GO4Industry

Application in Industry - Report I1

Verification of Renewable Energy in Industry

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About the project

GO4Industry

Industrial companies will in the future have to achieve climate-neutral production. This requires an immense increase in the use of renewable energy at all stages of the production process. These efforts necessitate careful emissions accounting along the supply chain. This in turn requires a reliable verification system for renewable energy that functions across borders in all sectors: electricity, gases, heating/cooling. In the Renewable Energy Directive 2018/2001, the EU has instructed the member states to implement such a system at the national level. In the "GO4Industry" project funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (until the end of 2021) and the Federal Ministry for Economic Affairs and Climate Protection (since 2022), Hamburg Institut and GreenGasAdvisors are developing the basis for a comprehensive national verification concept for renewable energy. This includes an analysis of how guarantees of origin and other verification concepts for renewable energy could enable cross-sectoral interaction in the future. The project results are available on the project website: https://go4industry.com.

Content

List of abbreviations

BEG	Federal funding for efficient buildings (*Bundesförderung für effiziente Gebäude*)
CBAM	Carbon Border Adjustment Mechanism
CDP	Carbon Disclosure Project
CEN	European Committee for Standardization
CCF	Corporate Carbon Footprint
CSRD	Corporate Sustainability Reporting Directive
EAC	Energy Attribute Certificates
EED	Energy Efficiency Directive
EEW	Funding Programme for Energy and Resource Efficiency in the Economy (Förderprogramm Energie- und Ressourceneffizienz in der Wirtschaft)
EU	European Union
GATT	General Agreement on Tariffs and Trade
GEG	Building Energy Act (*Gebäudeenergiegesetz*)
GHG	greenhouse gas(es)
GHG Protocol	Greenhouse Gas Protocol
GRI	Global Reporting Initiative
GO	Guarantee of origin
HKNR	German national GO register (*Herkunftsnachweisregister*)
ISO	International Organization for Standardization
kWh	kilowatt hour(s)
MWh	megawatt hour(s)
NFRD	Non-Financial Reporting Directive

PCF	Product Carbon Footprint
PPA	Power Purchase Agreement
RE	renewable energy
RED I	Renewable Energy Directive I (Directive 2009/28/EC)
RED II	Renewable Energy Directive II (Directive (EU) 2018/2001)
RED III Draft	Draft Renewable Energy Directive III (Directive (EU) 2021/0218)
RFNBO	Renewable fuels of non-biological origin
SBTi	Science-Based Target Initiative
TWh	terawatt hour(s)
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute
WTO	World Trade Organisation

1. Introduction

The environmental impacts of economic activities are increasingly the subject of public interest and are therefore being regulated more and more. In addition, companies are voluntarily aligning their actions with environmental protection standards in order to meet the requirements of their customers. Particularly in climate protection, certificates for renewable energy (RE) play a major role, as their use represents a major lever for greenhouse gas (GHG) reductions in industry.

Guarantees of origin (GOs) for electricity and mass balancing for biogas and liquid fuels are already well established and serve various purposes, as described in previous GO4I reports: for example, to meet regulatory requirements (so far mainly mass balancing), but also for the purpose of mandatory or voluntary reporting or GHG accounting (e.g. electricity GOs in the market-based approach).

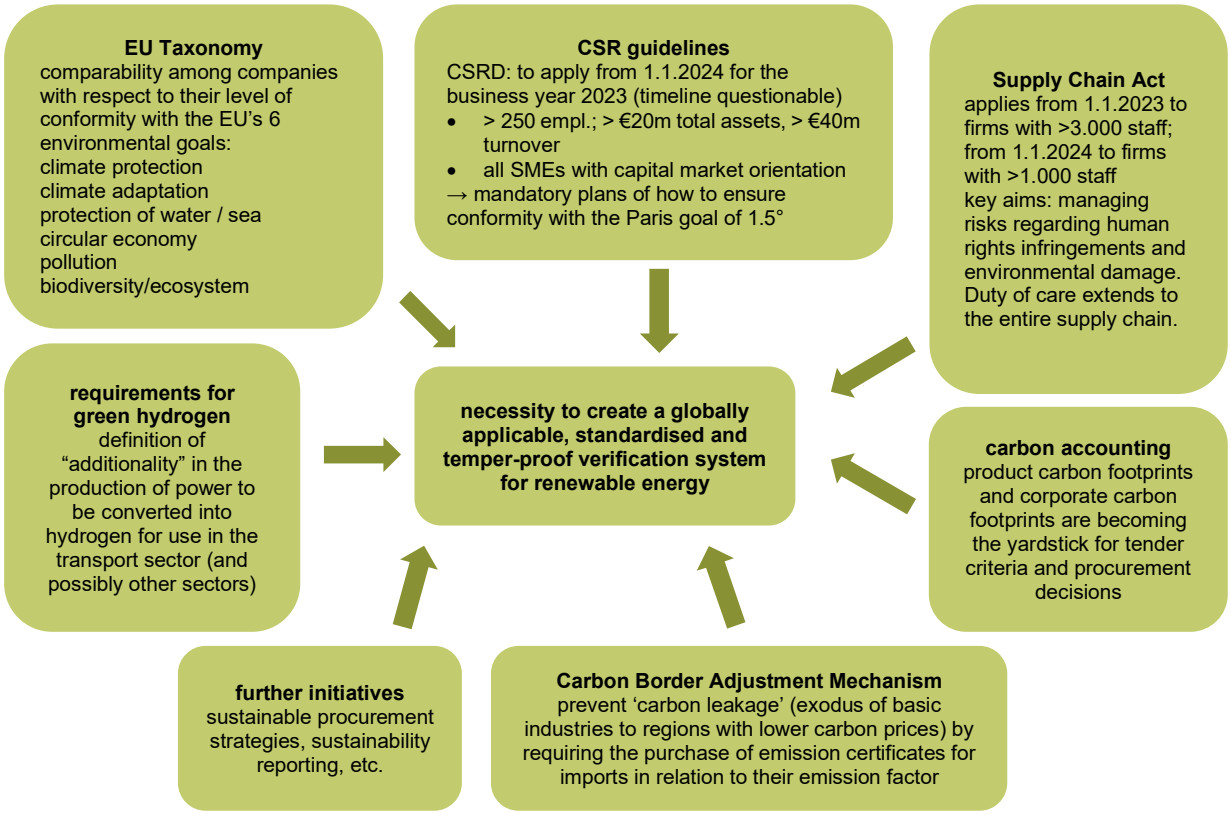
In principle, RE certificates have the potential to promote the growth of RE generation, not least due to the increased demand by industry. However, regulatory uncertainty, complexity, the lack of transparency, standardisation and functionality, as well as counterproductive developments in RE verification systems pose major challenges for the handling of RE verification in industry. In addition, before implementing new GOs for renewable gases and heating/cooling into their business practice, the companies need to see the possible use cases (see also GO4I Energy Sources Reports 2, Bowe and Girbig 2022, and 3, Styles and Claas-Reuther 2022).

