CO_2 Impact Methodology:

Saved and avoided emissions by Schneider Electric offers

Methodological Guide
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Life Is On | Schneider Electric

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Contents (cont'd.)

Time for climate impact disclosure

Climate is increasingly embedded in companies' strategies. Economic actors are committing to reduce their carbon emissions and set science-based targets compatible with a global warming of 1.5 or 2°C, striving to reduce risks and capture new opportunities associated with the energy and climate transition. Climate mitigation strategies make good business sense: energy efficiency, resource circularity and renewable energy enable recurring cost savings and increase the resiliency of supply chains. CO_2e pricing has already been enforced in several geographies (through quotas or taxes), and the cost of resources shows important volatility, weighing on productivity. Companies also ambition to increase the resiliency of their assets by avoiding "stranded assets" risks, meaning the deterioration of asset value due to inequation with "2°C-compatible" markets and regulations. The climate transition is also an opportunity to innovate, outpace competitors and attract talents, and appears as one of the mega-trends driving market evolution.

Standardized definitions and quantification methodologies are essential to assess climate impact and build trust, on corporate, customers and investors side.

Time has come to go one step further with **transparent climate impact disclosure**, focusing on key impact metrics depending on the activity of companies. For the **capital goods and consumer durables sectors**, a priority is to **measure and reduce the CO_2e impact of offers** during their lifetime, as solutions sold today will be used for years or even decades. Emissions from the use-phase of offers typically represent over 80% of the end-to-end CO_2 footprint of capital goods and consumer durables companies, and therefore the main lever of action to contribute to climate change mitigation. Many technologies bring energy efficiency and flexibility, enabling to cut CO_2 emissions from historical emissions. **Climate impact disclosure therefore needs to account fully for induced, avoided and saved emissions over offers' lifetime**.

The need for an innovative CO_2e methodology

To meet the challenge of the climate transition, it appears necessary to reinforce the ability to quantify the CO_2e impact of offers, looking both at induced and avoided or saved emissions. Customers demand increased transparency, with environmental information available at a fingertip and the ability to distinguish offers with a positive impact on climate. Investors request a full overview of the impact of investee companies, to reduce risks and capture opportunities in their portfolio. Both needs should be answered in a consistent manner, with a CO_2e methodology that can be used both at a granular and aggregated level, to quantify the CO_2e impact of single offers and full lines of business, and that enables to quantify CO_2e savings or avoidance compared to a reference situation.

Various initiatives exist today to try and clarify how CO_2e impact is quantified. The GHG Protocol published a paper[1] recommending best practices aligned with the ones implemented in our methodology, and works within the electrical technology industry are in progress to publish an industry specific standard. However, no methodology standardized today meets yet the need to quantify the CO_2e impact of offers for customers and investors. While traditional Life-Cycle Analysis (LCA) concentrates on quantifying end-to-end (cradle to grave) emissions, it gives no guidance on how to quantify CO_2e savings or avoidance compared to a reference situation. CO_2e Project Accounting methodology is granular and bottom-up, focusing on single identified large projects. It is therefore not applicable to a wide range of offers sold across a variety of end-user markets with different use-cases. Finally, Corporate CO_2e Accounting standards of the GHG Protocol cannot be applied at the offer level and provide no guidance on how to quantify CO_2e savings or avoidance compared to a reference situation. As a result, claims made by economical actors are often inconsistent and lack transparency, thus reinforcing the need for a shared methodology.

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[1] *https://ghgprotocol.org/estimating-and-reporting-avoided-emissions*

	LCA	CO_2e Project Accounting	CO_2e Corporate Accounting
Applicable at offer / single project level	✓	✓	✗
Applicable at aggregated line of business / corporate level	✗	✗	✓
CO_2 savings or avoidance compared to a reference situation	✗	✓	✗

The objective of this guide is to share and promote an innovative CO_2e impact methodology, that enables to quantify saved and avoided emissions by offers in use. This methodology is inspired from existing CO_2e accounting standards, with the ambition to leverage best practices from each.

This methodology ambitions to become a shared industry standard within the consumer durables and capital goods sectors. This methodology guide is an effort to share transparently on principles and calculation rules, so that all companies can disclose consistently the CO_2e impact of their offers.

The methodology is **pragmatic, robust and flexible** to allow fast adoption in the industry.

Our promise: 800 $MtCO_2e$ saved and avoided from 2018 to 2025

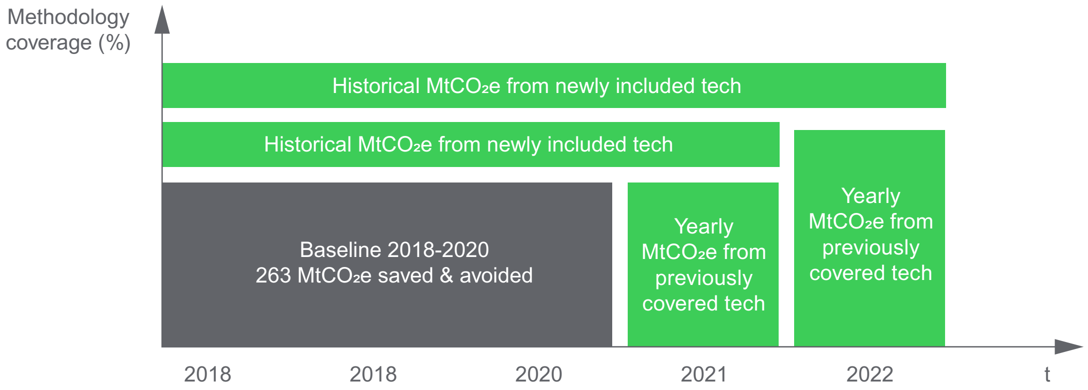
Schneider Electric, the global specialist in energy management and automation, is committed to helping its customers become more efficient and reduce CO_2e emissions. With EcoStruxure, our IoT-enabled architecture, we help buildings, data centers, energy infrastructures and industries manage their energy and processes in ways that are safe, reliable and efficient.

CO_2e savings are delivered at every layer of the 3-layer EcoStruxure™ architecture:
- We eco-design our **Connected Products**, to improve their efficiency and deliver electricity savings.
- The **Edge Control** layer gives the capability to manage on-site operations, with day-to-day optimization of energy consumption through remote access and advanced automation.
- Our portfolio of **Apps, Analytics & Services** leverages IoT data and the expertise of our engineers to identify additional energy efficiency opportunities, increase the lifetime of assets, optimize maintenance services and boost demand flexibility and renewable electricity.

At Schneider Electric, sustainability is a top priority and is embedded in our strategy, shaping our value propositions and technologies. **The Group's target is to enable its customers to save and avoid 800 million tonnes of CO_2 from 2018 to 2025 (7-year cumulative).**

Catch-up of historical saved & avoided emissions for new technologies

Every year, new Schneider Electric offers are included in the scope of this methodology and emissions saved or avoided related to them are calculated. But just because an offer is only included at year N does not mean that it did not save emissions over the previous years. These historical saved or avoided emissions are thus added to the consolidated indicator that is defined for the 2018-2025 period.



Key guiding principles

The CO_2e Impact Methodology is a **transversal** framework, applicable for all offers across the capital goods and consumer durables sectors, and that covers products, software and services. The methodology follows **5 guiding principles**:

1. **Rigorous and detailed**, the methodology has been developed with the support of an independent and expert consulting company **(Carbone 4)**:
   - **Detailed calculation rules** per offer/technology, leveraging in each case the best available data (such as sales data, market data, or expert estimates)
   - **Forward-looking emission factors**, to account for the future decarbonization of the world (as technologies sold today will be used for decades).
2. **Conservative and realistic**, we applied a conservative approach to all methodology assumptions to avoid “greenwashing” in climate claims. One of the most important principles of the methodology is the **distinction between Brownfield sales** (enabling emissions savings compared to previous years – saved CO_2e emissions) **and Greenfield sales** (enabling a limitation of emissions increase versus an alternative scenario – avoided CO_2e emissions).
3. **Transparent**, with a recommended disclosure framework applicable to all offers and all companies. The choice of reference situation and emission factors can lead to important variability of results between actors. It is therefore paramount to disclosure transparently calculation rules, to build trust and to enable further alignment between peers. This is why **Schneider Electric chose to publish the hereby full and detailed methodology** and to make it available for the market. **All calculation rules and data sources are disclosed transparently** for each offer.
4. **Compliant and verified**
   - The methodology is **aligned with the Greenhouse Gas Protocol accounting and reporting principles**. Notably, results are expressed in metric tons of CO_2 equivalent (tCO_2e) and include scope 1, 2 and 3 emissions as defined by GHG Protocol Standard.
   - As an independent verifier, EY reviewed the methodology prepared by Schneider Electric with regards to its consistency, accuracy, understandability, neutrality, completeness and relevance. The methodology has been assessed in view of the requirements of ISO 14067 and ISO 14021.
5. **Pragmatic, flexible and widely applicable**
   - This methodology has been designed to be applicable across the capital goods and consumer durables sectors.
   - Key principles are transversal to all long-lasting equipment manufacturers, software and service providers (capital goods and consumer durables sectors).
   - Pragmatic and flexible calculation rules can easily be adapted to a wide variety of activities, leveraging existing financial and business reporting.

Accounting and reporting principles

1. Applicability

This methodology is **applicable to companies selling long-lasting tangible assets** (such as buildings, machinery, equipment, vehicles and tools), software and services that will be used either by other businesses to produce consumer goods or by final consumers. Said differently, this methodology is applicable to the **capital goods** and **consumer durables** sectors, covering both sales to businesses and final consumers. For instance, this methodology is applicable to manufacturers of automobiles, aircrafts and machinery, as well as to their supply chain of components manufacturers.

2. Temporality

Two methodologies are available to quantity emissions from the use of products and services over their lifetime: yearly accounting and cumulative accounting.

This methodology uses the **yearly accounting methodology**, meaning that the methodology considers induced, avoided and saved emissions of the offers sold within the year, cumulated over the expected offers' lifetime.

