Analysis of the Commodification and Financialisation Aspects of the Green Certificate Schemes in Flanders and Norway

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Abstract

This article compares the green certificate scheme of Flanders, Belgium with the integrated certificate scheme of Norway and Sweden. It analyses the design and effect of both schemes by focusing on two key aspects: the commodification or the relation between the quantity and nature of renewable energy production and certificate creation and the financialisation or the market organisation in which the price of the certificates are set and the trading that has arisen.

Both schemes had a very similar and simple design in their early years of operation. Both schemes are effective in bringing enough new renewable power capacity to the market but they do not succeed in doing this in the most cost-efficient way. In the Norwegian-Swedish green certificate scheme, generation of new capacity is unevenly distributed between the two countries. This is caused by differences in taxes and depreciation rules, and some differences in the design of the schemes in the two countries which prioritises less cost-efficient Swedish project before more cost-efficient Norwegian projects. In the Flemish green certificate scheme, modifications to financialisation aspects prioritised photovoltaic energy over other most cost-efficient technologies. Modification to the commodification aspects of the scheme corrected for this malfunctioning but risks to affect the effectiveness to the scheme in time. As a result of these interventions, the technology neutral Flemish certificate scheme tends now more to a technology specific feed-in premium scheme.

For both markets we also investigate how the design of the markets influence risk allocation and what kind of uncertainties that affect investment decisions.

Both schemes demonstrate that their effectiveness and efficiency are very context dependent and that careful initial scheme design is essential. Both cases demonstrate also that market-based instruments, such as green certificate markets, although presented as alternatives government controlled support schemes, do not operate in a vacuum, within a context significantly shaped through policy efforts and associated measures. The challenges for policy makers in designing such schemes should not be underestimated.

Introduction

Growing efforts around the world to promote renewable generation over the past two decades have seen a variety of support policy measures in different jurisdictions. Generally these have fallen within two broad categories – *price* based approaches, including notably feed-in tariffs although a range of other fiscal measures have also been applied; and *quantity* based approaches, notably quota based green certificate schemes although tendering and auctioning processes all fall within this category. There has been considerable discussion of the merits and potential disadvantages of feed-in tariff and quota schemes and the EU has seen Member States adopt both approaches (Ringel, 2006; EC, 2008; Jacobsson et al, 2009). One way to describe quota based certificate schemes is as a process of renewable energy commodification and financialisation. Commodification describes the process by which distinct goods with different attributes and values are transformed into simple fungible commodities within undifferentiated price competition. Within certificate schemes, 'approved' renewable energy production is transformed into a tradable commodity – typically a green MWh certificate. These certificates are intentionally fungible and undifferentiated although they are generated by different renewable energy sources across a potentially wide range of contexts. By commodifying renewable generation in this way, these schemes facilitate financialisation – a process that aims to reduce any produced good or service into an exchangeable financial instrument which can be easily traded not only by parties that produce or use the product or service, but potentially also by any other party that might be interested in its underlying value. With quota systems, a green certificate provides a basis for trading between parties required to purchase or able to supply renewable generation, as well as potentially other parties. Similar approaches exist in other environmentally and energy oriented policy areas including carbon credit trading (Lohmann, 2005) and energy efficiency white certificate schemes (MacGill et al, 2013).

As such, it has been argued that renewable policy support choices fall somewhere on the spectrum between *standardised commodification* versus *specialised segmentation* (Midttun and Koefoed, 2003) and even *neoliberalism* versus *government intervention* (Toke and Lauber, 2007). Certificate schemes have some claimed advantages over feed-in tariff approaches. In theory, they allow the market to identify the cheapest way to deliver a desired level of renewable generation rather than relying on fallible government policy makers to specify which technologies should receive support, and at what level (MacGill et al, 2006). Furthermore, such schemes are argued to be more compatible with restructured, liberalized, electricity industries. Indeed, the European Commission argued strongly for the benefit of certificate based approaches on the basis of electricity liberalization in Europe (EC, 1999). There are some potential limitations, however, including the question of whether renewable energy is a natural commodity – meaning that a wide range of renewable technologies and particular projects all provide a similar commodity 'good' of equivalent value (Midttun and Koefoed, 2003; Toke and Lauber, 2007) – and possible problems with excessive financialisation more generally – including poor risk management by, and excessive economic wealth 'rent' transfers to, the financial industry (Jacobsson et al, 2009; Turner, 2010). Given actual EU experience with different schemes the European Commission has previously suggested that feed-in tariffs had proven more effective in terms of delivering targets, and efficient in terms of reducing costs for the community (EC, 2008).

However, the context for renewable energy in Europe continues to evolve including growing wind and PV penetrations in many markets, and growing efforts to unify European electricity arrangements. Indeed, the European Commission (2013) has recently argued that *"Any [renewables] support that is still necessary should therefore supplement market prices, not replace them, and be limited to the minimum needed. In practice, this means phasing out feed-in tariffs which shield renewable energy producers from market price signals and move towards feed-in premiums and other support instruments, such as quota obligations, which force producers to respond to market prices."* The question of how well quota based certificate schemes perform has, therefore, taken on growing importance.

In this paper we analyse the design and performance to date of two EU quota measures, the Flemish and Swedish-Norwegian green certificate schemes, promoting renewable energy production. These have seen some previous assessment, both as part of general assessments of the European experience, and some specific studies as well such as Verbruggen (2009) and Bergek and Jacobsson (2010). However, there are continuing developments, and lessons with both schemes. Furthermore, our analysis focuses particularly on questions and issues of commodification – the relation between the quantity and nature of renewable energy production and certificate creation – and financialisation – the market organisation in which the price of the certificates are set and the trading that has arisen. These terms are not in common use for assessing such policy measures. However, in our view, the question of whether diverse renewable energy options can be effectively commodified into a single renewable generation commodity, and then financialised to facilitate competitively driven investment is critical to the success or failure of such mechanisms.

