The European Experience with Renewable Energy Support Schemes and Their Adoption: Potential Lessons for Other Countries

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In the EU since the late 1990s, two schemes for renewable electricity support have competed with each other: feed-in tariffs (FITs) and tradable green certificates (TGCs). After electricity liberalisation began in 1997, the European Commission at first sought harmonisation of support rules and challenged FIT for violating legal provisions; however, it accepted a compromise for the first renewable energy directive of 2001. Focused attention on the results of two schemes produced valuable insights and showed overall better results for FIT. When the Commission returned to support TGC (now called guarantees of origin) harmonisation for the second renewable energy directive adopted in 2009, a coalition of Parliament and Council, strengthened by evidence gained from experience, again replaced the Commission approach by a neutral position. The controversy, its arguments and the insights it produced should be helpful for other countries facing similar policy choices.

I. Introduction

This article aims to analyse the introduction of different renewable electricity support schemes in Europe and the controversies which arose over this issue at the EU level, which resulted largely from EU efforts to prioritise the liberalisation of electricity. After an overview of the main competing schemes, it analyses the argumentative struggle over instruments – inspired by ideology and interests – against the background of insights into their actual operation gained from application over time along various dimensions: prices and competition (static efficiency), windfall profits, deployment, innovation, the ambivalence of incumbents towards RE and the potential for more committed new entrants. Finally, we look at the origin of purportedly "least-cost" "market-oriented" policy proposals in this area.

When the first support schemes for renewable electricity were first developed in Europe in the late 1980s, policy makers had little experience to go by. Supporting small-scale, decentralised technologies was quite different from funding the big science and technology projects which by then had dominated the energy sector for some time (e.g., different types of nuclear power plants including fast breeders and reprocessing, coal liquefaction, nuclear fusion, new turbines). It was not just a matter of RD&D, of developing a prototype which then could be turned over to the market. Only a few countries took the actual step of market creation for a host of new renewable generators. The new regulations were adapted to the prevailing electricity systems: regulated territorial monopolists in most cases, an emerging privatised electricity sector in a few instances. By the time the EU entered the field of regulating renewable electricity, experience with these new regulations was still scarce and ambivalent.

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II. The Broader Background

Fossil and nuclear electricity generation in Europe had received very considerable amounts of government support in the past, particularly in the wake of the oil crises of the 1970s. This is still the case today in at least three respects – firstly, via grandfathering for carbon emissions trading until 2013, secondly, via a near-total exemption from liability for nuclear accidents, and thirdly, for non-internalisation of external environmental costs in violation of the polluter pays principle. Renewable electricity also needs public support for reasons of addressing the challenges of energy security and climate change, to develop its potential to replace fossil and nuclear sources fuels and to compete with these sources on a level playing field.[1]

In the 1990s, several European countries were in the forefront of the development of renewable energy (RE) sources. In the phase of early market introduction of renewable electricity technologies, it soon became evident that such leadership was more closely related to appropriate regulation and financial support than to natural endowment, with some countries – typically those that used feed-in tariffs – being clearly more successful than others. Also in the 1990s, the European Commission was successful in advancing electricity liberalisation, in the context of liberalisation and deregulation efforts which were an essential feature of the new internal market policy of the EU.[2] The European Parliament and Council passed a Directive to this effect in 1996.[3] Soon afterwards Directorate General (DG) Energy – the subunit of the European Commission in charge of energy policy – began to criticise feed-in tariffs as not being compatible with a liberalised market. Since that time, the EU has adopted two renewable energy directives (in 2001 and 2009), each time after considerable political conflicts which sharpened arguments for different models of support for renewable energy.

III. Overview of Main Competing Schemes

The chief reaction of most European countries to the two energy crises of the 1970s was to expand – or at least to plan the expansion of – nuclear power and coal-based generation.[4] On a smaller scale, several countries also began to support the development of renewable energy (RE) sources, primarily in the field of electricity. One of the more promising technologies was wind power; demonstration projects were developed in Denmark, Sweden, Germany, the Netherlands, Belgium, the UK and some other countries. But in retrospect, it is clear that wind power – and RE generally – could only develop on a broader scale in countries which supported the next phase of development, i.e. market creation. In practice, this meant countries which introduced practicable financial support for renewables created markets, in line with the principle that ongoing innovation requires diffusion.[5] The leading countries were: Denmark, which was the first to develop the principle of feed-in tariffs in the late 1980s on the basis of voluntary agreements between wind power generators and the utilities;[6] Germany, where in 1990 feed-in tariffs were first enshrined in law;[7] and Spain, which had both feed-in tariffs and a premium system[8]. Financial support for renewables was generally justified by reference

1 A recent study of Germany arrives at a full cost price in 2010 (including state aid and externalities) of € 0.121/kWh for power from coal, € 0.128 for nuclear, € 0.076 for onshore wind and € 0.467 cent for photovoltaics. The high rate for PV reflects payments for 2010 installations but also continuing payments – much higher per kWh – for installations from earlier years of market introduction. In the 1970s, nuclear energy in its early phase had even higher costs per kWh (Swantje Küchler and Bettina Meyer, *Was Strom wirklich kostet. Vergleich der staatlichen Förderungen und gesamtgesellschaftlichen Kosten von Atom, Kohle und erneuerbaren Energien* (Berlin: Forum Ökologisch-Soziale Marktwirtschaft 2011)). Yet higher figures for the full costs of coal are contained in a recent US study which concludes that external costs alone add close to $0.178 to each kWh of coal power, making it considerably more expensive than all renewable sources there (Paul Epstein, Jonathan J. Buonocore, Kevin Eckerle *et al.*, "Full cost accounting for the life cycle of coal", in Robert Costanza, Karin Limburg and Ida Kubiszewski (eds), "Ecological Economics Reviews", 1219(1) *Annals of the New York Academy of Sciences,* pp. 73–98).

2 Michelle Cini and Lee McGowan, *Competition Policy in the European Union*, 1st ed. (Basingstoke: MacMillan, 1998).

3 Directive 96/92/EC concerning common rules for the internal market in electricity, OJ 2007 L 027.

4 Wilfried Kohl, *After the second oil crisis: Energy policies in Europe, America and Japan* (Lexington: Lexington Books, 1982).

5 Staffan Jacobsson and Anna Johnson, "The diffusion of renewable energy technology: an analytical framework and key issues for research", 28 *Energy Policy* (2000).

