

WHITE PAPER

RETHINKING ELECTRICITY

How companies can drive the
renewable energy transition
and reduce their emmissions.

Executive Summary

Electricity remains the single most important sector for mitigating climate change and companies have a unique role to play. Electricity is the largest source of carbon emissions and global demand for electricity is growing rapidly. Total emissions from electricity are increasing despite recent efforts of transitioning to renewables. We must vastly speed up the renewable energy transition to avoid the most catastrophic consequences of climate change. Companies are the central player for reducing global emissions related to electricity.

However, almost all “green” electricity contracts do not make a positive difference for the climate. There is a plenitude of “green” electricity contracts on the market, promising companies (and individuals) to reduce their emissions. These contracts are based on certificates – a system for tracking and claiming already-produced electricity – and do not make a difference for the climate. Instead, companies are led to believe they are making a difference for the climate when they in reality are not.

There are six major challenges with the current certificate-based system for procurement of electricity:

1. **Certificates do not reduce emissions.** There is no scientific evidence suggesting that certificate-based electricity actually reduces emissions.
2. **Skewed incentives and rewards.** The system rewards inaction over initiatives that actually reduce emissions (e.g. energy optimising measures).
3. **Focus is shifted from actual problem.** In Denmark, labelling of green electricity include carbon offsets that are not related to electricity consumption (e.g. planting trees).
4. **Additionality is not rewarded.** Companies are not rewarded for adding new renewable electricity to the grid.
5. **Additionality is not accessible.** 99% of companies do not have access to electricity contracts that add new renewable electricity to the grid (i.e. Power Purchase Agreements).
6. **Separation of certificates and physical electricity.** A company in Denmark may claim to be carbon neutral at night in wintertime through buying certificates from solar electricity produced during summer in Spain.

Reel has developed a novel scientific framework for carbon accounting of electricity consumption. The framework takes the following into account:

- **The baseline (A_B):** Accurate and fair attribution of emissions from consuming electricity from the grid.
- **Additionality (C_A):** Reductions arising from addition of new renewable electricity to the grid.
- **Optimisation (C_O):** Reductions arising from lowering your electricity consumption.
- **Reporting and communication (A_R):** How to report and communicate carbon footprint performance.

Companies can take three simple steps to reduce emissions from electricity. Reel helps companies reduce emissions from their electricity consumption. We recommend all companies to:

- **Add new renewable electricity to the grid.** Enter electricity contracts that ensure the construction of new renewable power plants.
- **Reduce consumption.** Use less electricity and naturally reduce emissions.
- **Optimise electricity consumption pattern.** Consume electricity at times with high shares of renewable electricity available at the grid.

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1. Why this white paper?

Electricity remains the single most important sector for mitigating climate change^{1/2}. Electricity is the largest source of carbon emissions (Figure 1) and global demand for electricity is growing rapidly. Total emissions from electricity are increasing despite recent efforts of transitioning to renewables. In fact, emissions from the annual increase in electricity consumption alone amount to nearly two-thirds of the total annual emissions from international aviation. Only 25% of global electricity generation come from renewable sources.

CALL FOR ACTION

The renewable energy transition is happening too slowly – the scientific community urges greater scale and pace to achieve the Paris Agreement goals^{1/8}. While there has been some progress in renewables, the transition is happening too slowly. In the US, the pace needs to be 8 times faster⁹. The vast majority of countries are not on track to meet SDG 7.2 – increasing the share of renewables in the energy mix¹⁰.