Our analysis is necessarily limited and preliminary given the complex and diverse electricity industry contexts within which such renewable energy support measures are implemented. As noted earlier, the compatibility of certificate schemes with restructured industries has been argued to be a significant strength. There is, however, considerable diversity between EU electricity industries in terms of both the diversity of generation and the market design and structure including levels of competition. This is certainly true for the Flemish, Norwegian and Swedish liberalised markets. There are significant potential implications for renewable quota schemes depending on the extent and effectiveness of the chosen electricity market arrangements.

The focus of this paper, however, is on the different quota schemes in the Flemish, Norwegian and Swedish jurisdictions. Again, there are considerable differences in the scheme designs and, particularly, the way the schemes have evolved over time. We highlight key factors with regard to commodification including issues of the way different renewable energy technologies are incorporated into the scheme, and how the broader context associated with deployment of the technologies is assessed. This is particularly important as different renewable technologies have often widely varying environmental, social and economic impacts. Other potential challenges include establishing baselines for existing renewable generation, or renewable generation that is competitive without additional support from the quota scheme. Outcomes to date and expected future scheme performance in terms of the technology mix that is supported are presented.

Key financialisation aspects of the different schemes are then considered. These include the efficiency and competitiveness, or otherwise, of the certificate market between the large consumers and electricity retailers/suppliers obliged to buy these certificates and the renewable energy project developers (who may be these retailers/suppliers) who provide them. Key factors here include the transparency and liquidity of spot and future certificate trading, and hence the scheme's ability to facilitate appropriate project development while helping market participates manage the inherent risks associated with this. .

The paper concludes with a discussion of key insights arising from the experience of the Flemish, Norwegian and Swedish green certificate schemes.

Norway - Sweden

Renewable energy objectives in Sweden and Norway

The governments of Sweden and Norway have agreed on a common market for green certificates (GCM) in order to promote new renewable energy projects until 2020 (Norwegian Ministry of Foreign Affairs, 2011). The official objective for the certificate scheme is to increase the renewable production in Norway and Sweden seen as a whole. For Norway the certificate scheme is one of the main instruments used to reach the target of 67,5% renewable share of the energy consumption for 2020 set in the Renewable Energy Directive (2009/28/EC). Implementation of the Renewable Energy Directive was an important motivation for establishing the green certificate market.

The Green certificate market in Norway and Sweden

Commodification. The electricity certificate system in Norway and Sweden issues power producers electricity certificates for the production from approved power plants. One electricity certificate is issued per MWh of electricity generated. The system is neutral regarding renewable technologies. The total number of certificates issued is directly related to the electricity production of the approved plants, and for CHP plants, the proportion of the renewable fuel also has an impact. Electricity production from biomass – including peat for CHP plans in Sweden - , geothermal, solar, hydro, wind and wave energy can receive certificates.

By 2020, the new market mechanism is expected to generate 26.4 TWh electricity annually. New power plants and production increases for existing plants are entitled to receive certificates. However, this applies only for a maximum of 15 years, and no longer than to the end of 2035. Certificates can be issued in Norway until December 31 2035. In Norway certificates will be issued to approved plants in operation before December 31 2020, while in Sweden certificates will also be issued to plants coming in operation later (but they receive certificates only until 2035).

Financialisation. The certificates can be sold by the power producers receiving them, creating an extra income in addition to the price charged from the power production. Electricity suppliers (and some electricity end users) have an obligation to buy certificates for a certain proportion of their electricity sales. This is the so-called quota obligation, and states the percentage of the electricity usage for which the suppliers needs hand over to the government for cancellation. If an insufficient number of certificates have been cancelled for the quota obliged parties a fee will charge for each certificate that is lacking in order to comply with the quota obligation. This is how the certificates are redeemed. The last cancellation of certificates will happen in April 2036.

Each government is financing 13.2 TWh, and this volume is decided by the number of certificates each government guarantee to redeem. The number can be updated at pre specified points in time, in order to reach the pre agreed level of 26.4 TWh.

The certificate quotas are given as a percentage of the electricity consumption that needs to be supplied from a renewable source included in the scheme. The quota percentage is different in Norway and Sweden, and the objective is that they will ensure that both countries consumers are expected to pay for 13.2 TWh of new yearly capacity before 2020. The quotas increase towards 2020, leading to an increased demand for electricity certificates, following the curve in **Figure 1** (Act 2011:1200). Norway's quota scheme is in force from 2012 to 2035, whereas the start point for Sweden's curve is 2003. Both countries quota curve have been constructed based on assumptions regarding future electricity consumption. For both countries the quotas are constructed so that 13.2 TWh x 15 years = 198 TWh will be redeemed by the government, or totally 396 TWh. Suppliers that are not able to present certificates for cancellation at the right quota level will be penalized. If the consumption deviates from the underlying assumptions, the quota curves will be revised (every 4th year) so that the number redeemed will meet the target in both countries.