6 Niels Meyer, "Development of Danish Wind Power Market", 15 *Energy & Environment* (2004); Poul Morthorst, "The development of a green certificate market", 28 *Energy Policy* (2000).

7 Staffan Jacobsson and Volkmar Lauber, "The politics and policy of energy system transformation – explaining the German diffusion of renewable energy technology", 34 *Energy Policy* (2006).

8 Pablo Del Rio and Miguel Gual, "An integrated assessment of the feed-in tariff system in Spain", 35 *Energy Policy* (2007).

to the external costs of fossil and nuclear generation, learning curve costs, and the fact that other forms of electricity had substantially benefitted from government support in the past. Up to this day, these countries show the highest penetration by far of new renewable energy technologies, and all three became major producers of wind power equipment, Germany and Spain also of equipment for solar generation (PV and concentrated solar power).

These feed-in tariffs had a few basic features in common. First, utilities, which were still territorial monopolies in most EU countries when these laws were instituted, were obliged to buy all renewable electricity produced in their territory and offered to them by suppliers of any size. Second, these utilities had to pay generators a rate defined for a certain period of time by the legislator or the executive, based in particular on the principle of a fair return for a given technology (a principle which also applied to the regulation of territorial electricity monopolists). The extra cost borne by the utilities were ultimately paid by electricity consumers, not taxpayers, although in Denmark and Spain some subsidisation by the state also took place. As this cost grew, there was often some special treatment for large industrial consumers who were not required to pay their full share.[9] Thus, payments under feed-in tariffs could not simply be equated to state subsidies. All in all, they created substantial stability and predictability for project developers, who on the basis of a sound project did not normally encounter problems either of financing or of selling the electricity they generated.

In the UK, quite a different regulatory approach was practiced at that time – in the 1990s. Thatcherite electricity policy involved the privatisation of the national electricity monopolist CEGB (Central Electricity Generating Board), which was meant to be split up into different companies to replace monopoly by competition. In this context, British nuclear generation proved unprofitable and could not be privatised without some form of subsidy. This led to the introduction of the Non-Fossil Fuel Obligation (NFFO) – a term that was expected to be received more favourably than "nuclear obligation" – and an attendant levy. A creative bureaucrat argued successfully that renewable generation could also benefit from this obligation, i.e. a quota for non-fossil fuels that energy suppliers had to achieve.[10] The support scheme for renewables – unlike that for nuclear power, which was cherished by the government for a variety of reasons, including its usefulness in combating the coal miners union – became a showcase of the passion for competition which then pervaded government think tanks. This concern for competitiveness did not take the external cost of fossil or nuclear generation into account; the central goal was to reach prices of "normal" generation as soon as possible. Project planners had to submit competitive bids at auction rounds which took place irregularly; the lowest bidders for each line of technology (the auctions differentiated in this respect) received contracts with specified prices. When prices for wind energy bids declined dramatically over the 1990s, this was interpreted by enthusiasts of the scheme as the triumph of competition over permanent subsidisation. It turned out however that those bids had simply been unrealistically low; most of the projects of later NFFO rounds were never built.[11] Quite possibly, the biggest impact of this scheme consisted in the creation of a myth – the myth of a successful incentive system for renewable energy based on competition which was rapidly bringing down prices through unleashing the forces of the market. This myth seems to have gained a foothold in DG Energy in the late 1990s in terms of renewable energy policy making, particularly in the White Paper of 1997[12] and the Working Paper of 1999.[13] The next biggest impact of NFFO was the creation of a strong anti-wind movement in Britain long before wind power even took off; this was the result of pressure on developers to pick the windiest spots regardless of landscape impact and local resistance, something that rendered timely consul-

9 Bernd Hirschl, *Erneuerbare Energiepolitik im Mehrebenensystem* (Wiesbaden: VS Research, 2008).

10 Hartnell quoted in Martin Uhlir, „Politische Unterstützung für Erneuerbare Energien Technologien zur Elektrizitätsbereitstellung in Deutschland und Großbritannien", M.A. thesis on file at the University of Salzburg (2011), at p. 67.

11 Catherine Mitchell and Peter Connor, "Renewable Energy Policy in the UK 1990–2003", 32 *Energy Policy* (2004); David Elliott, "Comparing Support for Renewable Power", in Volkmar Lauber (ed.), *Switching to Renewable Power: a framework for the 21st century* (London: Earthscan, 2005).

12 Commission White Paper for a Community Strategy and Action Plan, "Energy for the Future: Renewable Sources of Energy", COM(1997)599.

13 Commission Staff Working Paper," Electricity from renewable energy sources and the internal electricity market", SEC(1999)470.

tations with the local population practically impossible.[14]

IV. The European Commission Favours TGC Early On

The Commission had taken up the topic of support for renewable energy shortly after the adoption of the Electricity Liberalisation Directive in 1996. After a brief period of ambivalence, it soon became clear that its chief priority was to make such support compatible with liberalisation[15]. In its view at the time, feed-in tariffs could not serve this purpose as they were not formed in a process of market competition. This position led to a challenge of the German support scheme at the behest of the big German utilities. Once they realised that, contrary to their expectations, the German Feed-in Law of 1990 was greatly stimulating deployment of RE facilities, they attempted to stop or modify feed-in tariffs (FIT) by arguing that they represented unlawful state aid under EU law and complained to this effect to the Commission's competition authorities (DG Competition). At first, DG Competition – the stronghold of neoliberal policy beliefs in the European Commission – only asked the German government to review those tariffs and to adjust them downwards. Later on, it questioned the very principle of the 1990 Feed-in Law in proceedings before the European Court.[16] Parallel to this process, DG Energy was preparing drafts of the renewable electricity directive, which provided for harmonisation (i.e. a directive that would install a uniform framework for support schemes) along the lines of a tradable certificates scheme (see next section). Then-Energy Commissioner Papoutsis held tradable certificates to be superior in terms of static and dynamic efficiency as well as effectiveness, since the certificates were more market-based than feed-in tariffs, due to the reliance on direct competition between generators. This judgment was based expressly on economic theory and on the misleading evidence of the NFFO's success in bringing down prices as described above.[17]

1. Tradable Green Certificates and Subsequent Developments

A brief introduction of tradable green certificate systems (TGC) should suffice. The systems involve the following elements:

1.) A quota of renewable electricity certificates that all suppliers must meet during a given period of time (the quota usually increases over time and is expressed as a percentage of total electricity consumption);
2.) the provision that this quota may be met independently from the actual distribution of renewable electricity by a given supplier as long as that supplier handed in certificates in the required amount to the electricity regulator at the end of each year;
3.) the issuance of certificates to generators of renewable energy for each MWh of renewable electricity produced – certificate producers can sell them to those with regulated obligations;
4.) a market for trading certificates; and
5.) a penalty (or "shortfall charge") for those suppliers not meeting the required quota. This penalty must be high enough to deter free riding.