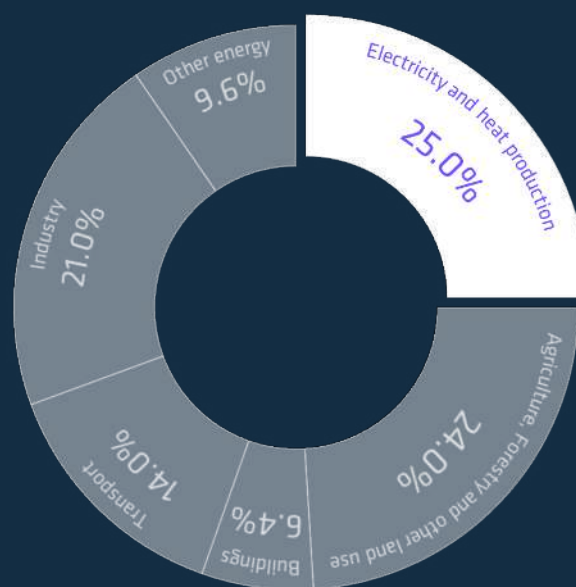


Figure 1: Global sources of carbon emissions¹

Market demand for renewable electricity is now the main driver in the renewable energy transition³. Historically, governmental subsidies have been a significant driver in the renewable energy transition. With rapidly falling development costs, renewable energy resources are reaching grid parity and a subsidy-free era has begun^{4/5}. As governmental subsidies are phased out, the demand for renewable electricity takes over as the main driver in the renewable energy transition³.

Companies increasingly want to take responsibility for the climate and their efforts are needed to drive the renewable energy transition. Corporate greenhouse gas disclosure has increased significantly during the last decade with a 70% increase since 2015 alone⁶. This illustrates an increasing trend of companies desiring to improve and communicate their carbon footprint to the public. To support this desire, many companies are switching to renewable electricity. The industrial and commercial sectors account for almost two thirds of the total global electricity consumption⁷. When companies within these sectors take responsibility for their electricity consumption, they have the scale to influence the renewable energy transition significantly.

However, 99% of companies cannot access electricity that reduces emissions. For 99% of all companies, the only way to access “green” electricity is buying certificates*. Certificates prove that renewable electricity has been added to the grid within the last 12 months¹¹. Following the GHG Protocol, companies are allowed to claim that they consume renewable electricity when buying certificates and reduce their carbon footprint accordingly¹². This system allows companies to claim artificial emissions reductions and is ineffective in driving the renewable energy transition¹³. Companies and climate-aware consumers are misled, and focus is shifted from initiatives that create a real climate impact.

A new paradigm is needed to empower companies to drive the transition on market terms – a paradigm that attributes emissions fairly and rewards genuine carbon emission reductions. Companies’ desire to switch to renewable electricity needs to be translated into actual emission reductions. A scientifically backed method to fairly attribute carbon emissions from electricity consumption needs to be established. Solutions that genuinely reduce carbon emissions need to be readily available for all companies.

*The certificate scheme is called Guarantees of Origin in the European Union and Renewable Energy Certificates in North America.

PURPOSE OF THIS PAPER

With this white paper, we aim to:

- Highlight the fundamental challenges that currently hinder the renewable energy transition.
- Introduce our scientifically backed method for attributing carbon emissions from electricity.
- Enable companies to genuinely reduce carbon emissions from their electricity consumption and transparently document their performance.

2. What is green electricity?

Everyone agrees on what it means to produce green electricity, but it is much harder to understand what it means to buy green electricity. Green electricity is an off-the-shell product offered by most utilities today. Typically, you pay a small premium to be powered 100% by green electricity. This section briefly covers the central terms and mechanisms needed to understand what happens when you buy green electricity.

Buying green electricity does not change the actual electricity you consume. When you buy electricity from your utility, the electricity is supplied from the public grid and comes from a mix of different sources. When electricity is generated, it is delivered to the public grid and instantly mixed with electricity from all other sources generating electricity at that time. It is impossible to separate electricity from renewable and fossil sources once it has been mixed on the grid. Consequently, you always consume the mix of electricity available on the grid at the time and place of consumption, which can differ widely as illustrated by Figure 2.

