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Upgrading Guarantees of Origin to Promote the Achievement of the EU Renewable Energy Target at Least Cost

Alberto Pototschnig
Ilaria Conti

Research Project Report
January 2021

Robert Schuman Centre for Advanced Studies
Research Project Report
RSCAS/Florence School of Regulation
26 January 2021

European University Institute
Badia Fiesolana
I – 50014 San Domenico di Fiesole (FI)
www.eui.eu/RSCAS/Publications/
cadmus.eui.eu

With the support of the
Erasmus+ Programme
of the European Union

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1. Introduction

With the 2015 Paris Climate Agreement, the European Union pledged to achieve greenhouse gas (GHG) emission reductions of at least 40% by 2030. In the Clean Energy for All Europeans package legislation, the European Union committed to support this pledge with other ambitious sustainability targets for 2030: a 32% share of renewables in final energy consumption, with a sub-target of 14% for the transport sector, set in Directive (EU) 2018/2001 (REDII)[1,2]; and 32.5%[3] energy efficiency improvements with respect to the 2007 baseline scenario. As part of the European Green Deal[4], the European Commission has proposed raising the level of ambition of EU environmental policies and reaching carbon neutrality by 2050. In order to achieve this goal, the GHG emission reduction target for 2030 will be increased to 55%. The renewable energy penetration objective is likely to be consequently increased to 38-40%.

The achievement of these ambitious environmental targets requires a change of pace in many sectors of the economy. The energy sector is called on to contribute with a massive increase in generation from renewable energy sources, both in the electricity and the gas sectors. As previously[5], the electricity sector will be called on to provide a more than proportional contribution to the achievement of the renewable penetration target. Indeed, it is likely that, by 2030, two-thirds or more of final electricity consumption will have to be met by renewable generation[6].

The gas sector will also be called on to play its role, no longer as a mere back-up for renewable electricity generation, but as a conveyor of renewable energy via molecules. Even if the decarbonisation of the

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[1] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources.

[2] The targets set in REDII and referred to in the text are subject to a revision clause for 2023. In the case of the overall target, such a revision would be triggered ""*where there are further substantial costs reductions in the production of renewable energy, where needed to meet the Union's international commitments for decarbonisation, or where a significant decrease in energy consumption in the Union justifies such an increase*" (Article 3(1) of REDII). Similar conditions are set for the revision of the transport-sector target.

[3] With an upward revision clause for 2023.

[4] Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, The European Green Deal Brussels, 11.12.2019, COM (2019) 640. In reality, a strategic long-term European vision for a prosperous, modern, competitive and climate neutral economy, which would lead to net-zero greenhouse gas emissions by 2050 had already been outlined in the Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee, the Committee of the Regions, and the European Investment Bank: A Clean Planet for all - A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy, Brussels, 28.11.2018, COM (2018) 773.

[5] Against a 20% renewable target for 2020, in 2017 renewables already accounted for 30.7% of gross final electricity consumption.

[6] Beyond the increase in the share of renewable-based generation in final electricity consumption, the absolute volume of renewable-based generation is likely to increase, as the extensive electrification of many sectors of the economy – including transport and heating – is likely to overweigh the reduction in electricity demand due to increased energy efficiency (EU Reference Scenario 2016 https://ec.europa.eu/energy/sites/ener/files/documents/ref2016_report_final-web.pdf and CAN-EEB Paris Agreement Compatible Scenario file:///C:/Users/530S-14ARR-2NIX/Downloads/A-Paris-Agreement-Compatible-PAC-energy-scenario.pdf, June 2020)

economy requires increased electrification, not every sector or process can be easily or economically "electrified", and gas will still be needed in some applications, both as an energy carrier and feedstock.

It is worth highlighting at this point that, as a good policy rule, since the GHG reduction target and the renewable energy penetration target are separate, albeit related, targets, they will need two separate, if possibly interrelated, policy instruments.

In its Energy System Integration Strategy, the European Commission looks at *"trustworthy and efficient markets [to] guide customers towards the most energy-efficient and cheapest decarbonisation option, on the basis of prices that properly reflect all the costs of the energy carrier used"*[7].

The EU policy approach to decarbonisation will be based on the reformed Emission Trading Scheme (ETS), which should provide a consistent pricing for carbon[8] and, therefore, promote decarbonised/low carbon energy vectors. However, while promoting renewable energies by charging their fossil-based competitors, the EU ETS alone will not likely ensure that the penetration of renewable energies meets said policy targets. A further, more targeted tool, is, therefore, needed.

Experience with renewable energy support in Europe is fairly varied. In the electricity sector, most jurisdictions have so far relied, above all, on feed-in tariffs (FITs), being replaced by feed-in premia (FIPs)[9]. Only a handful of jurisdictions have implemented Green Certificate (GC) schemes[10]. While FITs are typically administratively set, an increasing number of jurisdictions are using tendering procedures to assign the right to FIPs and to fix their levels. Providing certainty to investors has been a major consideration in the choice of support instruments[11].

In the gas sector, support for renewable gases has been much more limited[12], and so has been the penetration of these gases. In this context, it is now clear that, if renewable gases are needed to replace natural gas for heating and cooling, for electricity generation and as feedstock in industrial processes, they will have to be more effectively promoted. It is also clear that any decarbonisation scenario would require

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7 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Powering a climate-neutral economy: An EU Strategy for Energy System Integration, Brussels, 8.7.2020 COM(2020) 299 final, Section 3.4, page 14.

8 In reality, the ETS covers carbon emissions from the burning of fossil fuels. For example, carbon emissions from the use of biogas or synthetic gas are not charged under the ETS.

9 Where this happens, FIT may be maintained for smaller installations.

10 According to the "Status Review of Renewable Support Schemes in Europe for 2016 and 2017" of the Council of European Energy Regulators, of the 27 jurisdiction surveyed, 17 were using FIT and 16 were using FIP in 2017. In contrast, in the same year, only six were using GC systems.