Generators of renewable electricity, thus, had two revenue streams: from the sales of electricity at going market prices and from the sale of certificates.[18] The proponents claimed that tradable cer-

14 Moore cited in Uhlir, „Politische Unterstützung für Erneuerbare Energien Technologien zur Elektrizitätsbereitstellung", *supra* note 10, at p. 80; Till Stenzel and Alexander Frenzel, "Regulating technological change – The strategic reactions of utility companies towards subsidy policies in the German, Spanish and UK electricity markets", 36 *Energy Policy* (2008).

15 Volkmar Lauber and Elisa Schenner, "The Struggle over Support Schemes for Renewable Electricity in the European Union: A Discursive-Institutionalist Analysis", 20 *Environmental Politics* (2011).

16 Opinion of Advocate General Jacobs in Case C-379/98, *PreussenElektra AG v. Schleswag AG*.

17 Commission Staff Working Paper, "Electricity from renewable energy sources and the internal electricity market", SEC(1999)470; Hirschl, *Erneuerbare Energiepolitik im Mehrebenensystem*, *supra* note 9; Volkmar Lauber, "The Politics of European Union Policy on Support Schemes for Electricity from Renewable Energy Sources", in Lutz Mez, (ed.), *Green Power Markets* (Essex: Brentwood, 2007); Lauber and Schenner, "The Struggle over Support Schemes for Renewable Electricity", *supra* note 15.

18 Commission Working Paper, "Electricity from renewable energy sources", *supra* note 13.

tificates would allow for an optimal integration in a liberalised electricity market. Assuming that generators were subjected to rigorous competition, this system was expected to drive down prices for renewable electricity much faster than feed-in tariffs, which in turn was expected to lead to faster deployment of renewable electricity technologies and to more rapid innovation in their development. The additional costs of RE support under this scheme are also borne by the final customers.

DG Energy's insistence on harmonisation of national laws via the adoption of the TGC model led to intense conflicts between the European Commission on one side and the majority of the European Parliament, the Council, and the renewable energy sector on the other.[19] The advocates of FITs based their case not so much on claims of superior economic efficiency, but on evidence of a better record of deployment. FIT proponents also used another argument, which proved decisive in the political debate at the EU-level. They argued that the Commission was overstepping its bounds by outlawing FITs and requiring a specific support scheme – i.e. that it was interfering with member states' sovereignty in energy affairs. This claim met with strong support in the Council and could not be disregarded. The next Energy Commissioner – Loyola de Palacio – took over in 1999 and submitted a new directive proposal which abandoned Community-wide harmonisation of renewable support laws. In its preamble, the new directive stated that the experience necessary for such a decision was still lacking.[20] The matter was to be left to Member States as long as they respected the principles of the internal electricity market .[21] In March 2001, the European Court decided in *PreussenElektra v. Schleswag*[22] that the German FITs under the Feed-in Law of 1990 did not amount to state aid and, therefore, could not be challenged by the European Commission. The 2001 Directive also laid down that by October 2005 the Commission should evaluate the various national support schemes and present a report documenting the experience gained from them. If necessary, it could also formulate a proposal for a Community framework on that occasion. This inaugurated a period of competition between the two support schemes (FITs vs. TGC) in subsequent years. Reflection and debate regarding the two approaches was widespread, however, data for empirical comparisons were difficult to come by. This persisted until the middle of the decade, since the first tradable certificate schemes only started in 2002. Over the next few years, the UK, Belgium, Italy, Sweden, Poland, and Romania introduced TGC laws.

In 2005 the Commission submitted its report as scheduled but without a recommendation for a harmonised support scheme. Energy Commissioner Piebalgs (2004–2010) argued that experience gathered so far did not allow clear conclusions as to the superiority of one scheme over another. At the same time, the report submitted by the Commission[23] clearly showed that TGC laws were not working out as well in the European Union as they had been expected to and that their performance in some respects was clearly inferior to that of FITs. Around the same time, as experience accumulated, criticism of tradable certificate schemes started both in the scientific literature[24] and in politics. Political opposition was strongest in the UK, where committees of the House of Commons, the National Audit Office, the Scottish government, and the Carbon Trust all called for reform of the Renewables Obligation, the first TGC scheme in Europe that was actually put into place.[25]

19 Lauber and Schenner, "The Struggle over Support Schemes for Renewable Electricity", *supra* note 15.

20 Directive 2001/77/EC on the promotion of electricity produced from Renewable Energy Sources in the internal electricity market, OJ 2001 L 283/33, para. 15.

21 Directive 2001/77/EC on the promotion of electricity produced from Renewable Energy Sources in the internal electricity market, OJ 2001 L 283/33, Art. 4.

22 Case C-379/98, *PreussenElektra AG v. Schleswag AG* [1998] ECR I-02099.

23 Commission Staff Working Document, The support of electricity from renewable energy sources, COM(2005)627, at pp. 6, 28.

24 Volkmar Lauber and David Toke, „Einspeisetarife sind billiger und effizienter als Quoten-/Zertifikatssysteme: Der Vergleich Deutschland-Grossbritannien stellt frühere Erwartungen auf den Kopf", 9 *Zeitschrift für neues Energierecht* (2005); Tomas Kåberger, Thomas Sterner, Max Zamanian *et al.*, "Economic Efficiency of Compulsory Green Electricity Quotas in Sweden", 15 *Energy and Environment* (2004); Aviel Verbruggen, "Tradable green certificates in Flanders (Belgium)", 32 *Energy Policy* (2004); Catherine Mitchell, Dierk Bauknecht and Peter Connor, "Effectiveness through risk reduction: a comparison of the renewable obligation in England and Wales and the feed-in system in Germany", 34 *Energy Policy* (2006).

25 Uhlir, „Politische Unterstützung für Erneuerbare Energien Technologien zur Elektrizitätsbereitstellung", *supra* note 10, at p. 104.

