotas, possibly associated with a complementary rule on the use of the penalties collection by sharing this public income between the agents respecting their quotas, which creates an additional incentive to respect the quota; note that the penalty acts also as a price ceiling on the green certificates market;
- Introduction of a floor price in the event of a surplus of the certificates on the market, with a purchase commitment by the regulatory authority;
- Creation of rules for certificate exchanges with the organization of a green certificates exchange with various possible designs in terms of duration of the certificate, borrowing, banking which opens the room for manoeuvre for market participants;

By taking as example the British case of the 'Renewable Obligation Certificate System' (ROC System) which replaced in 2002 the mechanism of competion bidding of the Non Fossil Fuel Obligation (Mitchell and Connors, 2004), the quota was fixed at 3% in March 2003 and must reach 10.4% of the sales in 2011, but its growth has had to be extended to 15.4% in 2015 in order to give longer-run visibility on the RES-E producers revenue by maintaining the demand for certificates. To satisfy this obligation, the suppliers have the possibility of buying green electricity or certificates with an accredited producer. They can also discharge the buy-out price, i.e. the penalty in the event of non respect of the quota which is quite low (5c€/kWh) if we compare to the total cost of wind power (7c€/kWh) and the average wholesale price (3.5 c€/kWh).

quota at a level which does not involve a marginal cost close to the penalty; such a level would provoke a massive escape of obligated purchasers by the payment of the penalty or buy-out price.

In the array of rules it is important to note also the needs of foreseeability of the progression of the quota in the very long term in order to attract the investors. When the general RES-E quota will stabilise shortly (for instance from 2010), it gives rise to the anticipation of a price fall before the horizon of pay-out time of new RES-E units. In the same way the stability of the certification of technologies is needed, knowing that the introduction of an eligible technique is able to increase abruptly the number of certificates available and to make the price of the certificate fall and by then the economic value of RES-E units.

3.1 Compatibility with the market regime of electricity industries

This criterion is the only one which gives a clear advantage to this instrument. But this advantage is effective only if the liberalisation reform is in-depth with a clear-cut unbundling between supply and network activities and a complete opening-up of the final market for several reasons. With this instrument RES-electricity is in theory sold in an ordinary way on the electricity markets (the spot market or the market of forward contracts) and in a supplementary way by the sale of certificates to the actors subject to the quotas of certificates. The instrument respects the competitive game between participants in the electricity market, in particular by avoiding placing the RES-E generation apart from the electricity market.

In the second place, adoption of the in-depth market model leads to a 'de-territorialisation' of the supply of electricity which formerly was closely related to the network area of the distribution monopolies. For the previous instrument, this change poses a problem of definition of the purchase obligation, as has just been seen. For the exchangeable quotas mechanism, it does not pose a problem since the obligation imposed on suppliers is not linked to the location of new RES-E units, but on the holding of green certificates, which can be bought from any geographical production of RES-E units. However, as we have already underlined, in the countries with non-radical liberalisation reforms, i.e. with no clear-cut unbundling and with incumbents keeping a strong territorial base of de facto captive customers, the FIT instrument can continue to function, as is the case in Germany and France, provided that the obligated purchasers, the incumbents, are compensated for the costs of the RES-E quota obligation.

In the third place, as the quota of renewable electricity which is defined at the national level is mandated in an equitable way on all the competing suppliers, it is not necessary to envisage a specific financing mechanism to compensate for the obligation cost. Given that there is no externalised financing of the RES-E production cost, this facilitates the acceptation of the RES-E policy by the regulator and the large purchasers of electricity.

3.2 Limitation of environmental effectiveness by high transaction costs and risks

We must not forget the risks and the transaction costs between developers and obliged purchasers of certificates, as has been pointed out. While focusing on the market of green certificates, the promoters of this device underestimate the need for contractual security of the investors in RES-E and their lenders to ensure the financing of the investments and their returns. They increase the obstacles in the development of projects.