The methodology takes into account 100% of lifetime emissions of offers sold within the year:

- 100% of lifetime CO_2e emissions are taken into account at the time the sale is booked as revenues into financial statements, meaning that only the sales of the year are taken into account each year;
- Net sales are considered each year (sales output minus refunds) to account for overpayments, product recalls, cancellations, etc.

This enables to align the scope and period of financial and CO_2e reporting, while ensuring the absence of double-counting. The delay between the sale and the commissioning of offers at customer's site (due to stock at customer's sites, shipping time, installation time, billing time, etc.) does not impact results.

Cumulative accounting (not used in this methodology) considers induced, avoided and saved emissions of the offers sold in the past during the year of reporting. The implementation of this method is complex as it requires to have access to detailed sales and technical data of offers sold over the past decades, as well as defining tailored reference situations to account for each period. In addition, cumulative accounting does not meet the need from investors and customers to assess the CO_2e impact of offers currently sold by a company.

3. Greenhouse gases

According to the GHG Protocol Standard, results are reported in CO_2 equivalent (CO_2e). Through this unit, it is possible to aggregate contributions to global warming from the six main greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6). To achieve this, their Global Warming Potential on 100 years, sourced from the IPCC's AR6 (Assessment Report 6) is taken into account.

4. Link between saved & avoided emissions and Schneider's carbon footprint

Avoided and saved emissions are net emissions calculated over the full life cycle of offers (similarly to an LCA calculation approach) and thus include data from the company's scope 1, 2 and 3 emissions.

However, the methodology only covers a part of Schneider's activities so far. That is why total saved & avoided emissions should not be compared to the company's footprint.

5. Emission factors

The selection of GHG emission factors follows recommendations from ISO14064: emission factors are derived from a recognized origin, appropriate and consistent.

As a general rule, emission factors from public databases are preferred, such as ADEME, GHG Protocol and International Energy Agency (IEA). Emission factors from private databases can also be used when more relevant or accurate, such as Ecoinvent.

Emission factors include all greenhouse gases under the GHG Protocol Standard and are in metric tons of CO_2 equivalent.

In all cases, **the source and update frequency of emission factors should be disclosed transparently for each offer**.

As a key guiding principle, this methodology is “forward-looking”, meaning that relevant emission factors are adjusted to consider the future “decarbonization” of the world. Indeed, offers sold today have life expectancies of several years or decades, and induced, avoided and saved emissions will evolve in time depending on the evolution of the environment.

This mainly applies to electricity emission factors, where significant reductions of CO_2e emissions are expected over the next decades. Using current electricity emission factors would lead to a systematic overestimation of induced, avoided and saved emissions. Electricity emission factors are chosen using the “location-based” approach (as defined by the GHG Protocol), meaning that average country electricity emissions factors are used. The “market-based” approach cannot be used in this methodology, as Schneider Electric has no visibility of energy suppliers chosen by its customers’ over the lifetime of sold offers.

In this version of the methodology, Schneider Electric uses the 2017 “Reference Technology Scenario” (RTS) by the IEA[2] to discount electricity emission factors from expected future reduction of CO_2e emissions. The RTS takes into account commitments made in 2017 by countries to limit GHG emissions, including the Nationally Determined Contributions pledged under the Paris Agreement at the time[3]. By factoring in these commitments and recent trends, the RTS already represents a major shift from a historical “business as usual” approach and results in an average temperature increase of 2.7°C by 2100. Calculation is done for each offer, depending on the offer’s expected lifetime. For instance, in the RTS scenario, the average world electricity emission factor is reduced by 28% in 2035 compared to 2018.

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[2] *Energy Technology Perspectives 2017, International Energy Agency (IEA)*

[3] *NDCs have since been updated at the COP26 in 2021*

6. Data collection

According to the ISO 14064 Standard, data used in the calculation can be primary data or secondary data. Sales data is typically primary data, from financial or business databases. Other data used in calculation will mostly be secondary data, from market studies, expert estimates or existing technical standards.

	Data type	Data source
Primary data	Sales data	Sales database
Secondary data	Energy and material efficiency, Brownfield/ Greenfield split, offer use case scenario, lifetime, etc.	Market studies, expert estimates, technical standards

Primary data is preferred to secondary data. Among secondary data, the most consistent is chosen on a case by case basis, following the preferred order below:
1. Primary data
2. Technical standards
3. Public market studies (historical or prospective)
4. Private market studies (historical or prospective)
5. Expert estimates (internal)

In all cases, the **source and update frequency of collected data should be disclosed transparently for each offer**.

7. Uncertainties

This methodology follows the GHG Protocol principle for “accuracy”, meaning that results should give a faithful representation of the CO_2e impact of sold offers, reducing uncertainties as much as possible and enabling users to make decisions with reasonable assurance as to the integrity of the reported information.

With this methodology, uncertainties of results are similar to uncertainties of corporate scope 3 CO_2e accounting, and typically of the order of magnitude of +/-30%.

Uncertainty results from the combination of uncertainties of all terms of the calculation, as detailed in the table below:

Calculation terms	Uncertainty
Sales data	Very low, data typically comes from sales databases used for financial and business reporting
Energy and material efficiency, Brownfield/ Greenfield split, offer use case scenario	Medium, mostly world-average estimated based on experts estimates, technical standards, market studies
Lifetime	Low, from existing technical standards where possible. Conventional values from existing technical standards will further enable comparison of results between peers
Emission factors for electricity consumption	Low, as calculation rely mostly on energy emissions factors with a good level of accuracy. However, the forward-looking approach (discounting for future CO_2e decarbonzation of energy mix) relies on energy scenarios and increases the level of uncertainty
Rebound effects	Calculations in this methodology do not account for rebound effects that could occur after adopting energy efficient technologies, potentially leading to erase part of the energy savings due to high complexity and high level of uncertainty. Therefore, rebound effect is considered out of scope for this methodology.

8. Recommended disclosure for transparency

To ensure transparency and comparability of CO_2e savings and avoidance published by companies, the following should be disclosed for each offer:

- Description of the offer
- Definition of Greenfield reference situation
- Definition of Brownfield reference situation
- Boundary of calculation
- Emission sources included in calculation
- Avoided CO_2e calculation formula
- Saved CO_2e calculation formula
- Source of data of each term used in saved CO_2e and avoided CO_2e calculation formulas, including origin of data (expert estimate, sales data, market data, etc.) and calculation granulometry (world average, regional data, country data, etc.)
- Frequency of data update
- Non-confidential calculation terms, that have a significant impact on results, notably offer expected lifetime
- Source of emission factors

9. Double-accounting

As defined in the GHG Protocol, scope 2 and 3 emissions are by definition direct emissions (i.e. scope 1) of another entity. Like with all accounting methodologies, this methodology therefore generates double-accounting, between the reporting company (here Schneider Electric), its suppliers and its customers. This reflects the reality, as multiple entities in a value chain influence at the same time induced emissions, saved and avoided emissions. Scope 3 accounting therefore facilitates the simultaneous action of multiple entities to reduce GHG emissions.

This methodology follows scope 3 guidance from ISO 14064 and the GHG Protocol and **considers all relevant upstream, internal and downstream emissions induced, avoided and saved with offers** sold during the year.

Furthermore, the segmentation of Schneider's business can potentially lead to counting emissions twice between studied offers. It is especially true of cross-segment offers studied as a whole but through which some products may already have been accounted for in other offers. Whenever this case presents itself, **double counting is clearly identified and neutralised for the aggregation of all savings into one global indicator**.

Distinction between saved and avoided emissions

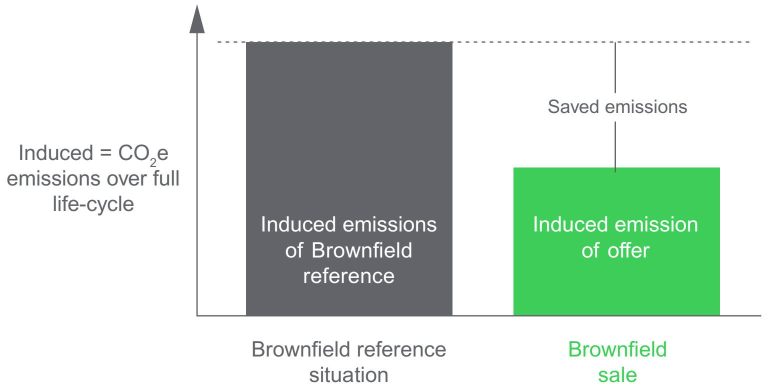
The distinction between saved and avoided emissions enables to better understand the contribution of Schneider Electric to mitigating climate change. It is based on separating Brownfield sales, which enable a reduction of global CO_2e emissions compared to previous years (saved CO_2e), from Greenfield sales, which enable a limitation of the increase of global emissions versus a business-as-usual alternative situation (avoided CO_2e).

Brownfield sales correspond to the situation where the offer sold replaces or upgrades an existing system, and Greenfield sales where the offer sold equips a new infrastructure.

A similar distinction exists in the finance and accounting communities, to distinguish "cost savings" that are calculated compared to the previous situation and impact the company's P&L (Profit & Loss account), from "avoided costs" that enable to avoid having to incur costs in the future. Cost avoidance will never be reflected in the budget or the financial statements, they will only be reflected in situations where the proposed action is not implemented. Cost avoidance is calculated compared to an alternative situation, such as a reduction of a proposed price from a vendor or the reduction for the need for additional headcount through process improvement[4].

"Avoided CO_2e" and "Saved CO_2e" are both net values, meaning they deduct emissions of the new offer installed across its lifecycle.

Following vocabulary defined in the finance sector, net CO_2e emissions in the case of Brownfield sales are called **"CO_2e savings"**. They correspond to a **reduction of CO_2e emitted into the atmosphere compared to previous years**. In this case, the reference situation is defined as the initial situation, meaning the greenhouse gas emissions that were emitted to the atmosphere before the sale of offer.