2. The EU's Energy and Climate Package

At the EU-level, climate change and renewable energy policies began to become more deeply intertwined. In early 2007, the European Council adopted the "20-20-20 by 2020" goals of the Energy and Climate Package, to be translated into a series of legislative proposals by 2008. Those goals consisted in the achievement, by 2020, of a 20 % reduction of greenhouse gases, a 20 % increase in energy efficiency, and a 20 % share of renewables in energy consumption (all energy sources, not just electricity). In summer 2007, the news (leaked from Brussels) that the Commission was planning in this context a harmonisation measure for RE introducing a new variant of a TGC scheme came as a surprise, given the 2005 report and the disappointing results of national TGC schemes. The Commission pointed out that the new certificates to be created under the proposed scheme – now called guarantees of origin (GOs) – would only serve the purpose of allowing Member States with limited access to RE resources to reach the RE targets to be set by the forthcoming directive at lower cost than would be possible by domestic generation. In this way, GOs would be similar to the flexibility mechanisms of the Kyoto Protocol.

Initially, the GO scheme would only serve for trading RE between Member States, leaving domestic support laws intact, but making sure that the best renewable resources would be used first, holding down total costs. In an early draft of the directive proposal, any person – and thus electricity companies – could have bought such GOs from companies in other Member States. Protests came at first from the RE sectors in FIT countries, which anticipated a threat to the stability of their regulatory regime. The UK was a leading force behind this idea of GOs, even though it clearly did not lack abundant RE resources but was missing a support scheme to develop them at reasonable cost (see below). Up until this point, the British government favoured the approach of buying certificates rather than reaching targets at home. This led to concerns e.g. in Germany that British "persons" might buy GOs for wind power from Germany at relatively low prices (compared to British prices anyhow). This could damage German support for continued wind power deployment at home and, in consequence, hurt the industrial base of the German wind power sector, i.e. its equipment producers. Also, Germany had a record of reaching RE targets earlier than planned. But if its own RE, generated under its domestic support scheme, would no longer be counted towards achieving its national targets due to private exports of GOs, it would lose control over reaching its RE targets.[26]

Commissioner Piebalgs, in a last minute meeting with representatives of the RE sector, tried to take these concerns into account. The directive proposal was redrafted in such a way as to allow member states to restrict the trade in GOs for specified reasons. At first, this was welcomed by all participants as a good solution and the official proposal submitted by the Commission was adapted accordingly. But legal experts from all sides soon had doubts whether such a clause would hold up to a challenge before the European Court by an electricity trader. In the European Parliament, directive rapporteur Claude Turmes proposed a different answer to the underlying problem, one that would also give Member States flexibility to achieve their targets by means other than domestic generation, yet not by relying on trading (this was called "non-trading flexibility"). These States should be allowed to rely on the statistical transfer of renewable electricity between Member State authorities, on joint investments, or on pooling their targets and support schemes.[27] Parliament arrived at an agreement with the Council, which produced a similar proposal on the basis of support from advocates of national sovereignty as much as from renewable energy stakeholders (this coalition now also included the UK). In the end, the Commission favoured this amendment, which became part of the final directive.[28]

In the political process in Parliament and Council, the disappointing performance and structural problems of tradable certificates described in the 2008 EU report played an important role; so did the perspective that under the proposed GO scheme,

26 Lauber and Schenner, "The Struggle over Support Schemes for Renewable Electricity", *supra* note 15.

27 European Parliament, Report on the proposal for a directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (COM(2008)0019 – C6-0046/2008 – 2008/0016(COD)); Committee on Industry, Research and Energy, Rapporteur: Claude Turmes. A6-0369/2008 of 26 Sept. 2008, pp. 17 *et sqq.*

28 Directive 2009/28/EC on the promotion of the use of energy from renewable sources an damending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, OJ 2009 L 140/16.

the achievement of national targets could effectively be undercut be GO trading. The main organisations supporting the Commission proposal were Eurelectric and other associations of the incumbent power industry, which invoked the supposedly superior efficiency and effectiveness of a "market-based" certificate approach (even though it was clear by this time that FITs were also market-based). This support overlooked the objection that the introduction of the GO scheme might hand windfall profits to power incumbents on the order of € 90 billion.[29] With evidence mounting against the use of TGC (as laid out in the following sections), proponents of certificates lost the discursive struggle and were ineffectual in their lobbying of the European Parliament.[30]

V. Empirical Results of FIT v. TGC

The empirical comparison of the practical operation of the two models of RE support set in around the middle of the decade. In 2005 the Commission argued that the experience was not conclusive yet. But the tentative conclusions of the Commission report of 2005[31] were confirmed by the analogous report in 2008[32] and by much research from policy scientists, some of it from prestigious institutions. Its results are interesting not just for the EU but also for other countries or institutions that are considering regulations regarding renewable energy support. It seems likely that much of the experience in the EU can indeed be applied to very different geographical and regulatory settings.

The subsequent comparison extends to the following criteria on which the expectations of the advocates of the two schemes differed quite substantially: The aptness of regulations at achieving static efficiency, i.e. at bringing down prices by means of competition; the problem of windfall profits caused by regulation, a problem which emerged quite soon in the discussion but which could only be analysed in hindsight; the effectiveness of regulation in achieving rapid and substantial deployment of RE capacity; its aptness to encourage innovation (dynamic efficiency), in particular by contributing to the development of a wide range of different renewable energy technologies needed in the effort to cope with climate change; and finally its ability to strengthen the rise of RE generation either by motivating incumbent electricity companies or by encouraging new entrants (or both). Often the expectations of neoclassical theory (invoked by TGC advocates) contrasted strongly with actual results. These expectations and the main results of empirical studies comparing FITs and certificate schemes (or analysing just one of the two) on those criteria are listed below. Those results played a decisive role in defeating the second (2007–08) Commission attempt to introduce a harmonised certificate trading scheme for RE.

1. Prices and Competition ("Static Efficiency")

One of the central arguments of DG Energy in 1999 for the preference of TGC laws over FITs had been that certificate systems would lead to lower prices, because power generators would be exposed more directly to competition; this argument was based in large part on economic theory. However, the Commission's own reports of 2005 and 2008 demonstrate the opposite to be the case. They show that *"well-adapted feed in tariff regimes are generally the most efficient and effective support schemes for promoting renewable electricity."*[33] The highest prices for RE generation are in fact paid under certificate systems. Figures 1 and 2 illustrate this for onshore wind power.