11 However, failures in the design of support schemes forced at least one Member State to adjust retroactively the level of support granted to renewables, greatly affecting investors' confidence. This led to the inclusion, in REDII, of provisions (in Article 6) on the stability of financial support for renewable energies, specifying that "*the support granted to renewable energy projects are not revised in a way that negatively affects the rights conferred thereunder and undermines the economic viability of projects that already benefit from support*" (Article 6(1)) and that "*Member States may adjust the level of support in accordance with objective criteria, provided that such criteria are established in the original design of the support scheme*" (Article 6(2)).

12 Article 4 of REDII governs "Support schemes for energy from renewable sources". However, while paragraph 1 which contains a general provision regarding the possibility of Member States applying support schemes, paragraphs 2 to 6 only relate to renewable-based electricity.

the gas sector – and conceivably renewable and decarbonised gases – to support the greater penetration of renewables in the electricity sector. To do so, they would need to provide flexibility in the forms of storing energy over longer periods of time and of transporting energy over longer distances.

Therefore, the question arises of the most effective instrument for promoting the development of renewable gases, and renewable hydrogen among them, taking stock of the long experience gained in supporting renewable-based electricity.

More generally, as the renewable penetration target could be achieved with different mixes of technologies and renewable energies (renewable electricity, renewable gases, renewable heat, biomass, etc.), an approach is needed which promotes the achievement of the target at least cost. And the need for least-cost solutions will be greater, the more ambitious the renewable target becomes.

Looking further into the future, there is a growing consensus that the EU carbon-neutrality goal set for 2050 will be achieved through two main pillars: increased electrification wherever this is possible; and the use of (renewable/decarbonised) hydrogen in those processes where electricity cannot be economically employed. Therefore, renewable energies are the essential instrument for achieving the 2050 goal and a set of policy instruments is needed to guide the EU through this transition.

In commissioning this Report from the Florence School of Regulation, the Directorate-General for Energy of the European Commission put emphasis on the use of Guarantees of Origin for the promotion of decarbonised and renewable gases. In addressing this issue we found that the same mechanism could be used to promote not only renewable gases, but renewable vectors across the whole energy sector in a holistic way in the context of (electricity and gas) sector coupling and, more generally, wider sector integration (e.g. including heating and cooling).

Therefore, in this Report, we propose a mechanism based on Guarantees of Origin (GOs) – and a variant of them, the Guarantees of Renewable Origin (GROs) – as a tool for promoting the achievement of the renewable energy penetration target at least costs. The implementation of the proposed mechanism would require some changes in legislation and an upgrading of the current voluntary GO schemes.

It is important to underline that this Report does not provide an assessment of the legal implications of the proposed mechanism. Nor does it try to get to grips with its political dimension. If the proposed mechanism were to be considered in the policy debate, many aspects would need to be looked into. They would have to be part of a more detailed implementation plan.

2. The EU legislation on GOs

Guarantees of Origin were introduced by the first Renewable Energy Directive (REDI)[13] for disclosure purposes, as a proof to final consumers that the energy they consumed was produced from renewable energy sources[14].

The main provisions of REDI[15] concerning GOs are to be found in Article 15, which provides all criteria that a GO must meet. Article 15 also requires Member States to ensure that a GO is issued on request from producers of electricity (and, at the discretion of the Member States, heating or cooling) from eligible renewable energy sources, as defined by the same Directive.

There is no fixed price for a GO, and their value depends on market demand and supply. The system is purely voluntary, and individual producers can decide whether or not they wish to make such a request. On the other hand, each electricity supplier is currently obliged to disclose to its customers the energy origins of all electricity sold[16].

Initially, GOs were related to electricity and heating and cooling, but the REDII extended the framework to gas, including hydrogen.

Particularly, Recital 59 states:

"*Guarantees of origin which are currently in place for renewable electricity should be extended to cover renewable gas. Extending the guarantees of origin system to energy from non-renewable sources should be an option for Member States. This would provide a consistent means of proving to final customers the origin of renewable gas such as biomethane and would facilitate greater cross-border trade in such gas. It would also enable the creation of guarantees of origin for other renewable gas such as hydrogen".*

Article 19 of REDII (*Guarantees of origin for energy from renewable sources*) provides for GOs to specify "*the source of energy; whether it relates to electricity, gas (including hydrogen), heating or cooling".*

The same Article 19 lists the additional minimum information that GOs must include, that is: "[information] *concerning the installation where the energy was produced; whether the installation or the unit of energy benefited from investment support or from a national support scheme; the date on which the installation became operational; the date and country of issue and a unique identification number*".

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[13] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

[14] Art,19 (1) of REDII: "for the purposes of demonstrating to final customers the share or quantity of energy from renewable sources in an energy supplier's energy mix and in the energy supplied to consumers under contracts".

[15] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0028&from=EN

[16] Article 19(8) of REDII; Annex 1.5 to Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU.

There is no mention, in REDII, of the maximum information that a GO could provide – which implies that GOs could easily be enhanced to include additional information on whether or not given energy is from a renewable source.

Moreover, the REDII still very clearly restricts the scope of GOs *to "the sole function of showing to a final customer that a given share or quantity of energy was produced from renewable sources"* (Recital 55*).* A potential upgrade of GOs as an instrument for achieving the EU renewable energy penetration target would then imply a revision of this specific provision.

3. Implementation experience and statistics

At the European level, there are currently three main issuing bodies for renewable energy certificates and Guarantees of Origin: the Association of Issuing Bodies (AIB), ERGaR (European Renewable Gas Registry) and CertifHy.