Net CO_2e emissions in the case of Greenfield projects are called **"avoided CO_2e"**. For a Greenfield sale, the reference situation answers the following question: « What would the customer's situation be if he was not implementing this offer? ». In other words, the reference situation reflects the most realistic market situation. The Greenfield reference situation can vary depending on the offer, on the end-user segment and on the geography, and can typically be a competitor's offer, a regulatory requirement or no alternative offer. Constructing highly performing new systems, to answer the needs of market growth, results in a **limitation of the increase of global CO_2e emissions**.

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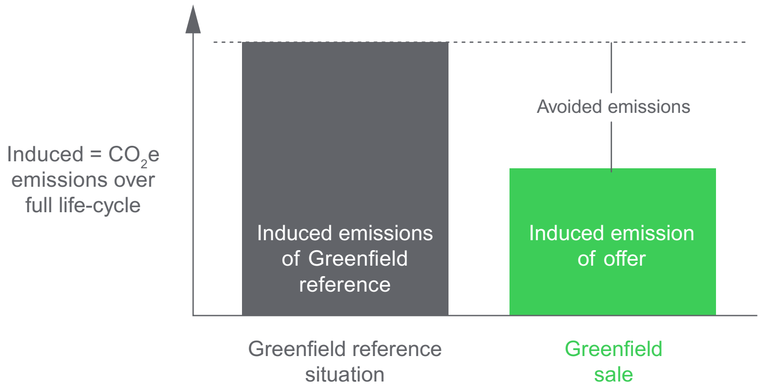
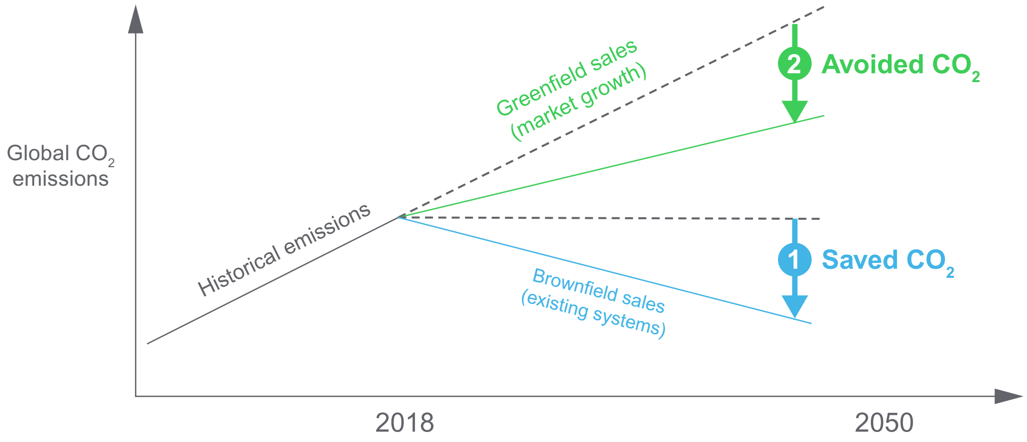
4 Defining cost reduction and cost avoidance, CAPS Research, March 2006



The distinction between saved and avoided CO₂e is at the heart of the CO₂e Impact Methodology: the objective to divide by 2 global emissions by 2050 compared to 1990 refers to "CO₂e savings", meaning a twofold division of total CO₂e emissions into the atmosphere. However, emissions avoidance is crucial to prevent future economic growth (and therefore Greenfield sales) to drive emissions up. Schneider Electric estimates that a threefold increase in energy efficiency is necessary to meet the combined objectives of saving and avoiding CO₂e emissions to mitigate climate change.

In a nutshell: Brownfield sales enable reduction of global CO₂ emissions compared to previous years (saved CO₂), Greenfield sales enable a limitation of the increase of global emissions (avoided CO₂). This distinction is crucial to quantify impact on climate change, with robust reference scenarios and conservative results.



The table below summarizes the distinction between saved and avoided CO₂e:

	Brownfield (BF)	Greenfield (GF)
What is the definition of BF/GF offer sales?	Is the situation in which the product or service sold replaces or upgrades an existing system **(retrofit projects)**.	Is the situation in which the product or service sold equips a new infrastructure to answer demand growth **(new projects)**.
How to define the reference situation?	The Brownfield reference situation is defined as the solutions in place prior to the sale of the offer. For instance, the product or service used in the past to fulfil the same objective.	The Greenfield reference situation is defined as the most likely alternative to fulfil the same output or service of the offer. For instance, the alternative offer from competitors or an alternative technology.
Saved or avoided emissions	SAVED EMISSIONS correspond to the reduction of CO₂ emission compared to previous situation	AVOIDED EMISSIONS correspond to the reduction of CO₂ emission compared to the most likely alternative

Calculating CO_2e emissions savings

Top-down philosophy

This methodology has been designed to be applicable in a "top-down" manner, looking at the CO_2e impact of total sales over a year. Calculation rules have therefore been designed to reflect accurately global market trends and average impact of technologies. Notably, Brownfield and Greenfield reference situations are assessed against market averages, rather than looking at specific contracts. For instance, in the building sector, the methodology will look at the global share of buildings being retrofitted, destroyed and newly built, to assess the share of Schneider Electric's offers that will address Brownfield and Greenfield market.

This choice is motivated by 3 reasons:

- Availability of data: detailed contract by contract information is rarely consolidated at global level, considering the variety of Schneider's customers (the 4 main markets are buildings, data centres, industries and energy infrastructure, representing 70% of global energy consumption), geographies (100 countries) and offers.
- Reproducibility and consistency of results: market averages can be consistently used by all companies within the same industry, at the condition that their own market exposure is in line with global trends (a niche actor would have to tailor calculation terms to reflect accurately his markets)
- Accuracy of results: global CO_2e impact is best estimated looking at global trends and markets. For instance, a sales team working on a specific new renewable capacity would not be able to assess whether this capacity will replace an existing capacity in the grid or whether it will answer a growth of electricity demand. Similarly, a sales team working on the commissioning of a new building will not know if a domino effect of moving companies and households will lead to the destruction of other building stock in the country. "Macro-effects" on climate are better assessed at the country or global level, rather than on a project-by-project basis.

This methodology can also be used in a more "bottom-up" manner, looking at specific sales per end-segment, country or line of business. Generally, the more "bottom-up" and granular the calculation is, the more information will be available on the offer's characteristics and the use case by the customers. In this case, offer or country-specific data will be used in the calculation instead of average market values, to reflect the specific situation. To perform a CO_2e impact calculation on a single project for a single customer, CO_2e project accounting standards would be preferred.

STEP 1: Product, system, ecosystem boundaries

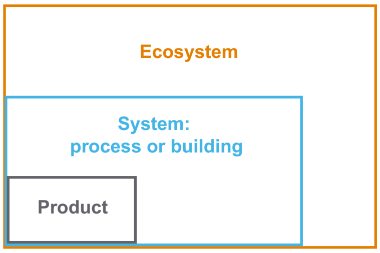
The boundaries of CO_2e emissions calculation are defined on a case-by-case basis, depending on the offer considered.

When looking at a product, three different levels of boundaries can be defined:

- **Product-level boundary:** The boundary can be set to the product itself, looking at the energy consumed and dissipated (e.g. Joule effect) over the product's lifetime.
  Examples: Transformers, Uninterruptible Power Systems, etc.
- **System-level boundary:** The boundary can be defined as the system in which the product is included, for instance a building or an industrial process.
  Examples: Building Management Systems (BMS) that deliver energy efficiency in buildings, Variable Speed Drives (VSD) that deliver energy efficiency on electrical motors, Process Automation solutions in industrial facilities, etc.

- **Ecosystem-level boundary:** The boundary can be defined as a larger ecosystem, for instance when the offer enables a superior quality of service and operation to a network, thanks to increased connectivity and managing capabilities.
  Examples: Smart Grid EcoStruxure that enables renewable integration in the electricity grid and energy demand management.

3 different boundaries of CO_2e impact



Boundary	Induced, avoided and saved emissions
Product	• CO_2e use e-phase emissions due to the final consumption of the product and CO_2e efficiency v/s reference product Examples: Transformers, UPS, etc.
System: process or building	• CO_2e savings delivered to the clients' process or building thanks to the offer sold Examples: Variable speed drives, BMS in buildings, process automation solutions, energy audit, energy performance contracting, etc.
Ecosystem	• CO_2e savings in an ecosystem thanks to increased connectivity and managing capabilities of an infrastructure enabled by the offer sold or thanks to superior quality of service and operation Examples: Smart grid solutions (that enable renewable integration in electricity grid, energy demand management), field service enabling better ecosystem energy efficiency and longer asset lifetime, etc.

When looking at a service, the product, system or ecosystem in relation to which the service is provided shall be identified. The CO_2e emissions to consider are then the ones within the boundaries of this product/system/ecosystem, **to which must be added the CO_2e emissions related to the provision of the service itself**.

In all cases, saved and avoided emissions are considered on the same boundary for a given offer. The definition of boundaries should follow ISO 14064 principles of relevance and accuracy. **Boundaries defined for each offer should be disclosed for transparency.**

STEP 2: Choose the Brownfield and Greenfield reference situations

A **Brownfield reference situation** is defined as the **initial situation prior to the sale of the offer**, meaning greenhouse gas emissions that were released into the atmosphere in the near past without the offer. This definition is applicable to all offers, end-user segments and geographies.