Mitchell et al. argued that the greater degree of insecurity that investors face under a certificate system makes for more expensive financing. This insecurity has several causes. First, a potential generator cannot be certain to secure a guaranteed price for his electricity or indeed to be able to sell it at all under a certificate system; there is no guaranteed

29 Mario Ragwitz, "RES potentials and targets, new flexibility systems & efficient instruments", March 2008, available on the Internet at <http://www.europarl.europa.eu/webnp/webdav/site/myjahiasite/users/jribot/public/JPM%20New%20Deal/renewable_energy_development.pdf> (last accessed on 31 May 2011).

30 Lauber and Schenner, "The Struggle over Support Schemes for Renewable Electricity", *supra* note 15.

31 Commission Staff Working Document, "The support of electricity from renewable energy sources", *supra* note 23.

32 Commission Staff Working Document, "The support of electricity from renewable energy sources", SEC(2008)57.

33 Commission Staff Working Document, "The support of electricity from renewable energy sources", *supra* note 32, at p. 3.

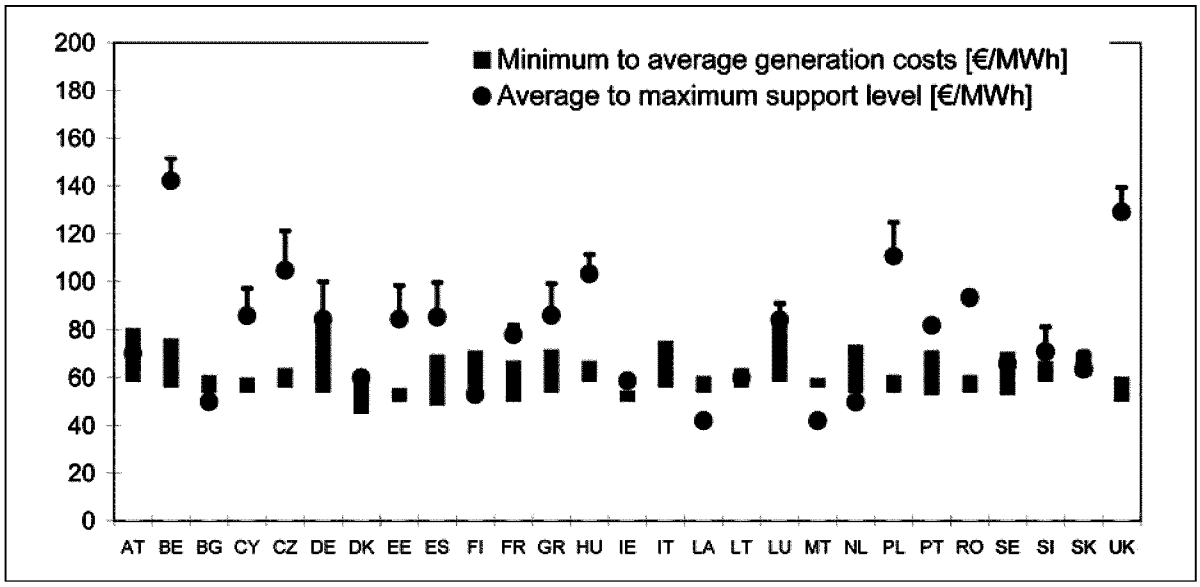

Figure 1: Support for onshore wind in EU-27

(Source: Commission Staff Working Document, "The support of electricity from renewable energy sources", *supra* note 32, at p. 24.)

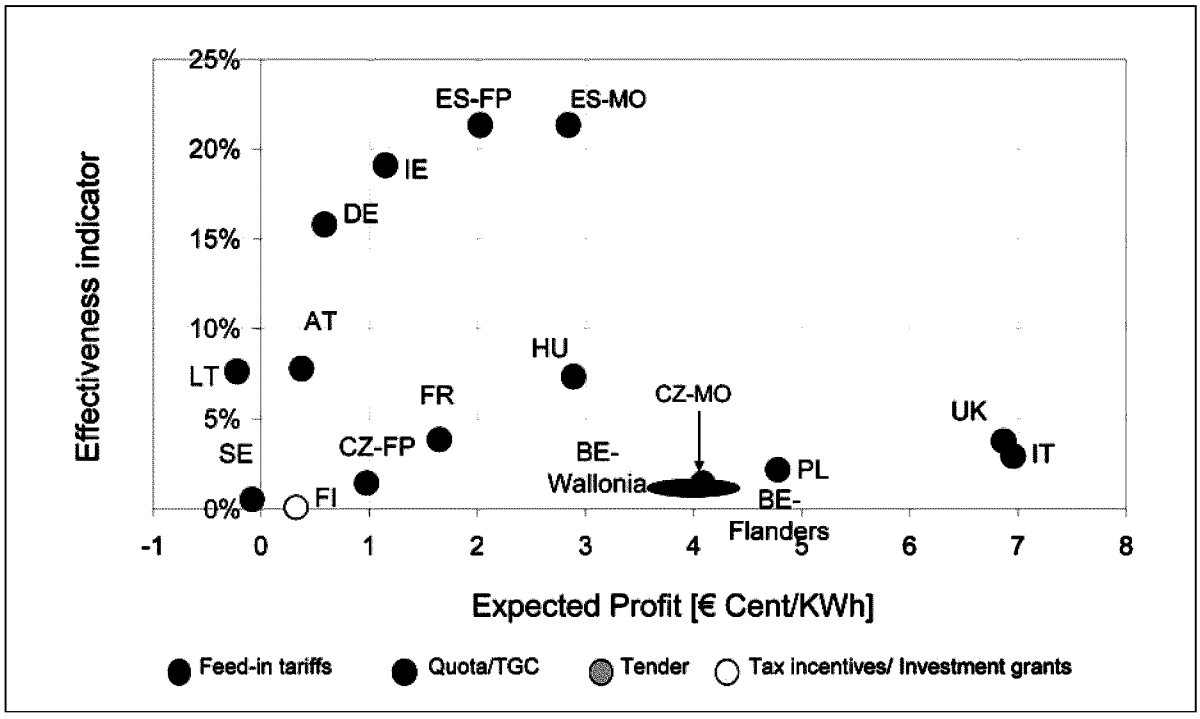

Figure 2: Support for onshore wind in EU-27

(Source: Commission Staff Working Document, "The support of electricity from renewable energy sources", *supra* note 32, at p. 32.)

price and off-take as under an "advanced"[34] FIT. Second, the same applies also to the TGCs themselves, whose price is particularly volatile. These risks will be reflected in higher due diligence

34 This expression is often used for FIT constructed on the "German model" – guaranteed and priority off-take; rates fixed for a considerable time period, often 20 years; built-in decline for each year's new cohort of installations incorporating technological learning.

