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Electricity Disclosure and Carbon Footprinting: Effects and incentives resulting from different approaches to account for electricity consumption in carbon footprints

(Deliverable 6.2 of the RE-DISS II Project)

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RE-DISS II
Reliable disclosure systems for Europe

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Summary

Calculation and publication of corporate carbon footprints and of carbon footprints for products and services have become mainstream to a large extent. For many sectors, electricity consumption is a highly relevant item in the energy balance, and related emissions are to be applied in the carbon reporting. In recent years, accountability of a specifically low emission factor particularly for renewable electricity supply (RES-E) has become the major driver of voluntary markets for RES-E for non-household consumers. However, this raises the question of how exactly an emission factor for the consumed electricity should be determined and subsequently be taken into account in the carbon footprint. With a view to existing European regulation on liberalised electricity markets and to fuel mix disclosure for electricity, it is of particular interest how the information on CO_2 emissions as provided in an electricity supplier's fuel mix disclosure statement relates to the carbon footprint of the commercial electricity consumer.

This report discusses similarities and differences of electricity disclosure and carbon accounting. Based on this, it presents different approaches in order to determine electricity-related emissions for carbon accounting, including a possible relationship to electricity disclosure, and discusses these approaches with respect to the effects on calculated results and incentives for decision makers to take action. This analysis should particularly contribute to the understanding of the influence of the choice of methodology, and thus support conscious definition and application of carbon accounting methodologies with respect to electricity-related emissions, and particularly the use of emission factors as provided with electricity disclosure statements. The general framework for the analysis is given by a focus on Europe and the market and policy framework which applies there. This includes, amongst other issues, national RES targets, support schemes, the disclosure obligation for electricity suppliers and the existing system for guarantees of origin (GOs).

The commonly applied approaches to calculate a carbon footprint do follow a straight-forward book & claim system of attributes within the system boundaries of the respective organisation, product or service without any assessment of possible environmental effects on a global scale. However, this discussion paper does analyse to which extent it seems appropriate to follow the ambition that the principles of carbon accounting should lead to results which incentivise decision makers to choose options to mitigate climate change.[1] It is also discussed to which extent the common approaches to calculate a carbon footprint are in line with such ambitions..

In that respect, electricity production and consumption are different to other accounting elements in carbon accounting, Due to large amounts of RES-E volumes which are available for voluntary markets, including existing both old RES-E production capacities and RES-E volumes which have benefitted from public support, explicit choice for RES-E does, for the time being, cause no pressure for building new RES-E in order to mitigate climate change.[2]

[1] These decision makers could be managers of the considered companies, customers of products which are in the focus of low-carbon marketing claims, but also NGOs and policy makers

[2] At the beginning of market liberalisation in Europe, production of old hydro was already in the range of 500 TWh/yr. In 2013 (considered as current status quo), the total RES-E production volume has reached 950 TWh/yr. The production volume which is to be reached by EU28+NO, CH, IS) by 2020 is defined by the RES Directive and the National Renewable Energy Action

This is an important aspect of discussion when RES-E supply is compared to other (competing) options for decreasing the calculated carbon footprint of a company or product. These alternatives are particularly improvements in energy efficiency and energy savings, which can be preferred from an ecological point of view. A comparable effect from RES-E supply would only be reached if new RES-E capacities are directly stimulated, and if this new RES-E directly replaces fossil production (and the related CO_2 emissions). This effect of RES-E markets is usually referred to as “additionality”.

This report proposes a concept for classification of different levels of additionality. These levels depend on 1) whether the respective RES-E volumes are taken into account for national RES targets as set by the Renewables Directive 2009/28/EC (RES Directive), 2) the age of the respective production facilities and 3) whether public support is being paid for the RES-E production. This classification therefore describes 1) whether a specific RES-E supply does support the increase of RES-E production volumes of the business as usual (BAU) scenario as set by the RES Directive, or 2) whether it contributes to the increase of existing RES-E volumes (towards BAU targets), and 3) who pays the additional cost for RES-E production over “conventional” production. This classification also includes a future scenario where the explicit demand for RES-E exceeds existing production capacities and where the consumers’ general willingness to pay for RES-E increases to a level which is sufficient to stimulate new RES-E investments. In this scenario, it is not differentiated between different RES-E products. This level of additionality is referred to as “additionality by overshooting demand”.

In order to analyse in this context to which degree the principles and instruments of electricity disclosure and the related information content is suitable to be applied for carbon accounting, characteristics of both instruments and differences between them are outlined on a general level. For electricity disclosure, existing book and claim systems do not differentiate between environmental benefits (in the sense of “additionality”) of the underlying electricity supply. Accordingly, they do not specifically incentivise consumption of RES-E electricity with a specific additional environmental benefit. However, this can be justified when electricity disclosure is considered a basic instrument for consumer information, awareness raising and increase of market differentiation in general. Furthermore, voluntary quality labels for green electricity are in a position to inform consumers (particularly household consumers) about relevant differences.[3] As explained above, the analysis of carbon accounting methodology in this report also assesses to which extent the respective results of a carbon footprint provide incentives for making decisions which are suitable to mitigate climate change. This also means that decreasing consumption is better than consuming a RES-E product, which under current market and policy framework in Europe does usually not imply a mitigation of carbon emissions.[4] Therefore, it seems preferable from an ecological point of view that accounting methodologies avoid that consumers are discouraged to implement efficiency and energy saving measures. In contrast to electricity disclosure, there is a direct trade-off between the “quality” of consumed (and accounted) electricity and the volume of electricity consumption.

Plans (NREAPs). This amounts to about 1.400 TWh/yr, and can be considered the business as usual (BAU) scenario.

3 These labels can also take further aspects besides the increase of RES production into account, e.g. ecological plant improvements or measures for improved integration of fluctuating RES in the overall electricity system.

4 This also does not include a contribution to any improvement under the existing emission cap which is defined by the EU Emission Trading Scheme (ETS).

Although carbon accounting is not legally mandated or regulated like disclosure, there exist different public standards and voluntary guidelines which describe on several levels of detail the technical principles which should be applied when setting up a carbon footprint. The most elaborate guidelines are the GHG Protocol Guidance for Scope 2 (WRI/WBCSD 2015), which explicitly focus on handling of electricity consumption under corporate carbon accounting. However, with respect to accounting of electricity consumption, available standards and guidelines do not in any case provide a clear recommendation, and are not fully consistent.

The most fundamental choice when defining a methodology for electricity accounting for a carbon footprint is the choice between what the GHG Protocol (WRI/WBCSD 2015) calls the market-based approach and the location-based approach. The market-based approach here can be roughly understood as the information which is provided with electricity disclosure according to the individually chosen electricity product. The location-based approach accords to the average production mix of the country or grid area in which the electricity consumption actually takes place. Those two different approaches have been analysed for the different scenarios of a country or grid area with a high RES-E share and a respectively low average CO_2/GHG emission factor, and of one with a low RES-E share and a respectively high average CO_2/GHG emission factor. The analysis included an assessment both for a RES-E consumer and for a grey consumer how choosing between these two different methods influences the results in the respective application examples, and which incentives this gives for the respective (commercial) consumer. These incentives have been assessed in the following dimensions:

- Incentives for applying measures for increased efficiency and energy saving in general
- Incentives for choosing a specific electricity product
- Incentives for facility-siting (corresponding to discrepancy between international competitors).

The results of this analysis include the following findings:

- The methodology chosen for carbon accounting can have a much stronger influence on the carbon footprint results than the actual supply situation of the commercial consumer.
- Both the market-based method and the location-based method can gain results which provide only a small incentive for efficiency measures or energy savings (irrespective of the actual level of efficiency potential). One could describe, for example, the following cases:
    - A Norwegian commercial consumer using the national production mix for carbon accounting, therefore having almost no incentive to reduce his energy consumption.
    - A German commercial consumer buying a RES-E product consisting of old hydro, which discourages him to reduce his energy consumption.
- None of the described “plain” approaches provides any incentive for choosing a high-quality RES-E product with additionality.
- For the market-based method, the incentive to apply any measure for reducing the carbon footprint increases with the share of specific RES claims in the respective area (at least in the case that the remaining attributes in the residual mix are fossil rather than nuclear attributes).

- Under the market-based approach, the choice between such reduction of the carbon footprint by RES-E or by efficiency measures is not supported by the accounting method. This choice therefore probably depends most on the price level of such measures.
- Currently, the reference for calculation of a grid mix is usually the national electricity system. Due to different national grid mixes companies which compete in a European market have competitive advantages or disadvantages, respectively, when calculating and communicating their carbon footprint. This is very clear for the location-based method, which refers to the (national) uncorrected production mix. But it also applies to some extent to the market-based method when choosing a non-specific electricity supply, which (on average) will correspond to the national residual mix.
- When applying the market-based method, the systematic discrepancy between competitors in different countries decreases with increased relative shares of claimed RES-E attributes which are deducted from the residual mix.
    - However, in domains with high RES-E production volumes the available RES-E volumes are larger in total.
    - Of course, this finding only applies in case that the remaining attributes in the residual mix are fossil rather than nuclear attributes.

As stated above, one of the challenges to be addressed by this paper is an analysis of whether and how different accounting methodologies lead to results which incentivise decision makers to choose options to mitigate climate change. In the light of existing regulatory and market framework in Europe (including e.g. high shares of old hydro), this suggests to require a high priority for incentivising efficiency and energy saving measures. Efficiency is incentivised in all scenarios to some extent, but under the market-based method efficiency competes with RES-E supply (with currently very low market price), and under the location based-method this incentive is very low anyway for low-RES domains. Thus, one can conclude that neither of these methods assigns a general priority for efficiency.

A more thorough analysis of the effects of such an undifferentiated incentive structure is mostly depending on the question how realistic the possible scenario of "additionality by overshooting demand" is. Such a situation of increased demand and also increased willingness to pay for RES-E on voluntary markets might justify an equal prioritisation of efficiency and RES-E supply from an ecological point of view. European RES-E targets for 2020 amount to an annual production volume of roughly 1.400 TWh (ECN 2011, OED 2013, Eurostat 2012[5]). About one third of this volume (≈ 500 TWh) has already been in the system as production by old hydro plants at the beginning of market liberalisation in Europe, and about two third of this volume (2013: ≈ 950 TWh[6]) is currently being produced from RES, with the increase being an effect of public support systems.[7] At the same time, prices for GOs from Norway (which amount for a major share of the European GO markets) are currently in

5 Please note that for Switzerland 2010 data has been used as proxy data for 2020.

6 RES-E production 2013 in EU28+CH+IS+NO according to RE-DISS II residual mix calculations, based on ENTSO-E production statistics.

7 At the same time, most of this supported RES-E is eligible for issuance of GO and generally available for voluntary markets. In case that national governments would decide to exclude the supported volumes from issuance of GOs and rather allocate the respective RES-E volumes to those consumers who pay for the support scheme (like is the case already today e.g. in Germany), this obviously would limit the volumes of available RES-E attributes in the market.

the range of 15 ct/MWh (EEX 2014), while the price level for Elcertificates (as indicator for cost of RES-E development towards 2020 targets) was 21,6 EUR/MWh in the same period (Statnett 2014) – roughly 150 times higher than the price for GOs. For comparison, the average market price for electricity at Nordpool was close to 40 EUR/MWh in 2013 (Nordpool 2014), roughly 250 times higher than the price for GOs. Although these figures only cover a status quo situation, they provide a numerical framework for necessary changes in consumer’s willingness to pay if voluntary markets are really meant to stimulate new RES capacities by overshooting demand. In combination with the high market share of green power products which is needed for the vision of “additionality by overshooting demand”, it also becomes clear that this vision would incur large-scale windfall profits for the operators and marketers of existing RES-E production capacities. Undifferentiated distribution effects limit the monetary efficiency of this approach. This shows that there is still a long way to go in order to reach additionality by overshooting demand, both in terms of further volume increase and in terms of available funding by increased prices on voluntary markets.

One option to better correlate the incentive structure derived from a carbon footprint with the expected ecological relevance is to change the definition of eligible RES-E attributes which can be claimed in a market-based approach for carbon footprint and to make this subject to additionality criteria.. For the time being, none of the officially implemented methods for carbon accounting allows for a distinction of RES-E products according to the additional environmental benefit which is related to them. Still, there are some proposals for different approaches which, already under current conditions in Europe, allow for an “additionality-sensitive” approach. Although ambitious additionality levels would obviously be desirable from an environmental point of view, some arguments support the incentivising of commercial consumers to consume electricity with “basic additionality” (meaning that new and unsupported electricity is consumed, which is accounted within the national RES targets of the producing country). In this case, the commercial RES-E consumer can claim that he bears the financial cost of the additional RES-E production as an active contribution to reaching the given targets and. Thus, he actively contributes to the solution rather than being part of the problem. However, any such definition of additionality requirements for making carbon-related claims would have to be broadly discussed and should be agreed on an international level in order to ensure a level playing field for market participants. Such requirements should be applied consistently in order to avoid systematic disadvantaging those who are using this more “restrictive” approach. Still, the application of such an approach could be possible on a voluntary basis, as it does not negatively affect carbon accounting results of other stakeholders. Of course, transparency on the applied method would have to be provided in order to allow for interpretation of the results.

But: experience shows that the aspect of additionality is not easy to handle as it introduces an extra level of complexity, which is not considered necessary by some stakeholders or not understood, particularly by non-experts on the topic. So for the time being, and in absence of such additionality-sensitive accounting requirements, at least requirements should be followed which assure high transparency on the influencing affects and the actual energy consumption, rather than just providing only one carbon footprint figure as final result. This should include parallel accounting both with the market-based method (which is in line with electricity disclosure principles) and with the location-based method, and subsequently an equal further use and communication of both figures. Such requirements have to some extent also been included in the GHG Protocol Scope 2 Guidance (WRI/WCSD 2015). From a practical point of view, the described dual approach has the benefit of being based completely on established methods and principles. This allows for straightforward accounting and is probably intuitive for the vast majority of those who consider calculating a carbon footprint. Besides that, reporting of additional parameters would further increase transparency on the actual meaning of the carbon footprint, including for example the consumed electricity volume in terms of MWh, and special characteristics of the consumed electricity (according to the market-based method, i.e. the electricity disclosure information). This could refer to information on green electricity labels of the electricity (if any), to the age of underlying production plants or to the level of public support (as is documented by GOs). Still, it is obvious that it has the drawback that reporting of the different values as described above (dual reporting and additional parameters) increases complexity for marketing and communication strategies, which might be easier if based on one single figure.

In general, the evaluation of carbon footprints which have been derived by different accounting methodology shows that the applied principles of carbon accounting have a strong influence on whether the gained results actually incentivise decision makers to choose options to mitigate climate change. As the sensitivity of results with respect to the chosen carbon accounting methodology shows, one can hardly refer to “the correct carbon footprint”. One could thus compare carbon footprint, and more specifically accounting of electricity consumption, with a public tax system. There is no correct and no wrong methodology, but one can expect that systems should be designed so that they are fair, coherent and generally applicable in order to give desirable incentives and to share the burden.

In order to further develop the instrument of carbon accounting towards this goal, and also to further clarify a sensible role of electricity disclosure and related instruments in that respect, several specific actions by different target groups would be needed. Carbon accounting experts (and to some extent also large commercial consumers as the main users of this instrument and electricity system experts) should foster discussions on how RES-E additionality can be fairly accounted for. Development of such an “advanced” methodology should include not only development and an agreement by a relevant group of players, but also broad publication and branding of this approach in order to enhance actual application. When following the GHG Protocol (WRI/WCSD 2015), large commercial consumers should ensure to report the non-obligatory aspects which can give information about the ecological relevance of the given electricity consumption (in the market-based approach). Consumer and environmental NGOs should first and foremost become familiar with the issues of carbon accounting and the special role of electricity accounting, and hereby consider the needs of household consumers with respect to communication of carbon footprints. This should hopefully put them in a position to contribute to the development and communication of an “advanced” carbon accounting methodology as stated above. In order to increase transparency already in the short term, it would be helpful if all parties calculating and publishing carbon footprints would provide comprehensive information. This should include a parallel accounting according to both the market-based method and the location based method, and publication of additional electricity related parameters like the volume of electricity consumption and e.g. information on green electricity labelling. Also electricity suppliers and national competent bodies can support this by provision of relevant background information.

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1 Introduction

1.1 General introduction and background

Calculation and publication of corporate social responsibility reports (CSR) and corporate carbon footprints have become mainstream for a large part of commercial electricity consumers in Europe. The carbon footprints of specific products and services are also calculated and used as a marketing instrument, and local authorities set up climate mitigation strategies based on territorial climate footprints. For many sectors, electricity consumption is a highly relevant item in the energy balance, and related emissions are to be applied in the carbon reporting. In recent years, accountability of a specifically low emission factor particularly for renewable electricity supply (RES-E) has become the major driver of voluntary markets for RES-E for non-household consumers. However, this raises the question of how exactly an emission factor for the consumed electricity should be determined and subsequently be taken into account in the carbon footprint. With a view to existing European regulation on liberalised electricity markets and to fuel mix disclosure for electricity, it is of particular interest how the information on CO_2 emissions as provided in an electricity supplier's fuel mix disclosure statement relates to the carbon footprint of the commercial electricity consumer.[8]

This report discusses similarities and differences of electricity disclosure and carbon accounting. Based on this, it presents different approaches in order to determine electricity-related emissions for carbon accounting, including a possible relationship to electricity disclosure, and discusses these approaches with respect to the effects on calculated results and incentives for decision makers to take action. This should particularly contribute to the understanding of the influence of the choice of methodology, and thus support conscious definition and application of carbon accounting methodologies with respect to electricity-related emissions, and particularly the use of emission factors as provided with electricity disclosure statements.

The general framework for the analysis comes from a focus on Europe and the market and policy framework which applies there. This includes the following aspects:

- National RES targets are defined with respect to the year 2020.
- There are RES-E support systems on national level, including quota systems, feed-in schemes and market premiums, but also tax incentives and production support.
- In principle, a liberalised internal market for electricity is implemented, but with some technical restrictions between national or regional systems, and some remaining shortfalls on the level of individual states.
- All European electricity suppliers are obliged to provide an annual fuel mix disclosure statement to their consumers.
- There is a European electricity market for guarantees of origin for electricity from renewable sources (RES GO) which are used for electricity disclosure.
    - These GOs may have no role for support schemes or for target accounting.