The choice of a **Greenfield reference situation** needs to be decided on a case-by-case basis, depending on offers, end user segments and geographies. The choice of a Greenfield reference situation should be based on the following principles inspired from UNFCCC Standards for the definition of Clean Development Mechanism baseline[5]:

Step 1: List of alternative scenarios. Identify all plausible alternative scenarios that provide the same output as the offer sold. These alternative scenarios should focus on common practice in the end-user sector and geography, and should consider:

1. Greenfield scenario 1: alternative offers on the market
2. Greenfield scenario 2: average market penetration of the offer, and other available technologies
3. Greenfield scenario 3: compulsory regulatory performance of new equipment or infrastructure, and reality of enforcement of these regulatory requirements
4. Greenfield scenario 4: impact of innovation on the environmental performance of the offer over the past years
5. Greenfield scenario 5: other offers that can provide the same output or service, without necessarily being the same technology or a direct competitor

Step 2: Barrier analysis. Establish a complete list of realistic and credible barriers that may prevent alternative scenarios from occurring, such as investment barriers (insufficient financial returns, lack of capital availability) and technological barriers (skilled labor, lack of infrastructure, risk of technological failure, technology availability in geography).

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[5] *UNFCCC, CDM Standard, Determining coverage of data and validity of standardized baselines, version 2, CDM-EB77-A05-STAN*

Step 3: Reference scenario selection. Eliminate alternative scenarios which are prevented by identified barriers. If several alternative scenarios still exist, select the most plausible scenario, that reflects the market common practice. Several scenarios can be combined to design a mixed alternative scenario, with weighing of several alternative scenarios.

In all cases, **the Greenfield reference scenario** used to calculate avoided CO_2e **should be disclosed transparently** for each offer. Depending on the sales distribution of Schneider's offers, different Greenfield reference scenarios can be applied for different sales cases.

STEP 3: Calculate the share of Greenfield and Brownfield sales

The split between Greenfield sales and Brownfield sales is assessed based on market data, either historical or prospective.

Method 1: Based on historical market data

Assessment of the shares of Brownfield and Greenfield sales can be based on historical market growth in volume of the offer and on the average lifetime of the offer, using the formula below:

With:

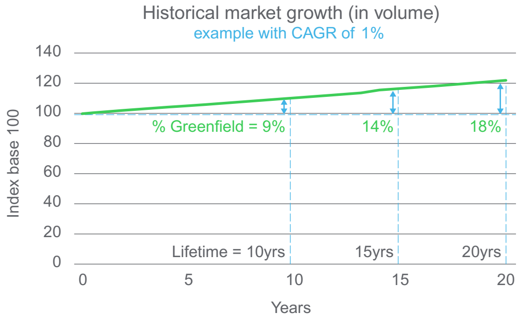
d: expected lifetime of the offer
x%: compound annual growth rate of market in volume over d past years

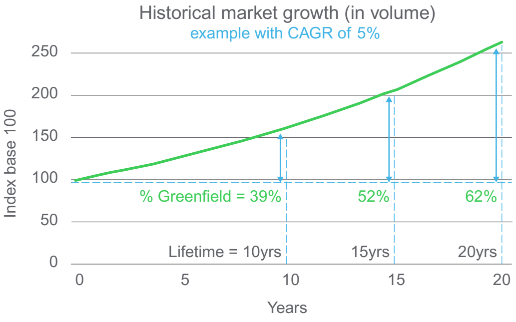
Calculation formula for % Brownfield and % Greenfield sales is:

% Brownfield sales = 1 / (1+x%)^d
% Greenfield sales = 1 – % Brownfield sales

This method is relevant if the dynamics of markets that the offer is targeting is expected to follow historical trends.

Two examples are illustrated below, for growth rates of 1% and 5%, logically resulting in contrasted share of Greenfield sales.





Market growth should be in volume rather than in value to neutralize price change and inflation.

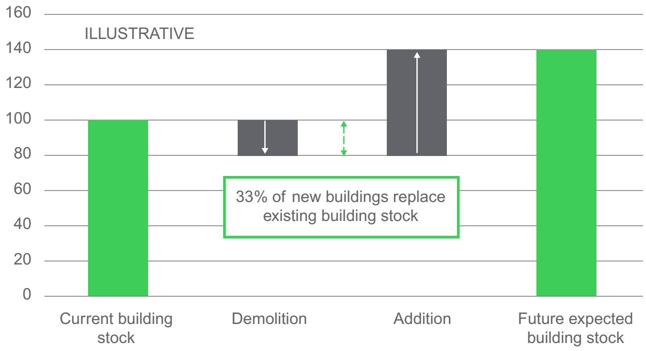
Method 2: Based on prospective (future) market data

Assessment of % Brownfield and Greenfield sales can also be made using prospective market studies, based on future expected market trends.

This method is relevant if the market dynamics of the offer are expected to change over the next years, due to economic growth, energy and climate transition, digitalization of the economy or any other reasons.

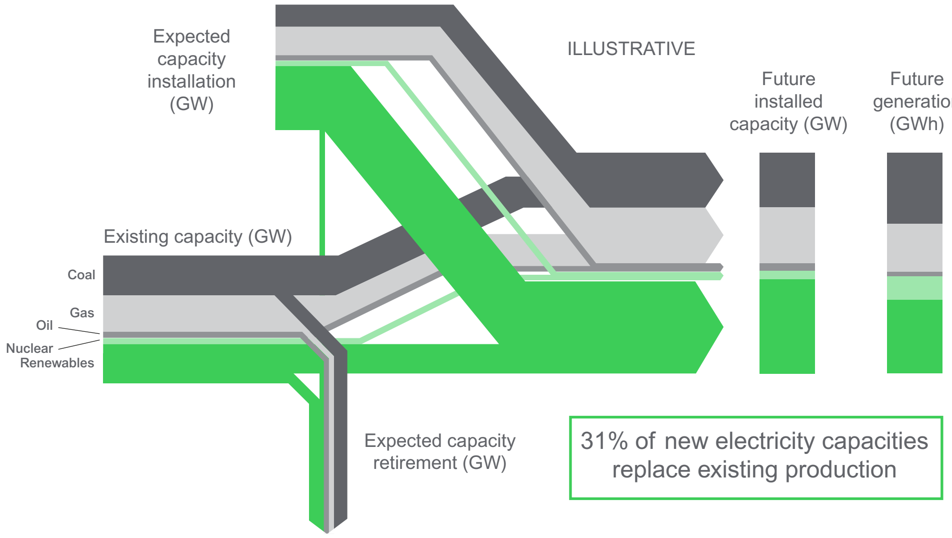
For instance, in the building sector, the methodology will look at the global share of buildings expected to be retrofitted, destroyed and newly built in the coming years, to estimate the share of Schneider Electric's products for Brownfield and Greenfield markets. This enables to quantify from a "macro" (top-down) point of view CO_2e savings against historical emissions and "avoided CO_2e" on the net increase of the global building stock.

Illustration of building sector prospective market study is available below:



Another example is in the power sector, with the analysis of expected electricity capacity additions and retirements over the coming years. This analysis enables to estimate the share of capacity additions that will enable to meet electricity demand growth versus the share that will replace decommissioned electricity capacity. Global data can be found in World Energy Investment Outlook published by the International Energy Agency, and country-specific data is often published by national governments.

Illustration of electricity capacity prospective market study is available below:



For both methods, attention should be put to select the right underlying market data that drives the offer's dynamics. For instance, for variable speed drives installed on electric motors, both speed drives and electric motors markets trends have to be considered to understand whether new speed drives are sold to equip new motors, existing motors with an obsolete speed drive or existing motors with no speed drive previously installed. Similarly, to assess the share of Greenfield sales for renewable equipment technologies (such as inverters installed on solar or wind farms), it is necessary to look at market dynamics of total installed (fossil and non-fossil) electricity capacities of the country.

STEP 4: Identify emission hotspots across the product’s lifecycle

After identifying the most relevant reference scenarios, it is important to understand how the emissions of Schneider’s offer relates to the emissions of these references.

1. If the offer is a product (UPS, VSD, etc.), the reference and Schneider’s product should be systematically compared across their whole lifecycle. However, in most cases, only a few life stages will reveal relevant trends, either because:

- The other stages represent a very small portion of the total life cycle emissions. Negligible emission sources are generally identified using Life Cycle Assessment results available in Product Environmental Profiles (PEP). Our products’ PEPs are publicly available in Schneider Electric Check a Product website or via the PEP EcoPassport association website.
- The two situations do not differ on the other stages. In this case, the difference between the two scenarios is zero and there are no saved or avoided emissions.

	Schneider emissions (tCO_2e)	Reference emissions (tCO_2e)
Production	30	0
Transport	1	0
Installation	1	0
Use	70	180
End of Life	20	22

An example of actual data

→

Schneider vs Reference
🟢
●
●
🟢
━

How relevant phases are identified

🟢	Emissions not equivalent and not negligible
●	Emissions not equivalent but negligible compared to whole life cycle
━	Emissions equivalent but not negligible
—	Emissions equivalent and negligible

Across Schneider Electric’s offer portfolio (such as variable speed drives (VSD), process automation, electricity transformers, UPS, power metering infrastructures, etc.), the most significant life cycle phases contributing to Global Warming Potential are:

- The use phase, due to energy consumption and the raw materials used in products. For use phase emissions (which correspond to category 11 “use stage of the product” in the GHG Protocol and ISO 14064), emissions considered can typically include:
  - direct and indirect emissions from energy consumption of the offer during use phase
  - direct emissions from fugitive or process emissions of offer during use phase
  - indirect emissions from the purchase of goods and services, travel, freight, etc. during use phase of offer
- The production phase emissions, which includes all emissions relating to the manufacture and sale of the product.

This assumption could be safely applied to a vast majority of capital goods and consumer durables[6].

The summary table below gives examples of emission sources that are considered, depending on the type of offer.

Emission sources	Examples of offer where emission sources will be taken into account
Direct and indirect emissions from energy consumption of the offer and reference situation during use-phase	• Variable Speed Drive • Building management system
Direct emissions from fugitive or process emissions of offer and reference situation during use-phase	• Process automation for natural gas flaring in O&G • Low-GWP gas cooling equipment
Indirect emissions from the purchase of goods and services, travel, freight, etc. during use-phase of offer and reference situations	• Predictive analytics for maintenance optimisation • Retrofit-ready offer that enables longer lifetime

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[6] *Some exceptions exist within this methodology, as for instance SF_6-free switchgears. For this solution, End-of-Life emissions are most crucial.*

All relevant emission sources are considered, based on ISO 14064 and the GHG Protocol principles of relevance and accuracy. The methodology covers scope 1, 2 and 3 emissions.