To elaborate on these topics, in the following this report first describes the drivers of the use of RE certificates in the industrial context (section 2) and then presents the main challenges and resulting requirements (section 3). Finally, the requirements for RE verification systems in industry are summarised (section 4).

2. Drivers of the use of renewable energy certificates in industry

Many companies want or need to prove their use of RE in various contexts: current and future regulatory requirements, mandatory and voluntary (sustainability) reporting, procurement strategies and other (voluntary) initiatives, as well as accounting for GHG emissions and other indicators (see Figure 1). In the following, these different corporate application areas of RE verification are presented.

Figure 1: Proving renewable energy use in different business contexts



Source: Hamburg Institut.

2.1 Future regulatory requirements

Previous reports have already outlined various national and European regulations that require RE verification, either in the form of statistical calculation rules or in the form of market-based verification such as mass balancing and GOs. Some of these regulations are also directly relevant for industry, such as those on the European Emissions Trading Scheme (zero-rating of biomass), on transport sector targets and the production of renewable hydrogen for use in transport of the Renewable Energy Directive (EU) 2018/2001 (RED II)

and on subsidy requirements.[1] The draft of the amended RED II, i.e. the **Renewable Energy Directive (EU) 2021/0218 (RED III), includes additional new requirements for the use of RE in industry** (European Commission 2021). The draft provides for the introduction of a **RE quota**, according to which the share of renewable energy sources in the amount of energy used for final energy and non-energy purposes in the industrial sector shall increase by an average of at least 1.1 percentage points per year until 2030. Measures that contribute to achieving this quota are to be included in the national energy and climate plans and progress reports. The use of RE is to be integrated into the audits required under the EU Energy Efficiency Directive (EED) in order to introduce the relevant industrial actors to existing cost-effective solutions for switching to RE. The draft also proposes the introduction of an RFNBO (renewable fuels of non-biological origin) quota. The RFNBO share should be 50% of hydrogen used for final energy and non-energy purposes in the industrial sector by 2030, thus boosting the use of electricity-based hydrogen. The **regulations** presented in many previous reports **on the production of renewable hydrogen for use in transport**[2] are to be **extended to RFNBO for use in any sector** according to the draft RED III. This also has implications for many industries that use hydrogen not for transport but for heating or as a reducing agent (e.g. in steel production).

According to the draft, for industrial products labelled as having been manufactured with RE and RFNBO, companies shall specify the exact **percentage of RE or RFNBO used in the raw material sourcing and pre-processing, manufacturing and distribution phase** (with the calculation following Recommendation 2013/179/EU27 or ISO 14067:2018). Such a mandatory regulation would unify the market for these products but would need to be assessed with respect to its WTO compatibility.

However, it is unclear how or by which instrument and thus with what effort the RE verification is to be handled in the individual cases. This also applies to the draft regarding the requirements for renewable electricity used for electrolysis (delegated act pursuant to Article 27(3) of REDII), which defines the regulations but not the specific verification instrument. Thus, the question arises whether RE gases should be verified using the more elaborate mass balancing or newly introduced GOs, which are more easily processed. For renewable electricity verification, GOs would be available with or without certain quality characteristics (e.g. plant location, plant age, temporal correlation, generation technology, etc.) and with or without "coupling", e.g. to the delivery of electricity between producer and consumer balancing groups. Only in the area of liquid fuels is the verification instrument foreseeable, as only mass balancing will be used here for the time being.

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[1] An overview is provided in Table 4 of the GO4I Baseline Report 4 (Sakhel and Styles 2021) and in the GO4I Energy Sources Reports 1, 2 and 3 (Sakhel et al. 2022, Bowe and Girbig 2022, Styles and Claas-Reuther 2022).

[2] This concerns in particular the requirements for the renewable electricity used; for a current overview, see Table 2 in the GO4I Energy Sources Report 1 (Sakhel et al. 2022).

For industry, it is important that the effort and the energy transition benefits are proportionate. The latter must be given, but the verification must remain manageable and must not compromise the companies' international competitiveness. It may therefore make sense to require **verification instruments with different degrees of effort for each regulation.** For example, it is appropriate that the direct use of renewable power carries lower verification requirements than the use of renewable, electricity-based fuels, whose production entails higher energy loss. In addition, **too much freedom in the choice of verification instruments can be counterproductive**, as this impairs the comparability of companies or products. This applies, for example, to the labelling of RE in products. Products for whose production, for example, electricity GOs with specific qualities were used have a higher energy transition benefit than those for which generic GOs were used, yet the products will be identical. If there is too much freedom of choice at this point and the information about certain RE qualities is lost or not transparent, products with different verification efforts and energy transition benefits will be created. Those differences are then not apparent to consumers, which means that "renewable quality" is not rewarded with competitive advantages, so there is little incentive to use "good quality".

The EU has also made a **proposal to introduce a CO_2 Carbon Border Adjustment Mechanism (CBAM)**, according to which some goods that are imported from third countries and are therefore not subject to EU climate policy shall carry a CO_2 price that mimics the pricing effect under the EU ETS (UBA 2022a, European Parliament 2022). This is to prevent emission savings in the EU on the one hand and the competitiveness of European industrial companies on the other hand from being offset or weakened by imports of CO_2-intensive goods from countries with less ambitious or no climate protection measures (prevention of carbon leakage). Besides its violation of international trade rules (e.g. WTO, GATT) due to certain discriminatory aspects and further implementation obstacles (see e.g. Stiftung Arbeit und Umwelt der IGBCE 2020), **the draft law has been criticised for not promoting the use of local RE** (I-REC Standard Foundation 2022). In the current form of the draft, the embedded emissions of a product that is subject to the CBAM are calculated on the basis of national averages or sectoral standards. This would mean that products or manufacturers are treated equally regardless of their efforts to use RE (on-site or off-site). To address this issue, it is proposed that the embedded emissions should be verified on the basis of internationally recognised energy attribute certificates, so that there is transparency regarding, for example, the use of RE. This calls for the **advancement and integration of greater granularity in the procurement and traceability of RE** (CSIS 2022) and also relates to the granular real-time electricity certificates presented in the GO4I Energy Sources Report E1 (Sakhel et al. 2022). Such granular verification can facilitate the creation of product-specific CO_2 footprints, so-called Product Carbon Footprints (PCFs) (see Sect. 2.4), by reconciling RE generation and consumption profiles. This could lead to a more accurate assessment of product-specific emissions and thus a fairer treatment of producers in the context of the CBAM. Ultimately, we should see greater incentives for the use of RE. Currently, the proposed CBAM only addresses direct emissions (Scope 1). However, the mandatory use of these certificates would have a much greater impact if indirect emissions from purchased energy (Scope 2)

were also addressed. That would also prevent foreign manufacturers from replacing fossil fuels with electricity from fossil fuels (Euractiv 2022). However, according to the draft, this is provided for after a certain transition period (European Parliament 2022, recital 17).