expenses, which represent an additional hurdle for small projects, reducing lender bank interest in small projects. Project developers also face a higher cost of finance resulting from the higher rate of return demanded by investors and banks exposed to the above risks.[35] These factors tend to restrict renewable generation to electricity incumbents, usually oligopolists.[36]

2. Single TGC Rate, Windfall Profits

There is a second reason why certificate trading systems combine high prices with low technology costs, at least as long as there is a single rate for all technologies and sources – a feature that was common to most TGC at first, the declared goal of which was to mobilise the cheapest resources first. Following this logic, it was common to include renewable generation technologies which had been operating successfully without additional support, as waste combustion in Belgium[37] or biomass combined heat and power generation in Sweden.[38] It was argued in those cases that it was important to create market liquidity for certificates and that including those technologies would advance that purpose. Under this logic, the cheapest RE technologies were particularly attractive to potential generators, since they produced the highest windfall profits;[39] at the same time this produced little innovation. When the first detailed studies documented the high percentage of windfall profits in the total revenue of renewable generators under certificate trading schemes, this came as a surprise. For Sweden it was shown, for the period of 2003–2008, that windfall profits averaged 79 % of total revenue to RE operators – revenue which went to incumbents operating mature technologies. A Belgian study of 2009 demonstrated average windfall profits of 59 % for Flanders in the period 2002–2007; these accrued mostly for organic waste combustion facilities owned by power incumbents using a mature technology. [40] Lastly, a 2005 study showed how payments for wind power were much higher per kWh under the UK certificate system than under the German FIT , despite much better wind conditions and supposedly stronger market competition.[41]

Over time, the single certificate price for all technologies came under criticism. In response, technology banding was introduced in some TGC countries, for example, in the UK's Energy Act of 2008. This meant that the number of certificates awarded for one MWh varies by technology and source. This comes closer to meeting the costs of particular sources and technologies, but it has been demonstrated to still not be as precise as what can be achieved under a FIT.[42] Another way to get around the problems resulting from a single certificate price was to introduce a FIT for what was then the most expensive generation technology, i.e. photovoltaics (PV); this was done in Belgium, Italy, and the UK.

In retrospect, it seems likely that considerable windfall profits were also achieved under feed-in tariffs for solar PV, when costs for PV installations fell rapidly in 2008–09. But in that case it was the extremely rapid decline in the costs of an emerging technology which already had a steep learning curve – plus major events such as the Spanish PV boom in 2008, which had a strong impact on PV markets elsewhere – that took authorities by surprise. In several European countries this led to a rapid and often dramatic reduction of feed-in rates, often combined with a cap. The high degree of transparency in the case of feed-in tariffs facilitated the rapid adjustment. Even in those cases, the windfall profits per kWh were probably substantially lower than in the cases of Sweden and Flanders reported above, and they benefitted the deployment of new technologies. By contrast, the windfall profits described above for TGC schemes benefited mature technologies over more than half a decade – and are still doing so at present.

35 Mitchell, Bauknecht, Connor, "Effectiveness through risk reduction", *supra* note 24; Aviel Verbruggen and Volkmar Lauber, "Basic concepts for designing renewable electricity support aiming at a full-scale transition by 2050", 37 *Energy Policy* (2009).

36 Stenzel and Frenzel, "Regulating technological change", *supra* note 14.

37 Aviel Verbruggen, "Performance evaluation of renewable energy support policies, applied on Flanders' tradable certificates system", 37 *Energy policy* (2009).

38 Anna Bergek and Staffan Jacobsson, "Are tradable green certificates a cost-efficient policy driving technical change or a rent-generating machine? Lessons from Sweden 2003–2008", 38 *Energy Policy* (2010).

39 Aviel Verbruggen and Volkmar Lauber, "Basic concepts for designing renewable electricity support aiming at a full-scale transition by 2050", 37 *Energy Policy* (2009).

40 Bergek and Jacobsson, "Are tradable green certificates a cost-efficient policy", *supra* note 38; Verbruggen, "Performance evaluation of renewable energy support policies", *supra* note 37.

3. Deployment

By lowering prices and putting renewable energy on a sound market footing, the European Commission in 1999 argued that TGC schemes would also be better in stimulating deployment beyond the short term (for the short term it held that FIT might do better). Now the installation of wind power has changed considerably since 2002, when Denmark, Germany and Spain had about 85 % of annual wind power installations in Europe.[43] Yet despite broader geographic distribution across Europe, FIT countries are still much more successful than TGC countries in terms of realising their renewable energy resource potential. This may seem paradoxical since TGC schemes pay higher prices per kWh when they apply them to the same renewable electricity technologies. Yet despite this extra financial incentive, levels of deployment under these schemes remain low when measured against their potential, particularly for wind power.[44] The wind power potential of the UK (including offshore wind) is much higher than that of Germany, but it appears unlikely that this potential will be drawn upon very extensively any time soon under the Renewables Obligation (the British TGC law), even under its revised version with technology-specific banding.[45] Overall, TGC schemes show a combination of higher prices for given renewable electricity than FIT, higher profits for renewable generators, lower technological innovation, lower deployment when measured against the national potential, and a poor record in creating a renewable electricity equipment industry.

4. Innovation ("Dynamic Efficiency")

The European Commission in 1999 argued that TGC systems, being market-based instruments, would be likely to accelerate innovation under the pressure of competition, whereas the safety and comfort of FIT systems would fail to produce it to the same degree.[46] Here too, the results are diametrically opposed to the initial argument advanced. We have already seen that the pressure of competition was not all that great among the oligopoly of incumbents that dominate the RE sector under a TGC system. We have also seen that TGC systems generally privilege the technologies and sources with the lowest costs, which means that investments are concentrated in mature technologies and failed to produce substantial innovation. There are additional reasons why FIT laws are more likely to contribute to innovation. It is not enough to allow RE generators to thrive. A renewable sector also needs producers of RE equipment. The high risks associated with becoming an electricity generator have already been enumerated above. It is even less appealing to potential investors to become the producer of innovative RE technologies under such a system. TGC schemes do not generate sufficient demand for new technologies, as they give priority to mature, incumbent technologies that have established production and value chains. Nor do they provide this market with sufficient stability and growth prospects to motivate RE equipment industries to locate in a country with a TGC.