2. If the offer is a service, (Field Services, PPA, etc.), the product in relation to which the service is provided is identified. The impact of this service on said product should be systematically compared across its whole lifecycle. In addition, one should consider the emissions **relating to the provision of the service itself**.

STEP 5: Calculate emissions from the production (product) or provision (service) of Schneider's offer

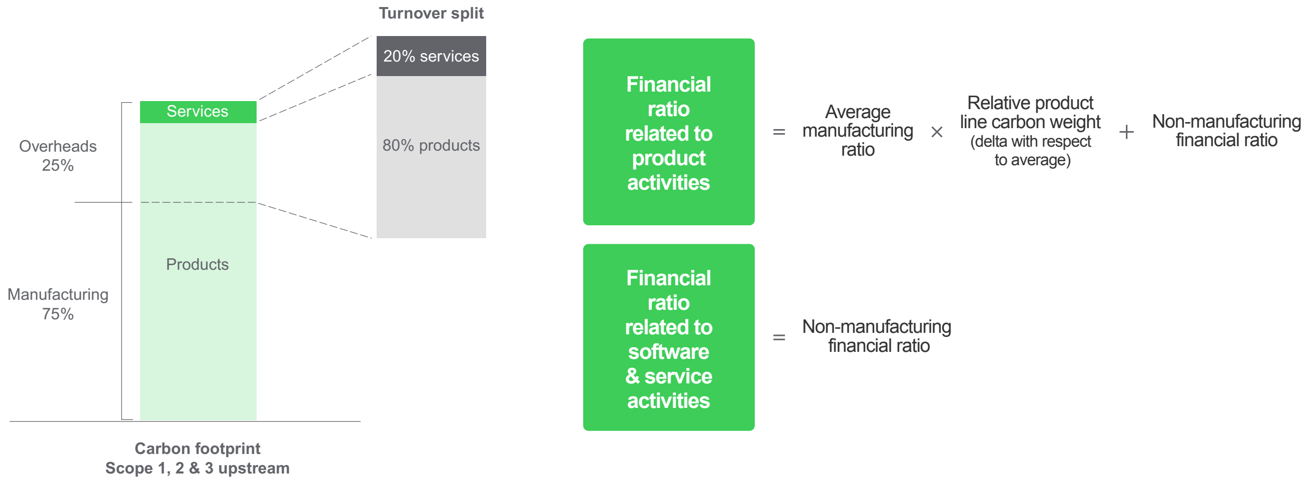
To implement the calculations identified thanks to STEP 4, production emissions and provision emissions need to be known. In the case of products:

- For Greenfield reference scenarios based on a market benchmark, emissions from production of the Schneider Solution can be ignored because we make the hypothesis that the production phase emissions of our competitors is equivalent to ours.
- For Brownfield scenarios or Greenfield scenarios in which the reference scenario is "do nothing", emissions from production are compared to the fact of "producing nothing". Emissions from production of the Schneider solution will thus be recorded as negative amounts in the total reduction of emissions.

In the case of services, emissions from the provision of the service must always be deducted from reduction of emissions.

Production and provision phase emissions are calculated for each offer in a two-step process:

1. Computing production phase emissions per euro of revenue thanks to an approach combining:
   - a top-down approach based on Schneider's 2020 carbon footprint on Scope 1,2 and 3 Upstream. From this carbon footprint we calculate a CO_2e/€ revenues ratio representing emissions from overheads (corporate, sales, marketing, etc.), and another one representing average emissions from product manufacturing.
   - a bottom-up approach based on the relative carbon intensity of Schneider's manufactured goods that enables a differentiation between the various carbon footprints.



2. $KgCO_2e$/€ revenues ratios are then multiplied by revenues for each Schneider solution. Data on 2020 revenues are sourced differently depending on the solution. One main source of data is a database of all business orders for Schneider Electric in 2020 (restricted access).

STEP 6: Calculate the product or service’s positive impact on CO_2 emissions

For each offer, a tailored methodology needs to be created and disclosed transparently to calculate CO_2 emissions reductions at every appropriate life stage. By convention, if the result of the calculation is positive, reductions are performed. Four different calculation methods can be used depending on the available sales data:

1. Method 1: Based on the volume of offers sold during the year
2. Method 2: Based on industry-specific ratios in $kgCO_2e$/€ of sale
3. Method 3: Based on the ROI from energy savings enabled by the offer
4. Method 4: Based on the share of energy OPEX in the offers’ total lifecycle cost

For methods 2, 3, and 4, there might be a geographical bias affecting the average pricing of the products, and consequently their emission intensity; therefore, a particular attention should be given to the distribution of sales and their average price. A possible solution to overcome this potential issue is to consider the specific price of the product for every geography or to calculate an average price based on the distribution of sales.

Method 1: Based on the volume of offers sold during the year

This methodology is applicable to homogeneous lines of business for which it is possible to count sales with a “physical unit”, such as a number of units, MW, kWh of energy, etc.

Examples: variable speed drives, transformers, green electricity contracts, energy performance contracting, etc.

In this case, terms of the calculation will typically be:

- Volume of offer sold during the year (unit/year)
- Annual energy consumption of the offer (kWh/year/unit)
- Energy consumption of Brownfield and Greenfield reference situation (or energy savings of the offer versus reference) (kWh/year/unit)
- Offer lifetime (years)
- % Brownfield and Greenfield sales (%)
- Electricity emission factor[7] ($kgCO_2e$/kWh)

Calculation formula for use-phase emissions will typically be:

$$\textbf{Avoided emissions} = \text{Greenfield sales (\%)} \times \text{Volume offer sold (unit/yr)} \times \left(\text{Energy consumption Greenfield reference (kWh/yr/unit)} - \text{Energy consumption offer (kWh/yr/unit)} \right) \times \text{EF energy over lifetime (kgCO}_2\text{e/kWh)} \times \text{Offer lifetime (yrs)}$$

$$\textbf{Saved emissions} = \text{Brownfield sales (\%)} \times \text{Volume offer sold (unit/yr)} \times \left(\text{Energy consumption Brownfield reference (kWh/yr/unit)} - \text{Energy consumption offer (kWh/yr/unit)} \right) \times \text{EF energy over lifetime (kgCO}_2\text{e/kWh)} \times \text{Offer lifetime (yrs)}$$

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[7] *Shortened EF in the rest of the document*

Method 2: Based on industry-specific ratios in kgCO₂e/€ of sale

This methodology is applicable for lines of business for which typical ratios of saved and avoided emissions in kgCO₂e/€ of sales can be created. This is the case in industries, such as the renewable industry, where CO₂e savings per Euro of investment can be estimated, based on market studies.

Examples: inverters and electrical distribution technologies for solar and wind farms, etc.

In this case, terms of the calculation will typically be:

$$\text{Avoided emissions} = \text{Offer revenues } (€/\text{yr}) \times \text{Avoided emissions v/s Greenfield reference } (\text{kgCO}_2\text{e}/€/\text{an}) \times \text{Offer lifetime (yrs)} \times \text{Greenfield sales (\%)}$$

$$\text{Saved emissions} = \text{Offer revenues } (€/\text{yr}) \times \text{Avoided emissions v/s Brownfield reference } (\text{kgCO}_2\text{e}/€/\text{an}) \times \text{Offer lifetime (yrs)} \times \text{Brownfield sales (\%)}$$

- Offer revenue during the year (€/year)
- Saved emissions per € of sale (kgCO₂e/€/year)
- Avoided emissions per € of sale (kgCO₂e/€/year)
- Offer lifetime (years)
- % Brownfield and Greenfield sales (%)

Calculation formula for use-phase emissions will typically be:

Method 3: Based on the Return on Investment from energy savings enabled by the offer

This methodology is applicable for lines of business that enable energy savings in a system, and that have negligible or nil use-phase emissions.

Examples: variable speed drives, building management system, etc.

In this case, terms of the calculation will typically be:
- Offer revenue during the year (€/year)
- ROI (return on investment) enabled by energy savings (years)
- Average energy price (€/kWh)
- Offer lifetime (years)
- % Brownfield and Greenfield sales (%)
- Energy emission factor (kgCO₂e/kWh)

Calculation formula will typically be:

$$\text{Avoided emissions} = \left(\underbrace{\frac{\text{Offer revenues } (€/\text{yr})}{\text{Greenfield reference ROI on energy savings (yrs)}}}_{= \text{ Reference annual energy savings (in €)}} - \underbrace{\frac{\text{Offer revenues } (€/\text{yr})}{\text{Offer ROI on energy savings (yrs)}}}_{= \text{ Offer annual energy savings (in €)}} \right) \times \frac{\text{EF energy } (\text{kgCO}_2\text{e/kWh})}{\text{Energy price } (€/\text{kWh})} \times \text{Offer lifetime (yrs)} \times \text{Greenfield sales (\%)}$$

$$\text{Saved emissions} = \left(\underbrace{\frac{\text{Offer revenues } (€/\text{yr})}{\text{Brownfield reference ROI on energy savings (yrs)}}}_{= \text{ Reference annual energy savings (in €)}} - \underbrace{\frac{\text{Offer revenues } (€/\text{yr})}{\text{Offer ROI on energy savings (yrs)}}}_{= \text{ Offer annual energy savings (in €)}} \right) \times \frac{\text{EF energy } (\text{kgCO}_2\text{e/kWh})}{\text{Energy price } (€/\text{kWh})} \times \text{Offer lifetime (yrs)} \times \text{Brownfield sales (\%)}$$

Method 4: Based on the share of energy OPEX in the offers' total lifecycle cost

This methodology is applicable for lines of business that generate significant use-phase emissions, while enabling use-phase emission savings compared to the reference situation.

Examples: electric motors, data center cooling, etc.