Finally, **at the German federal level, the Due Diligence Act, also known as the Supply Chain Act (*Sorgfaltspflichtengesetz / Lieferkettengesetz*), will come into force in 2023**. It defines requirements for the responsible management of supply chains for certain companies (BMAS 2021). The focus is on risk management with regard to violations of human rights and environmental obligations in the supply chain. The law does not explicitly address the use of RE but may include this item as part of the risk analysis. In addition, there has been a desire on the part of companies to "emissions neutralise" the energy used in supply chains through their own measures, such as buying RE certificates (see Section 3).

In addition, RE certificates can become relevant in the context of **subsidies or to meet regulatory requirements.** For example, according to the German Building Energy Act (*Gebäudeenergiegesetz*, GEG), mass-balanced, renewable gases can already count towards the primary energy demand or RE share calculation of residential and non-residential buildings, so they serve as a compliance option for legal requirements. Other funding programmes support investments in efficiency measures to reduce the use of process energy or promote the renewal and refurbishment of buildings. These include, for example, the Energy and Resource Efficiency in the Economy (EEW) programme, the BEG for non-residential buildings, and funding programmes by the KfW, the federal states or the EU. At present, however, the rules usually refer to efficiency improvements and resulting emissions savings. Buying energy from renewable sources is currently not required for these funding programmes. Consequently, the funding guidelines do not yet have a uniform set of specifications on how the purchase of RE can be verified. If and when buying RE becomes a prerequisite for funding, a uniform verification system should be in place.

2.2 EU taxonomy

The EU Taxonomy Regulation 2020/852 of 18 June 2020 describes the framework for sustainable investments within the EU internal market. It is an important component for the implementation of the European Green Deal and the expansion of sustainable investments in the EU. The basis of the taxonomy is the European Directive 2014/95/EU on CSR reporting, which was transposed into German law in 2017 (HGB §289b ff). This classification system aims to enable an objective classification of environmentally sustainable economic activities and thereby to make green investments more transparent and attractive, thus promoting investments in ecological and sustainable companies or projects. The assessment of an economic activity within the framework of the EU taxonomy thus affects the conditions for borrowed capital or investment recommendations, with relevant effects on companies. Climate protection is one of the six environmental goals of the taxonomy (European Commission 2022).

Establishing trust with entrepreneurs and credibility with consumers requires uniform and transparent implementation and evaluation of the achievement of the objectives. For each sector or material, the EU taxonomy defines climate-relevant indicators for evaluation. These indicators represent clear threshold values on whose basis to evaluate the sustainability of an investment. As the EU taxonomy is currently still in the design phase, no uniform standards for RE verification have been defined yet. They remain to be clarified in delegated acts (BAFIN 2020). Any difference in evaluation between the EU taxonomy and the mandatory sustainability reporting pursuant to various accounting approaches will also have to be explained. For the practical implementation of the EU taxonomy, however, uniform cross-border calculation and accounting methods are necessary to create transparency and credibility.

2.3 Sustainability reporting, procurement strategies and other initiatives

2.3.1 Mandatory sustainability reporting

The proposed directive on corporate sustainability reporting (CSRD) published in April 2021 expands the reporting obligation of the previously applicable European Directive 2014/95/EU. In June 2022, the European Commission, the Council and the European Parliament agreed on a compromise, which has yet to be formally approved by the European Parliament. It is assumed that the CSRD will be adopted in October 2022, replacing the current directive. The CSRD will significantly expand the scope of the reporting obligation; it is estimated that the number of reporting companies across the EU will increase from 11,600 to 49,000 (BMAS 2022a,b). In addition to small and medium-sized enterprises (SMEs), companies whose parent companies are based outside Europe are now also included. The reporting obligation thus applies to the following corporations and limited liability companies:

- large companies,
- SMEs that are capital market-oriented,
- third-country companies with a turnover of €150 million in the EU whose subsidiaries meet the above size criteria or whose branches exceed €40 million in turnover.

The CSRD will apply from 1 January 2024 to companies that are already subject to the current directive on non-financial reporting. The other companies will successively become subject to the reporting obligation (BMAS 2022b). The CSRD also aims to standardise the reporting obligation and places a stronger focus on quantitative content to strengthen the measurability and comparability of the information. The standards are currently still being developed by the EU and should incorporate existing standards and regulations while aligning with the EU taxonomy (BMAS 2022b). Among the most widely accepted standards are the Global Reporting Initiative (GRI) and the Carbon Disclosure Project (CDP), as well as general CO_2 accounting according to the GHG Protocol or ISO 14064.

Companies can already use guidelines developed by the EU (Communication 2019/C 209/01) to report climate-related information. The guidelines are intended to help close information gaps in climate-related disclosures and improve the quantity, quality and comparability of information to better meet the needs of investors and other stakeholders. The guidelines focus on two aspects of reporting. Firstly, companies should apply a dual materiality analysis, considering both financial materiality (the impact of climate change on business) and environmental and social materiality (the impact of business on climate change). Secondly, climate-related risks and opportunities should be considered throughout the value chain. Potential sources of negative climate impacts include the direct purchase of fossil fuels and the purchase of energy. Indicators to be reported include GHG emissions from the production of electricity and steam as well as heating and cooling, total energy consumption or production from renewable and non-renewable sources, with a breakdown of the different renewable energy sources. In addition, companies should present targets for RE consumption or production and describe their progress towards these targets. They are recommended to follow the GHG Protocol, ISO 14064, or life cycle analysis. With the extension of the non-financial reporting obligation to a larger group of companies and the inclusion of energy consumption, the breakdown of renewable energy sources and GHG emissions, the need for credible and transparent verification of RE is gaining importance for a larger group of companies.

2.3.2 Procurement strategies and other voluntary initiatives

In addition to regulatory requirements for companies, societal and economic drivers such as social awareness, consumer demand or investor ratings have gained significant influence on how companies monitor, assess, present and change the impacts of their business activities. Especially since 2019, the Fridays for Future movement has gained strong societal support, which also translates into political influence. In addition, environmental impact data have become established as key figures for evaluating companies and analysing investment risks. Corporate CO_2 emissions are now used to evaluate the environmental performance of a company (Niehues 2018). Platforms and ratings evaluate corporate environmental data, facilitating comparison. Data on corporate emissions and environmental risks are used as key figures in investment analyses and are required by stock exchanges such as the London Stock Exchange, NAS-DAQ-OMX and others.