Countries with FIT systems guarantee markets and market returns, which has encouraged the development of innovative RE technologies and equipment-makers there. These companies were started and grew in the FIT countries. By and large companies in these countries (Denmark, Germany, and Spain) have maintained their global leadership. TGC countries were largely unsuccessful in developing domestic equipment producers, even in cases in which their governments had supported the development of specific technologies up to the RD&D stage (Sweden, Netherlands, Belgium, and the UK, in the case of wind turbines). It remains to be seen whether the UK will be able to build an offshore wind industry that would be commensurate with its plans for the sector.[47] One of the main

41 Lauber and Toke, „Einspeisetarife sind billiger und effizienter", *supra* note 24.

42 Toby Couture and Yves Gagnon, "An analysis of feed-in tariff remuneration models: Implications for renewable energy investment", 38 *Energy Policy* (2010).

43 European Wind Energy Association, "Wind in Power. 2010 European statistics", February 2011, available on the Internet at <http://www.ewea.org/fileadmin/ewea_documents/documents/statistics/EWEA_Annual_Statistics_2010.pdf> (last accessed on 31 May 2011), at p. 9.

44 Commission Staff Working Document, "The support of electricity from renewable energy sources", *supra* note 32, at p. 10; pp. 25 *et sqq*.

45 Geoffroy Wood and Stephen Dow, "What lessons have been learned in reforming the Renewables Obligation? An analysis of internal and external failures in UK renewable energy policy", 39 *Energy Policy* (2011).

46 Commission Staff Working Paper, "Electricity from renewable energy sources", *supra* note 13.

47 Wood and Dow, "What lessons have been learned", *supra* note 45; David Toke, "The UK offshore wind power programme: A sea-change in UK energy policy?", 39 *Energy Policy* (2011).

objections to the Commission's 2008 plans to introduce TGC in the form of Guarantees of Origin was that this would threaten successful FIT systems and with them the whole industrial basis of the sector, i.e. the equipment producers.[48] Without this industry the contribution to innovation must necessarily remain limited.

5. The Different Roles of Ambivalent Incumbents under TGC and FIT

Electricity incumbents are generally ambivalent about the rise of RE, particularly when it threatens their growth prospects in the market for conventional power. This is true for FIT countries as much as for TGC countries. But there is a difference: under TGC laws the number of new entrants typically remains small, so there is no multitude of actors to build a renewables sector outside, and if necessary against, the preferences of the oligopolists.

Most incumbents[49] are lukewarm about deploying RE installations. Except for highly centralised technologies, as in the case of offshore wind, RE challenges their basic model of organisation (centralised generation in large power plants, distribution over a large territory), reduces demand for conventional power, and reduces the profitability of conventional power on the electricity exchanges. The latter is a result of the merit order system, unless the more costly renewable technologies (disregarding social and external costs of generation) are integrated in the auction system. Under the merit order system, which is characteristic of liberalisation, power plants are dispatched according to their price bids (e.g. for next day delivery), which must reflect operating costs (excluding capacity costs). The cost of the most expensive plant which is still needed on a particular point in time determines the marginal price of electricity at that point, which is then paid to all generators. Due to priority dispatch of renewable energy under "advanced" FIT systems, the cut-off point for conventional power plants required goes down the price curve; as a result, the price on the electricity exchange falls for all conventional generators. It is well established that this "merit order effect" of RE has produced substantial price reductions in the wholesale electricity market not just in Denmark, Germany, and Spain, but also in other countries such as France.[50]

Under these circumstances, it is understandable that incumbents are ambivalent about the competition from RE. Only by very high rewards can they be brought to invest in this sector. The difference with FIT systems in this situation is that new entrants are likely to have a stronger interest in deploying RE technologies beyond the comfort range of the incumbents.

The incumbents' preferences became public in the UK when German incumbent E.ON (now also operating in the UK) and French utility EDF both suggested to the British government that RE's share of the electricity market should be limited to 33 % (E.ON) or even 20–25 % (EDF) so as to not threaten the growth prospects for nuclear power.[51] This limit would severely constrain wind power, whose potential has been estimated at about 50 % of total UK electricity supply shortly.[52]

In Germany, a 2011 study (based on 2009 data) shows that the four electricity incumbents – supplying over 80 % of total electricity demand – only had a share of less than 2 % in new renewable generation (this excludes large hydro). The remainder came from regional and municipal suppliers, citizen wind farms, and private households, who together generated nearly all solar and wind power. Despite the existence of the FIT for many years,

48 Staffan Jacobsson, Anna Bergek, Dominique Finon *et al.*, "EU Renewables Energy Support Policy: Faith or Facts?", 37 *Energy Policy* (2009).

49 An exception must be made for the Spanish incumbents. They also did not oppose FIT in the premium variant.

50 Frank Sensfuss, Mario Ragwitz and Massimo Genoese, "The merit-order effect: A detailed analysis of the price effect of renewable electricity generation on spot market prices in Germany", 36 *Energy Policy* (2008); Gonzalo Sáenz de Miera, Pablo del Río González and Ignacio Vizcaíno, "Analysing the impact of renewable electricity support schemes on power prices: The case of wind electricity in Spain", 36 *Energy Policy* (2008); Sven Bode and Helmuth Groscurth, "Incentives to Invest in Electricity Production from Renewable Energy under Different Support Schemes", March 2008, available on the Internet at <http://www.arrhenius.de/uploads/media/arrhenius_DP_1E.pdf> (last accessed on 31 May 2011); European Wind Power Association, "Wind Energy and Electricity Prices – Exploring the 'merit order effect'", April 2010, available on the Internet at <http://www.ewea.org/fileadmin/ewea_documents/documents/publications/reports/MeritOrder.pdf> (last accessed on 31 May 2011).

51 Oliver Ristau, „E.on will Deckelung für erneuerbare Energien", 301 *Solarthemen* (2009), at p. 2.

52 David Toke, "The UK offshore wind power programme: A sea-change in UK energy policy?", 39 *Energy Policy* (2011).

incumbents' plans have not changed much through to 2020.[53] This may change after the nuclear meltdowns at Fukushima, Japan and the reinstatement of the nuclear power phase-out.[54] However, the only area where incumbents show new determination is in the area of offshore wind (after a record of delay so far). The biggest difference between the FIT in Germany and the TGC in the UK is that the UK Renewables Obligation effectively restricted RE deployment to incumbents, whereas the German Renewable Energy Act (EEG) supported the access of new entrants and thus avoided policy blockade by incumbents.