High risks in transactions. It is important not to lose sight of the fact that the characters of the instrument structure the relation between mandated suppliers, developers and bankers:

- the suppliers who undergo the obligation face uncertainty on the prices of the electricity and the certificates and they have to choose between different arrangements with developers-producers to respect the quotas;
- the developers-producers are more committed in transactions with mandated purchasers than these because they invest in relation to the RES-E policy: if the policy is cancelled or redefined, they are clearly exposed to the risk of value loss. They must set up projects whose preparation is costly and risky, secure cash-flow and reach a convenient return on investment,
- the lenders who are not easily taken in by the attractiveness of the certificates quotas.

For the developers, the risk of investing in RES-E units is much more significant than with the two previous ones, in particular if one seeks investment recovery by the revenues of direct sales of certificates and electricity. Uncertainty on the electricity price combines with uncertainty on the price of the certificate, and eventually on the complementary revenue from the buy-out payment (in the UK it is

ex post allocated to the agents who respect their quotas from the buy-out fund).

Moreover the price of the certificate presents for the developers a regulatory risk which one does not find with the other instrument. Indeed the stability of the rules of eligibility of technologies and their certification are not guaranteed: a change in a technique (the introduction of wood and fuel cofiring for example) increases abruptly the number of certificates available and cause a drop in the certificate price, which leads to a form of partial alienation of the value of the RES-E units developed within this regulatory framework. In the same way there is uncertainty on the effects of the quota trajectory when it gets close to its stabilisation for the future developer's incomes because their horizon of investment pay-out is generally higher than 10 years. The stagnation of the quota beyond a ten-years horizon can create the fear of an oversupply of certificates on the market and thus a fall of the certificate price.

Transactional difficulties for the developers-producers. The risk profile makes the relations between developers and mandated purchasers more complex; each are exposed to the risk of opportunism by the other party. A typical example is the wish of obligated suppliers to contract only in the medium term (3 or 4 years) with developers while these seek on their side to protect their investment by a long term contractual arrangement with a guaranteed price: the obligated suppliers want to be able to profit from an eventual drop of certificate price. Conversely if the quotas are severely increasing and the demand for certificates important, RES-E producers engaged in supply contracts at guaranteed prices could be tempted to break the contract and to impose a price renegotiation. Beyond these two cases, the 'framing' of the investments in RES-E by spot sales of electricity and certificates generates a lot of transaction costs.

Because of its nature the exchangeable quotas instrument leads to the adoption of other contractual arrangements than spot transactions on the market of green certificates to frame investment in new units. With regard to the obligated party the incurred risks and transaction costs lead large suppliers to commit to long-term contracts with guaranteed prices with no indexation on the certificate prices. The guaranteed prices are negotiated by reference to the cost of the new RES-E units. An alternative is the vertical integration with the development of RES-E units by subsidiaries paid at an internal price. Looking for long term contracts and vertical integration are necessary for ensuring the financing of the projects because it is the only way of making a project 'bankable' with a 'project financing' arrangement

to obtain loans. In the United Kingdom, since the implementation of the ROC system in the mid-2002, most of the investments are carried out by subsidiary companies of the five large suppliers and a small part is made by independents protected by a long term contract with a minimum contractual time-span of 13 years. It is also observed in Texas where, despite the possibility of exchanging certificates, all the distributor-suppliers who carry the obligation have negotiated bilateral long term contracts (10 to 25 years) to reach their quotas of renewable electricity (Langniss and Wiser, 2003).

Moreover, for the larger suppliers vertical integration offers the possibility of resorting to ordinary loans guaranteed on all their assets, which are significantly cheaper than project financing arrangements. Only the small obligated suppliers have permanent recourse to the certificates market, when they do not choose to escape the quotas obligation by the payment of the buy-out price. The function of the certificates market is reduced to that of a compliance market for the mandated suppliers. The transactional efficiency is lower than that of the other instrument, which affects the environmental effectiveness of the EQ instrument in terms of RES-E installation.