In this changed market environment, companies are driven by the desire to continue to secure and increase profitability while achieving credibility with customers. Other drivers may be to achieve a leadership role in the market and to have a leverage effect in climate policy development. For some companies, ethical considerations also play a role (Okereke 2007).

This is not only causing many companies to create more transparency about their environmental impact (including the use of RE) by (voluntarily) producing sustainability reports, but many are also going beyond their own economic activities, either voluntarily or due to pressure from stakeholders. In supply chains in particular, the lowest price is no longer

the sole decisive factor when awarding contracts, but GHG emissions from production increasingly also play a role. This is prompting companies to rethink their procurement strategies for energy and to pass requirements for low GHG emissions on along their supply chains (UBA 2019).

With this increasing stakeholder demand for information on corporate environmental impacts, the requirements on the transparency, accuracy and traceability of the collected data are rising (UBA 2019). While the attention used to be primarily on the environmental impacts of corporate electricity consumption, the use of heat, cooling and steam is now increasingly moving into focus.

For the voluntary preparation of sustainability reports, companies can follow the standards of the Global Reporting Initiative (GRI), the German Sustainability Code (DNK), the UN Global Compact or the *Gemeinwohlökonomie*. These standards also refer to the GHG Protocol and ISO 14064 for the accounting of GHG emissions from energy consumption.

In order to establish their pioneering role in the market and strengthen customer loyalty, many companies go beyond formal reporting and publicly commit to using RE and saving emissions. At the same time, they allow themselves to be measured against their success - or failure - by publishing their targets and measures. That way, they are sending a clear signal to the market about their active role in the energy transition and climate protection, which they seek to integrate into their corporate strategies (UBA 2019). The accounting of energy consumption and the resulting GHG emissions is usually based on the GHG Protocol and ISO 14064. The market-based approach (chapter 3) allows companies to influence the environmental impacts of their energy purchases and at the same time to demonstrate their commitment. However, this approach hinges on verification of the purchased energy products.

In the following, we present some of the platforms and initiatives for corporate emission reduction.

RE100, an initiative launched in 2014 by The Climate Group and CDP, aims to encourage companies to source 100% of their electricity consumption from renewable sources. RE100 explicitly refers to the emissions from companies' electricity purchases and references recognised reporting standards, such as the Scope 2 Guidance of the GHG Protocol. Companies that want to be part of this group publicly commit to a self-imposed "roadmap" to source all electricity from their global operations from renewable sources by a certain date. The companies themselves determine the steps towards this goal and can also publicly present their success. They report annually to RE100, and an external assessment of the measures is recommended. The information is published by the RE100 Initiative on their website, in case studies and in the annual report (UBA 2019). In August 2018, the initiative counted 140 international companies. By 2022, the number of participants has grown to 378.

The reporting platform of the **CDP** (Carbon Disclosure Project) goes further by also including the consumption of other energy besides electricity. The platform allows companies to publish information on environmental strategies and have them evaluated. CDP also offers city-specific information. The data is collected via sector-specific questionnaires, verified and evaluated by CDP. On this basis, companies are classified into four categories, depending on the extent to which the environmental impacts of their business activities are integrated into the overall management: D - Disclosure, C - Awareness, B - Management, A - Leadership (CDP 2017). The leadership level denotes that the company implements best practice measures and thus clearly assumes a pioneering role. For climate protection, this means that the companies have incorporated environmental risks into their strategy, have verified GHG balances and are implementing GHG reduction strategies. In 2021, 2500 European companies submitted data for publication, 200 of which achieved the Leadership level (CDP 2022).

The Corporate Net Zero Standard of the Science-Based Target Initiative (**SBTi**) is oriented towards the goal defined in the Paris Climate Agreement of limiting global warming to 1.5°C. Based on science-based data, companies should develop a roadmap towards a net zero emissions target. The central requirement is to drastically reduce emissions in a timely manner and to formulate short- and long-term targets. The standard was introduced in October 2021. Following the SBTi campaign "Business Ambition for 1.5°C", more than 600 companies have already committed to achieving a scientifically sound net-zero target before 2050 and have had this validated by the SBTi (SBTi 2022, BMAS 2022c). For the accounting of emissions from purchased energy, the SBTi currently still refers to the Greenhouse Gas Protocol and accepts the dual accounting according to the location-based and the market-based approach (for a detailed description of the market-based approach, see chapter 3). However, the SBTi is also aware that not all corporate procurement strategies that demonstrate low-emission energy procurement actually lead to emission reductions. SBTi is conferring with the GHG Protocol on this. Any results will be taken into account in the 2022/2023 revision of the SBTi criteria.

The **Race To Zero** campaign, launched by the UNFCCC, is an international initiative to put companies, investors, cities and regions on the path to sustainable growth and net zero emissions. Participating actors commit to the 1.5 °C target. This includes net-zero climate neutrality by 2050 and a 50% reduction in emissions by 2030. Within 12 months, the participants must publish a plan of how they will achieve this goal. The annual developments are presented publicly. This initiative also builds on existing platforms such as CDP. The driving forces are public awareness, self-commitment and the public presentation of success or failure. There is no third-party verification.

The **Green Electricity Procurement Guide** published by the **WWF** in 2021 sets out quality criteria for the procurement of green electricity, especially for large-scale consumers. The aim is to promote the growth of RE beyond the existing support systems, the focus being on new unsubsidised plants and electricity from photovoltaics and wind energy. Certain amounts of

electricity from new, subsidised plants and from plants whose subsidies have run out are also accepted. In each of these categories, the quality of the electricity can be proven by GOs (WWF 2021).

2.4 Standards for the accounting of greenhouse gas emissions

Accounting for GHG emissions enables companies to gain an understanding of the climate impact of their business activities. Depending on a company's sector and location, GHG accounting is mandatory for participation in emissions trading programmes, such as the EU ETS, and is included in mandatory CSR reporting. Where regulation is not yet in place, the companies may use the GHG balance for their voluntary sustainability reports, to assess financial risks pending a CO_2 price or to take efficient emission reduction measures. Beyond economic considerations, a GHG balance forms the basis for formulating climate targets, displaying them in the spirit of public relations on platforms such as the SBTi (2022) and tracking the progress of the climate strategy in the long term.