8 Similarly, the question of considering electricity-related nuclear waste in CSR of commercial electricity consumers could be raised. However, this paper will focus on the carbon aspect due to the higher relevance for specific demand in current markets.

  - Depending on national regulation, RES GOs can be issued and used only for unsupported electricity or also for supported RES-E.
- The whole electricity sector is covered by the European Union Emissions Trading Scheme (EU ETS), which sets an overall cap for the covered sources of emissions.

The commonly applied approaches to calculate a carbon footprint do follow a straight-forward book & claim system of attributes within the system boundaries of the respective organisation, product or service without any assessment of possible environmental effects on a global scale (see Chapter 3).

However, this discussion paper does analyse to which extent it seems appropriate to follow the ambition that the principles of carbon accounting should lead to results which incentivise decision makers to choose options to mitigate climate change.[9] It is also discussed to which extent the common approaches to calculate a carbon footprint are in line with such ambitions.

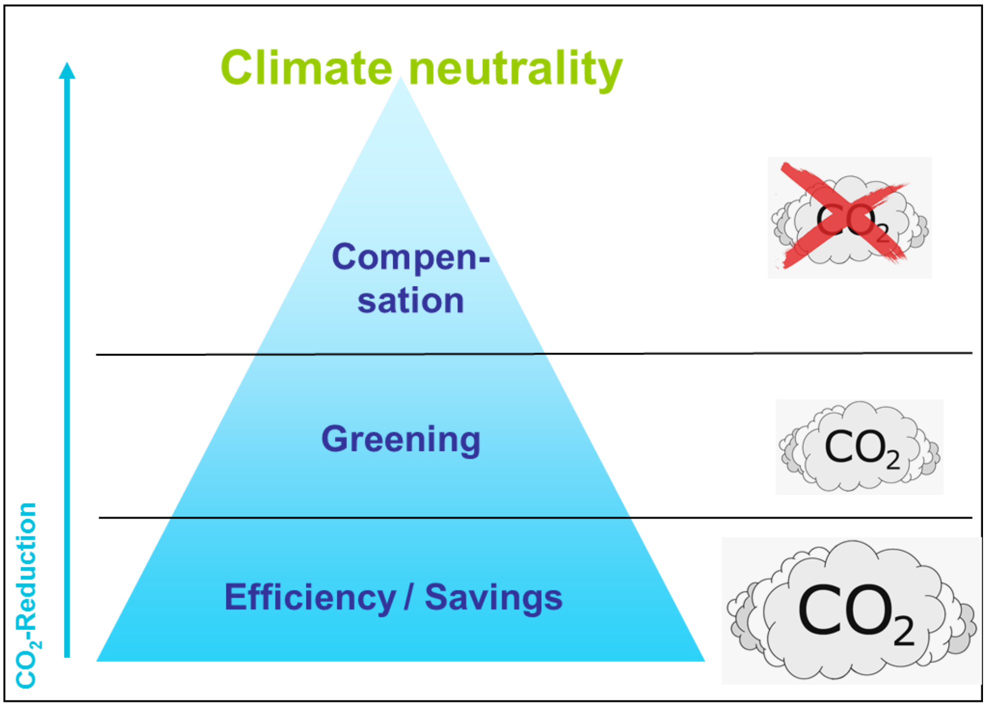
1.2 Prioritisation to reduce carbon footprint

As stated in Chapter 1.1, this report analyses different approaches for considering electricity consumption in carbon footprints, possibly based on electricity disclosure information, in order to assess to which extent carbon footprinting does lead to results which incentivise decision makers to choose options to mitigate climate change.

This principle is also reflected by the three-step approach shown in Figure 1 (based on Öko-Institut (2010), see also Carbon Trust (2006)). This gives the highest relevance to the reduction of energy consumption in general, and as second priority the greening of energy consumption, which can be understood as consumption of renewable energy sources. Both elements feed into the results of carbon accounting and therefore summarise the climate effects which are related to specific activities (e.g. operation of a company in a given year). Furthermore, it may be an additional goal to reach “climate neutrality” by compensating the remaining carbon emissions calculated during the first two steps by specific offset measures (e.g. financing forestation or carbon reduction measures in developing countries).

9 These decision makers could be managers of the considered companies, customers of products which are in the focus of low-carbon marketing claims, but also NGOs and policy makers

Figure 1: Three-step approach for prioritising climate-related measures towards the ideal vision of “climate neutrality”. This assigns the highest priority to efficiency and energy saving measures as compared to the greening of energy supply. The lowest priority is given to compensation measures.



A **carbon footprint** in such a framework is therefore the sum of greenhouse gas emissions (or removals) in a given system (like a product or company's activities), using the single impact category of climate change (based on ISO 14067 (2013)) In less technical terms, one can say that a carbon footprint measures the total greenhouse gas emissions caused directly and indirectly by a person, organisation, event or product (Carbon Trust 2015). **Carbon footprinting** or also **carbon accounting** thus is the process of calculating such a carbon footprint. In Figure 1, this would cover the basic two levels of efficiency and savings, and of greening. The third level (compensation) is also referred to as offsetting. Based on ISO 14067 (2013) one can say that **offsetting** is a mechanism for compensating for all or for a part of the carbon footprint through the prevention of the release of, reduction in, or removal of an amount of greenhouse gas emissions in an external process (which is outside the boundaries of the relevant accounting system).

It is obvious that this prioritisation has to be considered a schematic approach. This does not mean that necessarily all theoretical options for increasing efficiency have to be tapped before one should think about replacing consumption of conventional fuels by renewables. This might also depend on the national context of regulation and the structure of electricity generation, which has a strong influence on how large the potential is in order to increase RES shares and to substitute fossil or also nuclear production. The role of nuclear, by the way, is a shortfall of focussing on the carbon footprint from an environmental perspective. While large shares of nuclear which are claimed in a carbon footprint will lead to a low overall CO_2 value and are therefore attractive as alternative to renewables from that point of view, nuclear energy can hardly be considered environmentally friendly due to the nuclear risks related to it. Bearing that in mind, it shall be pointed out that a detailed discussion of the role of nuclear energy is beyond the scope of this discussion paper.

2 Complexity in the relationship between electricity disclosure and carbon accounting

2.1 General comparison of carbon accounting and disclosure as reporting instruments

In order to prepare the discussion of various options to take electricity consumption into account for carbon accounting, and also to address the possible relationship between electricity disclosure and the carbon footprint, characteristics of the two respective instruments shall be compared in the following chapter.

Electricity disclosure is applied mandatorily by all European electricity suppliers in a common regulatory framework as defined by the Internal Electricity Market (IEM) Directive (Directive 2009/72/EC). This regulation covers all electricity production and consumption in Europe. It therefore defines a more or less closed system for allocation of attributes. On top of that, initiatives like the RE-DISS project and cooperating competent bodies from key European countries have established further elements of coordination and harmonisation over and above the general requirements of the IEM and also the RES Directive, which regulates systems for guarantees of origin. This particularly aims at avoiding double counting of attributes which are disclosed to end consumers. However, it has to be stated that national disclosure systems in Europe are still not fully coordinated in order to avoid double counting.

Due to the internal European market for GOs and for physical electricity, the coordination of national disclosure systems has to take place on a European level in order to avoid negative implications on the stringency of other national disclosure systems. A full harmonisation of disclosure is only reasonable on national rather than on European level, as markets for supply of end consumers are limited to the national framework, and consumers would only compare their national supply products. In line with this consideration, detailed disclosure guidelines as established by competent bodies or branch organisations are applied at a national level in most European countries.

In electricity disclosure, the final recipient of the disclosed information is the end electricity consumer, which allows him or her to directly ask for information which appears relevant. In other words, disclosure systems in principle allow for provision of specific and complex information with respect to the electricity production.

Due to the mandatory disclosure to all European electricity consumers on the one hand and the limitations related to significance in terms of additional environmental benefits on the other hand, electricity disclosure can be considered a suitable instrument in order to raise awareness amongst all electricity consumers (particularly those who are not very interested in such issues for the time being), and therefore to consumer education and market differentiation. Only in the case of voluntary demand growing over and above existing old supply and a strongly increased willingness to pay, the system of electricity disclosure may lead to reduced atmospheric emissions when compared to a situation without such a system.

Customers have the choice of whether they want to demand electricity which is, for example, documented by “ordinary” GOs or also by GOs documented to be additional (e.g. from new unsupported plants), which may be documented by specific green power quality labels In some countries, next to green power labelling also supplier rankings are published by consumer and environmental NGOs and watchdog organisations. Both are instruments aiming at complementing the disclosure information, which shows only limited correlation between claimed RES-E (and low CO_2) attributes in electricity disclosure and additionality requirements (as described in Chapter 2.3).

Carbon Accounting on the other hand is voluntary[10] and can be carried out according to different standards and guidelines. In 2015, the GHG Protocol Scope 2 Guidance (WRI/WBCSD 2015) as an amendment to the GHG Protocol Corporate Standard has been published, which can be expected to be broadly applied for corporate carbon footprints. However, the recommendations of WRI/WBCSD (2015) include the dual application of two different accounting methodologies, and also the further existing standards and guidelines such as different ISO standards (14044, 14025, 14067, 14069) show that there are different possibilities how to account for the emissions which are related to the consumption of electricity. The link between disclosure information and carbon accounting depends on the relevant standards or guidelines chosen for carbon accounting. This leads to a more open system as compared to electricity disclosure, and the requirements for calculating the carbon footprint may differ between the different standards and guidelines.

It is not possible to generally define a geographic framework in which carbon accounting methods have to be coordinated or harmonised in order to assure consistent information towards final consumers and a level playing field for all market parties. This strongly depends on the sector, the type of the carbon footprint and the target group of the specific carbon report. A multi-national company will compete on a global level and would therefore be in favour of a common global methodology for reporting, while for smaller companies or for specific products which are only marketed in certain areas coordination of the accounting and reporting methodology on a European or on a national level might be more suitable.

If standards are applied on global or European level, it is a challenge that the framework conditions differ strongly (e.g. with respect to RES-E shares in the national production mix or with different legislative background for RES-E support). This can result in inconsistencies or imbalances between international competitors, although the same methodology is applied consistently. In other words, this means that even if the same methodology is applied, this does not mean that there is a level playing field for competitors with respect to what they can report, nor is there a similar informative value of the reported carbon emissions with respect to the individual “environmental performance” of the company.

Final recipients of carbon reports are usually others than those which have the actual choice of the underlying electricity supply. Usually it will be the (potential) customer of a commercial electricity consumer, or another third party (e.g. general public society who is reading a carbon-related marketing claim). Within companies, the information can be relevant for managing level, and in this case it can directly lead to a decision for either a specific electricity supply option or also for an alternative measure to reduce the carbon footprint. In the other cases, this introduction of a further communication step obviously makes it much harder to tell from the finally disclosed information which input has led to this figure. This is also a general problem of simplification, and in carbon accounting a lot of aspects are in the

[10] As an exemption, one can refer to the carbon accounting as is imposed for large non-energy-intensive organisations in the UK by the “Carbon Reduction Commitment (CRC) Energy Efficiency Scheme” on a national level.
For the role of voluntary standards like GHG Protocol and others, see Chapter 3.3.

end boiled down to usually one single CO_2 figure. However, depending on the application case of a carbon footprint, it might be that additional information is provided in comprehensive reports. This can particularly include a description of the underlying assumptions and input data (like emission factors). This is also foreseen, at least on a voluntary level, in the GHG Protocol Scope 2 Guidance (cf. Chapter 3.3.2).

In general, the aim of carbon accounting is to describe the environmental profile of a product, service or company with respect to climate change. This is commonly applied so that it reflects a straight-forward book & claim system. However, when asking the fundamental question “What is actually the value of a carbon footprint, and what is the underlying reason why one should care about it?”, the comparison with electricity disclosure systems in Europe suggests that the general aspect of initial awareness raising is not as relevant in this case. This is due to several reasons. On the one hand carbon footprinting is a voluntary system with voluntary standards, and can hardly be considered a “closed system” like it is the case for electricity disclosure. This increases the risk of cherry picking. Furthermore, and this is even more relevant, the simplification on one single CO_2 figure outlined above also leads to a further challenge in the assessment of actual environmental benefit: not only the lack of a distinction between different RES-E options (and their respective environmental benefit) is an issue, but also the lack of a distinction between RES-E and nuclear, and particularly the lack of a distinction between electricity supply options on the one hand and efficiency and energy savings on the other hand. Last but not least, and probably due to the manifold application fields of carbon accounting, there is no generally established flanking instrument for providing information to end-consumers on actual climate performance of different products. A positive example in this field is the WWF climate savers programme, which combines carbon accounting with a more comprehensive framework in order to support the sustainable decision making of companies.[11]

Table 1 provides an overview of the general characteristics of the instruments of electricity disclosure and carbon accounting and the respective differences.

Table 1: Overview of the characteristics of the instruments of electricity disclosure and carbon accounting (in the European context); for more detailed explanations please see the text description

Electricity Disclosure	Carbon Accounting
Defined common legal framework	No defined regulatory framework (but GHG Protocol and relevant international standard and guidelines).
Mandatory application by all defined actors (i.e. suppliers)	Voluntary application
“Closed system” (i.e. all production and consumption covered by disclosure)	“Open system” (i.e. covers only the production and consumption related to companies/public organisations which have decided to calculate their carbon footprint)

[11] For more information on the WWF Climate Savers Programme, see http://wwf.panda.org/what_we_do/how_we_work/businesses/climate/climate_savers/

Electricity Disclosure	Carbon Accounting
As the market for electricity and GOs takes place on a European level, a coordination of these systems on the European level is reasonable From the perspective of individual end consumers on the national market is relevant; therefore a full harmonisation of disclosure systems on the national level is sufficient	Different standards/guidelines and respective methodologies can be chosen by the companies (or other organisations). The question, to which region a harmonisation of methodologies should apply, is depending on the market boundary which is relevant for the individual branch and the target group of the carbon reporting: • Global • European • National
The final recipient of disclosed information is the electricity consumer	The final recipient of information is one of the following: • (Potential) customer of the (commercial) electricity consumer • Other "third" parties • Own company's managers
Disclosed information: • Fuel mix • CO_2 emissions and nuclear waste for that specific fuel mix • Possibly further information on production type and tracking instruments	Disclosed information: • CO_2 / GHG emissions of a company/product/service/(local authority) • Provision of additional information can take place on a voluntary level and is strongly depending on the format of reporting
No requirements for additionality; relevant challenges include the following: • no distinction between "old RES" and "additional RES "	No requirements for additionality; relevant challenges include the following: • no distinction between "old RES" and "additional RESs" • no distinction between RES and nuclear with regard to GHG emissions[12] • no distinction between RES supply and increased efficiency or energy savings[13]
Voluntary Labels and rankings as flanking instruments for transparency on actual environmental effects	Lack of generally established flanking instruments for providing information to end-consumers on actual climate performance of different products
Purpose: awareness raising, consumer education, market differentiation (limited: environmental improvement)	Purpose: should educate organisation about its own emissions, or consumers about the climate relevance of a product/service; suggested underlying purpose: this should help to trigger environmentally beneficial decisions

Taking this into account, the following analysis in the framework of this discussion paper will discuss to which extent the existing carbon accounting methods do not only provide technically logical results within a book & claim approach, but particularly to which extent these results of the respective carbon accounting methods are meaningful enough to trigger environmentally beneficial solutions.

[12] According to some corporate carbon footprinting standards, the company needs to document electricity energy sources.

[13] According to some corporate carbon footprinting standards, energy consumption may be presented as a separate indicator alongside GHG emissions.

2.2 Special characteristics of the electricity system with respect to carbon accounting

The electricity production structure in a grid area (e.g. on European or national level) is determined by long-term investments in production capacities. Once an investment has been made, actual production and supply on electricity markets is done according to marginal production cost. In Europe, this includes hydro power capacities for an annual power production in the range of some 500 TWh (RE-DISS II 2014, based on ENTSO-E statistics). Most of these plants were built several decades ago, have been amortised and thus can produce electricity at very low cost. Grid-based energy systems like the electricity system mean that a change of individual consumer preference (e.g. a switch to a RES product) does not automatically result in a change of production, as long as the specific demand for a certain type of product does not exceed the level of existing production.

This means that under this framework the implementation of a typical book and claim system (as is usually applied in GO systems for electricity disclosure) de-links the individual claim as expressed by the calculated carbon footprint from the related environmental effect (i.e. restriction of overall GHG emissions). From an environmental point of view, this is an essential difference to other accounting elements in carbon accounting, where a changed consumer preference for consumed goods or services would usually more directly impact the production structure. If, for example, a change of a heating installation of a building results in a fuel switch from fuel oil to wood chips and solar thermal, the individual change of emissions is comparable to the change of emissions on a global level. It can be argued that a book and claim system (or "attributional" accounting approach) correlates better with the actual environmental relevance of the consumption decision in such cases than in grid-based electricity systems.

Taking the current situation of RES markets and the regulatory framework in Europe into account, this is an important aspect of discussion when RES-E supply is compared to other options for decreasing the calculated carbon footprint of a company or product. These alternatives are improvements in energy efficiency and energy savings, which can be preferred from a strategic point of view according to the principles illustrated in Figure 1. A comparable effect from RES-E supply would only be reached if new RES capacities were directly stimulated, and if this new RES-E directly replaced fossil production (and the related CO_2 emissions). In order to provide the background for a comparison between RES-E supply and other options for decreasing the calculated carbon footprint, the following chapter will introduce a systematic classification of green electricity products with respect to the related environmental effects.

2.3 Re-iteration: What is additionality in green electricity markets?

2.3.1 The general concept of additionality

The general principle of additionality is a long discussed issue in green electricity markets. In this context additionality usually refers to an additional environmental effect over and above the status quo or a business-as-usual development, which is related to the consumption of a green electricity product. In other words, a consumer could ask: "*Does it make a difference to* *the climate and environment if I choose this specific product?*"[14] One of the typical aspects for additionality is "additional" RES-E production volumes ("*Does it help to increase the overall RES-E production if I choose this specific product?*").[15]

Although other aspects (like higher environmental standards for existing RES-E plants) could also be considered as "additionality", the aspect of increasing RES-E is clearly a relevant measure for the level of additionality in the context of carbon footprinting, as it influences the carbon emissions of the electricity system. Therefore, in the following chapters the term "additionality" should mean additionality by the increase of RES-E production volumes.