The main obligated suppliers which will de facto become directly or indirectly the major developers-producers do not look to have certificates in surplus, because the certificate price could stay at a high level, which maintains the value of their RES-E unit. In this situation smaller agents are incited to escape partly or totally to the RES-E quota obligation by paying the penalty.

3.3 Control of collective cost

The exchangeable quotas instrument has in theory three economic advantages: first the possibility of control of the collective cost by the monitoring of the development of the RES-E capacity and the tuning of the penalty (or buyout price), second the incentive to cost minimising exerted on the developers by the market pressure, and third the certificate exchanges between producers having different RES-E costs (cheap resources, technologies).

First in the logic of this market-oriented approach, government will prefer to create a 'safety valve' for helping the obligated suppliers to respect their quotas at limited costs and it defines a low penalty for that reason. The British EQ system shows how a low penalty drives a number of obligated suppliers to not respect their quota. Between 2002 and 2004 the 'buyout price' was 43 c€/kWh for a certificate: it is quite low because that corresponds to a reference

cost price of 75 c€/kWh of RES electricity (the market price of 'grey' electricity is 30 c€/kWh), while the long run marginal cost of wind power is around 60 c€/kWh. In this case the agents who are subject to the quotas with respect to the penalty can question the reaching of the national objective if many of them choose to escape the quota obligation by paying the buyout price. It is what suggests the two first years of operation of the British system in 2002–2004 when 41–45% were met by the payment of the buyout price (Ofgem, 2005). Since 2004 the buyout price has been increased to 70 c€/kWh and 31% of the quotas were met by the payment of it in 2005. Possibly it could be reduced in the future because the main suppliers have the means of respecting their increasing quota of certificates by less risky paths than the purchase of certificates. Anyway the aim of collective cost control which is behind the adoption of the EQ instrument and the definition of low penalty in fact contradicts the possibility of achieving the ambitious goal of installation of RES-E units.

Second, the instrument creates an incentive to decrease costs for new projects by the pressure of competition in which agents subject to the quotas of certificates are engaged without cost recovery rules for the obligation cost. It also allows for the limiting of rent on the side of the producers and choosing the least expensive solution. But this advantage of the FIT instrument should not be overestimated if the comparison is made with flexible feed-in tariffs. This advantage is counterbalanced by one drawback compared to the previous instrument: the importance of the risk for the developers and the obligated suppliers. This leads to two consequences: to incorporate significant risk premium and to incite the development of only the most mature technologies.

As first consequence, the obligated purchasers in the quotas have to pay the complete costs of the developers while choosing to engage in long term contracts. Developers seek a certain rate of profitability with some risk premium, and their costs are not so far from those of the mandated purchasers in the flexible FIT system such as they are conceived in Germany and France. Mitchell et al. (2005) show that, for the year 2002, the level of remuneration of wind power by the quota instrument in the UK is comparable with that of the FIT of other countries.[12] Consequently the cost for consumers with

12 Butler and Neuhoff (2004) show also that the added remunerations for wind power kWh by the quotas instrument (6 c€/kWh) are higher than the German sliding-scale FIT applied to the British conditions of wind resources (5.2 c€/kWh).

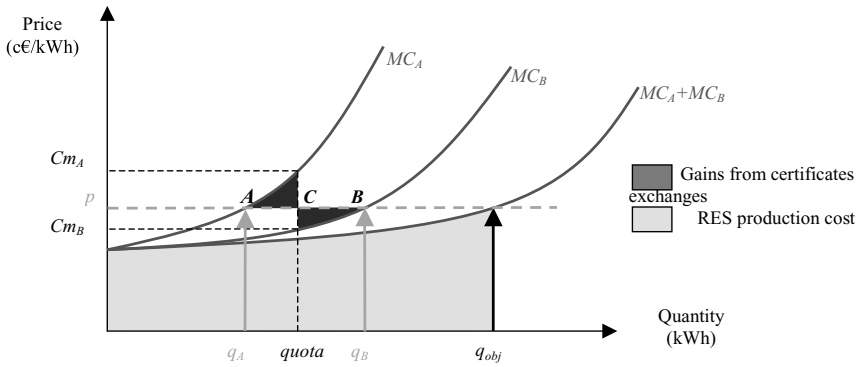

Figure 3 – Theoretical economic gain to certificates exchanges between two countries