In 1998, the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) launched an initiative to standardise GHG accounting. In a multi-stakeholder process involving companies, NGOs and government representatives, standards and guidelines have since been developed under the name **Greenhouse Gas Protocol** (GHG Protocol). The aim of the standards is to provide a framework that is as precise as possible, yet can be adapted to the specific requirements of energy markets all over the world. This leads to choices for displaying energy from renewable sources which are discussed in more detail below. In 2016, 92% of the Fortune 500 companies reporting to CDP referred to the GHG Protocol (GHG Protocol 2022). The first version of the Corporate Standard from 2001 established rules for the preparation of a GHG balance at the corporate level, the **Corporate Carbon Footprint** (CCF) (GHG Protocol 2004). In spring 2022, WRI and WBCSD announced a multistakeholder process to revise the SBTi Corporate Standard and the guidance for Scopes 1, 2 and 3. This update is to be implemented in cooperation with the SBTi in 2022/ 2023.

The International Standardisation Organisation (ISO) has also been developing standards on corporate GHG management since 2006 in **ISO 14064-1**. These are very similar in content to the standards set by the GHG Protocol. If a company reports according to the GHG Protocol, this usually also corresponds to the ISO requirements and vice versa.

Bost standards classify emission sources into three scopes. The first scope comprises emissions that are generated directly by the reporting company. These include combustion processes in stationary or mobile facilities, process emissions and the release of fugitive gases. The second scope includes emissions that arise from the external provision of energy. The third scope refers to emissions that arise in the company's upstream and downstream value chain. This includes emissions that are also attributable to the provision of energy but occur upstream of the actual combustion (e.g. in the extraction of fossil fuels or construction

of the plants). Energy-related emissions in Scope 2 are calculated as the product of activity data (e.g. electricity consumption) and an emission factor (in CO_2 equivalents per unit of energy). Emissions can thus be reduced by using less energy and/or by purchasing energy with a low emission factor.

The Scope 2 Guideline of the GHG Protocol (2015) specifies and illustrates the recommended approach and presents two basic concepts for accounting for electricity purchases. According to the location-based approach, the emission factor equals the average value of the respective electricity grid. This value should be stated in all cases. Secondly, the market-based approach takes into account the organisation's actual supplier relationships. The emission factor then refers to contractual instruments that associate electricity purchases with certain attributes or *only* include certain attributes. These can be Energy Attribute Certificates (EAC), such as Renewable Energy Certificates (RECs) and European Guarantees of Origin (GOs), or direct supply contracts with selected energy producers and supplier-specific emission factors. For this approach, the Scope 2 Directive defines minimum requirements for the quality of the contractual instrument. These include the prevention of double marketing, the traceability of the cancellation, the issued certificates and the energy consumption points of the reporting company belonging to the same energy market, and the "greatest possible" temporal proximity between energy consumption and the issuance or cancellation of the verification instrument. If possible, the reporting should refer to external certification, an electricity label, concrete energy generation units (plant type, location, age) or policy instruments. The different effects of the location-based and market-based approach are discussed in more detail in Section 3.

While the Scope 2 guidelines focus on the purchase of electricity, Annex A indicates that the approach is analogous for steam, heating and cooling. The GHG Protocol so far does not make any recommendations for the verification of green gases for the supply of energy on the company premises (Scope 1).

Although the Guidelines render the Corporate Standard more concrete, they still permit various options in the verification of the energy property. The GHG Protocol has already announced a revision of the Scope 2 Guidelines. A recent study on accounting for emissions from energy purchases argues that many contractual instruments recognised for the market-based approach do not lead to real GHG reductions (Björn et. al. 2022).

The normative Annex E of ISO 14064-1 discusses accounting for the purchase of electricity, heat, steam, cooling and compressed air. It holds that the location-based approach *must* always be applied. The market-based approach *may be* used if appropriate verification is documented. Energy performance certificates, renewable energy certificates, GOs, power purchase agreements (PPAs), green electricity certificates and supplier-specific emission rates are mentioned as examples.

Standards have also been established for GHG accounting at the product level: the **Product Carbon Footprint** (PCF). Based on the ISO standards 14040/14044 for life cycle assessments, the British Standards Institution (BSI) in cooperation with the British Department of Environment, Food and Rural Affairs (DEFRA) and the Carbon Trust developed the Publicly Available Specification 2050 (**PAS 2050**) in 2008. This in turn served the GHG Protocol as a template for the **Product Standard** (GHG Protocol, 2011). **ISO 14067** likewise applies to PCFs.

For PCFs, instead of scopes, a distinction is made between life cycle phases of the product, from material extraction through the production, distribution and use phases to disposal/recycling. The accounting conventions for electricity in the PCF standards of the GHG Protocol and ISO mirror the procedure described above for CCF accounting.

Another eco-label is the Environmental Product Declaration (EPD) based on life cycle assessment. It provides quantified environmental information from the life cycle of a product or service to enable comparisons between similar products or services. Regarding the use of energy, this comparison, too, is only of limited value. International standardisation is ensured by the ISO 14040 and ISO 14044 standards, which also consider energy consumption and emissions. Here, too, reference can be made to the grid electricity mix or the local utility.

The CCF enables the development of an emissions inventory and thus serves the internal management of GHG emissions and the associated risk over time. Increasingly, the environmental impacts presented in the CCF and how they are managed are also being used by rankings and stock exchanges as comparative tools and risk assessment indicators. This trend is even more pronounced in the case of PCFs, which are increasingly becoming a competitive criterion. The above-mentioned choices in accounting for energy sourcing pose a challenge in this respect. The GHG Protocol currently precludes any comparison of products based on PCFs. ISO 14067 requires identical requirements regarding quantification for comparing different products using the PCF. In order to reduce the leeway in applying the standards, associations and companies are creating their own guidelines based on the international standards, which are specifically tailored to the requirements of the industry and their own level of ambition and are thus already ahead of policy-making.

In the future, however, the requirements of CCF and PCF accounting will also have to become stricter with regard to the verification of energy so as to enable a valid comparison between companies and products. Certainly when the PCF serves as the basis for punitive tariffs (e.g. CBAM), it must be clearly regulated how exactly the emission factor of the energy inputs is to be calculated and by which instrument the RE property is to be verified. Here, too, not too much leeway should be left, and minimum standards should be set, as otherwise a multitude of verification instruments or qualities will impede comparability (see also Section 2.1).

3. Key interests and challenges in dealing with renewable energy certificates in industry

Dealing with renewable energy certificates is often not a trivial for industrial firms due to the market's complexity and lack of transparency, as well as the regulatory uncertainties. Challenges and resulting demands by industry regarding the application of renewable energy certificates were discussed, for example, in a workshop of the Federal Environment Agency (2022b) and in a GO4Industry project workshop with industry representatives.[3] The main points are presented below.