Green electricity offers usually pursue such additionality by applying one of the following concepts:

- **RES-E Supply Model:** Green electricity offered according to the RES-E supply model is the most common product, where the relevant environmental value is represented by the underlying production plants producing the electricity that is contractually supplied to the end-consumers (e.g. as contractually defined in a power purchase agreement (PPA) and usually represented by GOs).
- **Fund Model:** In such electricity products, the relevant environmental value is represented by a monetary fund, which is filled by an extra fee (usually in ct/kWh) from end-consumers of this specific electricity product. This fund is used in order to support and stipulate further RES investments.
- **Initiation Model:** In electricity models according to the initiation model, the supplier commits to initiating (including project planning, financing and construction) new RES plants in a certain time frame, the production of which might correlate to a specific share of the supply volume of the specific electricity product.

2.3.2 Additionality levels in "RES supply" products by increased RES volumes

Already at the end of the last century before liberalisation of electricity markets in Europe and the first launches of national support systems for RES-E the level of hydro power production in EU27+NO+CH was in the range of 500 TWh per year. This is comparable to the overall electricity consumption of Germany, or to half of the whole industrial consumption in Europe.

14 Strictly speaking, it can be hardly expected that an individual decision has an immediate link to a system change, unless one considers e.g. own investments of a consumer. But also within the market framework of demand and supply, a consumer could expect that the joint demand of him and other interested consumers is focussed on a market sector which is in the position of making a change, rather than distributing these consumers' willingness to pay also to other producers.

15 In some countries further ecological dimensions of additionality are also considered to be relevant, including higher environmental standards for hydro power or the flexible integration of fluctuating wind and PV production. This is reflected by the focus of major green electricity labels like Bra Miljöval in Scandinavia, or Naturemade in Switzerland. In Germany a shift from the focus on "new RES" has been prominently discussed since 2013, e.g. within studies funded by the German Umweltbundesamt (UBA 2014) or by the NGO and labelling organisation EnergieVision (HIC 2013). The reasons for this are that it has not been proven that voluntary markets for RES-E trigger major new investments, and that particularly the comparison to public support schemes shows the low relevance of voluntary demand as compared to public support with respect to the increase of RES volumes.

Calculations by the RE-DISS II project of the European Attribute Mix for 2013 show that of approximately 950 TWh RES-E production in 2013 in Europe[16] some 600 TWh were allocated to end consumers by GOs or comparable mechanisms (RE-DISS II 2014a). This includes the demand by consumers for specific RES products as well as allocation of RES generation for other reasons, e.g. as a result of allocation methods for supported RES-E.

According to the National Renewable Energy Action Plans (NREAPs) of Member States under the RES Directive, this RES-E production is expected to increase to 1.400 TWh in 2020 for EU27+NO+CH+IS (ECN 2011, OED 2013, Eurostat 2012[17]). So with a view to 2020, this target, and the trajectory on how the increase should develop over time can be considered the business-as-usual scenario.

With reference to that forecast, one can therefore define several levels of ambitions of what one would like to achieve in terms of additionality with the individual RES-E supply, and which claim one would like to make about it. The following categories can be applied to standard "RES supply products", where RES-E is supplied to end consumers (usually backed by RES GO from specific plants), and any additionality depends on the characteristics of the supplied electricity:[18]

<u>Absolute additionality:</u>

This is additionality as compared to the business-as-usual (BAU) scenario. This BAU scenario is defined by the European RES targets as set by the RES Directive, which lead to forecasted RES-E production volumes in the range of 1.400 TWh by 2020 (see above). Member States and their governments have to assure that these targets are reached, usually by applying RES-E support schemes. In order to reach "absolute additionality" for voluntary RES-E consumers, one would need to find a mechanism with which RES-E shares in voluntary markets are:

1. not counted to official targets on national levels.

   This would mean that RES-E volumes are actually increased over and above the business-as-usual scenario, which would not have been there without the voluntary demand. This would also require national governments to agree to a mechanism which would allow that such electricity volumes are actually not counted to the national production targets, or more precisely: that the national targets are exceeded by the respective "voluntary" volumes.[19]
   However, in order also to pay the cost for such increase rather than letting other consumers or tax payers pay for it, two further requirements have to be defined that the respective RES-E shares are:

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16 EU28+NO+IS+CH

17 Please note that for Switzerland 2010 data has been used as proxy data for 2020.

18 Note that these definitions do not fully fit to other models for green electricity besides the "RES supply model", like the fund model or the initiation model.

19 One should note that it seems quite unlikely that governments would agree to such a mechanism, as this would mean that national consumers or tax payers would have to subsidise the exploitation of possibly more expensive RES-E potentials in order to reach the national goals. This becomes even more complex taking into account that the voluntary RES-E market is international.

2. produced in newly built production facilities;[20] and
3. not benefitting from existing RES-E support schemes.[21]

When following this approach, a respective RES-E consumer can make the claim that by demanding this RES-E he (together with the other consumers who have the same level of ambitions) does trigger an increase of the overall RES-E volumes over and above what would be there anyway without his specific demand, and that he also bears the extra cost of this additional increase rather than letting others pay the extra cost.

Strong additionality:

This level of additionality would be reached within the defined RES-E targets, while requirements 2 and 3 of the absolute additionality case described above would have to be fulfilled. This means that the RES-E shares are:

- produced in newly built production facilities; and
- not benefitting from existing RES-E support schemes
  (in this case, this requirement should be understood so that the respective RES-E production not only receives no support, but is not even eligible for support).[22]

If these conditions are met can, a respective RES-E consumer can make the claim that by demanding this RES-E he does directly contribute to an increase of RES-E shares as compared to current policy instruments and trajectory (which means that the increase of RES-E production might be achieved already at an earlier stage). Furthermore, he can claim that he bears the additional financial cost of the RES production rather than letting others pay for this.

Basic additionality:

As in the strong additionality case, requirements 2 and 3 of the absolute additionality case would have to be fulfilled, meaning that the respective RES-E shares are:

- produced in newly built production facilities; and
- not benefitting from existing RES-E support schemes
  (in this case, this requirement means that a buyout of RES-E from existing support schemes can take place).[23]

[20] Buying out old RES-E would mean that the actual cost of additionality is just allocated to others and can therefore hardly be claimed by the one who is buying the old RES-E.

[21] Buying RES-E for which most of the extra cost of additionality has been paid by others in the form of public support schemes means that this additionality can hardly be claimed by the one who is buying the RES.

[22] This holds true with the exception of quota support schemes, in which a "non-participation" of RES production volumes automatically leads to additional production volumes.

[23] Such buyout means that the respective RES-E would be eligible for support under the respective support system, but does not make use of it and rather sells the unsupported RES-E in voluntary green markets. This applies for all different support schemes, including quota systems.

When following this approach, a respective RES-E consumer can not claim that (at least in the case of feed-in or market premium support schemes) he or she would directly contribute to a faster or stronger increase of RES production compared to the effects of current policy instruments and trajectory. But in any case, this RES-E consumer can claim (together with the other consumers who have the same level of ambitions) to bear the financial cost of the additional RES production rather than letting others pay for it. While one can argue that this is “zero additionality” in terms of additional RES-E produced (and therefore question the value of such approach), one could also say that the RES-E consumer in this case is at least actively contributing to the solution rather than being part of the problem (and therefore appreciate this approach).

The concepts for additionality which have been described under the terminology of *absolute additionality*, *strong additionality* and *basic additionality* aim to establish a green electricity market segment which focuses on direct pressure for increased RES-E volumes. An alternative concept is promoted based on the argument that by simply increasing demand for RES-E to the level of already available RES-E volumes, a pressure for increasing RES-E production volumes can be created in the medium to long term. GO markets have increased in recent years. Statistics provided by the Association of Issuing Bodies (AIB) show that within the EECS system RES-GOs representing some 246 TWh have been cancelled and therefore used in 2013 (AIB 2014a) as compared to a total annual RES-E production in the range of 950 TWh.[24] Although such GO markets in principle can generate extra income for electricity producers, this extra income is currently too uncertain and marginal in comparison with other income to influence the decisions of investors in renewable energy.[25]

When following this straightforward approach of simple increased demand for RES-E, which in itself does not take any explicit additionality aspects into account, different levels of additionality can be defined according to the system established above.

<u>Zero additionality:</u>

This level of (non-)additionality exists if old RES-E is being marketed, which is generally viable in the market, and thus it is considered that it would have been produced and consumed anyway, and does not need specific demand for RES-E. In the current European framework, this is particularly the case for old RES-E installations, the investment costs of which have been amortised and can produce RES-E at very low marginal costs. Given that support systems do fully cover the additional cost of RES-E production over and above the market price of electricity, the same applies to supported RES-E, irrespective of the age or technology of the plant.

However, if the volume of specific demand for such RES-E reaches and exceeds the available RES-E volumes of existing capacities, and willingness to pay by end consumers reaches a relevant level as compared to necessary level of support and electricity price (see

[24] RES-E production 2013 in EU28+CH+IS+NO according to RE-DISS II residual mix calculations, based on ENTSO-E production statistics.

[25] However, as is discussed in Raadal et al. (2012) it has also been argued that in the long term voluntary markets for GOs might have an influence on the production volumes of RES-E.

above), the underlying strategy of marketing “any RES” would lead to *additionality by overshooting demand* (see below).

> Additionality by overshooting demand:
>
> This additionality level is reached if the explicit demand for RES-E is at least in the range of existing RES-E production volumes, so that markets are getting short and prices for RES-E increase, which would stimulate new investments by producers who see additional marketing and income opportunities. This depends of course on the willingness of consumers to pay significantly higher prices for RES-E at this stage. In this case it would also be necessary to separate market segments (low-cost production vs. higher cost production). Otherwise, if the higher price levels are paid to all RES-E generation, it would result in high producer rents and significantly larger distributional effects from consumers to suppliers than under today’s quite targeted support mechanisms.[26]
>
> As a consequence, this situation would correspond to either the basic or the strong additionality level.
>
> It is quite evident that in order to gain additionality effects according to the “additionality by overshooting demand” level, it is important to minimise double counting in markets. Otherwise, specific demand cannot result in shortage of RES markets and subsequent specific support for RES.

Some stakeholders distinguish different levels of additionality according to the question whether an “*individual claim*” can be made or whether a “*collective claim*” can be made. In reality, it will always be hard to prove that the individual purchase decision of a RES-E consumer directly triggered the additional production of the same volume of RES-E and a replacement of the respective volume of conventional power. From a theoretical point of view, this would be the ideal scenario in order to make an individual claim. Still, it is obvious that the first proposed levels of additionality narrow down the availability of eligible RES-E volumes, so that additional demand has to lead to new RES-E capacities pretty soon.[27] Thus, there exists at least a relatively close link between additional demand and additional production, and the individual claims of RES-E consumers as described for *absolute additionality*, *strong additionality* and *basic additionality* could be understood as approximation under this convention.

In the described approach of *additionality by overshooting demand* a collective claim by all RES-E consumers would apply once the total demand of RES-E by end-consumers reaches the level of available volumes of RES-E production, and the average willingness to pay by consumers increases to a level which is sufficient in order to provide substantial incentives for investing in new RES-E plants. It is worth mentioning that there are alternative proposals on how the volume of available RES-E GO can reduced in European RES-E markets in order

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[26] As most of the given examples in this chapter refer to Norway and the Elcert system, it should be added for this example that only plants with a construction start date after 7 September 2009 are eligible under the Elcert support system. This means that the financial support is effectively focussed on these new installations.

[27] Of course this is depending also on the applied definition of „new“ plants, as the eligible age restriction is directly determining how limited the available RES-E volumes are, and therefore how direct an additional demand creates pressure for new capacities.

to induce the situation where demand exceeds the available volumes already at a comparably early stage which do not focus on modifications of the voluntary market itself, but which address the regulatory framework for RES-E markets. This is described under chapter 2.3.6.

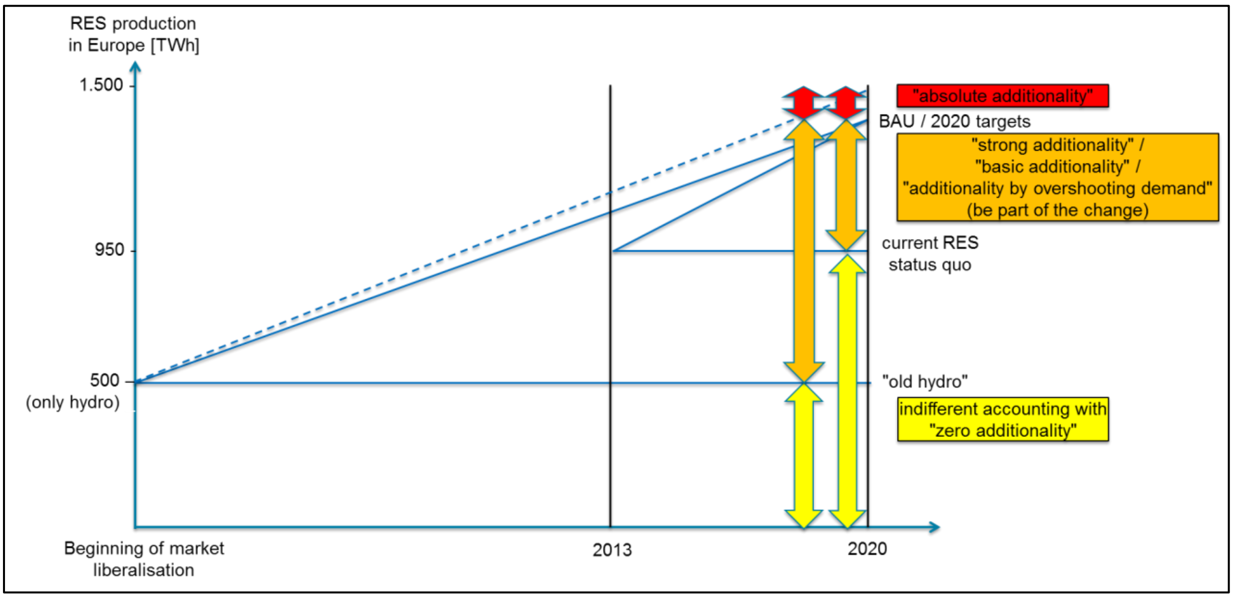
2.3.3 Comparative analysis of additionality in "RES-supply" products

Figure 2 illustrates the ratio between existing RES-E production volumes in Europe and those envisaged for 2020 according to the national RES targets as defined by the RES Directive and further specified by NREAPs. Trajectories are only indicative and not adjusted to interim values as given by NREAPs.

Figure 2 also illustrates the ratio of RES-E volumes which correspond to the different additionality levels described in Chapter 2.3.2. It therefore differentiates between the status at the beginning of the market liberalisation (2000) and today (2013) as the "status quo" reference.

The shown share of "absolute additionality" should be understood as qualitative illustration. The size of this share strongly depends on the possible change of legal accounting procedures (by allowing for a voluntary buy-out of RES-E volumes from target accounting, which is not known to be possible in any EU Member State for the time being), and also on the willingness of voluntary consumers to pay the full cost of this RES-E.

Figure 2: Illustration of the ratio between existing and envisaged 2020 RES-E production volumes in Europe, and the ratio of RES-E volumes which correspond to the different additionality levels (differentiating between whether the status of 2000 or 2013 is considered the "status quo" reference).



Additionality by overshooting demand will only be reached when a RES volume of between 500 TWh (hydro production at the beginning of market liberalization, equalling about half of current industrial electricity consumption in Europe) and 950 TWh (existing RES production in 2013) is explicitly requested by voluntary markets, depending on what is considered the status quo of electricity production. Taking the explicit allocation of supported electricity in some European countries into account, one could also argue that this upper limit is actually reduced by approximately 180 TWh (Grexel 2015), resulting in a RES-E volume of approximately 770 TWh which is available to markets. However, on a trajectory to reach European 2020 RES targets, this relates to 1/3 to 2/3 of the total envisaged RE-E production volumes in 2020, which have to be bought by consumers before additional production volumes can be stimulated. This market share corresponds to the amount of windfall profits of the operators and marketers of existing RES production capacities.

Clearly, with a view on long-term development also after 2020 and expected further increase of RES volumes, the share of RES volumes which can be considered "additional" increases compared to the volumes of "zero additionality" (at least when the beginning of market liberalisation is considered as starting point). In other words, the relative relevance of "old hydro" will decrease with time.

2.3.4 Additionality in products according to the "fund model" and the "initiation model"

The "RES supply model" as a green electricity product, to which the different additionality levels described above refer, is the most relevant with respect to supply volume of end consumers. But it is worth highlighting that there are further models for green electricity products to which this classification of additionality does not directly fit. In particular this includes the *fund model* and the *initiation model*.

The *fund model* aims at generating additionality by providing extra funding to "third" plants, separate from the electricity which is contractually provided to end consumers. In an ideal case, such extra funding is only provided to plants for which reference income (including public support) does not fully cover the generation cost, so that the funding can be used as a lever in order to bring these plants into operation. The *initiation model* follows the logic that the supplier commits to "initiate" within short time a sufficiently high amount of new RES-E production (e.g. start of operation of a new RES plant within 5 years which produces 75% of the electricity volume used by the consumers of the green product). Initiated plants in this case might still receive public support. This approach takes into account that funding is not the only barrier to increase of RES, but that tackling administrational or communicational barriers in combination with a very high RES-E installation rate can be considered "additional" as well, even if the financial burden is borne by public support schemes. This approach builds on different mechanisms to work in parallel in order to increase the RES generation.

In such models, additionality is obviously not reached by special characteristics of the supplied electricity or GOs. Therefore, the key challenge is not double counting of production volumes of supplied electricity or GOs, but verification of the further effects (support by funds and initiation). If such models are taken into account in carbon accounting, it would probably have to be done in an approach that considers the respective activities as “offset projects”, which compensate for emissions from own core activities (including consumption of electricity) that are taken into account when setting up the carbon balance at first hand.

2.3.5 Relevance of Emission Trading Schemes

When discussing the carbon accounting of electricity supply (often referred to as “Scope 2 emissions” based on the terminology of the Greenhouse Gas Protocol (WRI/WBCSD 2004)), not only the effects in terms of RES development should be taken into account, but also the interaction with carbon markets as established in emission trading schemes (ETS).