the quotas instruments is not inferior to the cost resulting from the flexible FIT tariffs. The second consequence, the quotas instrument is weak in terms of dynamic efficiency. It appears much less adapted than FIT (and also the bidding instrument not considered here) to support technologies that are still partially immature, given that all the eligible technologies have the same treatment. It de facto favours mature technologies. That means that it is necessary to use complementary instruments as FIT, bidding or tax credit for emerging technologies whose learning cost must be compensated.

3.4 Efficiency by the European integration of certificates markets

In the same way that the introduction of competition into electricity industries had mainly to be promoted to support the integration of the electricity industries in the European Union in view of cost and price decreases, the harmonised adoption of exchangeable quotas would make it possible to reduce the costs in respect of a European quota of RES-E by allowing the countries the least endowed in renewable resources (countries A in figure 3) to profit from the RES potentials of the best endowed ones (countries B).

But for these presumed advantages, the idea that a liquid and integrated market of certificates could exist beside an electricity market supposed itself to be integrated is pure utopia.[13] The passage from

13 In a revealing way, some theoretical works have examined this idealised perspective of the interrelationships between strategic behaviour

principles to reality holds surprises if one forgets the institutional conditions of integration of certificate markets, in particular the clarity and the homogeneity of attached 'property rights'. In the political project of harmonisation of RES-E instruments between Member States, the main idea is that certificates exchanges would allow an optimal effort between the Member States and would result in the priority exploitation of resources at the lowest cost, which would limit the total cost of the European objective. One would thus exploit the wind resources of Scotland, Galicia or the Peloponnese to sell certificates to obligated suppliers located in countries less endowed in resources like Germany and Belgium. But, as one will see, the obstacles are such that it is illusory to imagine such an integration of certificates exchanges at the level of the European Union. The mechanism has not the qualities that its promoters claim. Property rights defined by the RES certificates need to be clear, homogeneous and harmonised between countries, and this is not the case.

No possible harmonisation of property rights. The first obstacle to the homogenisation of property rights on certificates is the impossibility of having an integrated electricity market, even if it is wanted by governments, the European Commission and the main stakeholders. We must remember that the certificate price theoretically is the difference between the cost of the marginal RES-E project and the price on the electricity market. This means that if wholesale electricity prices are different between national markets, the property right on the green part of RES-E kWh will be different between countries. The countries where the price is significantly higher than in others, for instance an average price of 50€/MWh versus 30€/MWh, would see their RES-E projects subject to a penalty of 20€/MWh by comparison with the same type of projects based on the same technology and available resource in the second group of countries.

The integration of electricity markets exists by and large in certain regions, in particular between Nordic countries; there are some indications of integration between some 'continental' markets (France, Germany, Austria, Belgium, Netherlands). But first the so-called electricity peninsulas (Italy, Iberia, the Nordic countries, UK) will not be integrated tomorrow in a vast pan-European market with price unification for technical reasons: the physical limitations on

on an integrated market of green certificates and an integrated electricity market (Morthorst et al. 2003, Jensen et al. 2003, etc.).

interconnection capacities which separate the markets.[14] Second on supposedly integrated markets there are splits between the national markets in part of the year, and some regulatory rules (access to interconnections, no homogeneity of balancing rules) limit a complete integration of short term markets.