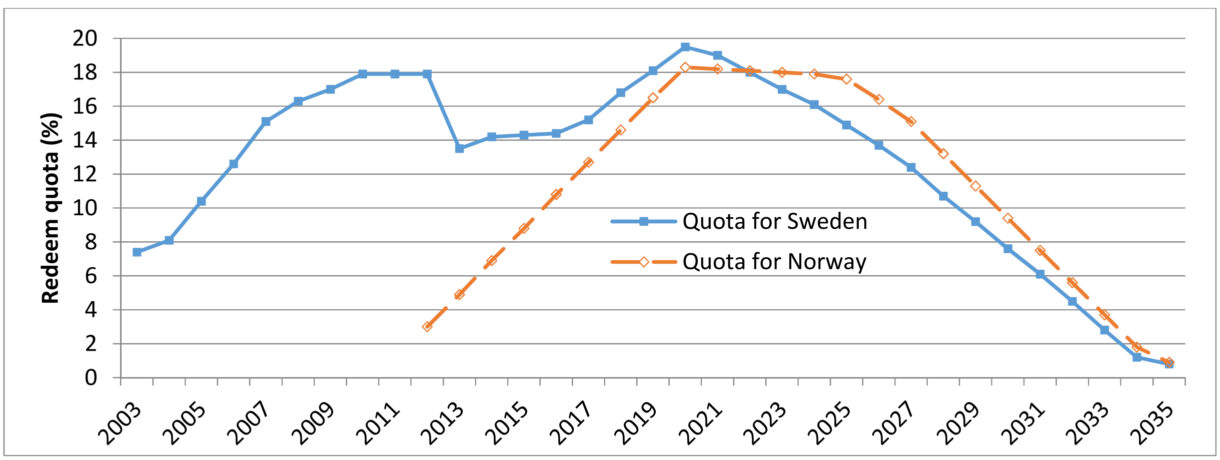

Figure 1: Quotas for Sweden and Norway.

Trading of an electricity certificate is performed in a common electricity certificate market, where the price is determined by supply and demand. It is possible to trade in both Swedish and Norwegian electricity certificates. The market participants with quota obligations must be in possession of sufficient electricity certificates related to the electricity usage and the quota curve. These certificates are then redeemed at certain intervals, and the market participants must purchase new electricity certificates to fulfil the obligation for the next period. The electricity customers cover the costs of the system, as the costs of purchasing certificates are added to the electricity bill. The number of issued certificates each year depend on the actual generation, and is therefore uncertain.

Potential for renewable energy in Sweden and Norway

The electricity production in Norway is mainly based on hydropower and new installations are expected to come either as hydropower or onshore wind towards 2020. The annual hydropower production is 130.5 TWh based on the normalization method described in EU Directive 2009/28/EC. The annual potential of hydropower production in Norway was in 2013 estimated to be 214.1 TWh (see **Figure 2Error! Reference source not found.**) (NVE 2013a). This is approximately 61% more than the existing production, however a large fraction of the potential (50.8 TWh) is restricted due to nature conservation, and can therefore not be utilized (NVE, 2013b).

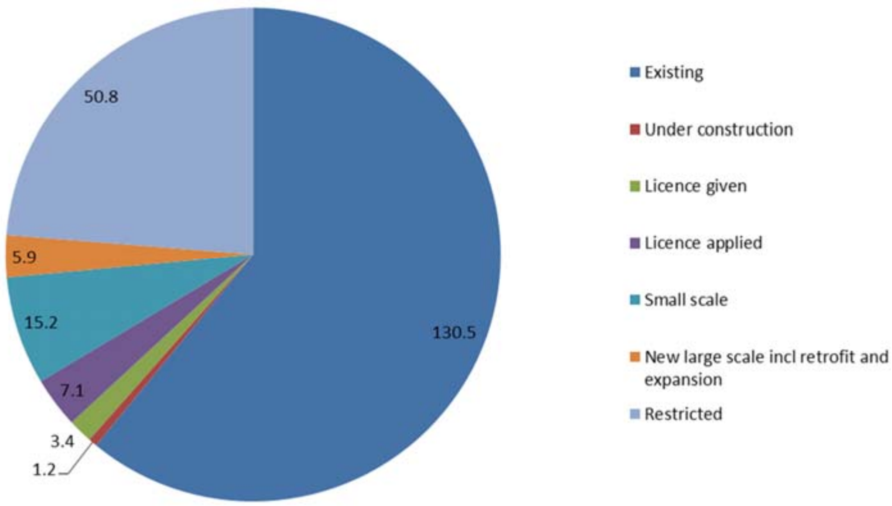

Figure 2: Hydropower potential in Norway, 2013 (TWh/year) (NVE 2013a)

Since Norway has a long and windy coastline, the potential for electricity production from both onshore and offshore wind facilities is large. As of early 2014, the total installed wind capacity in Norway was 811 MW (NORWEA, 2014), corresponding to an expected annual electricity production of around 1.9 TWh.

The overall potential for new installations in Norway is around 90 TWh divided into wind and hydropower. If the percentage of projects given license, as well as the construction time, is taken into account, the potential for new plants is reduced to 27 TWh. A potential of 11.9 TWh can be realized with the existing electricity grid, the remainder 20.3 TWh requires investments in the electricity transmission.

Sweden uses a combination of hydropower, nuclear power, and conventional thermal power. For Sweden, the potential for new power plants amounts to 131 TWh. Onshore wind energy account for the larges share (95.8 TWh), followed by offshore wind (26.1 TWh).

Table 1: Potential for new power plants in Sweden (IEA 2013)

Type of power plant	Normalized electricity production (TWh)
All plants already approved for certificates	4.7
Bio fuelled CHP plants	3.5
Hydropower	1.1
Onshore wind. License given	17
Onshore wind. License applied	71
Onshore wind. Unknown status	7.8
Offshore wind. License given	8.5
Offshore wind. License applied	17.6
Total potential	**131.2**

Effectiveness in meeting the targets and cost efficiency of design

In order to reach the common objective of 26.4 TWh new electricity generation until 2020, an average yearly increase of 2.93 TWh is needed.

In 2012, the certificate market generated 3.2 TWh new electricity production. Of these, approximately 2.8 TWh was installed in Sweden, whereas only 0.4 TWh was installed in Norway. In Sweden, wind power contributed most to the production increase, followed by bio fuelled CHP plants. For Norway, increased hydropower production accounted almost entirely for the increased production. In 2013, the production increase within the electricity certificate market was 3.0 TWh. Of these, 2.5 TWh was installed in Sweden, comprising wind, hydro and CHP plants. The remainder 0.5 TWh was installed in Norway; hydropower accounted for most of the increased production, but some wind power plants were also installed. **Table 2** summarizes the increased electricity production from the electricity certificate market for 2012 and 2013.