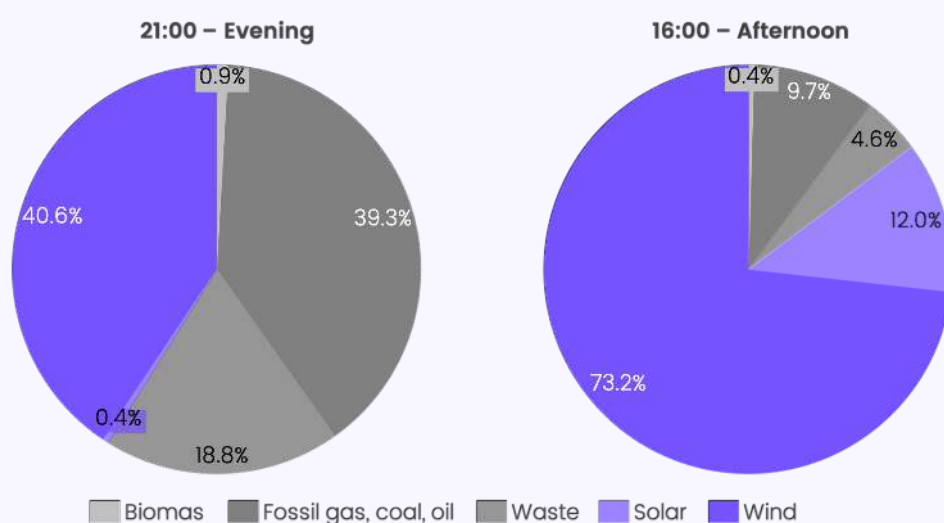


Figure 2: Grid mix in Denmark on the 19th of January 2019 at two different times of the day. Data provided by ENTSOE-E¹⁵.

You buy the right to the green electricity and not the green electricity itself. When you buy green electricity, you are buying certificates as an add-on to the electricity itself. The certificates guarantee that renewable electricity equivalent to your electricity consumption has been delivered to the grid somewhere in Europe within the last 12 months¹¹. As the certificates are separated from the physical delivery of electricity, this does not change the mix of electricity you consume. Therefore, it is more accurate to say that you buy the right to the green electricity instead of the green electricity itself. The purpose of certificates is to make up a market-based alternative to governmental subsidies providing renewable electricity generators with an additional revenue stream directly coupled to the amount of electricity generated and sold¹⁴.

Through certificates, you can achieve a carbon neutral electricity consumption. Companies follow recognised standards for greenhouse gas accounting, such as the GHG Protocol*. In 2015, an amendment to the GHG Protocol was released on so-called Scope 2 Guidance¹². Scope 2 refers to tracking and allocation of electricity attributes from renewable energy generators to the final consumers and cover emissions originating from electricity acquired and consumed by a company. The GHG Protocol provides two methods for scope 2 accounting. In the location-based method, companies are attributed emissions from the average market mix available at the time and place of consumption. The market-based method allows companies to achieve a carbon neutral electricity consumption through buying certificates. If a company buys certificates equivalent to its electricity consumption, the market-based method allows the company to account that they have consumed 100% renewable electricity (i.e. having no carbon emissions from their electricity consumption).

The Danish labelling system for green electricity is an indicator of carbon offsets and is not directly related to the electricity you consume. In Denmark, green electricity labelling follows guidelines developed by the Danish consumer ombudsman¹⁶. The guidelines provide an exemption from the general requirement that environmental claims in marketing efforts must be documented by an environmental impact assessment^{17/16}. This general requirement cannot be applied to electricity as it is impossible to separate fossil and renewable electricity once it has been mixed on the grid. Consequently, it is not possible for consumers to claim that the electricity they consume originate from renewable sources.

Green electricity options available for Danish electricity buyers¹⁶:

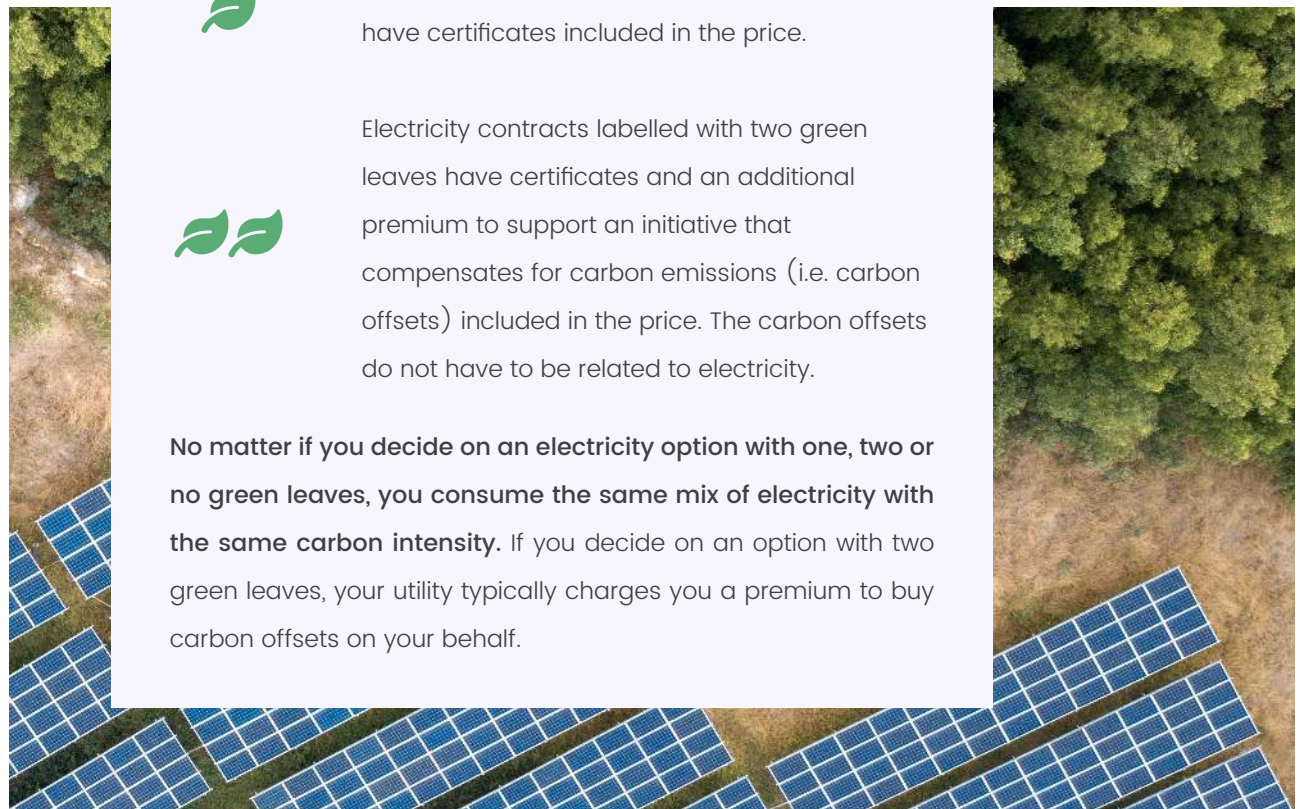


Electricity contracts labelled with one green leaf have certificates included in the price.



Electricity contracts labelled with two green leaves have certificates and an additional premium to support an initiative that compensates for carbon emissions (i.e. carbon offsets) included in the price. The carbon offsets do not have to be related to electricity.

No matter if you decide on an electricity option with one, two or no green leaves, you consume the same mix of electricity with the same carbon intensity. If you decide on an option with two green leaves, your utility typically charges you a premium to buy carbon offsets on your behalf.



*The GHG Protocol is the world's most used greenhouse gas accounting standard¹⁸. 92% of all Fortune 500 companies use the GHG Protocol to disclose their carbon emissions.

3. Challenges with the current certificate-based system

The following challenges all hinder the renewable energy transition and therefore work against global efforts to mitigate the climate crisis. The challenges are a consequence of outdated political structures, an opaque electricity market, and misleading labelling schemes. Based on extensive research, this section provides a brief introduction with the purpose of highlighting central aspects of each challenge.

[Find more details here](#)

A

Buying certificates does not reduce carbon emissions

Certificates have no meaningful effect on the renewable energy transition and do not reduce carbon emissions. Though certificate markets are growing, they are not functioning efficiently due to poor liquidity, high price volatility, and a constant state of oversupply¹⁹. The additional income from certificates is either too low or too uncertain to stimulate the development of new renewable energy. This means that certificates do not make up an effective market-based alternative to governmental subsidies and have failed to drive the renewable energy transition^{20/13}. Consequently, certificates are mainly valuable as a marketing instrument for electricity retailers. If the renewable energy transition is not stimulated, total carbon emissions are unchanged. Instead, consumers claim carbon reductions that have already taken place, and which would have taken place whether they bought the certificates or not. That does not reduce companies' carbon footprint and total carbon emissions are left unchanged.

B

Incentives and consequences are skewed towards inaction

The certificate system incentivises and rewards artificial action over real emission reductions¹³. The below example (Table 1) of two identical companies illustrates why the certificate system creates the wrong incentives and rewards. Both companies have similar starting points. Company A chooses to buy certificates to reduce its emissions and is rewarded by the market. However, company A has not actually reduced its emissions. Company B on the other hand invests in reducing its electricity consumption and thereby achieves actual carbon emission reductions. Company B appears worse on paper compared to company A and is therefore disfavoured by the market.