Taking into account that all European electricity production is covered by a carbon cap on the European level, which decreases over time, one could argue that the relevant reference for additionality should be this cap. As a conclusion, additionality could only be reached if green electricity is linked to cancellation of emission allowances (EUA) without corresponding emissions. However, an ETS can be considered a very unspecific and “overarching” policy instrument, and should be considered one element of a more diverse policy mix in order to reach sustainable electricity consumption. Also, the current situation on carbon markets shows that the level of available emission allowances is much higher than the actual demand, resulting in marginal CO_2 prices of 3-4 EUR/t, which probably does not reflect much more than just the transaction cost of carbon trading itself. Some experts expect that the over-allocation of emission allowances will persist even after 2020, unless a major revision of the ETS scheme is implemented. In such a situation, cancellations of EUA would only have an effect similar to the “zero additionality” as described above. These arguments support the position that it would be justified from a policy maker’s point of view to support the instrument of voluntary carbon accounting of companies as one element of the diverse policy mix, which can be considered independently from the ETS.

However, there is one relevant aspect of interaction between voluntary carbon accounting of electricity consumption and of ETS systems. In order to reduce its calculated carbon footprint (and thus enabling it to make a “carbon neutral” marketing claim), a consumer can offset remaining emissions, for which certificates like EUAs, but also Verified Emission Reductions (VERs) or Certified Emission Reductions (CERs) can be used. In accordance with the GHG Protocol, offset products (and related avoided emissions) have to be reported separately from the carbon accounting, as these are mechanisms which compensate for calculated corporate GHG emissions.

With the vision to be carbon neutral, this option for compensation determines a buy-out price for RES-E supply cost, efficiency or any other measures for emissions reduction.

2.3.6 Excursus: A regulatory approach to reach additionality in RES-E markets by limiting RES-E oversupply

Support systems for RES-E in Europe apply different approaches for allocation of the supported RES-E volumes to voluntary markets. In some countries like e.g. Norway, Sweden or the Netherlands a producer of RES-E can receive public support (by receiving quota certificates or a market premium), and in parallel can receive a GO which allows him to sell the supported electricity on the voluntary market for renewable energy. In some other countries, this is not possible. In Germany, for example, the disclosure attributes of supported RES-E volumes are allocated to end-consumers, which are financing the support mechanism, according to the financial contribution of each group of consumers to the support mechanism. This means that the respective volumes are not eligible for GO issuance and therefore not available to voluntary markets. Such a mechanism has the following effects:

- the overall volume of available RES-E attributes for voluntary demand is reduced;
- this exclusion from voluntary markets would only affect supported electricity which (as a first approximation) does not need additional funding in order to be economically viable and therefore does not need additional funding in order to be produced;
- the consumers' willingness to pay is focussed on those plants which have to compete on voluntary markets (or which voluntarily opt out of support systems in order to compete on voluntary markets without public support);
- an further growth of voluntary demand by end-consumers will lead to an earlier break-even with RES-E volumes which are available for the voluntary market as compared to the current regulatory framework;

In an analysis of the European RES-E Market and the volumes which are covered by RES-E support systems in Europe, Grexel (2015) illustrates a scenario where all supported RES-E volumes in Europe would not be eligible for GOs. Grexel comes to the conclusion that such a mechanism would have limited the available RES-E volumes to a range of approximately 550 TWh in 2014, which is only slightly more than the volumes of RES-E GOs cancelled in this year.[28] These results suggest that a scenario of "additionality by overshooting demand" would be already within reach if such regulatory changes would apply throughout Europe. Market players like RECS International have stressed the benefit that under such framework conditions RES-E markets could focus on the existing GO system and would not have to apply rather complex additionality criteria. They also have pointed out that this approach would remain the non-subjective, auditable claim as the basis for carbon accounting. Still, there are also some restrictions to this positive assessment:

- Not all cancellation of GOs is due to explicit demand by end-consumers, but takes also place as plain allocation of existing attributes. This means that the volume of GO cancellation to some extent overestimates the level of active demand for RES-E by end consumers.
- Additionality by overshooting demand only becomes possible once the willingness to pay by end-consumers reaches a level which is sufficient to stimulate new investments in RES-E production plants. This would require a significant increase as compared to today's level.
- While the described approach effectively excludes supported electricity, which presumably is not depending on the (limited) extra income from GO markets, it does not favour new plants over existing capacities, which presumably are not depending on an extra income from GO markets neither.
- A significant price increase, which would be necessary for stimulating larger-scale investments driven by the voluntary market, could lead to significant windfall profits for existing production like old hydro in the voluntary market. This limits the efficiency of the approach of overshooting demand.

[28] This volume of RES-E GOs includes both cancellation of EECS GOs and of national GOs outside the EECS system.

In the end, a general exclusion of issuing GO to supported RES-E generation across Europe would definitely change the framework for RES-E markets and would modify the need for additionality concepts. However, such regulatory changes are in the hands of governments and regulatory authorities, but not in the hands of producers, consumers or other market players. Therefore, the further analysis in this discussion paper will be based on the current framework conditions.

3 Overview of different accounting approaches

3.1 Established calculation principles for carbon accounting: attributional vs. consequential approach

Most procedure descriptions and standards describe carbon accounting as a methodology based on the attributional modelling approach, which is defined according to the life cycle analysis (LCA) methodology (ISO 14044 2006, European Commission 2010). In addition to the attributional approach, the LCA methodology also defines the consequential approach. These two approaches are described as "the account of the history of the product" (attributional) and "the consequences of possible changes between two alternative products" (consequential) (ISO 14044 2006). The principal difference between the attributional and consequential approach is that while the attributional approach displays an existing situation, the consequential approach analyses the way in which a situation changes as the result of a decision. In other words: the attributional approach is modelled under ceteris paribus – "other things being equal" – conditions, while the consequential approach is modelled under the conditions of mutatis mutandis - "the necessary changes being made" (Frischknecht & Stucki 2010). In accordance with the ILCD Handbook (European Commission 2010) the attributional LCA modelling approach is applied for reporting/accounting, such as carbon accounting. When environmental reporting is defined as having an attributional approach, the data is usually based on physical and/or financial/contractual relations, independent of which instruments are "responsible" for producing the product (or building the power plants). However, the use of average or generic data can also be applicable under the attributional approach.

This approach is also adopted by the GHG Protocol (WRI/WBCSD 2004) for carbon accounting purposes, while the consequential approach is used for the GHG Protocol's project-level accounting, such as offset (or avoided emissions) accounting. A company's carbon accounting shows the emissions related to a company's activity, which means the sum of the GHG emissions related to the different activities and purchases made by the company. Thus, the claimed attributes do not represent avoided atmospheric emissions. It is therefore important to make a clear distinction between corporate GHG emissions according to the GHG Protocol and avoided atmospheric emissions, e.g in terms of offset products.

3.2 Relevant parameters for defining a carbon accounting methodology

There are different methodological approaches for calculating the carbon emissions which shall reflect the electricity consumption of a (commercial) end consumer in his or her carbon footprint, or in the carbon footprint of a product or a service respectively. The amount of these emissions depends on the volume of electricity which is used and on the emission factor which is related to this electricity consumption. Of course it can be difficult to determine the specific amount of used electricity in individual cases, e.g. when having co-production of various goods and products where one has to decide how much of the consumed electricity is assigned to the production of the individual products. But usually, and particularly in the case of a company's carbon footprint, this is the easy part.

The more difficult question is the definition of the carbon emission factor which has to be applied to it.

In order to determine this emission factor, several methodological questions have to be decided upon. In principle, the following questions have to be addressed:

- Definition of input data: Which type of information is relevant to be considered?
- Documentation and verification of data: when is data considered to be reliable?
- Processing of data and communication: How shall input data be processed, and how shall results be communicated internally and externally?

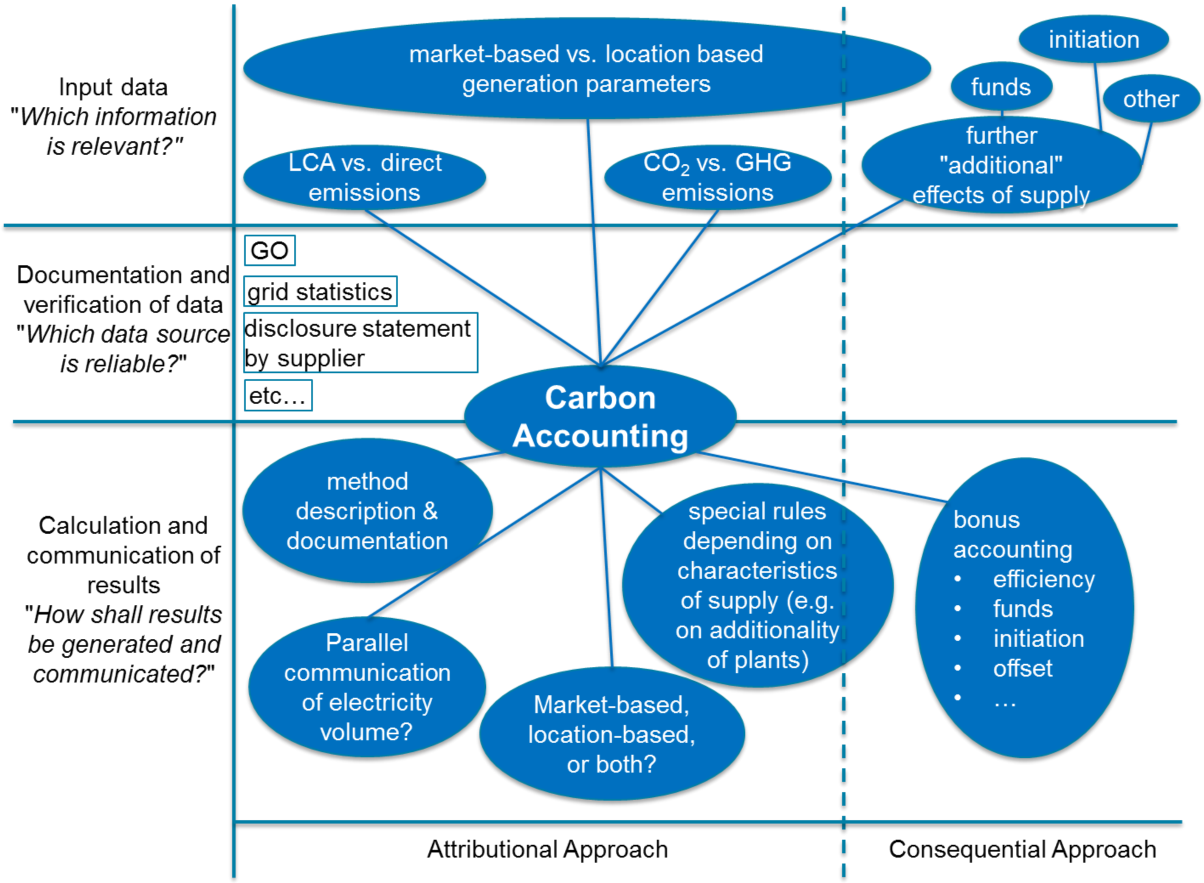
The major decision with respect to the type of input data is the choice between the market-based method and the location-based method for defining which mix of energy sources and production technologies is to be considered for my electricity supply, and does therefore determine my emission factor (for a qualitative sensitivity analysis, see also Chapter 4). In other words, the question would be whether the individual choice of supplied electricity in a liberalised electricity market should influence the emission factor for my own carbon accounting, or whether this emission factor should only depend on the location of my consumption, and therefore correspond to the overall average emissions in the respective electricity system? On an international level, this has also been discussed and analysed recently within the development process for the GHG Protocol Scope 2 Guidance (WRI/WBCSD 2014). However, besides this quite fundamental decision, further details of the methodology also have to be decided upon. This includes the question of whether only direct emissions of electricity production should be considered, or whether more comprehensive emission data based on a life-cycle analysis (LCA) shall be taken into account. Furthermore, one should decide whether only CO_2 emissions are to be taken into account, or whether emissions of all various types of greenhouse gases should be taken into account. This can also include information on additional effects of a specific supply, e.g. when being supplied with a green “fund” model.

With respect to verification methods and documentation, one has to decide not only which type of information would be relevant, but define, for example, how this information should be provided in order to assure sufficient accuracy and transparency. This could therefore include reference to specific grid statistics, to the electricity disclosure which has to be provided by European electricity suppliers to all their end consumers or make further references, e.g. specifically to the use of GO (either by the electricity supplier or directly by the end consumer).

In the end, it is also necessary to define how the input data as documented by the chosen data sources and accounting means has to be processed and communicated to the relevant target audience. With respect to data processing, this might mean that specific emission factors have to be used for different types of production (e.g. if being considered “additional”, see Chapter 4.2.4 , or how final results shall be displayed).

Figure 3 gives an overview of relevant elements of a carbon accounting methodology.

Figure 3: Different relevant elements which have to be defined as part of a carbon accounting methodology.



The following Chapter 3.3 provides an overview of how the different aspects are currently addressed by different existing standards, guidelines and methodology descriptions for carbon accounting of corporate and product footprints.

Chapter 4 aims to analyse the effects which the choice of methodology has on the results and therefore not only on the meaning and significance of the carbon balance, but also on its influence on decisions from the accounting company, which aims at reducing its calculatory carbon footprint.

3.3 Overview of existing guidelines and standards

3.3.1 Introduction

There are various methodology descriptions available which provide guidance for preparing the carbon footprint of organisations, products, services, local authorities or individual projects. This includes national and international formal standards, voluntary guidelines, or methodology papers which have to be applied in the framework of specific accounting programmes. Within the last years, the RES-E markets community has followed very closely the recent development of the GHG Protocol Scope 2 Guidance (WRI/WBCSD 2015). Following a four years development and consultation phase, including stakeholder involvement on a global level, this guidance document has finally been published early 2015. This document as an amendment to the GHG Protocol corporate standard describes a methodology for taking electricity (i.e. scope 2) emissions into account when calculating and reporting GHG emissions of organisations, i.e. on a corporate level. This chapter provides an overview of how the different methodological aspects described in Chapter 3.1 are currently addressed by the GHG Protocol Scope 2 Guidance on the one hand, but also within the different other existing standards, guidelines and methodology descriptions for corporate and product carbon footprints. The selection of methodology descriptions is not exhaustive, but should rather cover on the one hand the most relevant ones and on the other hand also provide an idea of the variety of possible methodologies. Some approaches are also included which try to take the aspect of additionality into account (ifeu et al. 2009, IZES 2014, UBA 2013).

3.3.2 GHG Protocol Scope 2 Guidance

- Title: GHG Protocol Scope 2 Guidance – A supplement to the GHG Protocol Corporate Standard, January 2015
- Publishing organisation: World Business Council for Sustainable Development (WBCSD), World Resources Institute (WRI)
- Application field: Corporate Carbon Footprint
- Status and relevance: Voluntary standard with broad global impact, being developed based on four-year stakeholder consultation process

Table 2: Methodology overview for carbon accounting of electricity consumption according to GHG Protocol Scope 2 Guidance (WRI/WBCSD 2015)

Input data	• For scope 2: only direct emissions[29] • No clear requirement on which gases have to be covered; this rather should depend on the available input data set (so this could e.g. include CO_2, CH_4 and N_2O, or also CO_2 only)[30] • Production mix and corresponding emissions both for grid mix and for supplier/product specific mix[31]; within the document this is referred to as location-based method and as market-based method
Documentation and verification	• For location based-method: statistics as available; advanced grid studies which would link emissions with the time-of-day usage and local demand patterns are considered as ideal case, [32] • For market-based method: A data hierarchy is defined depending on “quality criteria” for this data and on the availability[33] o Electricity attribute certificates (bundled/unbundled), like GO for European framework

[29] According to the GHG Protocol structure, further emissions as associated with the processing of upstream fuels, with transmission or distribution of electricity with the grid are tracked in scope 3 (see WRI/WBCSD 2015, 5.3, p. 34). Whether such emissions are therefore covered by a carbon balance according to the GHG depends on whether the respective organisation conducts a scope 3 assessment at all, or only includes scopes 1 and 2 in its carbon footprint.

[30] See WRI/WBCSD 2015, p. 49

[31] See footnote 35.

[32] See WRI/WBCSD 2015, p. 30 and 53

[33] See WRI/WBCSD 2015, p. 48

	o Contracts such as power purchase agreements (PPAs) for electricity which explicitly include the GHG emission rate attribute o Supplier/Utility emission rates as disclosed in an electricity disclosure statement o Residual Mix (to be used where no specific electricity purchase is made)[34] o Other grid-average emission factors (i.e. location-based data) • The quality criteria include[35] o Conveying GHG emission rate claims o Unique claims o Retirement/cancellation o Vintage o Market boundaries o Residual Mix
Processing and communication	• “Dual reporting”: calculation and reporting of results both according to the location-based and the market-based method[36]; However, for companies adding together scope 1 and scope 2 for a final inventory total, companies may also limit their reporting to one of both methods. • All emissions should be reported in metric tons of each GHG (where available) and in metric tons of CO_2eq[37] • Description/information[38] e.g. on o company and inventory boundary o Methodology, incl. category of instruments from which emission factors were derived, where possible specifying the energy generation technologies o Reference to an internal or external third-party assurance process or assurance of conformance provided by a certification programme, supplier label, green power programme etc. o Information on the lack of a residual mix which might lead to double counting between electricity consumers o Base-year information, including information on the respective method chosen for calculating this year’s emissions o Methodology which has been applied for goal setting of the organisation

34 Here WRI/WBCSD 2015 refers to the Residual Mix as calculated by the RE-DISS project in Europe. However, for the European framework all end-consumers of electricity should receive disclosure information for their supplier/product mix, so that in no case the Residual Mix would be applied according to the proposed “hierarchy”, unless a supplier directly applies the Residual Mix as his applicable mix (which can be the case e.g. in the Norwegian regulatory framework); the same applies also for next level (other grid average emission factors).

35 See WRI/WBCSD 2015, Table 7.1, p. 60

36 See WRI/WBCSD 2015, p. 59f, 62. This principle of dual reporting does only apply for reporting of the scope 2 emissions.