Table 2: Production increase within the electricity certificate market [TWh] (The Swedish Energy Agency 2013)

	Norway	Sweden	Sum
2012	0.4	2.9	3.3
2013	0.5	2.5	3.0

In conclusion, the investments in new renewable electricity generation in 2012 and 2013 are on schedule to reach the common objective; however an asymmetry between investments in both countries can be observed.

Jenssen et al (2012) have, in order to explain this asymmetry, examined how differences in taxes and depreciation rules in Norway and Sweden affect the return on investments in renewable energy generation that is eligible for certificates in the two countries. In Sweden the deprecation rules allow much faster depreciation of the investments, giving a tax advantage. The income tax in Sweden is 26.3% versus 28% in Norway. Except for hydropower plants, the property tax is higher in Norway. For hydropower the Norwegian "Grunnrente" tax also draws in a negative direction. This tax is related to the return from of the natural resource, rather than from labour and capital (ground rent tax). Jenssen et al (2012) estimates that the distribution of investments in the Norwegian-Swedish electricity certificate market is affected by these differences. They claim that 5.6 TWh of new renewable electricity in Norway, mainly wind, but also hydro, may be crowded out by more expensive Swedish wind power. It is reasonable to conclude that even though the certificate scheme may be effective in meeting the target of 26.4 TWh, it will most likely not do so in a cost efficient way.

Another important factor that may affect investments is the way the investors are exposed to uncertainties and the allocation of risk in the value chain, in this case between the investors, the government and the consumers. The main difference between the Swedish and Norwegian market design is that Swedish projects will be part of the certificate scheme also if they come into operation after 2020. It is likely that for the period from 2017-2018 there will be a limited number of new Norwegian projects, as there is a substantial risk they will not finish in time to qualify for certificates. As a result, the value of Norwegian projects, adjusted for this risk, is expected to be less than some Swedish projects. Again this prevents the lowest cost project to be the marginal one, and prevents a cost efficient implementation of the scheme. As an example, a Swedish wind farm located in the same area as a Norwegian candidate location with similar wind speeds and production capabilities may be preferred after the risk adjusted net present value analysis is done.

There is no limit to the number of certificates issued in the Norwegian-Swedish scheme. This may very well lead to an oversupply, which may reduce the certificate price dramatically, potentially down to zero. Most likely this will be compensated in years with oversupply with correspondingly low certificate prices if the target on average installed capacity is reached. It seems that the main risk here is placed on the investors in case of overinvestments. It is likely that this affects the willingness to invest. There is also a threat that a prolonged Swedish deadline will increase the chance of overinvestment, which again can lead to an oversupply. It is expected that some investors wait as long as possible to make their decision, in order to reduce this certificate price uncertainty. That will typically be until 2015 or 2016 for a large wind development in Norway, while in Sweden the lack of a hard deadline may invite even further delays. In this case investors in Norwegian projects will face a higher risk than investors in Swedish projects which may shift the investments away from cost efficiency.

In this setting there is little or no risk for the governments, since they have guaranteed only the cancellation of 398 TWh. Overinvestments means in this case over fulfilling the target. In case of underinvestments, further incentives may be given by increasing certificate prices (in practice increasing the quota volumes). This will be paid by consumers. It is less likely with government intervention in order to reduce investment incentives (reducing certificate prices).

Flanders

Renewable energy objectives

A renewable energy target for Flanders was for the first time proposed in 1999; the objective was to achieve a 3% renewable share by 2004 (Flemish Parliament, 1999). This target was a real challenge as the renewable share in 1999 was a modest 0.03% (VITO, 2000). In order to realize this target, the Flemish Green Certificate scheme (FGC scheme) was registered in the Electricity Decree on 17 July 2000 (Belgisch Staatsblad, 2000) and became effective in 2002. The Flemish government chose to introduce quota controlled by green electricity certificates as the central instrument in its renewable electricity policy in the expectation of an international green electricity certificate system in Europe (Bollen et al., 2011, p. 65).

The economic potential of renewable electricity in Flanders for 2010 was estimated in 2004 at 7 to 8%. Biomass (3.4 to 3.5%) was believed to contribute the most to this potential. The other renewable electricity sources with a significant potential were wind onshore (1.5%), wind offshore (1.2 to 1.7%) and biogas (0.7 to 0.9%). The potential for small hydropower and photovoltaic (both around 0.01%) was believed to be very minor. (Devriendt et al, 2005)

Design of the Flemish Green Certificate schemes

The rights and obligations of the FGC scheme are integrated by means of a certificate market among the parties to whom the FGC are assigned and the parties that have a redeem obligation of these certificates. FGCs are assigned to operators of renewable power installations. The FGC scheme assigns a Green Certificate to producers of renewable electricity for each MWh of renewable electricity produced. The redeem obligations apply to all power providers, authorized to provide power to end-consumers within Flanders. Each year, they have to redeem by March 31st a fixed amount of FGC corresponding to a share of their power sales of the previous calendar year. That share is stipulated by law and increases over the years in order to create an increasing demand for FGCs. In case a power provider does not hand in a sufficient number of FGC, he will incur a fine per certificate below its obligation. A certificate market allows trades of FGCs between the operators and the power providers. The FGC scheme offers the power providers the possibility to bank FGC in case of an oversupply, but does not offer the possibility to borrow in case of an insufficient number of available FGC.