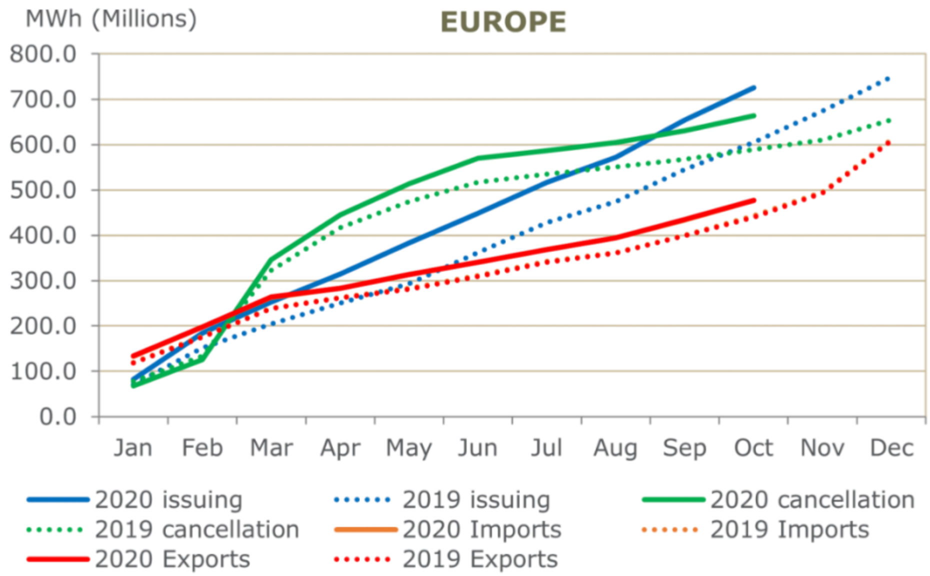
AIB is the largest and has been operating for longest; it was established in 2002. At the end of 2019 there were, within AIB, 27 issuing bodies of energy certificates from 24 European countries. The association aims to develop, use and promote a standardised system of energy certification for all energy carriers: the European Energy Certificate System - "EECS" [17].

AIB members largely support GOs for renewable sourced-electricity and cogeneration, and disclosure certificates for fossil- and nuclear-based electricity, as required by national legislation. AIB has also recently started working on gas certificates as well as on the rules that facilitate GO issuing following energy carrier conversion[18].

According to AIB data, the market activity around GOs is increasing: by the end of 2019, 79% of GOs issued for electricity produced during 2018 and 49% of GOs issued for electricity produced in 2019 were reported as having been cancelled. 6% of GOs issued for electricity produced in 2018 have now expired, up from 3% the previous year.

[17] The AIB's European Energy Certificate System – EECS – facilitates all form of certificate in a harmonised manner. This includes certificates introduced by legislation at the national level, whether used as evidence of fuel source or production technology, and whether for purposes of providing evidence to consumers or government

[18] AIB is also involved in a one-year project named FaStGO. This project provides expert advice to the European Commission DG ENER, based on the terms of Reference N° ENER/C1/2019-517: "Technical support for RES policy development & implementation. Establishing technical requirements and facilitating the standardisation process for guarantees of origin on basis of Dir (EU) 2018/2001." The tasks covered by this project include: mapping currently existing standardisation frameworks; specification of the technical requirements for the extended coverage of GO; system specifications; and the requirements for the associated infrastructure for cross-border exchange of GO for all energy carriers; systems for EU-based market supervision statistics; methodologies for enhanced prevention of financial fraud; and stakeholder consultation processes.



Source: AIB

The AIB website also provides several graphical presentations of common data for all countries, and by individual countries regarding – on the one hand – the issuing of GOs and their cancellation/expiration[19] and – on the other – GO transactions (number of imported/exported, transferred, cancelled and expired certificates).

It is important to distinguish between these two categories. The first type of statistics (about the issuing of GOs) relates to the moment in which the energy associated with the GO was generated and it provides information on how many active certificates[20] there are in the market for that specific period.

A year after the relevant month, the volume should be close to zero across the AIB since GOs have a lifetime of 12 months.

The second type of statistics refers, instead, to when the GOs were issued, transferred, cancelled, expired, or withdrawn (action based). Such statistics have, as a period of reference, the calendar month.

Based on the above statistics, the AIB compiles an overview of EECS GO transactions per domain, energy source containing information on GOs, by date of production of the related energy and by date of

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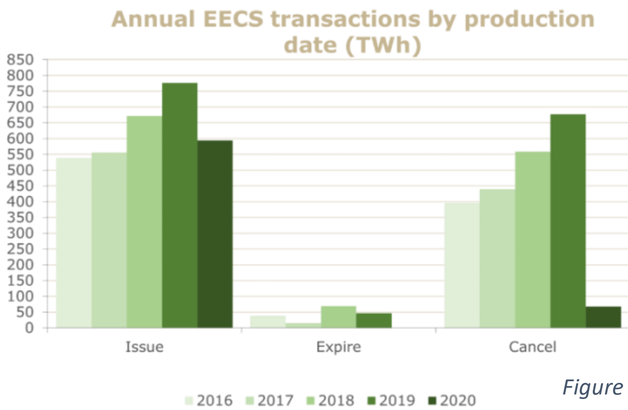
[19]Issuing, cancelling and expiration of GOs as defined by AIB

- Issue: The quantity of GOs issued by the reporting Domain (for energy production within the reporting Domain only);
- Cancel: The quantity of GOs cancelled by the reporting Domain, including those cancelled for use in other Domains (regardless of where the GOs were issued); and
- Expire: The quantity of GOs expired by the reporting Domain (regardless of where the GOs were issued).

[20] Active certificates = Issue – Cancel – Expiry – possible Withdrawals.

transaction. The statistics reported in the figures below were published on 14th February 2020 based on data collected in the period January-February 2020.



Source: AIB

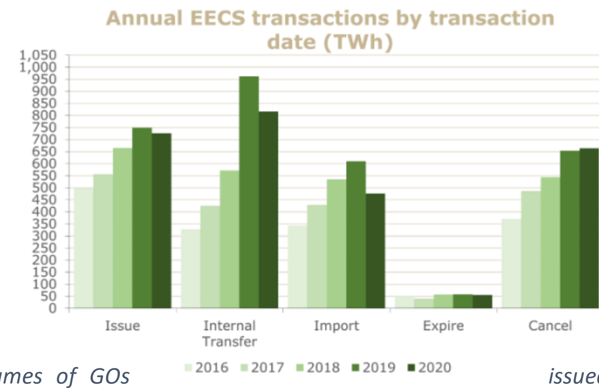


Figure 1 Volumes of GOs issued, cancelled, imported and exported in 2019 and 2020 (Source: AIB)

ERGaR was established as a cooperative effort among national *renewable gas* registries in Europe, to enable the cross-border transfers of renewable gas certificates among member registries.