B

Table 1: Example of two identical companies illustrating why the certificate system creates wrong incentives and rewards. Adapted from Brander et al. (2018)¹³.

	Company A	Company B
Starting point	10 tCO ₂ e from electricity	10 tCO ₂ e from electricity
Actions of same costs	Buys certificates equivalent to its electricity consumption	Implements energy efficiency measures to reduce electricity consumption
Reporting consequences	100 % emission reduction	30 % emission reduction
Actual consequences	None*	30 % emission reduction
Market response	Favoured due to better reporting performance	Disfavoured due to worse reporting performance

C

Focus shifted from problem

The Danish consumer ombudsman's labelling scheme on green electricity is shifting focus away from the actual problem. The Danish green electricity labelling scheme is problematic as it shifts focus from efforts directly linked to electricity consumption. This is done by bundling electricity with carbon offsets and thereby achieving carbon emission reductions from a completely different sector not related to electricity (e.g. by planting trees). Carbon offsets should be kept separate from measures directly related to electricity to keep transparency and ensure that it does not become a pretext for inaction.

D

Additionality is not rewarded

Actions leading to the addition of new renewable electricity to the grid is not rewarded¹³. Additionality in this context refers to the addition of new renewable electricity to the grid. Adding new renewable electricity to the grid is an effective way of reducing carbon emissions and driving the renewable energy transition. Certificates do not differentiate between electricity from existing renewable sources and new renewable sources. Consequently, companies are not rewarded for taking actions that ensure the addition of new renewable electricity to the grid.

¹³Except making company B's carbon footprint appear worse. When company A buys certificates and claims to be 100% powered by renewables, the average grid mix becomes heavier on fossil fuels to avoid double-counting.

E Additionality is not accessible

All companies should have the option to choose additional renewable electricity. Large companies increasingly turn to additionality to reduce carbon emissions from their electricity consumption. To do this, they typically sign Power Purchase Agreements (PPAs) with renewable energy developers. PPAs enable developers to build new renewable electricity plants (e.g. solar parks or wind farms). The new plants generate and deliver renewable electricity to the grid. PPAs enable companies to claim that they have added new renewable electricity to the grid equivalent to their electricity consumption. This way, the companies claim to be 100% powered by renewable electricity and contribute to the renewable energy transition. Until recently, PPAs have exclusively been available for C20 companies. Several barriers of entry make it impossible for 99% of all companies to sign PPAs.

F Separation of certificates and physical delivery of electricity

You may claim to be powered by renewable electricity at times when there is no renewable electricity on the grid. Currently, certificates are accounted for on an annual basis²¹. This means that the certificates you buy to cover your electricity consumption at night may originate from generation occurring at midday from a solar plant. At the time of consumption, there may be a large share of fossil-based electricity available at the grid, which is ultimately the electricity that you consume.



4. A new approach to carbon accounting of electricity consumption

The purpose of our carbon accounting method is to provide the transparency needed for companies to make informed decisions, while creating the incentives to genuinely reduce carbon emissions all the way to zero. This section presents our method for carrying out carbon accounting of electricity consumption based on research conducted at the Technical University of Denmark. Companies need access to accurate information on their carbon emissions. Based on this, they can make informed decisions on how to reduce their carbon footprint. Tools that effectively reduce carbon emissions need to be readily available. The reductions achieved should be transparently quantified and communicated. We have developed our method for carbon accounting as a direct response to the challenges highlighted in section 3. The purpose of our method is to provide the transparency needed for companies to make informed decisions, while creating the incentives for companies to aim for reducing their carbon emissions all the way to zero.

[Get in touch with Reel to learn how to implement our approach](#)

A_B

The baseline – Accurate and fair attribution of carbon emissions

Before making any decisions, an accurate and fair baseline needs to be established. The baseline represents the actual carbon emissions incurred as a direct consequence of your company's electricity consumption. This is the carbon intensity of the electricity mix available from the grid at the time and place of consumption*. This way, all companies are attributed the emissions they are responsible for. With this as the starting point, informed decisions can be made to reduce carbon emissions. The baseline is determined following our scientifically backed attributional modelling method for bookkeeping of carbon emissions.