Power

Most of the demands relate to the handling of electricity certificates, an area where some experience already exists and where, however, the special nature or "immateriality" of the good gives rise to particular problems.

Fundamentally, many companies desire more **regulatory clarity and improved manageability of RE verification**. This demand relates, among other things, to the rules for verification at sector interfaces (i.e. when converting one renewable energy source into another, such as electricity into electricity-based gas or heat/cold, or renewable gas into electricity, etc.; see also GO4Industry Fundamentals Report 4, Sakhel and Styles 2021). Particularly pressing are the requirements regarding renewable electricity for use in hydrogen production, an area where the lack of clarity impedes investment. The temporal coupling of electricity production and consumption envisaged in the respective draft of the delegated act (see section 3.2 in GO4I Energy Sources Report 1, Sakhel et al. 2022) is seen as both a challenge and an opportunity. In any case, manageable and, above all, internationally standardised certificates are required that can be seamlessly transferred to specific applications, such as PCFs.

As described in more detail in the GO4I Energy Source Report 1 (Sakhel et al. 2022), some **industrial companies or other large-scale consumers of electricity also express an interest in being allowed to cancel GOs themselves, i.e. to hold accounts with the HKNR** (see also e.g. BDEW 2021), so as to be able to procure GOs independently, in particular for verification pursuant to the market-based approach of the Greenhouse Gas Protocol or other GHG accounting and sustainability reporting practices. Three modes of cancelling GOs are relevant here:

- GO issuance and cancellation for self-supply from a company's own plants (Scope 1 accounting), as proof for stakeholders. Self-supply GOs would mark the claiming of

[3] The participants were not representative of the German industrial sector. Nevertheless, the discussion yielded a number of points that industry representatives had already raised elsewhere.

the green electricity property, so that a legally secure statement can be made about the company's production of green electricity. In addition, resale would be prevented.

- Cancellation of GOs for a company's own electricity consumption (Scope 2 accounting) for the legally secure disclosure of renewable power without necessarily involving the electricity supplier. This interest results not least from the fact that the existing electricity labelling, especially in the product mix (which also shows the generally valid, subsidised RE shares) is not perceived as sufficiently meaningful as it does not reflect the company's own procurement choices in satisfactory detail. Another relevant use case is GO cancellation in the context of PPAs. In the case of PPAs between generators and companies, the latter could more easily verify the processing of the certificates, without having to rely on their own in-house energy suppliers or separate contracts with energy suppliers regarding the cancellation of GOs from PPAs.

- Cancellation of GOs for the electricity consumption of third parties, e.g. to reduce upstream emissions along the supply chain (Scope 3 accounting). The supply chain is particularly difficult to control or influence if the contractual relationship is not directly with the suppliers but only with intermediaries. In this case, some companies are interested in cancelling RE certificates for the energy consumption that occurs during the production of their inputs. However, it is problematic that the cancellation of certificates so far must be linked to energy consumption or supply in the same amount. When cancelling certificates to off-set upstream emissions, cancelled certificates are not matched by a corresponding amount of energy consumption (especially since the suppliers may have already assigned other certificates to their electricity consumption). Offsetting possibilities are offered by the compensation markets within the framework of Article 6 of the Paris Agreement and the associated regulations adopted in Glasgow, which, however, work independently of GO markets. GOs may not be used for offsetting. The issues of verification of energy consumption characteristics and offsetting of GHG emissions are therefore considered separately. In the voluntary carbon market, it should also be noted that emission reductions from RE projects in the EU are already taken into account in the member states' national GHG reporting. For such projects to participate in the voluntary carbon market, new systems (potentially under Article 6.4 of the Paris Agreement) would need to be created so that authorised certificates could be issued for voluntary energy emissions offsetting if national GHG emission balances were adjusted at the same time to avoid double counting of emission reductions. This is not provided for so far (DEHSt 2021). Furthermore, in such a case it would have to be clearly regulated that the RE property of a plant could not be claimed via different certificates in different markets.

Finally, **some stakeholders expressed concerns regarding (the choice between) the different approaches or methodologies for determining the emission factor for green**

electricity. Companies may choose either **the location-based or the market-based approach** (UBA 2019), whose differences are summarised in

Table 1 below.

Table 1: Comparison of the location-based and the market-based approach

	Location-based approach	**Market-based approach**
Market structure	Can be applied anywhere in the world.	Corresponds to the structure of liberalised electricity markets.
Assessment basis for emission factor	Approximates physical conditions through average emission factor of the grid. But ignores actual and temporal feed-in.	Refers to the contractual relationship between supplier and consumer.
Proof	Electricity characteristic of the national average power mix.	Supplier statements, electricity product labelling, GOs, PPAs.
Advantages	Causal relationship between energy consumption and generation within a grid.	Rewards the consumer's procurement decisions.
Promotion of awareness	Low, as consumers have virtually no influence on the national power mix. Only a reduction in consumption leads to a reduction in emissions.	Promotes acceptance of the energy transition and awareness of the emissions resulting from electricity consumption.
Consumer influence on RE expansion	None.	Depends on the additional benefit of the electricity product.

Source: Based on UBA 2019.

In the **location-based approach**, the emission factor equals the average emission intensity of the local, regional or national grid in which consumers are located. The underlying assumption is that consumed electricity cannot be traced back to a specific generation facility. In the case of Scandinavia, a transnational grid (the Nordic Grid) can be chosen as the basis of the emission factor. In Germany, the emission factor of the national electricity mix is usually stated. The advantage of this approach is that a causal relationship is established between energy consumption and energy production within a grid; on average, each consumer is attributed the emissions caused by the electricity generation that is required to cover her consumption. This approach is applicable everywhere, even in non-liberalised markets (WRI 2015). In addition, it should provide an incentive for companies to consider the share of RE in the electricity grid when choosing locations for their production sites.

A disadvantage is the very coarse delimitation of the electricity grids, which makes it impossible to establish a connection between consumption and feed-in (the balancing of consumption and generation takes place at the level of the balancing group, rather than at the national level) and that the average emission factor of the grid cannot reflect the changing feed-in over time (Brandner 2018). In addition, the approach limits the companies' scope for action, as emissions can only be reduced by lowering electricity consumption; individual procurement decisions in favour of green electricity are not rewarded. Grids with high shares of RE also offer no incentive for companies to buy additional green electricity products, as the RE share that is already available in the grid is automatically purchased (RE100 2018). This fact was also strongly criticised in the GO4I industry workshop: Not only are there hardly any incentive for more RE expansion, but the possibility to use the location-based approach for emission accounting also brings systematic competitive disadvantages for energy-intensive industries (e.g. the metal industry) located in grids with low RE shares (e.g. Germany vs. Norway), regardless of whether they choose the location-based or the market-based approach.