The association currently has 26 members from 14 European countries. These are: established biomethane/renewable gas registries; gas DSOs & TSOs; biogas associations; and major stakeholders in the European biomethane market.

ERGaR offers two certification schemes:

- Certificate of Origin, which can be translated into GOs - with ERGaR acting as a hub to handle GOs at a technical level; and
- the ERGAR RED Mass Balancing[21] scheme.

ERGaR and AIB work together on the European Biomethane Guarantee of Origin (EBGO), through a research project (REGATRACE - Renewable Gas Trade Centre[22]), which looks at how to scale up renewable gases (and particularly biomethane) through the use of GOs.

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[21] Mass balancing is the methodology applied to trace virtually the chain of custody of renewable gas distributed along European gas networks. The operation of a mass balance system aims at indicating the intrinsic, green value of exported renewable gas without explicitly tracking the physical cross-border gas flow.

[22] In terms of geographical scope, the project aims at combining the existing national biomethane registries already in place in Austria, Denmark, Estonia, Finland, France, Germany, The Netherlands, Switzerland and the UK. Additionally, it expects the creation of issuing bodies in other countries participating in the project: (Belgium, Ireland, Italy, Lithuania, Poland, Romania and Spain), as well as setting up registries in the following seven supported countries: Croatia, Czech Republic, Greece, Latvia, Slovenia, Sweden and Ukraine. More information can be found here: https://www.regatrace.eu/wp-content/uploads/2019/11/REGATRACE-D2.1.pdf; https://www.regatrace.eu/wp-content/uploads/2020/04/REGATRACE-D6.1.pdf

GOs for hydrogen have been addressed by CertifHy, a Certification System project financed by the Fuel Cell and Hydrogen Joint Undertaking.

Between 2014 and 2016, the CertifHy project (phase 1) developed an EU-wide Green and Low Carbon Hydrogen Guarantee of Origin (GO) Scheme, including a definition for Green and Low Carbon hydrogen, and a roadmap with well-defined steps for the implementation of an EU-wide GO scheme. The first GOs were issued in December 2018.

The CertifHy GO scheme for Premium Hydrogen replicates the AIB certification scheme for renewable electricity and aims at disclosing information on the hydrogen produced, including energy source and greenhouse gas intensity; it also includes: GO governance; eligibility and registration of production plants; the GO and information content; issuance, transferability and cancellation; the registry system and trading platforms.

4. Achieving the renewable energy penetration target at least cost

As noted above, the EU renewable energy penetration target for 2030 is expressed in terms of the share of renewable energy in final energy consumption, with only a sub-target for the transport sector. Therefore, for the other sectors, the target could conceivably be achieved with any combination of renewable shares for different energy vectors[23]. The question, therefore, arises of which combination of renewable penetration levels for the different vectors delivers the overall target at least cost and whether the resulting mix of renewable energies is acceptable from an energy policy perspective[24].

It is a straightforward matter to show that the least-cost solution for meeting the overall renewable energy penetration target is the one for which the marginal cost of replacing a vector in its conventional, but decarbonised form with its renewable alternative is the same across all vectors. In the rest of this Report we will refer to the replacement of a vector in its conventional decarbonised form with its renewable alternative as "greening" the vector[25]. Therefore, an instrument which promotes the

[23] Even though a "normalisation rule" for accounting for electricity generated from hydropower and wind power is provided in Annex II of Regulation (EU) 2018/2001. However, this normalisation rule does not alter the fact that the overall renewable penetration target could be achieved through different combinations of renewable energy vectors. Rather it implies that the power generated by some technologies should be "normalized" before it is taken into account for the achievement of the overall target.

[24] Policy-makers might have views regarding the renewable vector mix which most effectively and efficiently delivers the 2050 EU carbon neutrality goal, and the intermediate renewable penetration targets in earlier years. As such, they might, therefore, be tempted to steer the energy sector towards that mix. However, policy-makers should be aware that steering the energy sector away from the mix which is delivered by a technology-neutral market mechanism might increase the overall cost of achieving the goal. A different aspect is the effort sharing among EU Member States, where the political agreement – based on the concerns of some Member States to limit the cross-border transfer of the benefits accruing from the development of renewable energies – might lead to a departure from the EU-wide least cost solution for meeting the 2050 carbon neutrality goal and the related intermediate targets.

[25] However, this clearly does not mean, and cannot mean, that the same electron or molecule change their sources and become renewable-based.

achievement of the overall renewable energy target at least cost should provide signals to equalise the marginal costs of greening the different vectors[26].

With the use of such an instrument, the actual renewable shares for the different vectors will be determined by the market on the basis of the relative costs of "greening" the different vectors. We would expect that vectors for which the cost of their greening is lower will make a larger contribution to the achievement of the overall renewable energy penetration target. Therefore, the approach proposed in this Report will ensure the minimisation of the cost of achieving the overall renewable energy target; subject to the limitations which will be discussed in Section 8. This approach will not deliver, by itself, a pre-defined renewable share for any of the vectors included[27]. In order to achieve that, additional support for specific vectors/technologies might be needed. In this respect it is important to clarify that the approach proposed in this Report could be accompanied by additional targeted support, to promote, for example, the development of infant technologies. It should be clear, though, that this kind of additional support, to the extent that it leads to a deviation from the mix of renewable energies delivering the renewable energy penetration target at least cost, would increase the cost of achieving that target[28].

5. The role of Guarantees of Origin in promoting the equalisation of the marginal costs of "greening" the different energy vectors

The equalisation of the marginal cost of greening the different energy vectors might be achieved by establishing a market for the renewable characteristics of these vectors. Tradeable Green Certificate (TGC) schemes used to promote renewable electricity in several EU jurisdictions are examples of this type of market. A TGC scheme, if well calibrated and properly implemented and enforced, guarantees the achievement of a renewable electricity penetration target. But the contribution of different renewable technologies to the achievement of the target is left to the market to determine.