37 See WRI/WBCSD (2015), p. 49.

38 See WRI/WBCSD (2015), p. 61f.

	• Further recommended or optional description/information[39] e.g. on
	  ○ Volume of reported electricity
	  ○ Biogenic CO_2 emissions from electricity use
	  ○ Other instrument retirement, including retirement required by regulatory policy
	  ○ Methodology for calculating upstream (scope 3) emissions
	  ○ Background information on electricity product features and market context
	  ○ Role of corporate procurement in driving new low-carbon projects in a narrative disclosure
	• Optional information, e.g.[40]
	  ○ Scope 2 totals disaggregated by country
	  ○ Avoided emissions estimation
	  ○ Scope 2 results calculated by other methods.

3.3.3 Other guidelines and standards

3.3.3.1 ISO 14040/14044[41]

- Title: Environmental management – Life cycle assessment – Principles and framework (ISO 14040:2006); Environmental management – Life cycle assessment – Requirements and guidelines (ISO 14044:2006)
- Publishing organisation: International Organization for Standardization (ISO)
- Application field: Environmental Management – Life cycle assessments; Climate change (as measured based on “Amount of GHG per functional unit”) is one out of several possibly relevant Impact Categories in Environmental management LCA[42]
- Status and relevance: Official and general ISO Standard for conduction of Environmental Management – Life cycle assessments

Table 3: Methodology overview for carbon accounting of electricity consumption according to ISO 14040 (2006) and ISO 14044 (2006)

Input data	• Electricity mix, efficiencies of fuel combustion, conversion, transmission and distribution losses[43] ○ This means that a LCA approach is required • Representative grid mix or a specific “site energy supply” mix shall be used, but no specification on clear preference. • Different GHG emissions (not only CO_2)[44]

39 See WRI/WBCSD (2015), p. 60f; it should be noted that the last draft of the guidance document recommended to report on the relation to compliance quotas (e.g. “above and beyond compliance quotas”, “Combined with a retired compliance instrument”, or “not surplus to compliance instruments.”). This is now included in the final guidance document without the explicit request to compare the voluntary claim with the mandatory requirement.

40 See WRI/WBCSD (2015), p. 61

41 Note that the text of these ISO Standards has been approved by CEN as EN ISO standards without any modifications.

42 ISO 14044 (2006), Chapter 4.42, Table 1.

43 ISO 14044 (2006), Chapter 4.3.3.1.

44 This is implied by consideration of emissions of CO_2-equivalents for different greenhouse gases, see e.g. ISO 14044 (2006), Table 1.

Documentation and verification	• No clear electricity-specific specifications
Processing and communication	• Category indicator result is mass of CO_2eq per functional unit[45] • No further electricity-specific specifications

3.3.3.2 ISO 14064-1

- Title: ISO 14064-1:2006: Greenhouse gases – Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals
- Publishing organisation: International Organization for Standardization (ISO)
- Application field: Quantification and reporting of greenhouse gas emissions on corporate level
- Status and relevance: Official ISO Standard for conduction of greenhouse gas inventories on corporate level

Table 4: Methodology overview for carbon accounting of electricity consumption according to ISO 14064-1 (ISO 14064-1 (2006))

Input data	• GHG emissions from the generation of imported (i.e. not self-produced) electricity[46] ○ i.e. not only CO_2 but also other GHG gases. • No specifications on whether LCA or only direct emissions shall be used for electricity supply. • No specifications on whether grid mix or a specific mix shall be used.
Documentation and verification	• No clear electricity-specific specifications
Processing and communication	• No clear electricity-specific specifications

3.3.3.3 ISO/TS 14067:2013

- Title: ISO/TS 14067:2013(E): Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification and communication
- Publishing organisation: International Organization for Standardization (ISO)
- Application field: Quantification and communication of product carbon footprints
- Status and relevance: ISO Technical Specifications, which are not binding to CEN or also national standardisation organisations (in contrast to ISO Standards)

[45] ISO 14044 (2006), Table 1.

[46] ISO 14064 -1, Chapter 4.2.3 referring to “Energy indirect GHG emissions”; please note that the term “indirect” obviously is used in order to differentiate between own production and purchased electricity, and not between LCA emissions and direct emissions at the place of combustion.

Table 5: Methodology overview for carbon accounting of electricity consumption according to ISO/TS 14067 (ISO 14067 (2013))

Input data	• GHG emissions rather than only CO_2 emissions[47] • LCA data shall be used rather than only direct emissions[48] • When supplier can deliver LCA data and exclude double counting of electricity attributes and associated GHG emissions, product specific LCA data shall be used; otherwise national or grid average LCA data shall be used. [49]
Documentation and verification	• Possibly documentation as provided by supplier (in case double counting can be excluded) • No further clear electricity-specific specifications
Processing and communication	• The treatment of electricity shall be documented in the carbon footprint (CFP) study report[50] • No further electricity-specific specifications

3.3.3.4 PAS 2050

- Title: PAS 2050:2008 – Specification for the assessment of the life cycle greenhouse gas emissions of goods and services
- Publishing organisation: British Standards Institution (BSI)
- Application field: Product and Service Carbon Footprint
- Status and relevance: British Standard

Table 6: Methodology overview for carbon accounting of electricity consumption according to the PAS 2050 (BSI 2008)

Input data	• LCA data[51] • GHG rather than only CO_2[52] • Assessment of emissions shall follow the attributional approach, unless otherwise indicated.[53] • In cases where the production source is part of a larger energy transmission system, data for that system should be generally used (example: national average electricity supply emission factor).[54] • Specifically for supply with RES-E, product specific emissions can be claimed if double counting with any other reporting (incl. national reporting) can be excluded.[55]

[47] ISO 14067, Chapter 6.4.9.3.

[48] ISO 14067, Chapter 6.4.9.3.

[49] ISO 14067, Chapter 6.4.9.3.

[50] ISO 14067, Chapters 6.4.9.3, 7.

[51] See BSI (2008), Chapters 6.4.2, 7.9.3.2.

[52] See BSI (2008), Chapter 5.1.

[53] See BSI (2008), Chapter 4.1.

[54] See BSI (2008), Chapter 7.9.2.

[55] See BSI (2008), Chapter 7.9.3.1.

Documentation and verification	• Possibly documentation as provided by supplier (in case double counting can be excluded) • No further clear electricity-specific specifications

Processing and communication	• Mass of CO_2eq to be reported per functional unit
	    ○ for business-to-consumer: both the GHG emissions from total product life-cycle and from use-phase only
	    ○ for business-to-business: upstream GHG emissions until point of delivery to the new organisation.

3.3.3.5 UBA Tendering Guidelines for Procurement of Green Electricity

- Title: Beschaffung von Ökostrom – Arbeitshilfe für eine europaweite Ausschreibung der Lieferung von Ökostrom im offenen Verfahren
- Publishing organisation: German Federal Environment Agency (Umweltbundesamt – UBA)
- Application field: Definition of public tenders for green electricity, including a methodology to calculate the environmental advantage of the respective electricity product with respect to GHG emissions
- Status and relevance: Official non-binding guidelines for public tenders; *the relevance for the discussion of this paper is the proposed methodology for calculation of reduction of emissions and the possible application of this method also for calculation of emissions for carbon footprints*

Table 7: Methodology overview for carbon accounting of electricity consumption according to (UBA (2013))

Input data	• Plant-specific data on:
	    ○ Age of the plant
	    ○ Primary energy
	    ○ Production volumes (equaling supply volumes)
	• Fuel-specific factors for reduction of LCA-based GHG emissions according to UBA (2009)[56]
	• LCA-based reference GHG emission factors for fossil production

Documentation and verification	• Several requirements which are probably due to the documents context as tendering guidelines[57]
	• Exclusion of double counting of environmental benefits[58]
	• Calculated GHG reductions due to supply from new plants
	• For old plants, grid average emissions are applied.
	• For new plants, the technology specific GHG reductions are taken into account; plants are considered to be new if being not older than
	    ○ Four years in case of wind, biomass, solar; and
	    ○ Six years in case of hydro and geothermal.

Processing & communication	• Total calculated reduction of GHG emissions as compared to reference emissions

[56] UBA (2013), Chapter 3.8.3.

[57] This includes the necessity of an actual physical delivery (i.e. linked use of RES-GO in the German context), delivery from distinct plants, and others (see UBA (2013), Chapter 3.1).

[58] See UBA (2013), Chapter 3.7.

This methodology could in theory also be used in order to calculate a value for overall "claimed" emissions for the purpose of a carbon footprint:

Claimed emissions = (Reference emissions) – (avoided emissions)

3.3.3.6 Joint discussion paper on green electricity accounting from German research organisations ifeu, Öko-Institut, Wuppertal Institut

- Title: Umweltnutzen von Ökostrom – Vorschlag zur Berücksichtigung in Klimaschutzkonzepten (*Environmental benefit of green electricity – Proposal for consideration in climate protection concepts*) (in German)
- Publishing organisation: ifeu, Öko-Institut e.V., Wuppertal Institut, Ö-Quadrat
- Application field: Proposal has addressed accounting of green electricity for the example of carbon footprints of local authorities, but the approach can also be applied for corporate or product carbon footprints.
- Status and relevance: Discussion paper as proposal for consideration of the actual environmental benefit of specific electricity products in carbon footprints.

Table 8: Methodology overview for carbon accounting of electricity consumption according to ifeu et al. (2009)

Input data	• In principle, LCA based GHG emission factors
	• Product-specific information:
	  o Plant age
	  o Plant or technology/fuel specific emission factor
	• Grid average emission factor (for national production mix; in case of European coordination preferably for European production mix)

Documentation and verification	• Third party verification for specific electricity supply in case of specific accounting.

Processing and communication	• Grid average emission factor as basis for carbon footprint (CFP);
	• Separate communication of CFP result including accounting of a supply-specific emission factor;
	• Calculation of supply-specific emission factor according to plant age:
	  o Age < 6 years:
	  plant (type) specific emission factor
	  o Age 6 years – 12 years:
	  (plant spec. emission factor + grid avg. emission factor) / 2
	  o Age > 12 years:
	  grid average emission factor
	• Communication with error bars recommended (reaching from result for 0 % supply specific claims to 100 % supply specific claims).

3.3.3.7 IZES Project Report "Green Electricity in Carbon Accounting"

- Title: Ökostrom in Klimabilanzen (*Green Electricity in Carbon Accounting*) (German)
- Publishing organisation: IZES – Institut für ZukunftsEnergieSysteme
- Application field: All different types of carbon accounting
- Status and relevance: Proposal for accounting of environmental benefits deriving from green electricity supply in carbon accounting (as result of a research project)

Table 9: Methodology overview for carbon accounting of electricity consumption according to IZES (2014)

Input data	• Average grid emission factor • Amount of CO_2 reductions by supply-specific additionality measures[59]
Documentation and verification	• Grid emission factors: adequate scientific databases or official publications • CO_2 reductions: program-specific verification mechanisms (might include third party verification)
Processing and communication	• Total emissions based on grid average emission factor • Separate communication: total emissions minus supply specific emission reductions

[59] These might include emission reductions as induced by product-related funds or by offsetting measures.

4 Analysis of effects and incentives of specific methodologies in carbon accounting

4.1 The choice between location-based and market-based method in the attributional approach

4.1.1 Dimensions of implications

Chapter 3 shows that there are quite different options to determine an emission factor for the same supply of electricity. One of the major issues is the distinction between the market-based method and the location-based method for defining the emission factor for electricity consumption which shall be used when calculating a carbon footprint. The following two sub-chapters 4.1.2 and 4.1.3 will assess how choosing between these two different methods influences results in different application examples, and which incentives this gives for the respective (commercial) consumer. These incentives will be assessed in the following dimensions:

- Incentives for applying measures for increased efficiency and energy saving in general
- Incentives for choosing a specific electricity product
- Incentives for facility-siting (corresponding to discrepancy between international competitors).

The scenarios as outlined in Table 10 are differentiated for a qualitative analysis.

Table 10: Different supply scenarios which are differentiated for a qualitative analysis of results of carbon footprints as calculated by different accounting methodologies, and the incentives which result for decision makers from these results

Grid mix	Specific supply
High RES share, low CO_2/GHG emission factor	RES consumer
	No RES (e.g. residual mix) → grey consumer
Low RES share, high CO_2/GHG emission factor	RES consumer
	No RES (e.g. residual mix) → grey consumer

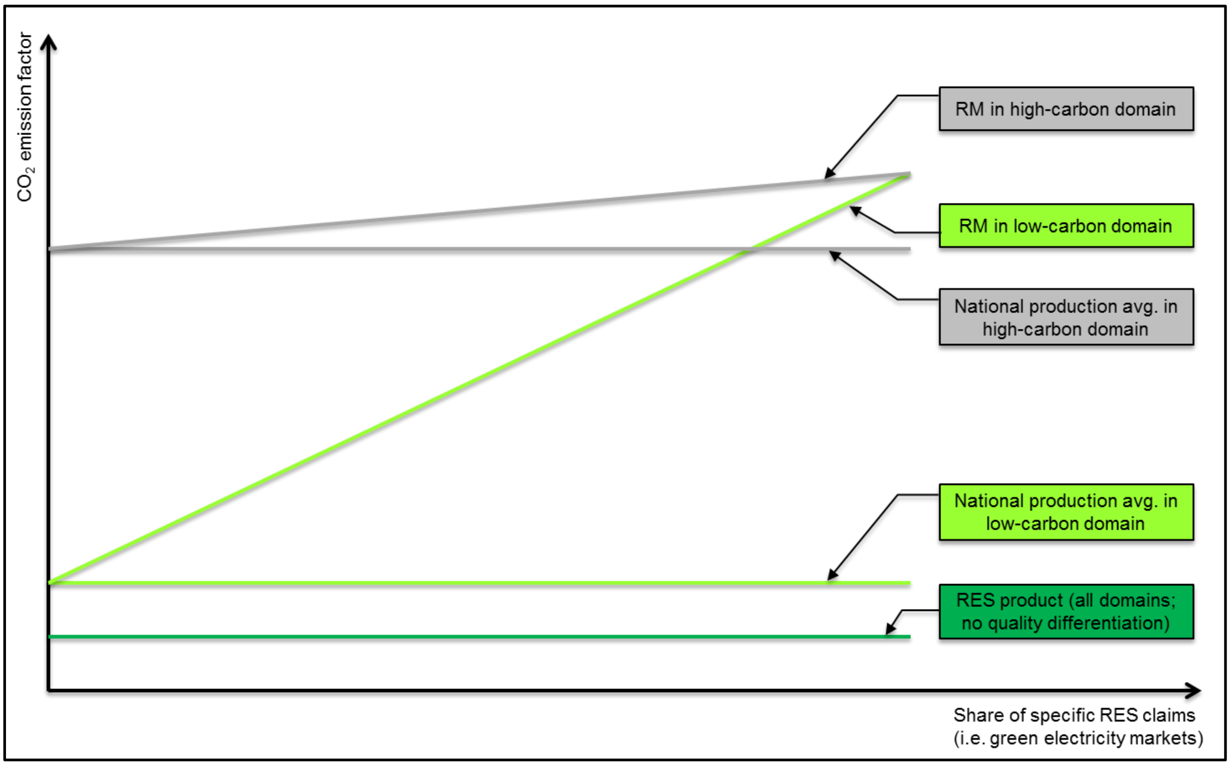
Similarly, WRI/WBCSD (2014) has also made a general assessment of what it has called the “decision making value” of each method.[60] Also IZES (2014) has based its proposal for an accounting methodology on an assessment of the different approaches.

60 WRI/WBCSD (2014), Chapter 7.4

Figure 4 illustrates CO_2 emission factors in different domains and carbon accounting regimes for different consumer types. It shows the different level of emission factors for the national average production mix in a country with a high share of fossil production and in a country with a low share. The emission factor of the national residual mix (i.e. national production mix minus used GOs) rises with increased share of green electricity markets (and thus increased use of RES GOs). In comparison, an emission factor for specific emissions of a RES-E product is shown. This figure will be used as a template for illustrating incentive structures under different carbon accounting methods in Chapters 4.1.2 and 4.1.3.

It shall be stressed that not all of the conclusions are also valid for countries with a high nuclear share, which also has a low CO_2 emission factor.

Figure 4: CO_2 emission factors in different domains and carbon accounting regimes for different consumer types



4.1.2 Location-based method

In the location-based method, the emission factor which has to be used for carbon accounting only depends on the location where the consumption actually takes place. Table 11 provides an overview of the results of carbon footprints according to the *location-based method* in a low-carbon domain (i.e. a domain with a non-carbon-intensive production mix). It furthermore indicates the incentives which result for commercial consumers in terms of:

- specific choice of supply,
- engagement in efficiency and energy saving measures, and
- facility siting decisions (which corresponds to the discrepancy between international competitors).

Table 12 provides this overview for the location-based method correspondingly in a high-carbon domain (i.e. a domain with a carbon-intensive production mix).