6. Few New Entrants Under Oligopolies and TGC

In most European countries, a generally oligopolistic structure of power incumbents remains in place.[55] In TGC countries, these oligopolists also dominate the RE sector. In the UK[56], new entrants tend to be rare. For most of the potential smaller developers, the risks are simply too high, so that only a sprinkling of them will become active. This is not altogether surprisingly given the hurdles they face in financing projects and in finding purchasers of electricity and certificates, while having to compete on uneven terms because large firms do not experience these problems or are able to ride them out. By contrast, FITs encourage new market entrants by giving market advantages and sometimes priority to RE generators. This emphasis on supporting small producers has a long tradition both in Denmark (with its particular form of Grundtvigian liberalism supportive of a small-structured economy) and in Germany. According to German ordo-liberal theory, a variant of neo-liberalism that used to be the dominant political philosophy in Germany and inspired the post-world war social market economy,[57] markets have a natural tendency towards concentration, producing ever more powerful big firms that are likely to impede competition. For this reason it holds that it is particularly important to create favourable conditions for new entrants, in order to check oligopolistic power. By facilitating the financing of projects (i.e. stable, predictable tariffs for a lengthy period) and the sale of electricity (i.e. the obligation on grid companies to purchase all RE tendered to them from domestic sources; priority dispatch), new entrants are supported. In Germany, independent producers of RE now number about half a million or more (200 000 in Bavaria alone).[58] In the UK, the situation is the exact opposite, though this is beginning to change under the recent FIT for small scale generation. Most RE projects in the UK are developed either by incumbents or for them. As a result, there is an oligopoly on the side of generators who are well aware that if the number of certificates approaches the amount set by the quota for a given year, the value of individual certificates will go down.[59] As oligopolists, they are able to coordinate their activities to remain below that amount without falling foul of competition legislation. Up to now, annual TGC quotas for RE were filled only for less than two thirds.[60]

VI. Conclusion

Although neo-liberalism and deregulation have been somewhat discredited by the financial crisis of 2008, it seems likely that the debates that surrounded renewable electricity policy in Europe will be repeated in many other countries dealing with

53 Bernd Hirschl, Anna Neumann und Thomas Vogelpohl, „Investitionen der vier großen Energiekonzerne in erneuerbare Energien", March 2011, available on the Internet at <http://www.ioew.de/uploads/tx_ukioewdb/IOEW_SR_199_Investitionen_der_vier_gro%C3%9Fen_Energiekonzerne_in_erneuerbare_Energien.pdf> (last accessed on 31 May 2011).

54 The conservative-liberal government which came to power had at first revoked the nuclear power phase-out negotiated by the social democratic-green coalition in 2000.

55 Fabio Domanico, "Concentration in the European electricity industry: the internal market as a solution?", 35 *Energy Policy* (2007); Steve Thomas, "The Seven Brothers", 31 *Energy Policy* (2003).

56 Stenzel and Frenzel, "Regulating technological change", *supra* note 14.

57 David Toke and Volkmar Lauber, "Anglo-Saxon and German approaches to neoliberalism and environmental policy: The case of financing renewable energy", 38 *Geoforum* (2007).

58 Bayerische Landesregierung, „Energie-Atlas Bayern", available on the Internet at <www.energieatlas.bayern.de> (last accessed on 31 May 2011).

59 Stenzel and Frenzel, "Regulating technological change", *supra* note 14; Judith Lipp, "Lessons for effective renewable electricity policy from Denmark, Germany and the United Kingdom", 35 *Energy Policy* (2007).

60 Wood and Dow, "What lessons have been learned", *supra* note 45; Bridget Woodman and Catherine Mitchell, "Learning from Experience? The Development of the Renewables Obligation in England and Wales 2002–2010", 39 *Energy Policy* (2011), at p. 3916.

this policy issue. In this context, the European experience could be valuable, both with regard to the terms and evolution of the controversy and with regard to the insights that it generated.[61]

It is not surprising to see that so-called least cost approaches to the energy and climate problem are regularly praised. In many nations, neo-classical economic theory is the dominant theory adhered to by most high-level bureaucrats and legislators. The enactment of laws seen to embody "least cost" policies in the field of renewable energy (in the form of the TGC) appealed to many politicians at the time when government regulation and state interventionism were widely viewed as inefficient and were gradually supplanted by a focus on markets. At the time, the argument for TGC over FITs conformed to a plausible and ascendant narrative. The FIT side did not have a similarly cohesive theory although it had some elements of it. The driving forces of least-cost, market-based policies for RE at the end of the last millennium included reasonable concerns about cost, an appealing argument from economic theory, and a lack of evidence.

In the meantime, much evidence about the performance of so-called "least cost" renewable energy law and policy has materialised. We have seen that TGC laws in practice operated to restrict new entrants to the renewable energy markets and thus reduced competition. They channelled market creation funding towards technologies which were already mature, while doing little to advance more innovative technologies with much greater promise. They provided incumbents with very high windfall profits, limited market access for new entrants, and burdened small end consumers with disproportionate burdens. They effectively held back the deployment of renewable electricity and inhibited the rise of a renewable energy equipment industry. At the same time, the opaqueness and complexity of the certificate trading schemes shielded them from criticism; it took years before the results described above transpired.

Not all actors however will be sensitive to evidence. Neo-classical ideas may be advanced by true believers but also by pragmatic interests. In the present case, TGC was propounded by the economic interests of the European electricity incumbents whose commitment to free markets was mostly rhetorical and who sought to retain oligopolistic structures which, while seemingly designed for competition, would in fact "structure" the new market in such a way as to primarily benefit incumbents.

Similar actors – with few exceptions electricity generation throughout the world is dominated by fossil-fuel incumbents reluctant to change – are likely to come up with similar proposals elsewhere, pushed by the same interests and possibly supported by similar ideological groups. In each case, it is important to review such proposals against the insights gained from practical experience in the EU. Success comes to those policy-makers who are willing to regularly revise their theories in the light of experience.

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61 There is one argument for TGC in the EU which is not advanced officially by the Commission but which was recently mentioned in several interviews by mid-level bureaucrats (Moritz Buschmann, „Erneuerbare Energien und das politische System – Der Ausbau von Wind- und Solarenergie als Resultat einer Interaktion von Politik und Technologie", Ph.D. thesis on file at the University of Salzburg (forthcoming)). The gist of it is that the EU is more likely to be successful with measures that do not involve a great deal of redistribution, and that FIT would involve more redistribution than TGC. This claim is not self-evident but should be investigated further. In any case, this is a problem special to the EU and does not apply to other countries.