In this Report we propose a similar mechanism, based on Guarantees of Origin (GOs). This mechanism would be extended not only to renewable electricity, but to all renewable energy vectors contributing to the achievement of the EU renewable energy penetration target[29]. With this kind of a mechanism, GOs, or, rather, their "renewable" variant (see the next Section), would act as a "common currency" to promote the equalisation of the marginal costs of "greening" the different energy vectors. In fact, the price of GOs will act as a benchmark against which the marginal costs of "greening" the different vectors would be compared. Each vector will be "greened" up to the point at which the marginal costs of greening an additional unit of that vector is equal to the GO price. With a single price for GOs – within the perimeters discussed in Section 8 – the marginal costs of "greening" different vectors would be equalised.

It has been suggested by some commentators that different renewable vectors provide different energy services and, therefore, that their quantities should not be directly added up in pursuing the renewable energy penetration target. These kinds of differences seem not to be reflected in legislation: Article 7(1) of REDII, on the "calculation of the share of energy from renewable sources" does not seem to introduce

[26] It is worth emphasising that equalising the marginal cost of "greening" the different energy vectors does not correspond to equalising the marginal cost of producing the different vectors from renewable (green) sources.
[27] Unless the instrument is applied separately to the different vectors. Please see Section 8.
[28] See also footnote 24.
[29] With the possible exception of the transport sector, given the sub-target set for this sector in REDII.

any weighting for the different vectors[30]. However, even if some weighting were eventually introduced, the proposed mechanism would still work in very much the same way. The GOs would be aiming at equalising the marginal cost of "greening" the weighted quantities of the different vectors and they would be traded on that basis.

6. Guarantees of Origin and Guarantees of Renewable Origin, a single instrument serving three purposes: disclosure, carbon footprint and renewable origin

As indicated above, legislation has so far restricted the use of GOs to disclosure purposes, i.e. to "*showing to a final customer that a given share or quantity of energy was produced from renewable sources*"[31]. However, the same GOs could also be used for the promotion of renewable energies as proposed in this Report, and also, if deemed useful, for recording the carbon footprint of the different energy vectors for the implementation of the EU ETS.

We already indicated in Section 2 that, according to current legislation, each GO shall be identified by a unique identification number and shall indicate: the (renewable) energy source; the production period; the energy vector (electricity, gas including hydrogen, heating or cooling); the production installation and its commissioning date; any support received by the installation or production; and the date and country of issue[32]. In order for GOs to be used as the main instrument for the promotion of renewable energies and, possibly, for the implementation of the EU ETS, they would have to contain additional information. In particular, for the former purpose, GOs would have to indicate whether the energy against which they have been issued qualifies as "renewable" according to legislation. Any GOs issued against the production of energy from renewable sources would be referred to as Guarantees of Renewable Origin (GROs).

Therefore, GOs could be issued on all energy produced in the EU – including energy produced from non-renewable sources[33]. But only those issued against energy produced from renewable sources would qualify as GROs. The other GOs would only be used for disclosure purposes and, possibly, for the implementation of the EU ETS.

It is important here to stress that the same GROs could be used both for disclosure purposes and as an instrument to promote renewable energies. We will return to this point in the next section.

7. The GRO system in practice. Issuance, trading, surrendering, cancellation

But how would a statutory[34] mechanism based on GROs work?

GROs would be issued to energy producers against their energy production from renewable sources.

[30] Beyond the normalisation rule in Annex II, as already indicated in footnote 23.
[31] Recital (55) of Directive (EU) 2018/2001.
[32] According to Article 19(7) of Directive (EU) 2018/2001.
[33] As already allowed by Article 19(2) of Directive (EU) 2018/2001: "*Member States may arrange for guarantees of origin to be issued for energy from non-renewable sources*".
[34] In the sense that the mechanism would provide the basis for the promotion of renewable energies and will be mandatory within its geographical scope. See Section 8.

As the renewable energy penetration target is expressed in terms of final energy consumption, an obligation would be imposed on energy consumers, or, in the case of small consumers buying from suppliers, on the suppliers serving them, to procure an amount of GROs equal to a pre-defined share of their final energy consumption[35]. In the following, this obligation will be referred to as the "GRO obligation". This predefined share of the GRO obligation might be the same for all types of consumers and energy vectors[36] or, if policy makers so decide, differentiated by consumer category and/or energy vector[37].

Large consumers and suppliers would be able to procure the required GROs directly from renewable energy producers or on the market. In fact, it would assist the efficiency of this mechanism if a market were established where GROs could be traded between renewable energy producers, large consumers and suppliers, as well as intermediaries and market makers, thus increasing its liquidity.

Large consumers and suppliers would be able to demonstrate the fulfilment of their obligations by surrendering the required quantity of GROs to an entity responsible for the operation, monitoring and enforcement of the mechanism. Once surrendered, these GROs would be cancelled.

GROs which are not surrendered within a pre-defined period after being issued would expire and would, therefore, be automatically cancelled.

The way in which GROs would be issued, traded, surrendered and cancelled might emulate the current practice for GOs used in voluntary schemes (such as the EECS).

As already noted, the same GROs could be used both for disclosure purposes and as the instrument on which the proposed mechanism is based. Let us take the example of a supplier with a 40% GRO obligation; that is one subject to the obligation of procuring and surrendering GROs representing an amount of renewable energy equal to 40% of the energy consumed by the customers the supplier serves. Said supplier would meet this obligation by surrendering the required quantity of GROs. However, on the basis of the surrendered GROs, the supplier would also be able to inform its customers that 40% of the energy that it supplies is of renewable origin. In fact, the supplier might want to lay claim to a larger share of renewable energy and therefore procure (and surrender) more GROs than those required by its GRO obligations. Or the supplier might decide, in procuring the GROs it needs, to favour local renewable energy producers and, in doing so, to claim that it supports local renewable production.

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[35] In this description, an aspect is neglected, which will have to be addressed at the implementation stage: the losses during transportation of an energy vector. Losses of energy during transformation processes (e.g. Power to Gas) will, instead, be taken into account by the surrendering of GROs related to the vector used in the transformation and the issuance of GROs on the vector resulting from the transformation. See Section 7.

[36] In this case, to achieve a 38-40% renewable energy penetration target, the obligation would be set at this level for all consumers and energy vectors.