The second significant obstacle to certificates market integration owes to the fact that this system is very demanding in terms of rules. If the general adoption of this instrument is decided in the European Union, not only all the rules (eligible technologies, type and duration of the certificate, certificate exchange rules, etc.) must be harmonised,[15] but the whole of the support instruments to RES-E (tax credit, direct subsidy to investment, premium on indirect fiscality, etc.) must also be harmonised, or completely suppressed. A country which maintained support of the quota system would create an artificial cost advantage for its RES-E production in development and this would distort the competition between projects at the European level.

The European view appears to ignore these obstacles because of the fascination for market exchange. An enlightener of that is the institutional fiction on which a number of modelling exercises rest, which were made for the European Commission to assess the advantage of integration of green certificates markets (REBUS, El-Green, GREEN-X, etc.) in order to have an economic reference in a perfect world. But some of them are unaware of the obstacles to integration of electricity markets and the distortions which will be introduced by the differences in rules of the quotas instrument between countries and in complementary instruments.

The less demanding alternative way to optimise the European policy cost. It must be added that the economic advantage which is looked for at the European level with the common adoption of exchangeable quotas could be approximated by another approach which simply defines differentiated national obligations (the RES-E percentage of the national electricity production) along with the estimated potential

14 In normal years the wholesale prices in the 'electricity peninsulas' without capacity surplus (Spain and Italy) are thus higher 40–55 c€/kWh, and should remain so, than in the markets with some capacity surplus of the 'continental market', as for the markets of Great Britain and Scandinavia (around 30 c€/kWh in 2004).

15 It is evident, but it merits being repeated, that RES-E production existing before the beginning of the RES-E policies must be excluded from the certificates system in order to avoid useless transfer of rents from one country to another without any RES-E capacity development.

of resources in each member state and the marginal costs. It is indeed the philosophy with which the voluntary objectives of development of the RES-E in the 2001 Directive were defined by referring to expert studies on the RES-E potential in each country (ESD, 1996). The adoption of constraining differentiated objectives to be reached with the use of freely chosen instruments (FIT, quotas or bidding not considered here) will be an effective substitute to a difficult convergence in the adoption of the exchangeable quotas instrument and the abandonment of the other instruments. The only caveat is the difficulty of defining economically and socially achievable objectives for each country, with a supposed equalisation of aligned long-run marginal costs of the RES-E objectives between the member states.

So if the rationale for the harmonisation of RES-E instruments in Europe is the social efficiency of integrated certificate markets, there is no chance at all to get it in the future, because the prerequisites of their integration on the basis of clear and homogenous property rights on the green certificates are considerable. As there is no chance of market integration on a fair basis, the pressures towards a harmonisation of RES-E instruments towards the quotas instrument have no legal justification.

To conclude on the quota instrument, one must stress again that fundamentally it is not the certificates exchanges but the quota combined to the threat of penalty for non-compliance. The mechanism of certificate exchanges plays only a minor role. The reality of contractual arrangements for developing RES-E units is not so different from that of the other instruments. As the quotas instrument introduces a large risk to invest, it incites vertical integration or long-term contracts with guaranteed prices to limit financial risk, while FIT instrument is organised around long term commitment on guaranteed price and purchases.[16] The principal type of competition in the quotas mechanism is a competition for long term contracts.

The theoretical economic advantage of the quotas instrument is reduced to the incentive to choose the least costly technological solution, but the other side of the coin is the absence of technological diversification. Moreover the design of the instrument which aims at a double control of the collective cost by the fixing of quotas and the definition of the penalty, affects the environmental effectiveness of

16 Note that the bidding instrument also relies on long-term contracts with a fixed price, the price being the bid price proposed by the developer-producer.

the instrument. In fact, as the British ROC experiment shows, the regulator tends to limit the cost for the obligated suppliers and the consumers by defining a low penalty. That reduces the environmental effectiveness of this quantity-instrument, as shown by the first results of the British quota instrument.