[Access detailed information on how we determine baseline footprint here](#)

*i.e. the location-based method according to the GHG Protocol's Scope 2 guidance

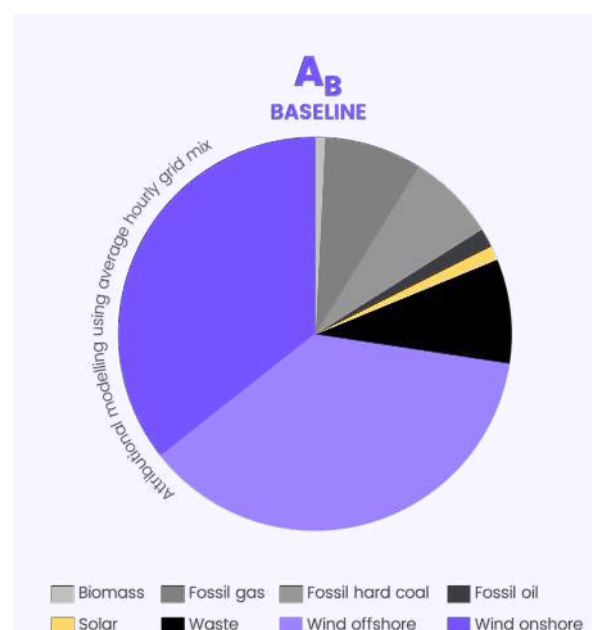


Figure 3: Example of the baseline quantified as a mix of different electricity sources

C_A**Additionality – The addition of new renewable electricity to the grid**

Additionality is an effective way for companies to contribute to the renewable energy transition and reduce carbon emission. The addition of new renewable electricity to the grid is referred to as additionality. Additionality does not change your company's baseline footprint as you continue to consume the mix of electricity available at the public grid. However, you do reduce carbon emissions as the addition of new renewable electricity to the grid substitute fossil sources of electricity. Following our scientifically backed consequential modelling approach, we quantify and attribute the reductions in carbon emissions arising from additionality. Our method allows for reporting of a reduced carbon footprint (**A_R**), where the emission reductions arising from additionality are subtracted from the baseline footprint. To ensure transparency and incentives to implement further reduction initiatives, the baseline and the additionality are reported individually as supporting documentation for the reduced carbon footprint.

[Access detailed information on how we quantify and attribute additionality here](#)



Figure 4:
Quantification and reporting of additionality and the reduced baseline

C_O**Optimisation – Reduce emissions through optimisation measures**

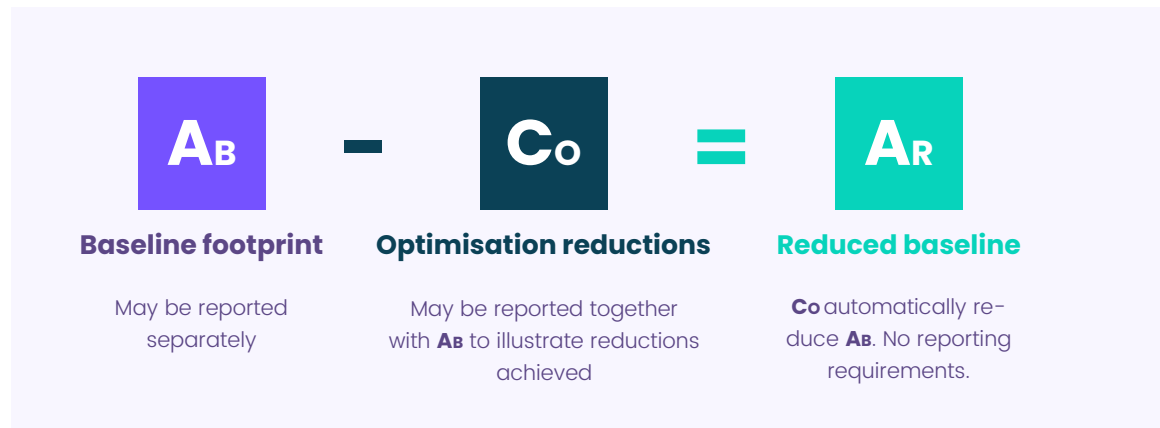
Quantification of carbon emission reduction potential from energy optimisation measures and optimisation of consumption patterns. A reduced baseline footprint can be achieved through two optimisation measures:

- Identifying and minimising unnecessary electricity consumption.
- Shifting electricity consumption to times with high shares of renewables in the electricity mix.