Table 11: Overview of results of carbon footprints according to the *location-based method* in a low-carbon domain, and of the resulting incentives in terms of 1) specific choice of supply, 2) engagement in efficiency and energy saving measures and 3) in facility siting decisions (which corresponds to the discrepancy between international competitors)

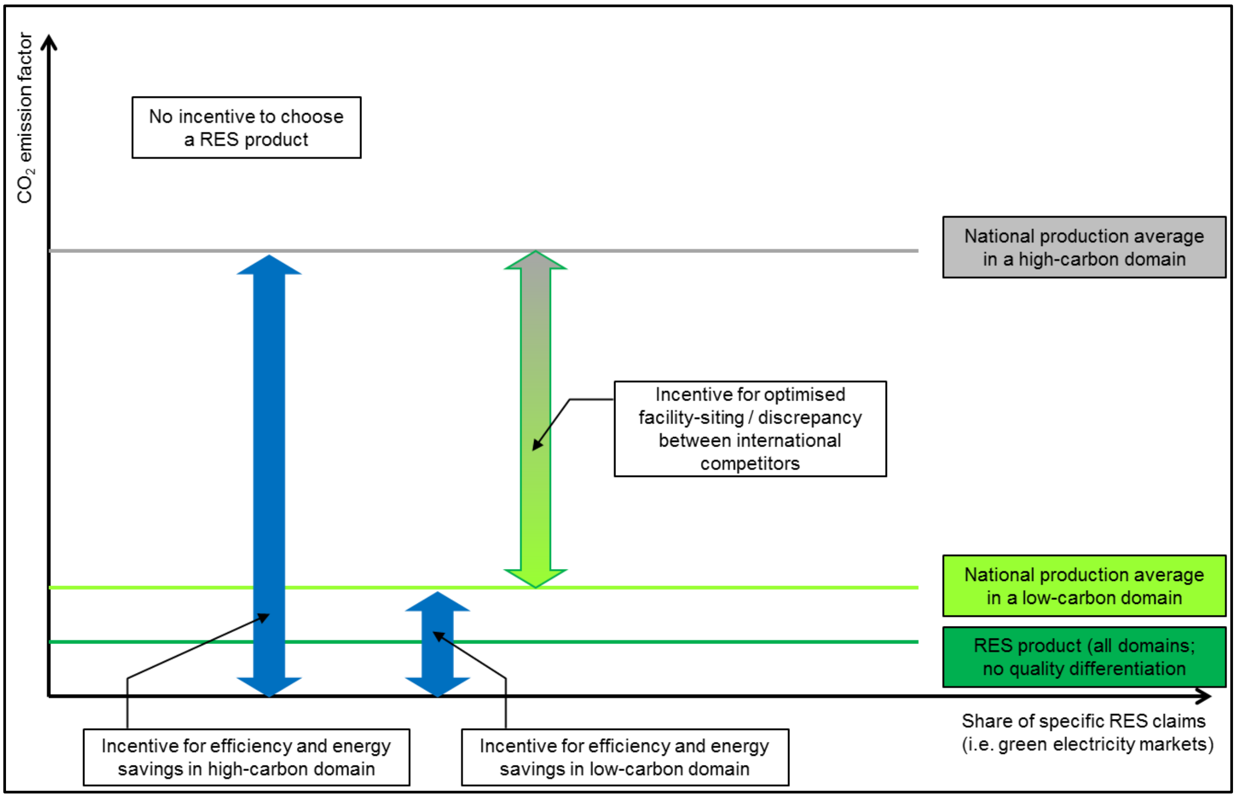
Location-based method Low-carbon domain		
Carbon footprint results		*RES-E consumer*: low emission factor (but no advantage compared to grey consumer) *Grey consumer*: low emission factor (no disadvantage compared to RES-E consumer)
Incentives for…	**Choice of supply**	*Specific RES-E supply*: no incentive *Specific RES-E supply with additionality*: no incentive
	Efficiency and savings	Increased efficiency/savings is the only option to improve carbon footprint, but still incentive is low due to low average emission factor
	Facility siting (international competition)	Incentive to stay in the respective area; Advantage compared to international competitors

Table 12: Overview of results of carbon footprints according to the *location-based method* in a high-carbon domain, and of the resulting incentives in terms of 1) specific choice of supply, 2) engagement in efficiency and energy saving measures and 3) in facility siting decisions (which corresponds to the discrepancy between international competitors)

Location-based method High-carbon domain		
Carbon footprint results		*RES-E consumer*: high emission factor (no advantage compared to grey consumer) *Grey consumer*: high emission factor (but no disadvantage compared to RES-E consumer)
Incentives for…	**Choice of supply**	*Specific RES-E supply*: no incentive *Specific RES-E supply with additionality*: no incentive
	Efficiency and savings	Increased efficiency/savings is the only option for improving carbon footprint, and this incentive is high due to the high emission factor
	Facility siting (international competition)	Incentive to move to less carbon-intensive areas; Disadvantage compared to international competitors

Figure 5 displays these incentives as resulting from the location-based method both for low-carbon and for high-carbon domains.

Figure 5: Overview of incentive structures for commercial consumers due to carbon accounting according to the *location-based method* both for a low-carbon and for a high-carbon domain



4.1.3 Market-based method

In the market-based method, the emission factor which has to be used for carbon accounting depends on the consumer's individual choice of electricity supply. Table 13 provides an overview of the results of carbon footprints according to the *market-based method* in a low-carbon domain. It furthermore indicates the incentives which result for commercial consumers in terms of:

- specific choice of supply;
- engagement in efficiency and energy saving measures; and
- facility siting decisions (which corresponds to the discrepancy between international competitors).

Table 14 provides this overview for the market-based method correspondingly in a high-carbon domain (i.e. a domain with a carbon-intensive production mix).

Table 13: Overview of results of carbon footprints according to the *market-based method* in a low-carbon domain, and of the resulting incentives in terms of 1) specific choice of supply, 2) engagement in efficiency and energy saving measures and 3) in facility siting decisions (which corresponds to the discrepancy between international competitors)

<table>
<tr><th colspan="3">Market-based method
Low-carbon domain</th></tr>
<tr><td colspan="2">Carbon footprint results</td><td><u>RES-E consumer</u>: very low emission factor;
the advantage of a RES-E consumer compared to grey consumers depends on the level of the “remaining” attributes in the grey mix (in average this means the residual mix): the larger the RES market share, the larger is the advantage compared to grey consumers.

<u>Grey consumer</u>: the value of emission factor and disadvantage compared to RES-E consumers depends on the level of the “remaining” attributes in the grey mix (in average this is the residual mix): the larger the RES market share, the larger is the disadvantage compared to RES consumers.</td></tr>
<tr><td rowspan="3">Incentives for…</td><td>Choice of supply</td><td><u>Specific RES supply</u>:

Incentive depends on the overall market demand for RES-E:
• smaller incentive for specific RES supply in case of low market demand for RES-E
• stronger incentive for specific RES supply in case of high market demand for RES-E.

<u>Specific RES-E supply with additionality</u>: no incentive</td></tr>
<tr><td>Efficiency and savings</td><td>Incentive for efficiency/savings depends on two aspects:
• the higher the share of specific RES-E claims, the higher is the incentive for grey consumers to either switch to RES-E supply or to implement efficiency and energy saving measures;
• Depending on the level of costs for switching to RES-E supply compared to the costs for efficiency or energy saving measures, either the first or the latter is incentivised.

The incentive for RES-E consumers to address efficiency and savings measures is low.</td></tr>
<tr><td>Facility siting (international competition)</td><td><u>RES-E consumer</u>: no difference as compared to other areas

<u>Grey consumer</u>: incentive to stay in the respective area;
advantage compared to competitors in other areas.

The level of this incentive to stay in / move to the respective area and of the advantage compared to competitors depends on the residual mix share in the given area compared to other areas.</td></tr>
</table>

Figure 6 displays these incentives as resulting from the market-based method for low-carbon domains.

Figure 6: Overview of incentive structures for commercial consumers due to carbon accounting according to the *market-based method* in a *low-carbon domain*.

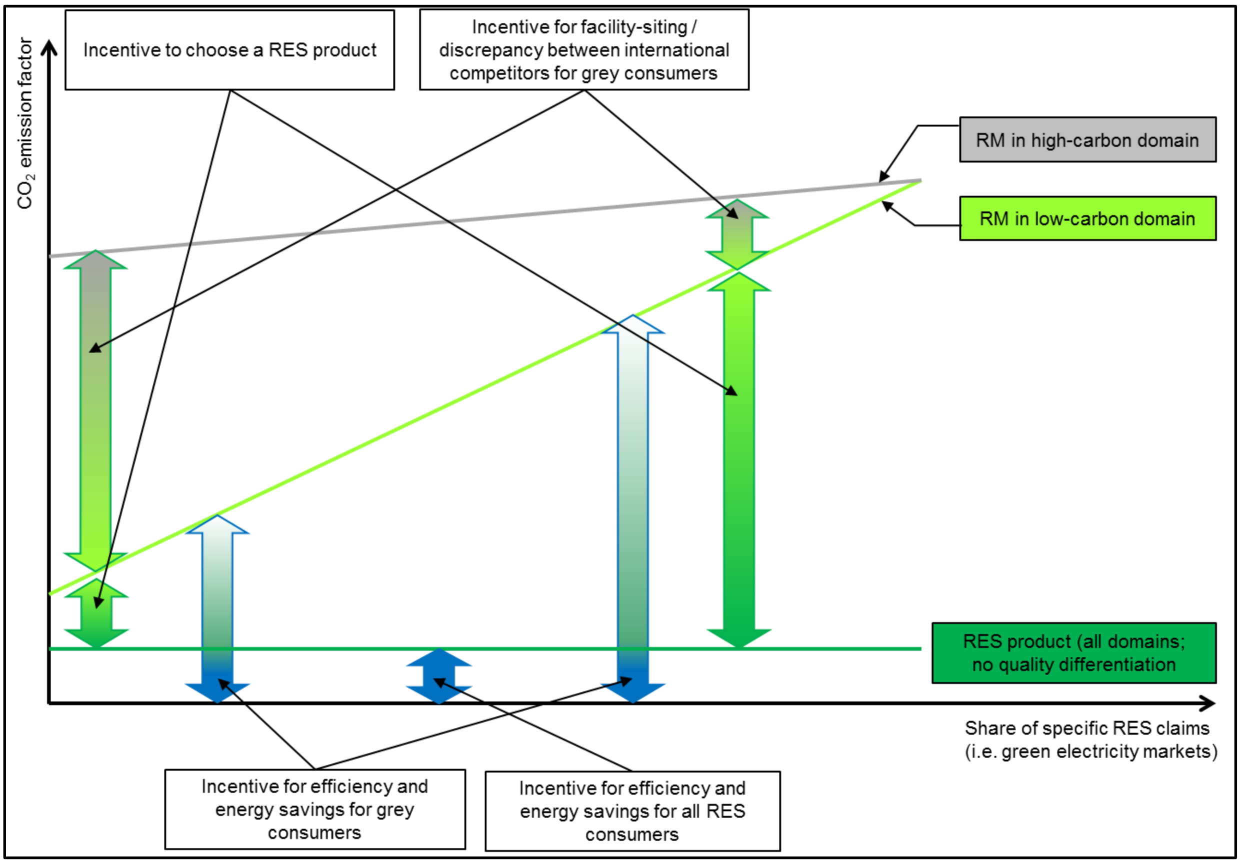


Table 14: Overview of results of carbon footprints according to the market-based method in a high-carbon domain, and of the resulting incentives in terms of 1) specific choice of supply, 2) engagement in efficiency and energy saving measures and 3) in facility siting decisions (which corresponds to the discrepancy between international competitors)

<table>
<tr><th colspan="3">Market-based method
High-carbon domain</th></tr>
<tr><td colspan="2">Carbon footprint results</td><td><u>RES-E consumer</u>: very low emission factor;
there is a strong advantage compared to grey consumer;
there is only a slight dependency on the amount of the “remaining” attributes in the grey mix (in average this is the residual mix): the larger the RES-E market share, the larger is the advantage compared to grey consumers, but this effect is much less relevant than in a low-carbon domain.

<u>Grey consumer</u>: high emission factor;
there is a disadvantage compared to RES-E consumers;
there is only a slight dependency on the amount of the “remaining” attributes in the grey mix (in average: the residual mix). The larger the demand for RES-E, the larger the disadvantage compared to RES-E consumers, but this effect is much less relevant than in a low-carbon domain.</td></tr>
<tr><td rowspan="3">Incentives for…</td><td>Choice of supply</td><td><u>Specific RES-E supply</u>: very high incentive for specific RES-E supply.

<u>Specific RES-E supply with additionality</u>: no incentive.</td></tr>
<tr><td>Efficiency and savings</td><td>Incentive for efficiency/savings depends on two aspects:
• the higher the share of specific RES-E claims, the higher is the incentive for grey consumers to either switch to RES-E supply or to implement efficiency and energy saving measures; however, the incentive for switching to RES-E supply or to implement efficiency and energy saving measures is generally high as compared to a low-carbon domain, and only to low degree dependent from the share of specific RES-E claims.
• Depending on the level of costs for switching to RES-E supply compared to the costs for efficiency or savings measures, either the first or the latter is incentivised.

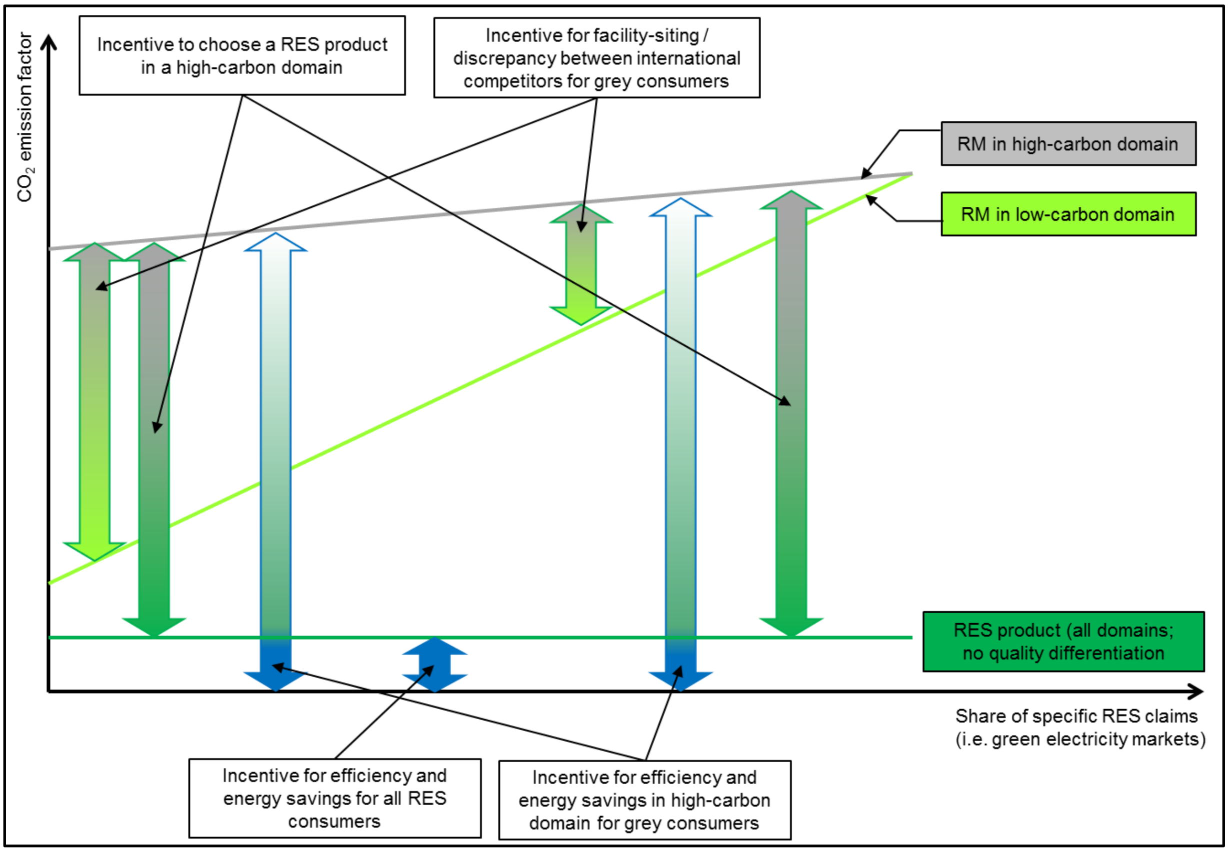
The incentive for RES-E consumers to address efficiency and savings measures is low.</td></tr>
<tr><td>Facility siting (international competition)</td><td><u>RES-E consumer</u>: no difference as compared to other areas.

<u>Grey consumer</u>: incentive to change to other areas;
disadvantage compared to competitors in other areas.

The level of this incentive to move to other areas and of the disadvantage compared to competitors depends on the residual mix share in the given area compared to other areas.</td></tr>
</table>

Figure 7 displays these incentives as resulting from the market-based method for high-carbon domains.

Figure 7: Overview of incentive structures for commercial consumers due to carbon accounting according to the *market-based method* in a *high-carbon domain*.



4.1.4 Comparative analysis of market-based and location based approach

When comparing the descriptions of results which are gained when applying either the market-based or the location-based approach, and the incentives which are related to that, the following becomes clear:

- The methodology chosen for carbon accounting can have a much stronger influence on the carbon footprint results than the actual supply situation of the commercial consumer.
- Both the market-based method and the location-based method can gain results which provide only a small incentive for efficiency measures or energy savings (irrespective of the actual level of efficiency potential). One could describe, for example, the following cases:
    - A Norwegian commercial consumer using the national production mix for carbon accounting, therefore having almost no incentive to reduce his energy consumption.
    - A German commercial consumer buying a RES-E product consisting of old hydro, which discourages him to reduce his energy consumption.

- None of the described “plain” approaches provides any incentive for choosing a high-quality RES-E product with additionality.
- For the market-based method, the incentive to apply any measure for reducing the carbon footprint increases with the share of specific RES claims in the respective area (at least in the case that the remaining attributes in the residual mix are fossil rather than nuclear attributes).
- Under the market-based approach, the choice between such reduction of the carbon footprint by RES-E or by efficiency measures is not supported by the accounting method. This choice therefore probably depends most on the price level of such measures.
- Currently, the reference for calculation of a grid mix is usually the national electricity system. Due to different national grid mixes companies which compete in a European market have competitive advantages or disadvantages, respectively, when calculating and communicating their carbon footprint. This is very clear for the location-based method, which refers to the (national) uncorrected production mix. But it also applies to some extent to the market-based method when choosing a non-specific electricity supply, which (on average) will correspond to the national residual mix.
- When applying the market-based method, the systematic discrepancy between competitors in different countries decreases with increased relative shares of claimed RES-E attributes which are deducted from the residual mix.
    - However, in domains with high RES-E production volumes the available RES-E volumes are larger in total.
    - Of course, this finding only applies in case that the remaining attributes in the residual mix are fossil rather than nuclear attributes.

4.2 Further parameters of carbon accounting methodology

4.2.1 CO_2 vs. GHG emissions

As already discussed in Chapter 3, the climate impact of different fuels and technologies can be expressed either using CO_2 emissions as a proxy parameter or total GHG (greenhouse gas) emissions. The latter includes CO_2 emissions, but also other relevant gases like methane and N_2O, and is usually reported in CO_2 equivalents. RE-DISS II (2013) provides a systematic overview of the relevance of both indicators for electricity generation. Major lessons learnt from that analysis for accounting of electricity-related emissions in carbon footprints include the following:

- GHG emissions provide a more complete picture of the greenhouse gas emissions and therefore in principle are better suited for calculation of carbon footprints; however, in some cases data availability might be not satisfactory.
- The differences between CO_2 and GHG emissions for individual fuels and technologies are small when only looking at direct emissions, but become more relevant when taking LCA data into account (especially for renewables).
- Increase for fossil fuels varies between 1,4 % (lignite) and 12,9 % (hard coal) from CO_2 emissions to GHG emissions. For nuclear power, the increase is about 12 %.[61]

[61] Examples used in RE-DISS II (2013) refer to production in Germany.