[37] It is important to stress that the efficiency characteristics of the mechanism proposed in this Report – to achieve the renewable energy penetration target at least cost – are not affected by the way in which the burden of achieving the overall renewable energy penetration target is allocated across different consumer categories and energy vectors. This would only affect the way in which the cost of achieving said target are shared among different consumers.

From these examples it is clear that there is no conflict between the use of GROs for meeting the GRO obligation and their use for disclosure purposes.

8. The GRO granularity and trading

As indicated in Section 4, a mechanism based on GROs would minimise the cost of achieving the renewable energy penetration target by equalising the marginal cost of "greening" the different energy vectors.

In this context, there are a number of dimensions which need to be considered in designing such a mechanism:

- the geographical scope of the mechanism;
- the cross-vector dimension; and
- the time granularity.

In all cases, the wider the perimeter within which the mechanism operates and within which GROs could be traded – in terms of participating jurisdictions, energy vectors and time granularity – the greater the flexibility offered (to large consumers and suppliers) to meet their GRO obligations. And greater flexibility should lower the cost of achieving the renewable energy penetration target. However, greater flexibility means that the obligation related to the final energy consumption of one vector at a specific time in a specific jurisdiction could be met by renewable energy of a different form, produced in a different jurisdiction and/or at a different time.

While in this Report it has so far been implicitly assumed that the GRO mechanism would operate across different vectors – from which the reference to the equalisation of the marginal costs of greening the different vectors – the exact perimeter and structure of the mechanism would need to be carefully designed. The mechanism could apply to a subset of vectors and jurisdictions, separately or as part of the same mechanism.

8.1 The geographical scope

Different Member States are endowed with different renewable energy resources and would, therefore, have different costs of renewable energies compared to their conventional decarbonised equivalents. Therefore, significant savings in achieving the renewable energy penetration target might be obtained by producing more renewable energies where their cost differentials are lower, using them also to fulfil the renewable energy obligations in jurisdictions characterised by higher "greening" costs. This opportunity would require the cross-border tradability of GROs. This however would imply that the renewable energy obligations in one jurisdiction could be met by renewable energy production in another jurisdiction. Thus, while large consumers and suppliers in the former jurisdiction would face the (somewhat lower) cost of meeting their obligations, the local benefits of renewable energy production (e.g., in terms of job creation) would accrue to the latter jurisdiction[38].

[38] This kind of decoupling of the accrual of the costs and benefits of an increasing share of renewables led Member States to reject the Commission's proposal in 2007 for an EU system of Certificates of Origin. However, the statistical

In deciding the geographical scope of a GRO mechanism, a trade-off would, therefore, have to be considered between:

- The minimisation of the costs of achieving the overall renewable energy penetration target, which would call for the widest possible geographical scope;
- Maintaining the local benefits of renewable energy production in the proximity of those large consumers and suppliers that pay for greening the energy, which would suggest a more limited geographical scope of the mechanism, or its segmentation into different geographical markets.

In fact, the proposed mechanism is totally flexible in terms of the geographical scope of its implementation. It might be implemented across the whole EU, perhaps including EEA states, or at a regional level. Alternatively, the mechanism might be implemented, in parallel, in different sub-regions, with trading between them subject to specific conditions and limitations.

Finally, in order to avoid any double-counting of the renewable energy produced and consumed in a jurisdiction, the GRO mechanism would have to become the mandatory instrument for accounting renewable energy for the achievement of the renewable penetration target within participating jurisdictions. This, however, does not exclude the possibility that some renewable energy technologies might be further supported by more targeted mechanisms, with the caveat that this would likely result in a deviation from the least-cost solution for achieving the overall renewable energy penetration target.

8.2 The (cross-)vector dimension

There are significant differences in the costs of "greening" the different vectors. For electricity, generation from a number of renewable technologies – such as onshore wind and solar PV – is increasingly commercially viable even without subsidies. This is not (yet) the case for renewable gases. The cost of biogas and renewable hydrogen is still substantially higher than their decarbonised, but not renewable, equivalents.

Therefore, the cost of achieving the overall renewable energy penetration target could be significantly reduced if there were flexibility in the renewable energy mix which is used to meet these targets. In practice this would require large consumers and suppliers to be able to meet their GRO obligations related to the final consumption of one vector by procuring and by surrendering GROs issued *vis-à-vis* the renewable-based production of another vector. For example, a large industrial consumer of hydrogen might be allowed to meet its GRO obligation with GROs issued in respect of the production of any renewable vector, including, for example, electricity.

The implications of this kind of flexibility would be a greater supply of GROs issued *vis-à-vis* the renewable-based production of those vectors where the greening costs are lower. As a result, the renewable-based

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transfers envisaged in Article 8 of Directive (EU) 2018/2001 and the EU renewable energy financing mechanism, being launched by the European Commission also provide some flexibility in the way in which overall EU renewable energy penetration targets and the individual Member State contributions are achieved. In particular, in its EU renewable energy financing mechanism infographics, the European Commission emphasises that the mechanism will bring benefits to a "contributing" member state in terms of "potentially lower direct and indirect costs than deployment of installations at home" and of "access to potentially cheaper or otherwise unavailable renewable energy sources".

production of these vectors would be greater than the quota imposed on their final consumption, while the reverse would happen for those vectors whose greening costs are higher.

Alternatively, the mechanism might require that the GRO obligation related to the final consumption of one energy vector be met by surrendering GROs issued *vis-à-vis* the renewable-based production of the same vector. That would lead to a segmentation of the GRO market and cost minimisation would only be achieved within each vector. This is what currently happens, for example, with TGC schemes, which apply only to electricity and in which cost minimisation is only achieved among the different renewable-based electricity production technologies.

In deciding the (cross-)vector dimension of a GRO mechanism, a trade-off would, therefore, have to be considered between:

- The minimisation of the costs of achieving the overall renewable energy penetration target, which would call for the mechanism being jointly applied across all vectors;
- Ensuring that a pre-defined quota of renewable-based production is achieved for each vector, which would suggest that the mechanism is applied separately to the different vectors.