In this case, terms of the calculation will typically be:

- Offer revenue during the year (€/year)
- % energy consumption cost and % CAPEX cost in offer total lifecycle costs
- % energy efficiency versus Greenfield and Brownfield reference
- Average energy price (€/kWh)
- % Brownfield and Greenfield sales (%)
- Energy emission factor (kgCO₂e/kWh)

Calculation formula for use-phase emissions will typically be:

$$\text{Saved emissions} = \underbrace{\frac{\text{Offer revenues (€/yr)} \times \text{Energy consumption in lifecycle cost (\%)}}{\text{CAPEX in lifecycle cost (\%)}}}_{= \text{ Energy consumed over product's lifetime (€)}} \times \frac{\text{EF energy (kgCO}_2\text{e/kWh)}}{\text{Energy price (€/kWh)}} \times \frac{1}{(1 - \%\ \text{EE}^{\text{Brownfield}})} - 1 \times \text{Brownfield sales (\%)}$$

Notes

- *Same formula for "Avoided emissions" than "Saved emissions", replacing Brownfield by Greenfield*
- *"Saved emissions" formula is valid only for changes of equipment using the same source of energy (otherwise slightly more complex formula that accounts for the change of energy emission factor)*

Glossary

Induced emissions of offers – emissions generated by the goods and services sold by the company in the reporting year, over their expected lifetime, and covering the full lifecycle of the offer (manufacturing, installation, use and end-of-life).

Induced emissions of reference situation – emissions generated without the company offer either in Brownfield or Greenfield situation, over its expected lifetime, and covering the full lifecycle (manufacturing, installation, use and end-of-life).

Brownfield sale – is the situation where the offer sold replaces or upgrades an existing system.

Greenfield sale – is the situation where the offer sold equips a new infrastructure.

Reference situation – is the scenario that reasonably represents the anthropogenic emissions that would occur in the absence of the sale of the offer.

Brownfield reference situation – is the reference situation in the case of a Brownfield sale. In this case, the reference situation is defined as the initial situation, meaning the greenhouse gas emissions that were emitted to the atmosphere before the sale of offer.

Greenfield reference situation – is the reference situation in the case of a Greenfield sale. For a Greenfield sale, the reference situation answers the following question: “What would have been the customer’s situation if they hadn’t purchased this offer?”. In other words, the reference situation reflects the most realistic market situation.

Saved emissions – of an offer are net emissions, calculated as the difference between induced emissions of an offer and induced emissions of the “Brownfield reference situation”.

Avoided emissions – of an offer are net emissions, calculated as the difference between induced emissions of an offer and induced emissions of the “Greenfield reference situation”.

Yearly accounting – the method takes into account induced and avoided emissions of the offers sold during the year, cumulated over the expected offers’ lifetime.

Emission factor (EF) – it is defined by the UNFCCC as the average emission rate of a given GHG for a given source, relative to units of activity (e.g. kWh, tonnes of product, € of revenue).

Forward-looking emission factor – the average emission rate of a given GHG for a given source, adjusted for its lifetime accordingly to “Reference Technology Scenario” (RTS) by the International Energy Agency (IEA)[8].

Net emissions – across the whole methodology takes into consideration: a) the difference between the reference situation and Schneider Electric’s offer, b) the emissions from production of the offer (which are deducted from emissions avoidances).

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[8] *Energy Technology Perspectives 2017, International Energy Agency (IEA)*

How investors can use the CO_2e impact metric

Following the dynamic created during the Paris Agreement (COP21) in 2015, an increasing number of investors are investigating and valuating climate risks and opportunities in their portfolio. Notably, the Task Force on Climate-Related Financial Disclosure (TCFD) published in 2017 recommendations to improve communication on climate risks between investors and companies. Regulation is also evolving; for instance, the French law on Energy Transition for Green Growth (Article 173) defines a "comply or explain" rule for investors to report on how they integrate energy transition and climatic risks.

Saved and avoided emissions can be used by investors to calculate "climate investment impact ratios", to assess how much CO_2e their investment in Schneider Electric enables to save or avoid, in tCO_2e per € of equity and/or obligation.

Credentials

The methodology hereby presented was initially developed in collaboration with Carbone 4 in 2017.

Starting 2018, Schneider Electric discloses externally quarterly CO_2e savings enabled by its offers for customers.

This methodology was initially published in July 2019, after being verified by EY (see independent report on se.com). The first version of this document included 8 Schneider offers on which the methodology was applied; the version 2 of this document includes now 17 offers on which the methodology is applied.

Appendix: Detailed CO_2e impact methodology for Schneider Electric offers

The following section discloses CO_2e impact methodology for the following offers sold by Schneider Electric:

1. Variable Speed Drives
2. Process Automation for the O&G industry
3. Electricity Transformers
4. UPS Single phase
5. Power Purchasing Agreements (PPA)
6. Building Management Systems
7. Power Monitoring Systems
8. Energy Performance Contracting
9. Power SCADA Operations
10. Distribution and Energy Management Systems
11. Cooling machines
12. Microgrids
13. Power Quality equipment
14. Data Center Design & Science
15. SF_6 Recovery services
16. AirSeT products
17. Field Services

1. Variable Speed Drives (VSD)

Definition of the offer

A Variable Speed Drive (VSD) is an equipment that regulates the speed and rotational force of an electric motor, via the control of the power that the machine uses, allowing to operate at variable speeds depending on operational needs of the machine.

For instance, many industrial processes, such as assembly lines, must operate at different speeds for different products. VSD are equally useful when process conditions demand adjustment of flow, such as in a pump or a fan, where the variation of the drive's speed may save energy compared with other techniques for flow control.

Schneider Electric's VSD offers are grouped into four main applications: machines, building, process and soft starters. For this methodology, soft starters are not considered to allow any efficiency benefit; machine application allow a limited saving; the most important savings are generated with building and processes applications (further details in the calculation terms table).

Boundaries

System boundary, considering electricity savings delivered by the VSD on motor's electricity consumption.

Definition of reference situation

Brownfield reference situation: Brownfield reference situation distinguishes two cases:
- VSD sales that are installed on existing machines, processes and buildings not previously equipped with a VSD.
- VSD sales that are installed on existing machines, processes and buildings previously equipped with a VSD (replacement).

Greenfield reference situation: Greenfield reference situation is based on the actual market penetration (x%) of VSD in the Greenfield electric motor market (Greenfield scenario 2). The calculation distinguishes two cases:
- For x% (=VSD market penetration) of sales volumes, VSD equip newly commissioned electric motors for which a VSD will be installed in current market conditions. Schneider Electric's VSD are not considered to be more energy efficient than the industry average. The reference situation is the case where another VSD is installed, and avoided emissions are equal to 0.
- For (1-x)% of sales volumes, VSD equip newly commissioned electric motors for which a VSD will not be installed in current market conditions ('Schneider Electric vs. GF no market' in table below). The reference situation is the case where no VSD is installed.

Emission Sources

	Schneider vs. BF no previous VSD	Schneider vs. BF VSD replacement	Schneider vs. GF no adoption of the solution on the market	Schneider vs. GF on a market where the solution is adopted	Comments
Production	🟢	🟢	🟢	▬	Schneider induces additional emissions when the alternative does not require a new VSD
Transport	●	●	●	—	Schneider induces additional emissions when the alternative does not require a new VSD, but they are negligible
Installation	●	●	●	—	Schneider induces additional emissions when the alternative does not require a new VSD, but they are negligible
Use	🟢	🟢	🟢	▬	Energy Efficiency performance comparison for all situations. GF market reference is considered as efficient as Schneider offer
End of Life		—	●	—	Emissions are small compared to a whole life cycle

🟢 Emissions not equivalent and not negligible
● Emissions not equivalent but negligible compared to whole life cycle
▬ Emissions equivalent but not negligible
— Emissions equivalent and negligible

Relevant emission sources have been identified using Life Cycle Assessment results available in Product Environmental Profiles. The PEPs are publicly available in Schneider Electric “Check a Product” website or via the PEP EcoPassport association website.

Calculation method for use-phase

Method 1, based on the total volume of VSD sold during the year, in number of units sold per reference.

Calculation formula

$$\text{VSD Saved } CO_2 = \text{VSD sales (W/country)} \times \left(\text{Brownfield new installation (\%)} \times \text{Net EE new installation* (\%)} + \text{Brownfield replacement (\%)} \times \text{Net EE replacement (\%)} \right) \times \text{VSD use case over lifetime (hour.yr)} \times \text{Country electricity EF (kg}CO_2\text{e/kWh)}$$

$$\text{VSD Avoided } CO_2 = \text{VSD sales (W/country)} \times \text{Greenfield sales (\%)} \times \text{Net EE new installation* (\%)} \times \text{VSD use case over lifetime (hour.yr)} \times \text{Country electricity EF (kg}CO_2\text{e/kWh)}$$

** Value depends on end-user segment (machine / other); Net EE: net energy efficiency, discounting internal VSD consumption*

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Sales data	Schneider Electric sales database	For direct VSD sales: Nb of units sold per product reference number and per country. For system VSD sales: linear extrapolation based on direct VSD sales	Annual	Confidential
Power (W) and end-user segment	Schneider Electric technical database	Product reference number enables to know the power of each VSD, in Watt and the end-user segment (machine, soft starters, other applications)	Annual	Confidential
Use Case	Is the usage of the products in terms of hours over its lifetime (details below)	World average	Every 3 years	–
Lifetime	CEMEP[9]: "Energy-Efficiency with Electric Drive Systems" (page 22)	World average	Every 3 years	12 years
Hours used per year	IEA EE Electric Systems	World average	Every 3 years	250 days/year, 12 hours/day
Internal VSD energy consumption	Expert estimate, based on Schneider Electric's VSD LCA (PEP Ecopassport)	World average	Every 3 years	2% (VSD efficiency of 98%)
% Brownfield (new installation / replacements), Greenfield sales	Expert estimate	World average	Every 3 years	Confidential
% market penetration of VSD in Greenfield	Market study	World average	Every 3 years	30%
% energy efficiency (EE)	Expert estimate	World average, depending on end-user: machines, soft starters or other applications (building, process)	Every 3 years	• Replacement: 4% • New installation for: – Machines: 5% Soft – Starters: 0% – Other applications (building, process, etc): 30%
Net Energy Efficiency	Is the calculated difference between the energy saved by the products and the energy consumed by it	-	-	-

Emission Factors

Emission factor	Source	Scope	Update frequency	Values
Electricity – direct emissions	IEA, electricity emission factors, 2017 edition (2014 data)	Country	Every 3 years	–
Electricity – upstream and T&D losses	DEFRA 2017	Country when available, or global average	Every 3 years	–
Electricity – Infrastructure and supply chain	IEA and IPCC, 2014	Country when available, or global average	Every 3 years	–
Electricity – forward-looking	Forward-looking discounting: ETP 2017, RTS scenario	Region	Every 3 years	–

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[9] *The European Committee of Manufacturers of Electrical Machines and Power Electronics.*

2. Process Automation for the Oil & Gas industry

Definition of the offer

Process Automation is providing architectures and system solutions to end-users from various industries, which enable management optimization for industrial production processes and consequently save energy and reduce CO_2e emissions.