The Flemish energy market regulator (VREG) assigns the certificates to the operators of renewable power or cogeneration installations and redeems the certificates handed-in by the power providers. The VREG also facilitates the certificate markets. To this end, the VREG has the obligation to provide information on granted and obliged parties and monthly statistics on the number of FGCs issued, the number traded with their average price and the number redeemed. (VREG, 2004a). In 2009, the VREG created a FGC clearing platform, the "Green Certificate Exchange" in collaboration with the power exchange platform Belpex in order to facilitate the market of FGCs (Belpex, 2014). The interest in the Green Certificate Exchange however was very limited due to a structural oversupply of certificates at that time.

Since their operation, the FGC scheme has been subject to amendments. The most significant amendments in the first years that the scheme was operational are related to the mechanism which sets the price of the FGC – that is the financialisation aspect of the FGC scheme. Later on, the amendments modify the basis on which FGCs are issued per MWh renewable energy produced – that is the commodification aspect of the FGC scheme. These two aspects are discussed in the following chapter.

Commodification and financialisation aspects in the original design

Within the Flemish Green Certificate scheme, 1 FGC is by default issued per MWh of net renewable electricity produced within the Flemish region and for renewable energy from photovoltaic, wind on-shore, hydro, tidal energy, geothermal, biogas, landfill gas or biomass. Net production of renewable electricity is defined as the quantity of electricity delivered to the grid or consumed on-site and is the gross production, delivered by the generator, minus the auto electricity consumption by the production unit itself. There are some exceptions. If the operator can demonstrate that he applies the best available technology in case of power production from manure, waste or waste water, he can receive 1 FGC per gross renewable electricity production. Another exception is that renewable electricity production from biomass needs correction for energy use needed to transport the biomass to the border of the Flemish region.

When the FGC started operating in 2002, there were two features in place to set the price of the FGC. On the one hand, there was a redeem obligation, defined as the percentage of power deliveries for which the power providers have the obligation to present an equivalent number of FGCs. This obligation was set at 1.4% for 2002, to increase to 2% for 2003, 3% for 2004 and then linear to 5% for 2010. On the other hand, there is a fine for every FGC that the power provider failed to redeem, set at 125 €. (Flemish Parliament, 2001)

Modification to the financialisation aspects

The redeem obligation was reduced in early in the schemes lifetime (in 2003). It was noticed that the renewable energy projects did not develop as fast as expected; a reduction of the redeem obligation prevented that the power providers would have to pay excessive fines. The redeem obligation was then set at 2% for 2004, to increase linear to 6% in 2010. The fine was set at 75 € for every missing FGC to redeem in 2002: 100€ in 2003 and 125€ from 2004 onwards as **Figure 3** indicates. (Flemish Parliament, 2002; 2003)

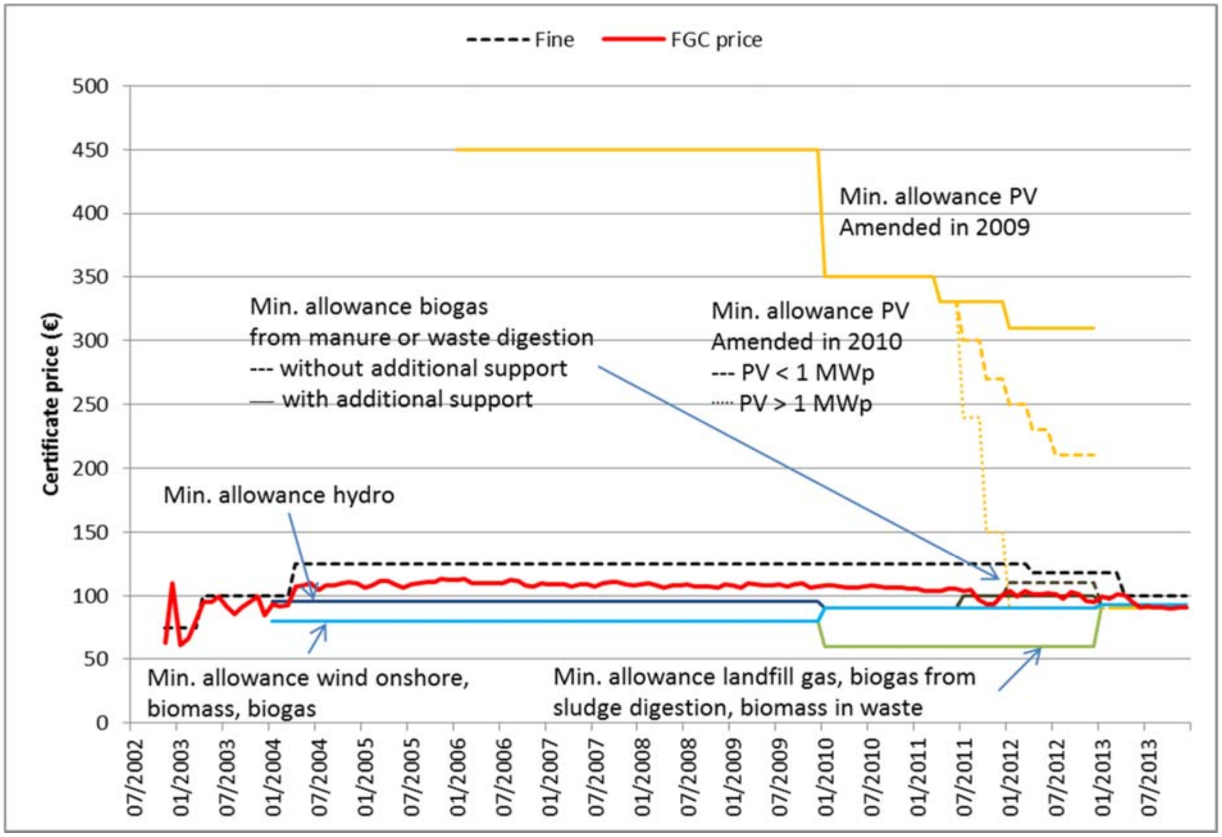

Figure 3: Evolution of the FGC price, fine and minimum allowances for various technologies in the Flemish green certificate scheme (VREG, 2014a; VREG, 2014b)