The emission reductions achieved through optimisation measures are directly related to the electricity consumed and therefore automatically accounted for in the baseline footprint.

[See how optimisation measures are accounted for in the baseline footprint here](#)

Figure 5:
Quantification
and reporting of
reductions achieved
through optimisation
measures

**A_R**

Reporting and communication

Making reporting transparent and automatic is a central piece in the puzzle. Your company's baseline results should be published as a stand-alone metric in your carbon reporting. This way, transparency is kept intact by reporting the actual carbon emissions associated with your electricity consumption. Applying optimisation measures, you can naturally reduce your baseline footprint. Adding new renewable electricity to the grid will not directly affect your baseline, why this needs to be reported separately. Ultimately, the accumulated result of all your actions is reported as the reduced baseline. If you are using our platform, we quantify all metrics and automatically generate performance reports.

[Learn more about our assessment and reporting methodology here](#)

Figure 6: Summary of our method for quantification and reporting of carbon emission reductions



5. Guide: How to reduce carbon emissions from electricity

Take actions on your electricity consumption to contribute to the renewable energy transition and reduce your carbon footprint effectively. Buying certificates does not reduce your carbon footprint. The public criticism of certificates leading to greenwashing has been ongoing for more than a decade with a new wave of public criticism hitting the media in the beginning of 2021. Several large Danish companies have been accused of greenwashing²². Following this guide, your actions will lead to genuine carbon footprint reductions, and you will not end up accused of greenwashing.



Add new renewable electricity to the grid. To add new renewable electricity to the grid, companies can enter procurement agreements (referred to as PPAs). Through a PPA, your company enables the development of a new solar or wind park that generates renewable electricity. This renewable electricity substitute fossil sources of electricity. Consequently, your company contribute to the renewable energy transition and reduce its carbon emissions. Until recently, PPAs have only been available for C20 companies. Reel offer new renewable electricity (based on PPAs) to all companies.

[Calculate your potential carbon footprint reduction](#)



Reduce your electricity consumption. The most direct way to reduce carbon emissions is to reduce the amount of electricity you consume. Typical energy optimisation measures include replacement of old equipment and the use of smart software to minimise unnecessary electricity consumption (e.g. through optimisation of ventilation, heating and lighting). This way, you both reduce emissions and money spent on electricity.



Adjust your electricity consumption to take place at times with low carbon intensity.

As showed in Figure 2, the availability of renewable electricity on the grid is highly variable. By consuming electricity when the share of renewables in the electricity mix is high (i.e. when the sun is shining and the wind is blowing), you naturally reduce your carbon footprint. This entails that you can adjust your consumption pattern*. If your company has equipment that only run for a given number of hours every day, forecasting tools allow for planning of consumption to take place at optimal hours.



Ready to take meaningful actions to reduce your carbon footprint? We are eager to help you achieve your carbon emission reduction goals.

[Get in touch to learn more](#)

*Reel recognizes that flexible consumption is challenging for most companies as they have fixed production processes that either align with normal working hours, or are fixed (i.e. the factory runs 24/7). Therefore, it is not possible for all companies to adjust their consumption to align with periods of high renewable electricity availability on the grid.

6. About Reel

Rooted in science. Developed for the market. Reel is founded at the Technical University of Denmark (DTU) as a spinout from the world-renowned Quantitative Sustainability Assessment Group. Based on extensive research, we have developed a novel framework to measure and attribute environmental impacts from electricity consumption. With the framework, we aim to introduce the transparency and incentives for consumers to make informed decisions and take meaningful actions. We strive to transform how renewable electricity is procured and empower all companies to reduce their carbon footprint.



Interdisciplinary activists. We are a team of sustainability experts, business professionals, and software developers with a shared mission of making a significant contribution in the fight against climate change. With our combined experience, strong partnerships, and novel approach, we are transforming the market of renewable electricity procurement.

[Get in touch with us](#)



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