The calculation of avoided and saved emissions focuses on the Oil & Gas sector (O&G), which is historically an important end segment.

The O&G industry is typically categorized into three main segments: upstream, midstream and downstream. They are defined as follow:
- Upstream – searching for potential underground or underwater crude oil and natural gas fields, drilling exploratory wells, and subsequently drilling and operating the wells that recover and bring the crude oil or raw natural gas to the surface.
- Midstream – transportation (by pipeline, rail, barge, oil tanker or truck), storage, and wholesale marketing of crude or refined petroleum products. In the case of liquefied natural gas (LNG) it also includes the liquefaction and regasification of gas.
- Downstream – refining of petroleum crude oil and the processing and purifying of raw natural gas, as well as the marketing and distribution of products derived from crude oil and natural gas.

Given the market structure of Schneider's offers, CO_2e emissions of upstream operations have been calculated together with midstream operations (which include LNG plants, LNG regasification and gas processing).

In addition, petrochemical activities (for ethylene, ammonia and methanol production) have been considered as another category in the methodology.

Boundaries

System-level boundary: considering electricity savings delivered by the automation processes installed or maintained in oil & gas facilities and operations.

Definition of reference situation

Brownfield reference situation: Brownfield reference situation distinguishes two cases:
- Replacement and maintenance of existing Process Automation Systems (PAS), or parts of it, in existing installations.
- New PAS projects that replace existing capacity being decommissioned.

Greenfield reference situation: Greenfield reference situation refers to the installation of a PAS for a new plant or a plant extension. Greenfield reference situation is defined as the situation where another PAS system is installed, providing similar energy efficiency benefits. Avoided emissions are therefore equal to 0. (Greenfield scenario 3).

Emission sources

	Schneider vs. BF retrofit	Schneider vs. BF replacement	Schneider vs. GF market	Comments
Production	🟢	━	━	Schneider induces additional emissions when the alternative does not require a new equipment
Transport	●	—	—	Schneider induces additional emissions when the alternative does not require a new equipment, but they are negligible
Installation	●	—	—	Schneider induces additional emissions when the alternative does not require a new equipment, but they are negligible
Use	🟢	🟢	━	Energy Efficiency performance comparison for all situations. GF market reference is considered as efficient as Schneider offer
End of Life	—	—	—	Emissions are small compared to a whole life cycle

🟢	Emissions not equivalent and not negligible
●	Emissions not equivalent but negligible compared to whole life cycle
━	Emissions equivalent but not negligible
—	Emissions equivalent and negligible

There are no avoided emissions as it is estimated that the whole Greenfield market is equipped with process automation systems, given the importance of energy costs in the Oil & Gas sector. In this methodology, we consider that Schneider Electric's process automation systems deliver comparable savings to that of competitors.

Relevant emission sources have been identified using Life Cycle Assessment results available in Product Environmental Profiles. The PEPs are publicly available in Schneider Electric "Check a Product" website or via the PEP EcoPassport association website.

Calculation method for use-phase emissions

Method 2: a ratio of saved and avoided emissions in $kgCO_2e$ per € of sales has been created for this methodology. This ratio is multiplied by yearly sales to estimate CO_2 savings and avoidance.

Considering the important weight of energy costs in total operating costs of the O&G industry, the O&G sector is mature in terms of energy efficiency. In this methodology, we considered that all relevant O&G operations are equipped with a process automation system. Recurring sales are mainly maintenance contracts renewed every year with the objective of maintaining and improving the energy efficiency of existing operations. Saved emissions are calculated for each year of sales, and not cumulated in time as yearly maintenance is needed to sustain performance.

Large project sales correspond to the installation of the new process automation system. In this case, total saved and avoided emissions are cumulative over the lifetime of the system. Sales are distinguished between recurring maintenance contracts and large project sales depending on order value (using a threshold limit).

Calculation formula

$$\text{PA Saved CO}_2 = \text{Average emissions savings per € of retrofit (kgCO}_2\text{e/€)} \times \text{Total volume of orders (€) - Brownfield retrofit} + \text{Average emissions savings per € of replacing existing capacity (kgCO}_2\text{e/€)} \times \text{Total volume of orders (€) - Brownfield replacing capacity}$$

$$\text{Average emissions savings per € of retrofit (kgCO}_2\text{e/€)} = \frac{\text{Average savings in CO}_2\text{ emissions (\%)} \times \text{Average emission per site (kgCO}_2\text{e/yr)}}{\text{Brownfield (retrofit) average order cost (€/yr)}}$$

$$\text{Average emissions reduction per € of replacing existing capacity (kgCO}_2\text{e/€)} = \frac{\text{Average savings in CO}_2\text{ emissions (\%)} \times \text{Average emission per new site (kgCO}_2\text{e/yr)}}{\text{Brownfield (replacing capacity) average order cost (€/yr)}} \times \text{Average lifetime equipment (yr)}$$

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Sales data (average order cost, volume of orders)	Process Automation sales database	Global sales	Annual	Confidential
Average reduction in CO_2 emissions for Brownfield (maintenance)	Schneider expert estimate	World	Every 3 years	0.5%
Average reduction in CO_2 emissions for Brownfield (replacing existing capacity)	Schneider expert estimate	World	Every 3 years	0.5%
Average CO_2 emission per site (MTons/Yr)	Schneider expert estimate	World	Every 3 years	Upstream: 0.23 $MtCO_2$ Downstream: 1.88 $MtCO_2$ Petrochemicals: 0.92 $MtCO_2$
Average CO_2 emissions per new project (new site or extension) ($MtCO_2$/Yr)	MTO Market Report 2016 IEA	World	Every 3 years	Upstream: 0.15 $MtCO_2$ Downstream: 1.23 $MtCO_2$ Petrochemicals: 0.60 $MtCO_2$
Average lifetime equipment – for new projects sales (years)	Schneider expert estimate	World	Every 3 years	15 years
Brownfield replacing capacity – Share of new projects replacing existing capacity	Capacity reduction over capacity addition – MTO Market Report 2016 IEA	World	Every 3 years	18%

Emission Factors

The average emissions of CO_2 per site are based on average emission intensities of the industry, per unit of output. The average emission per site is calculated based on the average production output per type of site.

Emission Factor	Source	Scope	Update frequency
CO_2 emissions of petroleum refining	2001 US Refining Energy Balance "Energy Efficiency Improvement and Cost Saving Opportunities For Petroleum Refineries", an ENERGY STAR® Guide for Energy and Plant Managers (LBNL-56183), Feb. 2005	World average	Every 3 years
CO_2 emissions of ethylene production	"Environmental impacts of ethylene production from diverse feedstocks and energy sources", Ghanta, M., Fahey, D. and Subramaniam, B., Applied Petrochemical Research, June 2014, Volume 4, Issue 2, pp 167-179	World average	Every 3 years
CO_2 emissions of ammonia production	https://ammoniaindustry.com/ammonia-production-causes-1-percent-of-total-global-ghg-emissions/	World average	Every 3 years
CO_2 emissions of methanol production	"A comparative analysis of methanol production routes: synthesis gas versus CO_2 hydrogenation", Proceedings of the 2014 International Conference on Industrial Engineering and Operations Management, Machado, Camila F. R., de Medeiros, José Luiz, Araújo, Ofélia F. Q., Alves and Rita M. B., Bali, Indonesia, January 7 – 9, 2014	World average	Every 3 years
2015 global CO_2 emissions data	https://insideclimatenews.org/news/19052016/global-co2-emissions-still-accelerating-noaa-greenhouse-gas-index	World average	Every 3 years

3. Electricity Transformers

Definition of the offer

Transformers are static electrical devices that transfers electrical energy between two or more circuits; they are used for increasing or decreasing the alternating voltages in electric power applications, and for coupling the stages of signal processing circuits.

A transformer is essentially characterized by its rating (the power it can transform), and its losses (no load losses and load losses). No load losses are independent from the load, while load losses are proportional to the load squared. To assess the energy consumed per year by the transformer (e.g. energy lost in the transformer), it is necessary to know the load squared at every moment. A load profile is therefore needed to estimate transformers' energy losses.

Schneider Electric produces a large range of transformers, with ratings varying from a few kVA to dozens of MVA. This diversity enables Schneider Electric to address several markets, from commercial buildings to electric utilities, to industry.

Boundaries

Product-level boundary: The boundary is set to the product itself, looking at the energy consumed and dissipated (Joule effect) over the product's lifetime.

Definition of reference situation

Brownfield reference situation: Brownfield reference situation is defined as the share of today's sales that replace transformers installed 25 years ago (average lifetime of transformers). This share is estimated using historical economic growth. Based on sales geographical split, a distinction is made between developing and developed countries (retrofit share is higher in developed countries).