In 2004, the concept of minimum allowances was introduced. These minimum allowances are guaranteed floor prices at which the operators of renewable power units can sell their FGCs, in case an oversupply of certificates would result in a significant decrease of the certificate price. These minimum allowances are issued by the grid operators, who have the obligation to buy the FGCs if these certificates are presented to them. The minimum allowances are a feed-in premium by design; their level is technology dependent: 80€ for onshore wind and biomass projects and 95€ for (small) hydro projects. Grid operators can sell these certificates on the certificate market in order to, at least partially, recuperate the cost of their obligation. The remaining part of the cost (the positive difference between the minimum allowance and the market price) is charged to electricity consumers by means of distribution tariffs imposed by the grid operators. These minimum allowances set a floor price for the certificates on the certificate market, whereas the fine in case of redeeming an insufficient number of certificates sets a ceiling price.

The concept of the minimum allowance was from 2006 on used to optimize the support to photovoltaic (PV) installations. From 1998 to 2005, PV installations were subsidized by an investment grant. Grants could only be issued per calendar year as long as the foreseen budget was not exhausted. In order to provide stability in support to the PV sector, the investment subsidy was replaced by a minimum allowance within the FGC scheme. The level of minimum allowance, however, was set at 450€, which is about four times higher than the market price of the FGC in 2005 (106-111€). The minimum allowance was also guaranteed for 20 years. (Flemish Parliament, 2005)

This amendment in the FGC scheme, in combination with other measures to support PV installations such as investment tax reduction and a revolving power meter[1], led to massive investments in PV. These investments started to raise questions about the cost-efficiency of the scheme. As a consequence, a method to calculate the funding gap[2] for every renewable electricity technology was introduced in 2009. This led to a first gradual decline of the minimum allowances for PV, replaced by an even steeper decline proposed in 2011, indicated on **Figure 3**. Every announcement of a decline in support levels however caused a new rush for PV investments. The minimum allowance for the other technologies was increased from 80 to 90€. (Moorkens et al., 2013)

These investments created an oversupply of FGCs on the market from 2009 on, amplified by a reduction in power consumption as a result of the global financial crisis and a consequent reduction in the number of FGCs to redeem. In order to absorb the oversupply of FGCs, the redeem obligation for 2008 was increased from 3.75% to 4.9% (Flemish Parliament, 2008; 2009; 2010). In 2011, a new redeem quota was proposed, up to 13% to be redeemed on 31 March 2021. At the same time, the fine per missing certificate was lowered to 100€.

In 2013, the FGC scheme was reformed drastically, as is explained in the following subchapter on the modification of the commodification aspects. The redeem obligation quota were further increased from 14% in 2013 up to 20.5% in 2020. Additionally, the price band between the minimum allowance (set at 93€) and the fine per certificate below the power providers' obligation (100€) was narrowed. (Flemish Parliament, 2011)

Modifications to the commodification aspects

The method to calculate the funding gap for every renewable electricity technology revealed in 2009 that the number of FGCs issued to biomass co-firing coal plants is higher than needed to make this technology economical feasible. As a response, the Flemish government decided to introduce the concept of banding in 2010: co-firing up to 60% biomass with coal is issued with half the number of tradable FGCs instead of the full number. (Flemish Parliament, 2010)

The modifications to the FGC scheme did not provide an adequate answer to the cost concerns and the scheme was subject to a thorough evaluation in 2011. Based on that evaluation, it was decided to generalize the concept of banding to all technologies in the FGC scheme. From 2013 on, the number of FGCs issued are fine-tuned to the financial feasibility of the various technologies to attain a given profitability level and updated every year. In principle, they can vary between 0 and 1.25 FGC per 1 MWh renewable electricity. In practice, they are topped at 1, see **Table 3**.

As a result of the introduction of technology specific banding factors and the narrowing of the price band for the FGC between 93-100 €, the technology neutral certificate scheme tends more to a technology specific feed-in premium scheme; or in other words, the FGC scheme has moved from a quantity based approach to a price based approach.

Table 3: Banding factor for various technologies in the Flemish green certificate scheme from 2013 on

Banding factor or the number of FGC issued per MWh renewable electricity produced		New in 2013	New in 2014	New in 2015(°)
Photovoltaic	Transformer capacity < 10kW	0.23	0.268	0
	Transformer capacity 10kW - 250kW	0.63	0.522	0.600
	Transformer capacity 250kW - 750kW	0.49	0.436	0.496

1 Revolving meter: electricity meter that is allowed to twist backwards in case on-site production exceeds consumption
2 Communication from the Commission (2014/C 200/01) on 'Guidelines on State aid for environmental protection and energy 2014-2020' defines the 'funding gap' as "the difference between the positive and negative cash flows over the lifetime of the investment, discounted to their current value (typically using the cost of capital)"

Wind on-shore	Maximum turbine capacity ≤ 4MWe	0.80	0.777	0.692
Biogas; electrical capacity ≤ 5 MWe	For digestion of manure and agricultural products	1	1	1
	For digestion of gardening and kitchen waste	1	1	1
	For heat recovery of landfill gas	0.196	0.241	0.304
	For digestion of sewage sludge	0.208	0.329	0.367
	Other digesters	1	1	1
Biogas; electrical capacity 5 – 20 MWe	For digestion of manure and agricultural products	1	1	1
	For digestion of gardening and kitchen waste	1	1	1
	For heat recovery of landfill gas	0.001	0.0409	0.0959
	For digestion of sewage sludge	0	0.0752	0.124
	Other digesters	1	1	1
Biomass; electrical capacity ≤ 20 MWe	For the combustion of solid biomass (pellets)	0.984	1	1
	For the combustion of liquid biomass (biofuels)	1	1	1
	For the combustion of wood waste	0.829	0.884	0.945
	For the combustion of the biodegradable fraction of municipal or industrial solid waste	0	0.0496	0.00