In fact the rationale of the adoption of this instrument rests on one practical advantage and one hidden advantage. The practical advantage is the compatibility with a thorough liberalisation reform of the electricity industry at the level of distribution. But given the general move of vertical and horizontal re-integration in the European electricity industries it is doubtful that the RES-E obligation which would result from a future Directive on RES-E development which will have to be designed in the single terms of RES-E quotas in every country. The hidden advantage is the better acceptability of the instrument by the regulators, the obligated suppliers and the large electricity consumers: for the first there is no need of externalisation of the financing of the cost of the RES-E obligation; for the second, the control of the overall costs of the policy by market incentives and by the possibility of escaping the obligation by paying the buy-out price is an important advantage.

4. Conclusion: the lack of an optimal instrument

There appears to be no clear-cut advantages in favour of any one instrument (see Table 1), especially as defects of the FIT could be corrected by flexible rules.

- FIT promises great environmental effectiveness and technological variety by its character of technology-specific support, but FIT with time-constant tariffs is the least propitious for the control of the collective cost and the developers' rent, though it is the most efficient in dynamic terms. It is

Table 1 – Comparison of performances of FIT and EQ instruments

	Feed-in tariffs	Exchangeable quotas
Collective cost control	+ with flexible FIT	+
Dynamic efficiency	++	–
Environmental effectiveness	++	0/+
Transaction cost & RES-E Investment protection	++	–
Compatibility with in-depth liberalisation	0	++

efficiently adapted by flexible price rules applied to limit costs for consumers and producers' rents.

- The exchangeable quotas also introduce large transaction costs and risks for the main agents, the obligated purchasers and the developers. The EQ instrument incentivises both of them to choose long term contracts and vertical integration. Certificate exchanges are only a marginal way to respect quotas and create incentives for seeking productive efficiency. This instrument is not technology-specific and not favourable to the commercial maturation and dissemination of other technologies than the most mature. In terms of environmental effectiveness exchangeable quotas offers the possibility of escaping the obligation by the payment of the buy-out price. In terms of social equity, the cost of a policy is mainly passed on to households and commercial market segments with the lowest price-elasticity.

As emphasised here, the defects of the FIT instrument could be completely reduced by a correction to the rules to make them more efficient and more equitable by the reduction of the new producers' rents. Finally, the most discriminating criteria to select one instrument is its compatibility with the in-depth liberalisation regime: this would play to the advantage of the quota instrument, but only if the market reform in a country is in respect of the pure decentralised competition model, this is not the case currently. The theoretical advantage of the development of an integrated certificates market is completely offset by its feasibility and the absence of real integration of electricity markets.

Ultimately, this analysis highlights two unusual points. First, it is the institutional environment which determines the way in which social effectiveness is appreciated: the relative values attached to environmentalism or the culture of market. These values contribute to how the social effectiveness of these instruments is perceived. The more government and public authorities seek to control the collective cost of their policies, the more the instruments will be based on market mechanisms. However, the more a government seeks high performance in environmental policies, the more it will arbitrate in favour of the FIT tariffs.

For a few years now fierce promoters of market instruments for the promotion of RES-E have been more cautious, as shown by the recent evolution of the position of the European Commission towards a transitory compromise attitude (European Commission, 2004). But the forcing of a harmonisation of instruments towards a uniform EQ

system would not have the attendant benefits. The choice of RES-E instrument should remain basically a political decision, depending on governmental preferences (environmental effectiveness, control of collective costs, rent limitation) in the specific cultural context of each country. Efficiency can be mainly gained by the improvement of instruments.