The **market-based approach**, on the other hand, is based on a conscious procurement decision for a specific electricity product, whose influence shows up in the emissions balance. Procurement is usually based on a contractual commitment to a specific energy supplier, differentiated electricity products, the purchase of GOs that are either detached from or linked to the supply of electricity, and the purchase from a selected power plant. This results in a specific emission factor that can deviate from the overall grid characteristics (WRI 2015). That factor can be proven by means of an emission factor published by the power supplier (e.g. in the electricity labelling), by GOs or by direct supply contracts (PPAs). The advantage of this approach is that it rewards the individual procurement strategy and addresses the issue of Scope 2 emissions. The prerequisite is a certain degree of liberalisation of the electricity market, which allows consumers to choose green electricity products.

Some criticise that the approach is only based on contractual connections (between consumers and electricity suppliers) and need not reflect electricity deliveries between balancing groups or temporal or spatial connections between generation and consumption (various forms of "coupling" are possible, but the electricity can also be bought independently of the GOs). If the power is supplied via the grid, the green properties cannot be physically tracked.[4] However, one perspective for further development could be to take greater account of infrastructure bottlenecks. For example, GO trading volumes can significantly exceed the electricity volume that is or can be physically delivered between countries due to limited grid interconnection capacity (this applies to trading with Norway, for example). Ignoring physical grid restrictions can reduce the incentive for RE expansion in the region where a company is

[4] Even if electricity deliveries are tracked in the balancing group system, it is difficult to exclude opposing trades with featureless "grey electricity". Balancing energy, which may have to be used at short notice to maintain balancing group compliance, is also procured as grey electricity.

located. However, so far green power products in Germany have made hardly any contribution to the domestic growth of RE anyway, which has been largely driven by the public subsidy system, and publicly supported RE plants currently may not generate additional revenue from selling GOs (see GO4I Energy Sources Report 1, Sakhel et al. 2022). For the market-based approach to yield any tangible emission reductions, the certificates must satisfy certain criteria that ensure an additional benefit for the energy transition. The criteria of some quality labels for electricity, such as the *Grüner Strom* label, ok-power or the WWF procurement guide, are good examples of this. Such criteria may refer to the proportionate procurement of GOs from new plants or priority being given to certain technologies. The criteria should be aligned with the respective energy market and reviewed at regular intervals.

The choice between the location-based and the market-based approach means that the GHG accounting methods of different companies are hardly comparable (see also Styles 2022). The GHG Protocol therefore recommends that companies present their GHG emissions according to both approaches – and yet the choice remains available. This could be addressed in standards by demanding that even companies that do not buy green energy products must also report the results of the market-based approach - in this case using the electricity labelling of their electricity supplier.

This would also address the current problem that **the choice between the two accounting approaches can lead to double claiming of the RE property in corporate GHG accounting**.[5] This is the case when some companies, using the location-based approach, claim the RE property of the average RE share in a grid, while at the same time GOs from this grid are used by other companies for GHG accounting or other purposes under the market-based approach within or, more likely, outside the grid area. There is clearly a need for additional regulation at this point, especially if the emissions accounting is to serve regulatory purposes (CBAM, CSR Directive, etc.). One way of addressing the problem is to limit the choice of approaches (and possibly also the quality range of the certificates) for certain applications[6] as much as possible. For example, only the market-based approach with some evidence of a specific additional benefit for the energy transition could be permitted.[7] That would address the problem of double claiming of the RE property, make the accounting methodology clearer and more comparable, and reflecting the procurement behaviour of companies in the emissions balance (cf. Maaß et al. 2019). This approach could also raise the demand for GOs.

[5] This has no influence on the achievement of national RE targets, e.g. under RED, for which GOs play no role.

[6] The choice is less of a problem in the context of calculating emissions in the public sector (e.g. municipalities).

[7] ISO 14064-1 prescribes the location-based approach. While this addresses the double claim of the RE property, corporate procurement behaviour continues to have no effect.

Gases

The demands made with regard to the electricity sector are mirrored in the area of green gases. Here, too, greater clarity and practicability of verification are needed, as is more information on the origin of such gases, especially when offsetting or compensation mechanisms are used. That being said, standardisation in the area of mass balancing of liquid fuels is relatively advanced, as globally recognised, verifiable sustainability criteria across all processing and transport stages of the fuel have already been established. For example, mineral oil companies can prove the origin and sustainability criteria even for production outside the EU. This is necessary, among other things, for the establishment of a CBAM. The **EU-wide database for the central issuing and cancellation of certificates for gases and liquid energy sources** (European Commission 2021), which is currently being planned, will promote the standardisation process within the EU.

In this context, companies will need to know about the different **areas of application for mass balancing and the new GO system** (see also GO4I Energy Sources Report 2, Bowe and Girbig 2022). The double marketing and double claiming of the RE property must continue to be prevented in order to avoid a situation where for a certain amount of gas, both mass balancing certificates and GOs are issued and used for different purposes at the same time. The administration of the certificates via a common EU-wide platform will be very valuable in this respect.

As with electricity, **some companies also aspire to independently manage gas certificates themselves**, especially those companies that operate their own power plants (so that, for example, renewable power generated from the companies' own biogas could be verified independently).

The **reporting of GHG emissions along the upstream chain of gas production** is also relevant for green gases, given the minimum requirements for GHG savings in regulatory crediting options, e.g. under RED II. The same also applies to sustainability requirements, especially for biogenic energy sources. Some companies would additionally like to neutralise the emissions from gas consumed in upstream production. Here, however, a similar problem arises as in the electricity sector.

However, it is also clear that the quantities of green gases that would be necessary for industrial use are not yet available. And since their supply can be expected to remain very limited due to competition for land, the focus here is on renewable hydrogen.

Heat and cold

The German industry has little to no experience in the use of RE certificates for heating and cooling, as such certificates have not yet been introduced here (unlike in the Netherlands, for example). It is therefore important to provide a platform for companies to learn about the functioning and possible applications of such certificates.

Generally speaking, many of the points raised in the electricity sector (such as the desire to be able to certify self-supply, manageable rules for verification especially at the sector interfaces, etc.) will also become relevant in the heating/cooling sector (for an overview of the various use cases for heating/cooling RE verification in industry, see the GO4I Energy Sources Report 3, Styles and Claas-Reuther 2022). A special feature is that in the heating/cooling context, requirements for the ecological quality of thermal energy supplied via grids have already been established in regulatory and subsidy law, with the focus so far being on per-grid indicators. It is therefore recommended that the **allocation of green properties by means of GO cancellation in labelling and GHG accounting rules as well as under regulatory and subsidy law be designed consistently** in order to prevent the double marketing and/or claiming of the renewable property of heating/cooling across different areas of application. Regulation should also determine the conditions under which specific green district heating/cooling products can be offered in a network and for which purposes (e.g. for regulatory and subsidy law requirements) product accounting can be used.