One last aspect relates to the vector dimension of the GRO mechanism and its application to energy transformation. Hydrogen cannot be found as such in nature and should be produced through chemical processes, typically requiring energy. In this context, "green" hydrogen would have to be produced by using renewable-based energy. For example, green hydrogen produced by electrolysis would require the use of renewable electricity.

Within the GRO mechanism proposed in this Report, electrolysis will produce "green" hydrogen, against which GROs would be issued, only if the electricity used in the process is accompanied by an equivalent amount of GROs. The operator of the electrolyser would then have to surrender these GROs – to have the electricity used in the process qualify as renewable – and would be issued with GROs in respect to the hydrogen output.

In its Hydrogen Strategy, the Commission seems to imply that renewable hydrogen would be produced by electrolysers directly connected to solar- and wind-powered electricity generators[39]. Directly linking electrolysers to renewable-based electricity generators, while ensuring that the hydrogen will be produced with renewable electricity, would limit the capacity utilisation of the electrolysers to the production pattern of the linked generators. In most instances this will limit the load factor of electrolysers, thus increasing the cost of "green" hydrogen.

[39] Cfr. Section 3 (page 7) of the Hydrogen Strategy: *"From now to 2030, investments in electrolysers could range between €24 and €42 billion. In addition, over the same period, €220-340 billion would be required to scale up and <u>directly connect</u> 80-120 GW of solar and wind energy production capacity to the electrolysers to provide the necessary electricity."* (added highlights). However, in footnote 28 of the Hydrogen Strategy, The Commission recognises that renewable hydrogen could also be produced by electrolysers not directly connected to renewable electricity generators as long as "*certain conditions are met, including the additionally of the renewable electricity used*". This additionality criterion could be easily addressed by the GRO mechanism proposed in this Report, as illustrated in the text.

An alternative approach which is proposed here would be to use the GROs to qualify the electricity used in electrolysers as renewable. This approach, while consistent with using GROs to qualify a share of the final energy consumption as coming from renewable sources, could be criticised for creating only a "virtual" correspondence between the electricity produced from renewable sources and the electricity consumed by the electrolysers. In this context, it is to be noted that some of the flexibility mechanisms currently allowed by legislation – such as statistical transfers – also rest on a "virtual" or accounting correspondence. Moreover, what should matter the most is that the renewable energy penetration target is achieved at the EU level, with each Member State making its contribution, and that this is done in the most cost-efficient way.

In this context, concerns have been raised that, unless electrolysers are physically linked to renewable electricity generation, their demand for renewable electricity would lead to an increase in electricity demand. This demand would likely be met by marginal, possibly non-renewable or non-decarbonised sources, thus leading to an increase in the electricity sector carbon footprint. This is clearly a serious concern. However, as long as the GRO mechanism is adopted as the basic statutory mechanism, as proposed in this Report, it would guarantee that the renewable electricity against which the GROs required by the electrolysers are issued is additional to the renewable energy required to meet the renewable penetration target with respect to final electricity consumption.

In fact, the demand for GROs by an electrolyser, for its energy to be defined as renewable, would be on top of the demand for GROs by electricity consumers and suppliers subject to GRO obligations. This increased demand for GROs could only be met by the additional production of energy from renewable sources.

8.3 The time granularity

Member States are required to meet their renewable energy penetration target on an annual basis.

This means that, within a GRO mechanism, the obligation on large consumers and suppliers could also be imposed annually. However, it is possible that Member States would prefer to have shorter periods within which the renewable energy penetration quota has to be achieved.

A GRO mechanism could be designed with any desired time granularity. In fact, large consumers and suppliers might be required to fulfil their GRO obligations with respect to their final energy consumption in a quarter or a month – or even a week or a day – with GROs issued *vis-à-vis* renewable-based energy production in the same quarter or month – or week or day. Clearly, the longer the period of time over which the obligation applies, the greater the opportunities for producing renewable-based energy at lower costs (just by extending the options), and therefore the lower the cost of meeting any obligations.

However, longer periods would weaken the physical link between final energy consumption and a quota of it being renewable based.

The time granularity of the GRO mechanism would also affect the deadline for surrendering the GROs to demonstrate the fulfilment of the obligations and the moment in which non-surrendered GROs are cancelled. A GRO mechanism operating over, say, a year might require surrender by a deadline at some stage in the following year and the cancellation of non-surrendered GROs thereafter. At the other extreme, a GRO mechanism operating on a daily basis would require surrendering within a much shorter timeframe and cancellation thereafter.

In deciding the time granularity of a GRO mechanism, a trade-off would, therefore, have to be considered between:

- The minimisation of the cost of achieving the overall renewable energy penetration target, which would call for the mechanism having the lowest time granularity, i.e. being applied over longer periods;
- Maintaining some sort of – albeit loose – physical link between the final consumption on which the obligation is imposed and the corresponding quota of renewable-based energy production, which would suggest that the mechanism is applied with a greater granularity, i.e. over shorter periods of time.

9. Statute and governance

For the GRO mechanism proposed in this Report to become the basic instrument for promoting the development of energies from renewable sources, it would have to acquire statutory status, i.e. it would have to be mandated by legislation. The same GRO mechanism might also be used for accounting the renewable-based energy production towards the achievement of the EU-wide penetration target and contributions by Member States.

While a statutory GRO mechanism could take advantage of the experience gained by the current voluntary schemes (see Section 3), a number of design features would have to be defined in legislation. A detailed design and implementation plan is beyond the scope of the present Report; however, in what follows we highlight three aspects which would definitely need to be addressed in such a design:

- The issuing of GROs;
- The trading of GROS;
- The tracing of GROs and enforcement.

The experience of the EU ETS could help with the design of all three points. In fact, while the GRO mechanism proposed in this Report would play a different role from the EU ETS in the decarbonisation of the EU economy, the GROs would share several features with the EU ETS allowances (EUA):

- GROs, like the EUAs, would be the basic statutory instrument for promoting a specific energy/climate objective;
- GROs, as the EUAs, would provide the "common currency" instrument for promoting the equalisation of marginal costs across different opportunities to pursue the energy/climate objective.