- For renewable technologies, the difference lies between 9 % (wind) and 220 % (biomass).
- This shows that for most technologies, both approaches provide results in the same range and therefore will not lead to different climate strategies or even contradictory conclusions. The only exemption from this is biomass, where consideration of GHG data obviously is crucial in order to avoid fundamentally wrong results and subsequent counter-productive decisions to take action.

More detailed analysis can be found in RE-DISS II (2013).

4.2.2 LCA vs. direct emissions

Also the differences between LCA data and data for direct emissions for different electricity production options have been analysed in RE-DISS II (2013). Major lessons learnt from that analysis for accounting of electricity-related emissions in carbon footprints include the following:

- Total emissions as based on an LCA are higher as compared to direct emissions, as direct emissions are only one part of the more comprehensive LCA.
- The relative difference between LCA and direct CO_2(only) emissions varies between 2,5 % (lignite) to 13,7 % (oil) for the fossil based technologies.[62] For nuclear and RES technologies, the relative difference cannot be calculated as direct CO_2 emissions are zero.
- The relative difference between LCA and direct GHG emissions varies between 3,1 % (lignite) to 16,7 % (hard coal) for the fossil based technologies.[63] Emissions from RES technologies become significant when taking the LCA approach.

More detailed analysis can be found in RE-DISS II (2013).

4.2.3 Choice of tracking mechanism: the double counting question

Most of the discussion of whether specific RES electricity supply allows for a "fair claim" in the carbon footprint for low-carbon electricity consumption focusses on the question whether double counting can be excluded or not.

This is a logical consequence of the standard carbon accounting principle to follow an attributional approach ("Which input, including its attributes, can be clearly assigned to the analysed service/product/company, and shall therefore be used as input attributes to the respective carbon footprint?"). The attributional approach here might either be understood as taking information into account which is specific for the electricity product (i.e. a market based approach according to the electricity disclosure information), or it might be based on a grid specific average fuel mix (i.e. location based approach, e.g. on national level). As outlined above, there are arguments for questioning whether the attributional approach is also reasonable in the case of electricity. Questions have been raised as to whether one should include aspects of the consequential approach in order to maintain a higher correlation between individual carbon footprints and the resulting incentives for decision making on the one hand, and the related environmental benefit on the other hand.

[62] Examples used in RE-DISS II (2013) refer to production in Germany.

[63] Examples used in RE-DISS II (2013) refer to production in Germany.

However, applying the location-based approach in carbon accounting would quite easily allow for avoiding double counting in carbon footprints. The only relevant prerequisite would be the consistent definition and application of geographical scopes.[64]

Allowing the plain market-based approach for carbon accounting would mean that it is essential to avoid double counting of the claimed attributes in order to pursue the "additionality by overshooting demand" approach. Only by avoiding double counting, "shortness" of RES electricity can be achieved. Such shortness, in combination with a strongly increased willingness to pay by end consumers, could result in incentives for more production.

Current tracking systems are designed for electricity disclosure. Under the premise that in the liberalised European electricity market a market-based tracking approach is appropriate in any case, the best option to avoid double counting of a product-specific claim can be considered the use of guarantees of origin (GOs). This has been intensively discussed in the E-TRACK II project (E-TRACK II 2009a) and is also implemented in the RE-DISS Best Practice Recommendations (RE-DISS 2012). Use of such GOs does not automatically exclude that it can be double counted, but it is the only instrument which offers a very high protection against double counting. However, whether double counting then takes place or not is no longer in the hands of the one using a GO, but is depending on other parties. For electricity disclosure, most countries apply clear rules which reduce the risk of double counting of a GO attribute in electricity disclosure to a minimum. One could therefore conclude that using a GO for electricity disclosure is as much as can be done.

4.2.4 Specific regulation to address additionality

Neither the location-based method, nor the market-based method in their fundamental form as discussed in Chapters 4.1.2 and 4.1.3 is able to distinguish a premium RES-E product which includes any sort of mechanism of directly triggering an added environmental benefit. At the same time, it is common sense that the major incentive for commercial consumers to buy RES electricity is accountability for their carbon reporting (this trend has already been documented by the E-TRACK II project in 2009 (see E-TRACK II 2009b). Therefore, one can assume that if a commercial consumer chooses a RES product, he or she will probably choose the cheapest one which allows them such a claim. As shown in Chapter 2.3.2, this will only lead to actual environmental effects when the level of "additionality by overshooting demand" is reached, and consumers are willing to pay for significantly higher prices for RES-E.

Still, there are some proposals on how environmental benefits of RES products could be taken into account already today. Three such proposals have been presented in Chapter 3.3. The proposals brought forward by UBA (2013) (see Chapter 3.3.3.5) and by ifeu et al. (2009) (see Chapter 3.3.3.6) follow the principle that low specific emission rates (or reduction of emission rates, respectively) can be applied when supply from new plants can be documented. In these cases, pressure for substitution of conventional carbon-intensive production and therefore an overall environmental benefit is assumed. If no supply from new plants can be proved, an average default mix and the respective emission factor have to be applied according to these proposals. At least ifeu et al. (2009) highlights that the parameter setting for the distinction of "new" plants is not a fully scientific based value, but more a political decision which should be agreed as common convention in order to establish a level playing field for market participants. The proposal made by ifeu et al. (2009) applies only elements of the attributional approach. However, it does not correspond to a clearly distinguished application between the market-based method and the location-based method, but makes choice of these methods depend on plant age, which is used as a rough proxy for additionality.

Of course such an approach raises the double counting question, as it would not be centrally known how many carbon attributes have been specifically claimed based on this method, and how many have not.[65] If one wants to play safe, the method should therefore not refer to the production mix of the area, but to the residual mix which is corrected for all used GOs (very conservative), or alternatively for all GOs which are eligible for this method (e.g. all GOs from plants < 6 years)[66]. In general, the primacy of avoiding double counting has to be weighed against the goal of having an "additionality-sensitive" approach for carbon accounting.

IZES (2014) comes to the conclusion that any approach allowing for a specific (low) carbon emission factor misrepresents the ecological relevance of such supply (usually by overestimating it) (see Chapter 3.3.3.7). Therefore, they propose not to use the market-based method for carbon accounting at all, but only the location-based method. For electricity products which achieve a positive environmental benefit by separate additionality aspects (funds, new investments, …), IZES proposes deducting the respective benefit, i.e. the amount of saved emissions, from the overall carbon footprint and communicate this as separate information. From a methodical point of view, this means that any voluntary market choice for RES-E would therefore not be addressed by the attributional approach at all, but only by a consequential calculation approach. This would be applied only subsequently to the accounting itself and be considered as offset measure (see also Chapter 1.2).

Particularly ifeu et al. (2009) and IZES (2014) both stress the relevance of communicating the uncertainties which are related to the accounting methodology, and to be conservative with any reference to any improvement caused by the consumption of RES electricity. In terms of communication, this includes separate communication of results achieved by different methods, application of error bars, and an emphasis on conservative values as gained by the location-based method in order to emphasise the development of emissions with time as caused by efficiency and savings measures.

65 This would require the implementation of a central supervisory body which is notified of all carbon footprints which are calculated and which take a product-specific emission factor (e.g. as based on GOs) into account. This would have to be done in parallel to existing structures for supervision of electricity disclosure.

66 Such a calculation of a separate residual mix for carbon accounting as compared to residual mix calculations for electricity disclosure would, however, involve high additional administrative costs.

5 Discussion and conclusions

The preceding chapters have described different methodical approaches in order to take electricity consumption into account when calculating a carbon footprint, including the possible relationship between these methods and the instrument of electricity disclosure. A major challenge to be addressed by this paper is an analysis of whether and how different such methods lead to results which incentivise decision makers to choose options to mitigate climate change. This will be analysed in more depth in the following chapter.

Chapter 4.1 defines three fundamental practical measures to reduce the carbon footprint: the switch to a low-carbon energy supply (here: a RES-E product), measures for energy efficiency and energy savings or moving the production sites to an area which allows for the application of lower emission factors.

It is assumed that the quite drastic approach to make decisions on the siting of production facilities depend on carbon emissions related to different countries only plays a marginal role in reality. This puts the focus on measures for increasing efficiency and for saving energy in general, which are assigned highest priority in the three step approach as presented in Chapter 1.2.

5.1 Do carbon footprint results support ecological improvements by favouring efficiency measures?

Analysis in Chapter 4.1 in combination with Chapter 3 shows that efficiency and energy saving measures are suitable means for reducing a carbon footprint under all of the established carbon accounting methods. However, analysis also shows that in countries with a low average emission factor for the national production mix the application of the location-based method only provides very low incentives for efficiency measures, not taking into account that such reduced electricity consumption would probably have effects not only on the national grid, but also on larger scale in an integrated European electricity market. A striking example would be a Norwegian commercial consumer who applies the national production mix for carbon accounting, therefore having almost no incentive to reduce his energy consumption based on his carbon footprint.

Also the market-based approach does not consistently result in prioritised incentives for such efficiency and savings as compared to supply with RES-E (see Chapter 4.1.4). This is on the one hand depending on the share of existing RES-E claims, as increased claims for low-carbon attributes taken out of the respective residual mix contribute to an increased emission factor of this residual mix. On the other hand it depends on the price level of RES-E (or RES GOs, respectively) as compared to considered costs and benefits of efficiency measures. Taking low prices for RES GOs into account (average price on EEX for “Nordic Hydro” GOs in the range of 0,15 EUR/GO (EEX 2014)[67]), the purchase of such GOs will usually be the low-cost and the low-effort measure which is incentivised by such accounting. As an example

[67] Average price for GOs in the product “Nordic Hydro” since the start of the GO trade at EEX (June 2013 to June 2014).

for this case, one can refer to a German commercial consumer buying a RES-E product, which discourages him or her to reduce their energy consumption.

5.2 Do carbon footprint results support ecological improvements when accounting RES-E attributes without specific additionality criteria?

Chapter 3 shows that all the presented methods which are approved on an international level suggest that RES-E consumption in a market-based approach should be considered (if at all) without any distinction according to further criteria of additionality. Chapters 2.1 and 2.3, however, outline that under current regulatory and market framework in Europe an active choice for a RES-E product does not lead to an increase of RES-E production and a mitigation of carbon emissions in the short term. Still, there is the long-term vision of “additionality by overshooting demand”. This vision expects a pressure for additional RES-E production caused by increased demand for RES-E in the long run, and considers the current phase only as starting period for functioning markets. There are prominent efforts supported by market player associations to increase the share of RES-E volumes which are requested by end-consumers not only in the domestic sector, but increasingly in the commercial sector. Recently the RE100 initiative has been taking up speed which tries to commit large commercial consumers cover their electricity consumption fully by renewables.

In terms of electricity volumes, additionality by overshooting demand would be reached when a RES-E volume of between 500 TWh (hydro production at the beginning of market liberalisation, equalling about half of current industrial electricity consumption in Europe) and 950 TWh (existing RES production in 2013) is explicitly requested by voluntary markets.[68] Taking the explicit allocation of supported electricity in some European countries into account, one could also argue that this upper limit is actually reduced by approximately 180 TWh (Grexel 2015), resulting in a RES-E volume of approximately 770 TWh which is available to markets. However, on a trajectory to reach European 2020 RES targets, this necessary demand relates to 1/3 to 2/3 of the total envisaged production volumes in 2020 which would have to be bought by consumers as green power products before additional production volumes can be stimulated.

Besides a strong increase in demand, it would also be crucial that consumers show a sufficient willingness to pay for RES-E as compared to the market price for plain electricity in order to stimulate further RES-E production. On the power exchange EEX, the average price for GOs in the product “Nordic Hydro” since start of the trade of GO products at EEX has been in the range of roughly 15 ct per GO (i.e. 0,15 EUR/MWh RES-E) (EEX 2014).[69] For comparison, the average price for Elcertificates, the support certificates in Norway and Sweden which are meant to stimulate new RES capacities, was 21,6 EUR/MWh in the same period (Statnett 2014) – roughly 150 times higher than the price for GOs. This indicates the current level of support as determined by a market mechanism which has to be paid over and above the market price for electricity in order to finance an increase of RES-E towards the existing RES targets. The average market price for electricity for Norwegian and Swedish

[68] It depends on whether one considers the status at the beginning of market liberalisation as the reference point for market demand or today‘s level of RES-E production. However, it is probably appropriate to consider both demand and production at the same time as relevant indicators.

[69] Period from June 2013 to June 2014.

bidding areas at Nordpool Spot in the year 2013 ranged between 37,5 and 40 EUR/MWh (Nordpool 2014) – roughly 250 times higher than the price for GOs. Although these figures only cover a status quo situation, they provide a numerical framework for necessary changes in consumer's willingness to pay if voluntary markets are really meant to stimulate new RES capacities by overshooting demand. In combination with the high market share of green power products needed for the vision of "additionality by overshooting demand", it also becomes clear that this vision would incur large-scale windfall profits for the operators and marketers of existing RES-E production capacities.

One argument often put forward by proponents of the vision of "additionality by overshooting demand" is that this approach would assure already under current market conditions that consumers' money is given to those actors who are active in RES-E production, and who might therefore invest their revenues in more RES-E. This may be the case to some extent, but the situation is more complex as the example of Norway shows: in 2013, 130 TWh of RES-E were produced, almost all of which was from hydro power. Net exports of RES-E GO from Norway amounted to 104 TWh (corresponding to 80 % of Norwegian RES-E production, and to 42 % of all exports of RES-E GO within EECS in 2013), which means that this RES-E has actually been sold to voluntary international markets (AIB 2014a). However, the Norwegian National Renewable Energy Action Plan (NREAP) shows that RES-E generation can only be expected to rise from 130 to 143 TWh by 2020 (OED 2013), i.e. by approximately 10 %.[70] Assuming that Norwegian RES-E producers are particularly active within Norway and do not intensively invest in other EU Member States, this example suggests that those producers who currently sell the existing RES GOs are probably not the ones who will actually install the major share of new RES-E production capacities to meet European RES targets. Besides that, references as given above show that the current price level for GOs is only marginal and hardly sufficient to provide relevant incentives for new investments.

The paragraphs above show that there is still a long way to go in order to reach additionality by overshooting demand, both in terms of further volume increase and in terms of available funding by increased prices on voluntary markets. Undifferentiated distribution effects furthermore limit the monetary efficiency of this approach.

5.3 Can RES-E supply with "additionality" be defined so that carbon footprint results support ecological improvements by the accounting of RES-E?

There are different views with regard to whether or not additionality of RES-E supply should be a requirement for carbon accounting. However, as Chapter 5.2 shows, undifferentiated accounting of RES-E attributes does not, for the time being, ensure that the carbon footprint provides sufficient incentives for efficiency and energy saving measures as compared to RES-E supply. One option to better correlate the incentive structure with the expected ecological relevance is to change the definition of eligible RES-E attributes which can be claimed in a market-based approach in a carbon footprint and to make this subject to additionality criteria. For the time being, none of the officially implemented methods for carbon accounting allows for a distinction of RES-E products according to the additional environmental benefit related to them. Still, there are some proposals for different

[70] The Norwegian NREAP expects for 2020 a gross final electricity consumption of 126,6 TWh and a RES-E share of 113 %, meaning a RES-E production of 143 TWh (OED 2013).

approaches which, already under current conditions in Europe, allow for an "additionality-sensitive" approach.[71]

From a methodological point of view, one can distinguish whether the actual emissions (attributional approach), the avoided emissions (which is why the generation is considered additional; the consequential approach) or both aspects are included in the carbon accounting. This might be relevant for the consistency of such approaches with existing principles of carbon accounting, e.g. as defined by the ILCD Handbook (European Commission 2010), and thus for the acceptance of such approach as an agreed convention. The approach as proposed by IZES (2014) requires carbon accounting based on the location-based approach, and considers avoided emissions by product-related additionality as an offsetting measure which can then be deducted from the total emissions caused by energy supply. In contrast to this, the approach as defined by ifeu et al (2009) combines the location-based method and the market-based method as elements of the attributional approach, and uses the plant age as a proxy additionality criterion.

Chapter 2.3.2 has defined several levels of additionality for the RES-E supply model. Although ambitious additionality levels would obviously be desirable from an environmental point of view, some arguments support the incentivising of commercial consumers to consume electricity with "basic additionality" (meaning that new and unsupported electricity is consumed, which is accounted within the national RES targets of the producing country). In this case, the commercial RES-E consumer can claim that he bears the financial cost of the additional RES-E production as an active contribution to reaching the given targets and. Thus, he actively contributes to the solution rather than being part of the problem.

However, any such definition of additionality requirements for making carbon-related claims would have to be broadly discussed and should be agreed on an international level in order to ensure a level playing field for market participants. Such requirements should be applied consistently in order to avoid systematic disadvantaging those who are using this more "restrictive" approach. Still, the application of such an approach could be possible on a voluntary basis, as it does not negatively affect carbon accounting results of other stakeholders. Of course, transparency on the applied method would have to be provided in order to allow for interpretation of the results.

But: experience shows that the aspect of additionality is not easy to handle as it introduces an extra level of complexity, which is not considered necessary by some stakeholders or not understood, particularly by non-experts on the topic. These obstacles suggest that it should be assessed whether, and if so, to what degree, other requirements for carbon accounting and reporting can also support the accounting of electricity consumption in carbon footprints in a way which incentivises decisions which are appropriate to mitigate climate change.

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[71] It is noticeable that all the mentioned proposals for such a differentiated accounting originate from Germany. This is the country in which not only more GOs are imported from other countries (2013: 69 TWh) and in which more GOs are cancelled (2013: 50 TWh) than in any other European country (AIB 2014b), but which has over 120 TWh domestic RES-E production within the public support scheme that is not even included in these statistics but disclosed to consumers based on a pro-rata allocation.

5.4 The GHG Protocol Approach: Can further accounting requirements be defined so that carbon footprint results better support ecological improvements?

Chapter 5.3 concludes that the application of additionality requirements for accounting of RES-E would be sensible from an environmental point of view, but is challenging to implement in agreed standard procedures. As the current situation does not comply with the vision of additionality by overshooting demand, such special additionality requirements would be necessary in order to justify fully that both efficiency measures and the switch to RES-E supply are equally incentivised under the current situation. Chapters 5.1 and 5.2 show that an application of the undifferentiated market-based or location-based method does not lead to prioritized incentives for efficiency in different countries and market situations, so that consistent application of either the one or the other would lead to non-preferable incentives at least in some cases. On the other hand, it seems advisable to work towards a consistent application of a common approach in order to create a level playing field between competitors and to enhance the understanding of results of carbon footprints. As long as carbon footprints can be produced based on either the one or the other methodology, it seems quite clear that it is attractive for companies to choose the method which gains the most advantageous result for the respective situation.