Another special feature of the use of heat and cold certificates in industry is that industrial companies can increasingly **supply unavoidable industrial waste heat or cold**.[8] On the one hand, the companies are thus switching roles, from being mainly consumers to producers, which means they deserve stronger involvement in the GO system (HKNR). On the other hand, the consideration of unavoidable waste heat and cooling in RE verification systems and corresponding labelling rules could support the efforts to integrate more of such energy into the supply systems.

Liquid fuels

The verification of liquid renewable fuels was not discussed very much, as the companies represented in the discussions (unlike the logistics, shipping or aviation industries) have only marginal contact with this, e.g. potentially when operating their own vehicle fleet. Moreover, no major changes in the verification process are planned in this area (mass balancing will remain in place for the time being). Processing these certificates via a future central European register will help to further standardise the systems involved (for more details, see the GO4I Energy Sources Report 2, Bowe and Girbig 2022).

[8] In other energy sectors, such as electricity, this is also possible if a company wants to sell surplus energy from its own RE plants. In the case of unavoidable waste heat, however, this situation is much more common as companies (e.g. heavy industry and data centres) are typically the main sources of unavoidable waste heat.

4. Conclusion

In summary, the industry representatives raised the following general focal points of interest regarding RE verification:

- **RE verification requires more regulatory clarity and practicability**, especially at sector interfaces. This currently applies in particular to the verification of renewable electricity for use in hydrogen production.

- The industry representatives called for **general standards that apply not only to regulatory requirements but also to voluntary GHG accounting**. In particular, the criteria for meeting the requirements of regulatory and subsidy law should be consistent and in accordance with voluntary verification systems. In the context of voluntary GHG accounting, too, uniform requirements offer transparency, enable greater comparability and at the same time improve the credibility of company reports. The introduction of the CBAM and the EU's standardisation efforts (e.g. the Union Database) support this.

- The relevance of **non-European energy imports is increasing,** especially due to the growing demand for hydrogen. This reinforces the call for universally valid, achievable and verifiable standards. Existing verification systems for renewable gases and liquid fuels are already moving in this direction, as they can be used to prove RE properties even beyond the EU borders.

- **The application of the location-based and the market-based approach should be regulated more firmly, and the choice between them should be restricted** (see sections 2.1 and 3). As mentioned above, the market-based approach offers greater incentives for changing the corporate procurement strategy. It would be advantageous for the relevant standards to require companies to report the results of the market-based approach in addition to the location-based approach.

- **Renewable energy certificates should be extended to the self-supply of energy for Scope 1 accounting**. For reasons of transparency, it seems advisable to distinguish between self-supply certificates and those issued for grid feed-in. Such a distinction can also be reflected in the labelling rules.

- Some entrepreneurs with high energy demand would like to have **independent access to the GO register** so that they do not need to rely on a utility to keep GOs for the energy they have generated in their own assets or bought through PPAs. For electricity, this has implications for the design of electricity labelling and should therefore be examined in more detail.

- Furthermore, some (progressive) entrepreneurs are looking to **use GOs beyond their own corporate emissions accounting**. If that were possible, these companies could

reach out to their supply chains and calculate PCFs or CCFs more accurately. However, GO cancellation for the electricity consumption of third parties within the scope of Scope 3 accounting, for example, would have to be critically examined, since this would require breaking the existing close association between the certificates and the energy consumed. Particularly in the case of cancelling GOs on behalf of upstream suppliers, this could increase the risk of several GOs being cancelled for the same unit of electricity and different energy properties being shown by different actors. This would increase the complexity of electricity labelling and could reduce the transparency of statements on the ecological quality of the purchased or supplied electricity. In addition, there would be a risk of overtaxing the actual purpose of GOs. It may therefore be preferable to offset emissions in the supply chain via CO_2 certificates or other forms of climate finance. The use of GOs for offsetting purposes should be avoided in any case: GOs serve to unambiguously assign energy characteristics to consumers, especially in the case of grid supply, where the characteristics of all connected generation plants are mixed. This includes the clear allocation of the emission factors of purchased energy, which can be used for Scope 2 accounting. In contrast, if GOs were used to offset GHG emissions generated by a company's own activities or along its supply chain, the emissions would be counted twice: once for the renewable electricity generation as included in the national or European GHG balance, and again for offsetting. Separating the GO cancellation from actual electricity consumption or delivery means risking that the boundaries between a verification system for the properties of procured energy on the one hand and voluntary carbon markets on the other hand could become blurred. It would also become a challenge to ascertain what the GOs were used for and what statements were associated with them. If GOs were to be used for third parties, it would therefore be advisable to make a concrete reference to the supplier's energy consumption and to inform the supplier that GOs (or other certificates) are being cancelled on their behalf (so that simultaneous offsetting is also avoided). The companies would thus act as a kind of intermediary of GOs to their suppliers. The supply chain actors could also claim the renewable property of the energy or use it in their PCFs, etc. (in the sense of a "controlled and meaningful double claim" in the context of Scope 2 and Scope 3 accounting). However, Scope 3 cancellation of GOs could potentially shift the responsibility for the environmental impact in the production of goods and services from the producer to the customer. This may disadvantage companies that lack the financial capacity to provide emission services to their supply chains.

An alternative would be the mandatory and systematic recording of GHG emissions along the entire supply chain (internationally and in a fully digitalised fashion), for an efficient flow of information along the chain. While such a solution or a simpler procedure for the GHG accounting of the supply chain is unlikely to be implemented in such a "radical" form any time soon, especially considering the international nature of

many supplier relations,[9] changes in many areas are giving this topic ever more momentum. For example, the revised CSRD will extend the systematic recording of GHG emissions to a larger set of companies. At the same time, GHG emissions data is increasingly being integrated into tenders. This will raise the requirements for documentation of environmental impacts within the supply chain and challenge companies in the design of their procurement strategies and supplier relationships. Changing suppliers in favour of more transparent companies can also have a motivating effect.

- It is increasingly important for companies that measures such as GHG accounting, especially including the supply chain, and the sourcing of RE actually achieve an (additional) climate impact (this also includes, for example, the consideration of the spatial or temporal connection between the generation and consumption of energy in the market-based approach). Also of increasing interest is the attempt, through the procurement of 'local' RE, to give climate change and the measures to mitigate it a regional dimension, even though this contradicts the original approach of the European free market for GO.

[9] International standards and criteria are usually based on the lowest common denominator (cf. the GHG Protocol).

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