9.1 The issuing of GROs

It would be appropriate that in each Member States or region one entity would be entrusted with issuing GROs once it has verified that the energy production against which they are issued is accurate in its quantity and that it is of a renewable source, as defined by law. It might be possible to entrust more than one entity in each Member State or region with issuing GROs, as long as care is taken to avoid the double issuing of GROs for the same energy. Common standards for the verifications required for issuing GROs would be needed to ensure a level-playing field across the EU.

9.2 The trading of GROs

GRO trading should, instead, be allowed on the widest possible terms. While the liquidity of the GRO market might be promoted by the concentration of trading in a few marketplaces, this should be the result of market forces and it seems inappropriate to introduce limitations on the freedom of trading, beyond those required to avoid double counting or fraud.

9.3 GRO tracing and the enforcement of the mechanism

For the proper functioning of the GRO mechanism, it would be imperative that GROs be traced throughout their lifecycle, from their issue, to their transfer and trading, to their surrendering and cancellation, or withdrawal or expiry.

One option for ensuring the proper tracing of GROs would be the establishment of a single EU Registry, similar to the one established for the EU ETS. All issued GROs will be recorded in this Registry, along with any subsequent lifecycle event. Large consumers and suppliers subject to the GRO obligation would have to ensure that, by the given deadline, they would have the required quantity of GROs under their name in the Registry. Their obligation would be met by surrendering said GROs for cancellation.

An alternative solution would be to allow several Registries to operate in parallel. This would require common standards, as well as interoperability rules which would ensure seamless transfer and trading of GROs, as well as their surrender, irrespective of the Registry in which they are recorded. Clearly, the single-registry solution would be easier to implement, even though it would mean a radical departure from the multiple voluntary GO systems operating at present (see Section 3 above). A single-registry approach could also act as the accounting system for measuring the quantity of energy from renewable sources produced in each Member States and, therefore, in the EU as a whole.

The design of the GRO mechanism would also require enforcement provisions. A penalty for non-compliance with the GRO obligation would have to be defined. As in other similar mechanisms, the non-compliance penalty would have a double role. It would promote compliance. However, it would also act as a cap on the price of GROs: no party would be willing to pay a price for GROs higher than the penalty, since, if such a price exceeds the penalty, it would be cheaper to pay the latter. The penalty would then be necessarily fixed at a level at which policymakers are ready to concede that the achievement of the renewable penetration objective is becoming too expensive and, therefore, that the objective could be relaxed. In a sense, the two roles of the penalty are complementary. For GRO prices up to the penalty level, the penalty promotes compliance. For GRO prices above the penalty level, the penalty represents a safety valve to prevent the pursuit of the renewable energy penetration target becoming overly expensive for the economy.

9.4 The international dimension

REDII envisages the possibility of joint projects between Member States and third countries for the production of electricity from renewable sources. REDII sets a series of conditions which have to be met in order for the electricity from renewable sources produced in a third country to be taken into account for the purposes of calculating the renewable energy shares of the Member States[40]. Thus, it seems appropriate that only when these conditions are met, should GROs be issued against any renewable energy produced in a third country.

10. Conclusions

The GRO mechanism proposed in this Report to achieve the EU renewable energy penetration target at least cost is politically very ambitious, because it suggests a mechanism ideally linking different types of renewable energy, across vectors and across jurisdictions. In order to deliver its full benefits, this mechanism would require some degree of flexibility in the mix of renewable energies and on the location of their deployment. This latter dimension of flexibility was turned down by Member States when the European Commission envisaged an EU market for certificates of origin, as part of its legislative proposal which led to REDI[41].

However, our proposal starts from the basic consideration that the renewable energy penetration target is collective for all Europe, hence it would be worth thinking of an EU-wide mechanism to achieve it.

Moreover, the current target of 2030 is likely to be twice as high[42] as the 20% one for 2020, set by the 2009 Directive. Therefore, the costs of achieving this higher target are likely to be much more substantial and the benefits of achieving it at least cost correspondingly greater. As a result, Member States may now look more favourably at a scheme that will ensure a least-cost solution.

The mechanism proposed in this Report is intended to act as the main, basic support mechanism for renewable energies. As indicated in Section 4, policymakers might decide to complement this mechanism with additional targeted support schemes, for example in promoting infant technologies, being aware that such additional support might increase the costs of meeting the renewable energy penetration target. In this sense, the proposed mechanism might be considered as "subplementing" other additional support schemes.

As indicated in the introduction, this Report has been commissioned by the Directorate-General for Energy of the European Commission, which also asked for the engagement of stakeholders. To meet this requirement, and also in line with normal *modus operandi* of the Florence School of Regulation (FSR), two online Debates were organised, the first on 6 October and the second on 6 November. These were widely

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[40] Article 11 of Directive (EU) 2018/2001.

[41] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

[42] As indicated in Section 1, the 32% renewable energy penetration target set by Directive (EU) 2018/2001 for 2030 is likely to be increased to 38-40%, in line with the increase in the GHG emission reduction target from 40% to 50-55%, by the same year, envisaged in the European Green Deal.

advertised and had respectively 134 and 103 attendees. The Debates were used to present the main features of the GRO mechanism proposed in this Report and to collect feedback from participants via polls and spontaneous questions from the audience. These polls returned overwhelming support for an enhanced role for GOs as the main, instrument for promoting the deployment of renewable energies, with, respectively, 85% and 87% of participants indicating their agreement. Moreover, when asked about the vector and geographical dimensions of a possible GRO mechanism, a large majority of participants[43] indicated their preference for a mechanism applied across all vectors and across multiple jurisdictions.

Clearly the results of polls run by the FSR in public online Debates cannot be considered as representative of the position of the general public. However, these numbers show the interest and support of stakeholders who have a specific interest in this policy area, as demonstrated by registering and participating in these Debates.

Therefore, the proposal presented in this Report is presented to the Directorate-General for Energy of the European Commission for its consideration.

[43] 60% in the first Debate and 66% in the second Debate.

QM-03-21-034-EN-N

Research Project Report
26 January 2021

ISBN:978-92-9084-983-4
doi:10.2870/848062

Publications Office
of the European Union