(°): proposed values; not yet approved
Source: Flemish Energy Agency, 2013a, 2013b, 2014

Effectiveness of the Flemish Green Certificate market

After a start-up phase in 2003 and 2004, the number of FGCs issued stabilized in 2005-2007, see Error! Reference source not found.. Most FGCs were issued to biomass and biogas fuelled renewable power production units, while on-shore wind projects start to be developed in Flanders. The year 2008 is earmarked by the start of a dedicated biomass (pellets) fuelled power station. Since 2008, interest grows for the installation of photovoltaic panels in the residential sector. As a result, the number of FGCs issued started to exceed the number of FGCs to be redeemed from 2009 on. Hence, the FGC scheme has proven to be effective in achieving the renewable energy target. In 2010, 3.1 TWh renewable energy was produced, which is just above the 6% renewable electricity target (Flemish Parliament, 2011). From 2011, restriction on disposal of manure on land leads to a growing interest of manure digestion and related biogas production.

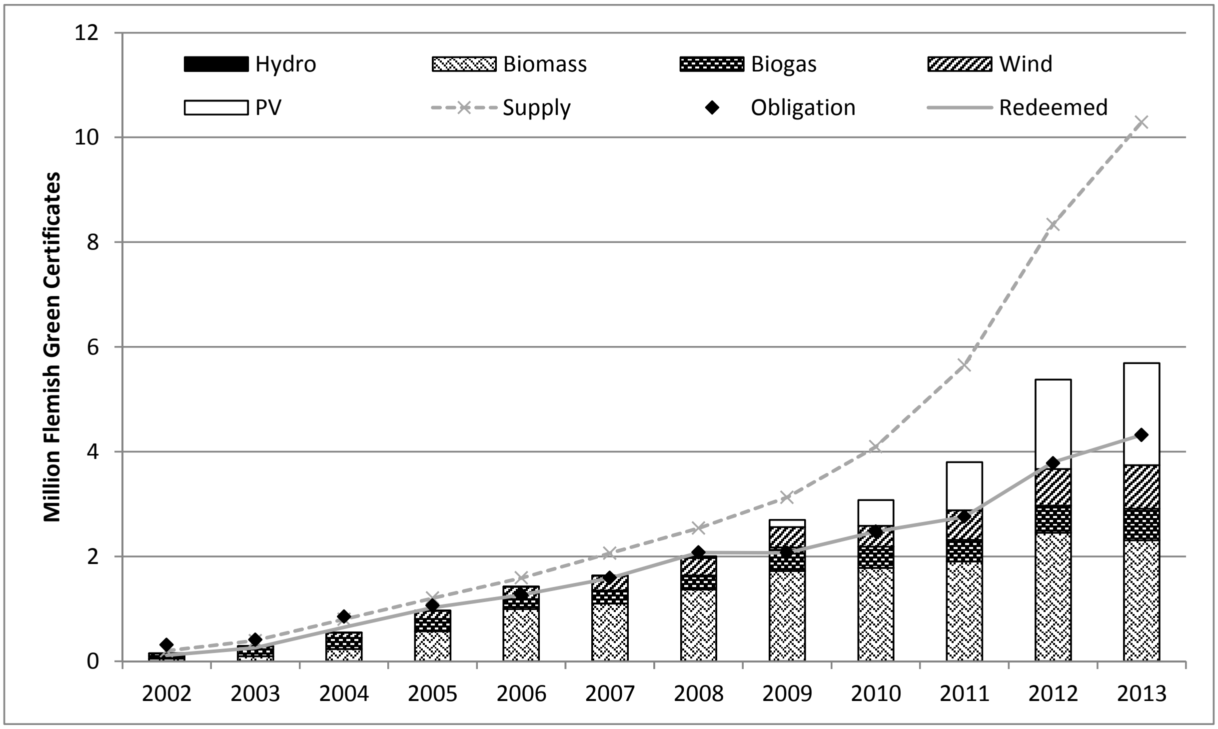

Figure 4: Number of FGCs issued (bars), available on the market (supply line) and redeemed (VREG, 2014a)

Risk management by the Flemish Green Certificate market

The FGC scheme allows that the price of a tradable green certificate market varies according to the balance of demand and supply of these certificates and this imposes a risk to investors in renewable energy production. In its original design, the FGC scheme attempts to reduce this risk by setting a ceiling price for the certificate in the form of a fine per missing certificate at clearance. Introducing a minimum allowance further reduced risks for investors, as this protects investors for significant drops in FGC price in case of an oversupply. Within the FGC scheme, these minimum allowances vary from one technology to another. This is in favour of the investors in the technology with the highest minimum allowance, but poses a risk for investors in other renewable energy technologies as overinvestments in the former technology might create an imbalance between supply and demand in FGC and a consequent drop in FGC price. The high minimum allowance for PV illustrate this risk.

Modification of legislation puts investors also at risk. Especially the drastic reform of the FGC scheme, discussed in the course of 2012 and finally introduced in 2013, demotivated in renewable electricity production. In 2013 only 67 MW of new capacity was added versus 447 MW in 2012 (VREG, monthly statistics on eligible FGC installations). This is below the 234 MW of new capacity that the Flemish authorities expect to be installed annually between 2013 and 2020, split into 80 MW wind, 150 MW PV and 4 MW biogas. This expected capacity together with the existing capacity would generate 7.9 TWh of renewable energy by 2020 (Flemish Energy Agency, 2013c).