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L'efficacité comparée des instruments de promotion des énergies renouvelables dans les industries électriques libéralisées

L'article compare l'efficacité des deux principaux instruments utilisés pour la promotion de la production électrique à base d'énergies renouvelables (ENR) dans le cadre des politiques climatiques. Fondés sur une obligation d'achat placée sur les fournisseurs d'électricité, ils agissent soit par les prix (les tarifs d'achat utilisés en Allemagne, France, Espagne), soit par les quantités (quotas de certificats verts échangeables comme en Grande Bretagne, Italie). Dans leur version de référence, les instruments se différencient en termes de rente laissée aux producteurs, de contrôle du coût pour les consommateurs, d'incitations à l'efficacité par le marché, de garantie de long terme pour les investisseurs en ENR et de conformité avec le régime de marché de l'industrie électrique. La comparaison montre que les qualités attribuées aux quotas échangeables qui ont la faveur des partisans du marché sont largement surévaluées et qu'aucun ne présente des avantages déterminants par rapport à l'autre. On montre que les qualités théoriques intrinsèques des quotas échangeables qui sont mises en avant pour justifier son adoption par les membres de l'Union européenne sont largement surévaluées. On conclut que les gouvernements doivent être laissés libres de choisir l'instrument qui leur convient en fonction de la hiérarchie de leurs objectifs: volontarisme environnemental et climatique versus contrôle des coûts par la pression concurrentielle.

Die soziale Effizienz von Instrumenten zur Förderung erneuerbarer Energien in der liberalisierten Elektrizitätswirtschaft

In diesem Beitrag wird die soziale Effizienz der beiden wichtigsten regulatorischen Instrumente verglichen, die angewendet werden, um den Einsatz erneuerbarer Energiequellen in der Elektrizitätserzeugung (RES-E) zu fördern, indem ihre Rolle bei der Förderung des Klimaschutzes in Betracht gezogen wird. Sie basieren auf einer

Abnahmeverpflichtung und laufen entweder über den Preis (feed-in-Tarife) oder über die Menge (RES-E-Quoten). Entsprechend ihrer Konstruktion führen die Instrumente zu unterschiedlichen Ergebnissen in verschiedenen Ergebnis-Dimensionen wie: Intensität der Marktanreize, Kontrolle der Kosten für den Verbraucher, Sicherung von RES-E-Investitionen und Konformität mit dem neuen Markt-Regime der Elektrizitätswirtschaft. Der Vergleich zeigt, dass keines der Instrumente eine optimale Lösung in jeder dieser Dimensionen bietet. Insbesondere werden die dem Instrument der Quoten immanenten Vorzüge überschätzt, welche vorgebracht werden, um die EU-Mitglieder zu deren Einführung zu veranlassen. Die Regierungen werden deshalb jeweils ein Instrument entsprechend dessen relativer Bedeutung im Hinblick auf die von ihnen verfolgten Ziele auswählen: Umweltpolitik oder Kostenkontrolle durch Druck des Marktes.

Eficiencia comparada de los instrumentos de promoción de las energías renovables en las industrias eléctricas liberalizadas

El artículo compara la eficiencia de los principales instrumentos utilizados para la promoción de la producción eléctrica a partir de energías renovables (ENR) en el marco de las políticas climáticas. Fundamentados en la obligación de compra a los proveedores de electricidad, los instrumentos se activan bien a través de los precios (tarifas de compra obligatoria utilizadas en Alemania, Francia y España), bien a través de las cantidades (cuotas de certificados ambientales canjeables como en Gran Bretaña e Italia). En la versión de referencia los instrumentos se diferencian en función de los ingresos que proporcionan a los productores, en el control de costes para los consumidores, estímulo a la eficiencia para el mercado, garantías a largo plazo para los inversores en ENR y conformidad con las reglas de mercado. La comparación pone de manifiesto que las cualidades atribuidas a las cuotas canjeables que cuentan con la preferencia de los participantes en el mercado están ampliamente sobrevaloradas y que ninguno presenta ventajas determinantes en comparación con los demás. Se pone de manifiesto, asimismo, que las cualidades teóricas intrínsecas de las cuotas canjeables que se han tomado como referencia para justificar su adopción por parte de los miembros de la Unión Europea están ampliamente sobrevaloradas. Se concluye que los gobiernos deben ser libres para elegir los instrumentos que les convengan en función de la jerarquía de sus objetivos: preocupación ambiental y climática versus control de costes por las presiones competitivas.