An approach to overcome at least part of these shortfalls is the dual application of both the location-based and the market-based method. Although this increases complexity to some extent, it provides transparency on the specific situation and therefore allows for a better understanding of the meaning of the carbon footprint. Such a dual application also increases the probability that at least one of the given results provides incentives for targeted measures to mitigate climate change (namely efficiency measures). Clearly, such incentives are only ensured if the results of both approaches are not only calculated, but also subsequently equally further used and communicated.

The GHG Protocol Scope 2 Guidance (WRI/WBCSD 2015) does not only include such a dual reporting requirement, but it also includes a quite comprehensive list of additional requirements or suggestions for reporting which seem appropriate to increase transparency and to support appropriate incentives by carbon footprinting. This includes the following (see also chapter 3.3.2):

- Required information:
  - Dual reporting of scope 2 emissions (both for the market-based and for the location-based method)[72]
- Recommended information with respect to the characteristics of consumed electricity volume (according to the market-based method, i.e. the electricity disclosure information):
  - Reporting of the consumed electricity volume in terms of MWh;
  - Biogenic CO_2 emissions from electricity use
  - Other instrument retirement, including retirement of certificates as required by regulatory policy[73]

[72] However, one should not that this requirement is not maintained for the calculation and reporting of inventory totals, where the GHG Protocol allows to freely choose one of the two different options.

  - Instrument features associated with their contractual instruments claimed, including
    - Instrument certification labels which entail their own set of eligibility criteria
    - Characteristics of the energy generation facility (could be technology, plant age, level of support)
    - Policy context of the instrument
  - Role of corporate procurement in driving new low-carbon projects in a narrative disclosure
- Optional information:
  - Reference to an internal or external third-party assurance process or assurance of conformance provided by a certification programme, supplier label, green power programme etc.
  - Scope 2 totals disaggregated by country
  - Avoided emissions estimation
  - Scope 2 results calculated by other methods.

Such dual reporting can therefore address the challenge of providing incentives for efficiency and energy saving measures, as reduced electricity consumption will be shown in most cases in at least one of the two different provided carbon footprints, and in any case in the reported volume of electricity consumption. One should note that the dual reporting requirement only refers to the reporting of scope 2 emissions; in order to derive an inventory total, the GHG Protocol then again allows just choosing only one of both results of the scope 2 calculation, which of course leaves room for choosing the more advantageous one.

The proposed option to report on special characteristics of supplied electricity probably only provides limited incentives to demand for RES-E products with additionality, but at least allows to communicate special efforts and ambitions.

From a practical point of view, the described dual approach has the benefit of being based completely on established methods and principles. With respect to the market-based method, such an approach allows the use of data that has already been provided to European electricity consumers by the instrument of electricity disclosure, and the location-based method uses national production statistics or data usually available from official sources. This allows for straightforward accounting and is probably intuitive for the vast majority of those who consider calculating a carbon footprint. Still, it has the drawback that reporting of the different values as described above increases complexity for marketing and communication strategies, which might be easier if based on one single figure.

5.5 Technical requirements for avoiding double counting and the role of electricity disclosure

The obvious impact of choice of methodology on results of carbon footprints also means that a consistent accounting methodology would be helpful in order to create a level playing field for all competing market parties, and for allowing education of consumers, managers, NGOs

[73] See WRI/WBCSD (2014), p. 60f; it should be noted that the last draft of the guidance document recommended to report on the relation to compliance quotas (e.g. “above and beyond compliance quotas”, “Combined with a retired compliance instrument”, or “not surplus to compliance instruments.”). This is now included in the final guidance document without the explicit request to compare the voluntary claim with the mandatory requirement.

and policy makers about "What does or what can the carbon figure actually mean?". However, such consistency does not automatically mean that a methodology of this kind would necessarily bring about environmentally helpful results. This depends on the definition of the methodology itself in the context of the market situation and the regulatory framework.

Several method descriptions highlight the relevance of avoiding double counting. Chapter 4.2.3 also discusses this and demonstrates that, more specifically, exclusion of double counting is important for everything which can lead to an improvement of the carbon footprint. If accountability for a carbon footprint shall be limited to electricity which has a direct additional environmental benefit (e.g. unsupported production from new plants), then this requirement would have to focus on such production attributes at least. In the case that only very specific production or measures would qualify for such "positive and specific" accounting, the magnitude of any correction, for example of a location-based emission factor in order to avoid double counting, would probably be only marginal, and have no significant effect on the resulting incentives for decision making. In this case, one could even consider whether such a correction to avoid double counting is really needed. Still, it would be crucial to avoid explicit double counting of the claimed benefit by individual consumers in any case. As long as carbon accounting systems do not take any specific RES-E additionality requirements into account but consider RES-E consumption without any "additionality distinction" in the market-based method, double counting has to be avoided for all electricity volumes and the corresponding carbon emissions in order to support the vision of additionality by overshooting demand. However, the mere fact that several contradicting methodology proposals exist and are applied leads to the conclusion that double counting cannot be excluded for the time being.

When applying the plain location-based method, it is quite easy, at least in theory, to avoid double counting by applying coordinated geographical definitions. However, it should be ensured that such coordination is being carried out under supervision of a commonly agreed standard or a responsible authority. This should also take the following issue into account: Application of national production mix data and corresponding national average emission factors result in differentiation between competitors on two sides of national borders, while European electricity systems are becoming more and more connected. This applies to the market side, but also to the technical grid side. While application of national data currently is common practice, it can be stated that at a specific level of international integration of electricity systems it becomes appropriate to apply a common European value.[74] This is very obvious for the location-based method. However, one should note that this issue also applies to some extent for the market-based method when choosing a non-specific electricity supply, which (on average) will correspond to the national residual mix.

When applying the plain market-based method, this method follows the same "book and claim" principle as is done in electricity disclosure. In electricity disclosure systems, major improvements have been made in recent years in order to avoid double counting, and respective accounting mechanisms are in place. Within the well-regulated framework of electricity disclosure, the disclosure information based on GOs and possibly also other reliable tracking methods (including a duly calculated residual mix) can be considered reliable, particularly with regard to minimisation of double counting. If a consistent application of this disclosure information for carbon accounting is ensured for the market-based method,

[74] Any discussion on this should also take particularities of isolated grids like those of Malta or Iceland, for example, into account.

double counting of corresponding attributes in carbon balances would also be minimised. However, the reliability of the tracking instruments which have been used by a supplier to calculate the respective electricity disclosure statement are probably hard to assess for end consumers. Usually, only the results (fuel mix, direct CO_2 emissions and radioactive waste) would be communicated to end consumers.[75] Large commercial consumers which make an individual contract with their respective suppliers of course have the possibility to define eligible tracking instruments like GOs as part of the contractual agreement.[76] One should bear in mind that this holds true specifically for RES-E. While RES-E is of highest value on voluntary markets, fossil CHP technologies or even nuclear can also be considered appropriate from a commercial consumer's point of view in order to follow a low-carbon strategy. Still, in many countries there are no such GOs available for use in the markets and for electricity disclosure, at least not for the time being. This leaves the question open of which tracking instruments should be required in order that such production could also be accounted for in carbon accounting. Furthermore, for the time being one should be aware that it is hardly possible to fully avoid double counting of electricity disclosure information in carbon accounting, knowing that there are no consistent rules which are applied by all possible users of carbon accounting.

If disclosure information based on reliable tracking instruments is consistently applied and double counting is therefore avoided to a large extent, the added demand for RES-E by commercial consumers could contribute to the vision of additionality by overshooting demand. For other (more direct) additionality levels, it would be particularly important to minimise the double counting of the “valuable” attributes, e.g. of RES production specifically of new and unsupported plants. For green electricity offers according to the fund and initiation models, avoiding of double counting would even not be a key element, but the verification of the support of third plants by funds and initiation would be more relevant (see Chapter 2.3.4).

In any case, if information based on electricity disclosure systems is being used, the most relevant information is the fuel mix information which is being provided. Electricity disclosure regulation also requires suppliers to indicate the level of CO_2 emissions with their disclosure statements. Usually, this parameter is based on fuel-specific generic values as defined by the country of disclosure. In contrast to this, as has been discussed in Chapters 4.2.1 and 4.2.2, the most representative results are gained by using LCA data for emissions of all relevant greenhouse gases (GHG). This means that respective emission factors would have to be applied based on the fuel mix (potentially also taking into account the country of origin and more technology-specific information), rather than just applying the emission factor which is provided with the electricity disclosure statement. However, results for “only” direct emissions and restriction on CO_2 emissions are more or less in the same range for most fuels and technologies. An essential difference between both methods only applies for biomass, where the “direct CO_2” method can lead to clearly misleading results.

[75] Please note that the current Draft RE-DISS II Disclosure Guidelines for Suppliers suggest to indicate the used tracking instrument as additional parameter to electricity disclosure statements (RE-DISS II 2014b).

[76] In some EU Member States, it is also possible for consumers to use GOs independently from the supplier of the physical electricity and the related disclosure statement. More information on this option and the related implications can be found in RE-DISS II (2014c).

6 Outlook and Recommendations

The presented analysis has provided an overview of the interaction and the systematic differences between electricity disclosure in the European framework and the accounting of electricity consumption in carbon footprints according to different methodologies. The evaluation of the respectively gained carbon footprints shows that the principles of carbon accounting have a strong influence on whether the gained results actually incentivise decision makers to choose options to mitigate climate change. As the sensitivity of results with respect to the chosen carbon accounting methodology shows, one can hardly refer to "the correct carbon footprint". One could thus compare carbon footprint, and more specifically accounting of electricity consumption, with a public tax system. There is no correct and no wrong methodology, but one can expect that systems should be designed so that they are fair, coherent and generally applicable in order to give desirable incentives and to share the burden.

In order to further develop the instrument of carbon accounting towards this goal, and also to further clarify a sensible role of electricity disclosure and related instruments in that respect, recommendations can be formulated for different target groups. .

Carbon accounting experts and also **large commercial consumers** as the main users of this instrument can build directly on the guidance which is given by WRI/WBCSD (2015). Already in the short term they should take comprehensive measures in order to increase transparency on the meaning of the carbon footprint results and underlying measures and methods,. This should include a dual accounting according to both the market-based method (i.e. the electricity disclosure approach) and according to the location-based method not only for the limited scope 2 reporting, but also for final inventory totals and for goal settings in order to maintain the purpose of this dual reporting. Furthermore, the indication of electricity consumption volumes and information on specific "quality attributes" of specific electricity products, e.g. a premium label do allow for an assessment of the environmental relevance of the RES-E choice. This allows a more differentiated analysis of the actual performance and environmental relevance of the reported figures at least for expert readers of a carbon footprint report. In cooperation with **electricity system experts** the mentioned targets groups should also foster discussions on how RES-E additionality can be fairly accounted for under the current framework conditions. This process could build on existing standards like the GHG Protocol Scope 2 Guidance (WRI/WBCSD 2015), but further develop additional criteria and requirements. Development of such an "advanced" standard should include not only the development and an agreement by a relevant group of players, but also broad publication and branding of this approach in order to enhance actual application. For the framework of Europe, relevant **LCA expert groups** should also discuss an application of average European emission factors rather than national emission factors at least for those countries which are part of the mainland electricity grid system in order to contribute to the establish a level playing field for European market players. Obviously, carbon footprints can also be calculated already today based on one of the existing proposals for "additionality-sensitive" methodologies on a voluntary level. Such a decision by individual companies would be restrictive particularly for the respective companies themselves, without negatively affecting others' footprints.

Consumer and environmental NGOs should first and foremost become familiar with the issues of carbon accounting and the special role of electricity accounting, and hereby consider the needs of household consumers with respect to communication of carbon footprints. Although it will probably be difficult due to limited resources and the complexity of such discussions, it would be valuable if they could also assess the implications of environmental relevance and consumers' perspectives with respect to specific accounting methodologies. Based on this, it would be desirable if they could actively contribute to discussions for comprehensive reporting requirements and for an "advanced accounting methodology", as described in the paragraph above.

Electricity suppliers should be aware of the limitations of carbon footprints to express actual environmental effects, and therefore be defensive with their related marketing claims. They should provide comprehensive disclosure information at least to interested parties, including information on detailed fuel source category, used tracking mechanisms and LCA-based emission factors for CO_2eq rather than for CO_2 only. After publication of an "advanced accounting methodology", they should provide information which is relevant according to that standard.

National competent bodies for disclosure could at the current stage contribute by centrally providing average emission factors for the national electricity production, and discuss a joint calculation and publication of average values on European level with their international colleagues. This should not only include publication of CO_2 emission factors as required by the IEM Directive, but also additionally LCA-based emission factors for CO_2eq "backup" data.

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Annex: Comments received on the draft version

During the consultation period of this discussion paper, comments have been provided by several stakeholders. Some of those comments provided specific suggestions for improvements of the report, which have been taken into account for this final version to the extent deemed reasonable by the authors. Other comments had been addressing the issue of the report on a very general level. These statements are summarised in the following list:

- The ambition that scope 2 carbon accounting should have an ecological effect is not supported by all stakeholders. It is referred to the technical definition that carbon accounting is technically defined so that this is a pure fact-based allocation of production attributes without a linkage to future effects. It is stressed that the allocation of a kWh which has been already produced can not lead to changes on production of electricity. Giving the consumer the impression that their purchase of an existing “product” has a direct ecological or production influence is misleading.
- The emission factor of an installation is unchanged by what caused the project to be build.
- Claims such as "The kWh would not have been there if I didn't purchase it" are impossible.
- It is considered impossible that the use of labels or “additionality criteria” for carbon accounting could improve the ecological effect of carbon accounting. This is due to the fact that no common definition of such additionality criteria exists, and therefore resulting additionality claims would be subjective.
- Introduction of additionality claims would increase the complexity of carbon accounting methods.
- The concept of additionality has not been implemented in markets with much success. Therefore, the concept should not be further pursued.
- It should be stronger acknowledged that there are different concepts of additionality.
- Applying direct contracts instead of GOs would limit potential renewable generating resources that can be claimed, increase transmissions costs for delivering the electricity, and increase verification and compliance costs.
- "Individual choice will not change the production mix, but the collective choice over time will. If all consumer choose for renewables, the fossil-plants will need to be closed because due to market-based/financial reasons. If supply is exceeding demand than this influence will not be as strong. By limiting the supply (or increasing the demand) we are able to strengthen consumer influence on producers. This is only possible as the result of collective choice."
- "Collective claims have the ability to influence decisions on the production of electricity. We have seen this with many modern products:
  Organic pumpkins (while part of a segregation system) work in a similar manner to that of renewable electricity. An individual or collective group purchasing organic pumpkins cannot have as requirement that at the moment of purchase their purchase led to the creation of more organic pumpkins – this goes against the principles of purchasing organics. The product must first exist before a consumer can claim ownership."

- "Collective changes happen overtime because the actual produced attributes being claimed by the group cannot be changed after they have been produced. Collective claims can however influence producers to change their actions in the next production round."
- "The renewable electricity market in Europe currently does not have the ability to strongly influence the production-side of electricity. The cost-price of between the production of fossil-fuel stations and renewables is too large. Additionally the market for renewable electricity must compete with the imbedded costs of previous investments before ‘new’ renewable production stations will be built.
  It should also be noted that in Europe the production of electricity is subsidised whereas the consumption of electricity is not, this is different than in other modern electricity markets. In this situation consumers wanting a specific electricity product would need to compete with the subsidised lower production price offered by the national government."
- With respect to corporate carbon footprinting: only by reporting overtime one can see whether energy consumption or individual carbon footprints were reduced. Most knowledgeable consumers will be aware that the procurement of renewable electricity is a long-term decision and not a single-year decision. This contributes to the influence of collective actions, including projects like RE100.
- Consistency in methodology is a critical aspect of carbon accounting, disclosure, and the eventual long-term influence of RES-E consumption on the market. For this reason, the establishment of the GHG Protocol Scope 2 Guidance has been supported by so many organisations.
- The GHG Protocol Scope 2 Guidance is a compromise following a long international consultation process. These discussions should not be re-opened.
- Building on GHG Protocol Scope 2 Guidance, the paper should concentrate on the question "What can companies do more within the framework of the market?"
- In order to assess the overall value of carbon footprinting, it is crucial to differentiate the respective area of the application of carbon footprinting. When used as a scientific tool to identify carbon hotspots in companies' supply chains, carbon footprinting in general can be a useful approach to improve their environmental performance. When it comes to communication to consumers, carbon footprinting used for environmental claims are more critical, e.g. because the informative value of single GHG emission figures tends to be low or even misleading.
- The market-based approach could flaw the results of carbon footprinting, as companies could "virtually offset" a major part of their energy-related GHG emissions by buying cheap GOs. Allowing such a "compensation approach" could cannibalise efforts for energy efficiency.
- Undifferentiated accounting of production related emissions in the market based approach does incentivise the cheapest option, which puts "old GO" in a more advantageous position than GO with an added benefit or efficiency measures. There should be a method established which acknowledges the additional value of RES-E with ecological additionality.
- Communication of carbon footprints should be improved so that they can be understood in a broader context. This should e.g. include the communication of the absolute power consumption in a continuous and comparable way.
- Also voluntary instruments like carbon accounting should help to increase the share of renewables and to decrease carbon emissions by providing according incentives.

The provided report shows that this is hardly given by the methodologies which are applied under the current framework, which is a good baseline for further discussions.

- It seems worth discussing if it is the best approach to put an absolute "priority on energy efficiency". The clear promotion of additional RES-E and substitution of conventional electricity production should also be a target of such instruments. Hopefully, this can be taken into account in any further methodology development.
- A problem which is not addressed by the report is that also nuclear energy could be used in the framework of carbon footprints in order to reduce a carbon footprint. This of course is not in line with the overall ecological ambitions which should also be facilitated with carbon accounting.
- There should be further efforts to clarify how either the methodology for carbon accounting or the communication of the respective results, or both, can be improved in order to fulfil the ambition to generate a relevant impact with the instrument of carbon accounting.