In the first years that the FGC scheme was operational, the supply of FGC was insufficient to meet the demand, which put the electricity providers as obliged party at risk at a moment that the Flemish electricity markets were in a full transition from a regulated to a liberalised market. FGC market analysis revealed that most of the FGC are issued to parties having a redeem obligation as well. As a consequence, the incumbent electricity producers control the FGC market while challengers were at higher risk of paying fines for missing FGCs. To illustrate, more than half of the FGC were issued to the largest incumbent power producer in 2009. As a result of their relative share of market, only 54% of the certificates issued is traded which limited the liquidity in the FGC market (Flemish Parliament, 2010). Electricity providers are allowed to bank excess FGCs in case of an oversupply and to use these FGCs for the redeem obligation of the subsequent years. However, if the oversupply is structural, which is currently the case, some of the FGCs risk to be invalid before they can be redeemed.

The grid operators bare the highest risk in case of an oversupply. Investors in renewable energy production present FGC to grid operators in order to recover the minimum allowance. In case of an oversupply, there is little change that the grid operators can recover these costs by presenting in turn the FGC to the market. The only way left to recover these costs is by increasing the tariffs for electricity transport for the electricity consumers, who at the end are at risk for paying the costs.

Discussion and conclusions

The comparison of the Norwegian-Swedish green certificate scheme and the Flemish green certificate scheme reveals some interesting similarities and differences related to the commodification aspects, the financialisation aspects and the distribution of the risks to the various stakeholders in play.

Both schemes had a very similar and simple design in their early years of operation. Both created a tradable commodity by issuing one green certificate per MWh of renewable power generated by a distinct list of eligible renewable power technologies. This commodification process was technology neutral as it did not discriminate one of the technologies of this list. The financialisation aspect of both schemes was arranged by setting a percentage of power sales by power providers that need to be covered by green certificates that they need to purchase on the certificate market.

While the Norwegian-Swedish scheme seems to deliver in its first two years of operation as anticipated – although an asymmetry in investments in both countries can be observed – the effectiveness of the Flemish scheme in its early years was insufficient to generate enough green certificates to cover the demand. This has put the power providers at risk of paying excessive fines and as a response, the redeem quota were reduced, which is exactly the opposite of what is proposed as an action in the case the Norwegian-Swedish scheme is confronted with an underinvestment in renewable power capacity. In addition, the financialisation of the Flemish scheme was modified by introducing minimum allowances. Their purpose was to reduce the risk for investors in renewable energy. One year after their introduction however, a market equilibrium in demand and supply on the Flemish green certificate market was achieved questioning the impact of these minimum allowances on the effectiveness of the scheme.

Both the Norwegian-Swedish and Flemish scheme are hence effective in bringing enough renewable power capacity in the market. Another similarity of both schemes is that they do not succeed in bringing this renewable power capacity in the market in the most cost-efficient way, albeit as a result of different causes. In the Norwegian-Swedish case, this is caused by differences in taxes and depreciation rules, and some differences in the design of the schemes in the two countries. Removing these differences could create a level-playing field for investments in both countries and would create conditions in which the lowest cost project is the marginal one. This is an important lesson when creating common markets for commodities. In the Flemish case, the reduced cost-efficiency is caused by a design aspect of the scheme: the introduction of minimum allowances above the market level of the certificates. They were introduced for one specific technology; photovoltaic to be more specific. It is a small scale technology which has a short time lag between investment decision and start of operation compared to the other larger scale renewable power technologies. The fast development of photovoltaic power in Flanders eventually created an oversupply of green certificates on the market. This has put the distribution grid operators at risk as green certificates are presented to them then to recover the minimum allowance. This situation resulted in a further complication of the commodification aspect of the Flemish green certificate schemes by introducing technology specific banding factors. This in turn puts the investors in renewable energy at risk; as a drastic decrease in new investments since the reform of the scheme illustrates, the current Flemish green certificate scheme might demonstrate not to be effective in time, although cost-efficient by design.

As the rate of renewable energy penetration across the EU continues to rise, electricity market arrangements are increasingly being tested, and social concerns regarding the costs of this renewable support increase. Green certificate schemes would seem to provide some promising opportunities to assist in managing these challenges. However, their effectiveness and efficiency are very context dependent as the Norwegian-Swedish and Flemish green certificate schemes demonstrate. Careful initial scheme design is essential, yet it is also clear that ongoing reactive and proactive governance – the rules for changing the rules' is required as circumstances change whilst still providing appropriate investment certainty. A green certificate scheme design addresses in principle two issues: the way renewable energy production is commodified into green certificates and the market structure that is set up to financialize these commodities. The case of the Norwegian-Swedish green certificate scheme illustrates that the current design insufficiently takes into account country specific market conditions to create a level playing field for generating additional renewable power capacity in both countries, which might require modification to the underlying commodification arrangements. The case of the Flemish green certificate scheme demonstrates that modifications to the design of certificate mechanisms should be well considered beforehand, and that its impacts should be well analysed in advance. Both cases demonstrate that market-based instruments, such as green certificate markets, do not operate in a vacuum. Although market-based instruments might be an alternative to more directly government controlled support schemes, they must still operate within a context significantly shaped through policy efforts and associated measures in the areas of energy, environment, industry and regional development and EU integration. There is no escaping the challenging policy task of crafting an effective, efficient and equitable response to Europe's many energy challenges. Quota schemes would seem to offer some attractive advantages over such approaches – advantages that arise from the commodification and fiancialisation of renewable energy generation. However, renewable energy is not a natural, entirely fungible 'commodity' good and financialisation brings its own challenges as well as potential advantages. The challenges for policy makers in designing such schemes should not be underestimated.

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