Greenfield reference situation: Greenfield reference situation refers to the installation of a transformer to equip a new infrastructure. Avoided CO_2 emissions are estimated based on the performance of other transformers available on the market (Greenfield scenario 1). The current transformer technology of Schneider Electric is not more efficient than market equivalents, so avoided emissions will be 0.

Emission sources

	Schneider vs. BF replacement	Schneider vs. GF market	Comments
Production	🟢	–	Schneider induces additional emissions when the alternative does not require a new transformer
Transport	●	—	Schneider induces additional emissions when the alternative does not require a new transformer, but they are negligible
Installation	●	—	Schneider induces additional emissions when the alternative does not require a new transformer, but they are negligible
Use	🟢	–	Energy Efficiency performance comparison for all situations. GF market reference is considered as efficient as Schneider offer
End of Life	—	—	Emissions are small compared to a whole life cycle

🟢	Emissions not equivalent and not negligible
●	Emissions not equivalent but negligible compared to whole life cycle
–	Emissions equivalent but not negligible
—	Emissions equivalent and negligible

Relevant emission sources have been identified using Life Cycle Assessment results available in Product Environmental Profiles. The PEPs are publicly available in Schneider Electric "Check a Product" website or via the PEP EcoPassport association website.

Calculation method for use-phase

Method 1, based on the volume of transformers sold during the year. Total saved and avoided emissions are cumulative over the average lifetime of the products.

Two load profiles have been defined, depending on the size of the transformer (below or above 3150 kVA). The consumption profiles are defined considering periods of low consumption (ex: night, holidays, etc.) and periods of high consumption. Load profiles also take into account end users' needs (transformers for utilities or large industries have a higher load factor than transformers for buildings or small industries). Energy losses are assessed for each transformer, using the load profile, the transformer technical data (rating and loss values).

$$\text{Efficiency (\%)} = \frac{\text{Rating (kW)} \times \text{Load Factor (\%)} \times \text{Cos Phi}}{\text{Rating (kW)} \times \text{Load Factor (\%)} \times \text{Cos Phi} + \text{No Load Losses (P0 kW)} + \text{Load Factor (\%) \^{}2} + \text{Load Losses (Pk kW)}}$$

As technical characteristics of sold transformers are only available for some of the transformers, an extrapolation is made based on the ratings. This extrapolation enables to assess all total induced, saved and avoided emissions based on the emissions of known transformers.

Calculation formula

$$\text{Transformer Saved CO}_2 = \text{Total Energy saved (MWh/year)} \times \text{Brownfield (\%)} \times \text{Average lifetime of the product (years)} \times \text{Country electricity EF (kgCO}_2\text{e/MWh)}$$

$$\text{Energy Saved (MWh/year)} = \left(\text{New generation average efficiency (\%)} - \text{Previous generation average efficiency (\%)} \right) \times \text{Quantity of unit sold} \times \text{Rating (kW)} \times \text{Load profile (hours)}$$

Avoided emissions

To assess avoided CO₂ emissions, it is necessary to evaluate the performance of other transformers available in the market. As a general rule, Schneider Electric transformers show similar performance than to that of transformers of other global suppliers. Some local transformer suppliers sell transformers with lower performance levels. However, as a conservative hypothesis, this methodology estimates that the performance of Schneider Electric transformers' is similar to other transformers available on the market. We therefore quantify no avoided CO₂ emissions for Schneider Electric transformers.

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Sales Data: Quantity of units sold	Sales data, in quantity of units sold per reference	Country	Annual	Confidential
Technical specificities of products: Rating, No Load Losses, Load Losses	Product technical specifications	Global	Annual	Confidential
Cos Phi	Schneider expert estimate	Global	Every 3 years	0.9
Load profile	Schneider expert estimate	World average	Every 3 years	Confidential
Efficiency rating per load				
Average efficiency (calculated)				
Average efficiency of previous generation of transformers	Schneider expert estimate	World average	Every 3 years	98.4%
Average lifetime of the product	Schneider expert estimate	World average	Every 3 years	25 years
% Brownfield	Weighted economic growth over the last 25 years in Schneider main sales countries	Developing / developed countries	Every 3 years	Developing countries: 24% Developed countries: 66%

Emission Factors

Emission factor	Source	Scope	Update frequency	Values
Electricity – direct emissions	IEA, electricity emission factors, 2017 edition (2014 data)	Country	Every 3 years	–
Electricity – upstream and T&D losses	DEFRA, 2017	Country when available, or global average	Every 3 years	–
Electricity – Infrastructure and supply chain	IEA and IPCC, 2014	Country when available, or global average	Every 3 years	–
Electricity – forward-looking	Forward-looking discounting: ETP 2017, RTS scenario	Region	Every 3 years	–

4. Uninterruptible Power supply (UPS) Single Phase

Definition of the offer

UPS Single Phase are products that enable devices to be powered at the right voltage and frequency. They ensure that devices receive a continuous, supply of power, whatever may happen on the grid.

To transform the power from the grid into power that has the right characteristics tailored to the device, a UPS consumes energy. A ratio therefore exists between the energy supplied to the device and the energy entering the UPS.

New UPSs perform better than old ones given that for the same amount of energy supplied to the device, less energy enters into the UPS (the ratio increases). Therefore, replacing an older UPS by a new one enables to save energy.

Boundaries

Product-level boundary: The boundary is set to the product itself, looking at the energy consumed and dissipated (Joule effect) over the product's lifetime.

Definition of reference situation

Brownfield reference situation: Brownfield reference situation is defined as the share of today's UPS sales that replace old products installed 10 years ago (average lifetime of UPS). This share is estimated using a weighted average of historical market growth by geographical area, based on private market studies.

Greenfield reference situation: Greenfield reference situation refers to the installation of a UPS in a new facility. Avoided CO_2 emissions are estimated based on the performance of other UPS available on the market (Greenfield scenario 1).

Emission sources

	Schneider vs. BF	Schneider vs. GF	Comments
Production	🟢	━	Schneider induces additional emissions when the alternative does not require a new equipment
Transport	•	—	Schneider induces additional emissions when the alternative does not require a new equipment, but they are negligible
Installation	•	—	Schneider induces additional emissions when the alternative does not require a new equipment, but they are negligible
Use	🟢	🟢	Energy Efficiency performance comparison for all situations. GF market reference is considered less efficient as Schneider offer
End of Life	—	—	Emissions are small compared to a whole life cycle

- 🟢 Emissions not equivalent and not negligible
- • Emissions not equivalent but negligible compared to whole life cycle
- ━ Emissions equivalent but not negligible
- — Emissions equivalent and negligible

Relevant emission sources have been identified using Life Cycle Assessment results available in Product Environmental Profiles. The PEP are publicly available in Schneider Electric "Check a Product" website or via the PEP EcoPassport association website.

Calculation method for use-phase emissions

Method 1, based on the volume of UPS single phase sold during the year. Total saved emissions are cumulative over the average lifetime of the products.

To assess avoided CO_2 emissions, it is necessary to evaluate the performance of other UPSs available in the market and used for the same applications. A benchmark is available, as ENERGY STAR label compares the performances of all UPS ranges in order to identify the highest performing ones.

For Greenfield sales, it is therefore possible to assess the average performance of sold UPSs and to compare this with Schneider Electric's UPS performance.

Calculation formula

UPS Saved CO_2 = Brownfield (%) × Power use difference between Schneider and reference (kW) × Use time (h) × Forward looking EF ($kgCO_2e/kWh$) × Average lifetime of the product (years)

UPS Avoided CO_2 = Greenfield (%) × Power use difference between Schneider and reference (kW) × Use time (h) × Forward looking EF ($kgCO_2e/kWh$) × Average lifetime of the product (years)

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Sales data, per reference (Output Wattage)	Schneider sales database	Sales per reference and generation	Annual	Confidential
Average annual CO_2 emissions per W per generation	Single phase UPS efficiency comparison calculator, online public tool, Schneider Electric https://www.schneider-electric.com/en/work/solutions/system/s1/data-center-and-network-systems/trade-off-tools/single-phase-ups-efficiency-comparison-calculator/	World Note: CO_2 emission electricity emission factor is corrected to align with forward-looking EF	Annual	Detailed results (per generation) available online
% Brownfield	UPS market growth forecast (private market study), CAGR of 1.2% with lifetime 10 years)	World	Every 3 years	88.4%
% Greenfield	GF = 1-Brownfield %	World	Every 3 years	11.6%
Average lifetime	Schneider expert estimate	World	Annual	10 years
Average efficiency of UPS sold in the market (Greenfield sales)	Schneider expert estimate, based on the ENERGY STAR market study	World	Every 3 years	Smart UPS On-Line: 0.64 $kgCO_2e/W/yr$ Smart UPS: 0.2 $kgCO_2e/W/yr$ Smart UPS VT: 0.39 $kgCO_2e/W/yr$ Back UPS: 0.92 $kCO_2e/W/yr$
Average efficiency of previous generation UPS (Brownfield sales)	Schneider sales database from 10 years ago	World	Annual	Confidential

Emission Factors

Emission factor	Source	Scope	Update frequency	Values
World electricity emission factor over the studied period – RTS	– Direct emissions: IEA, electricity emission factors, 2017 (2014 data) – Upstream and T&D losses: DEFRA, 2017 – Infrastructure and supply chain, IEA and IPCC, 2014	World average	Every 3 years	573 gCO_2eq/kWh

5. Power Purchase Agreements (PPA)

Definition of the offer

A power purchase agreement (PPA) is a contract between two parties, one which generates electricity and one which is looking to purchase electricity.

Within Schneider Electric, the Sustainability Business provides advisory services to negotiate and sign PPA contracts, providing market, accounting, procurement and legal expertise. This enables customers to source renewable electricity, mitigate the risk of energy cost volatility and negotiate better contracts in energy markets.

This methodology has been developed specifically for medium to long term (several years) PPA agreements concerning the development of new (or very recent) renewable power capacities and is not applicable to electricity contracts with existing renewable capacities. To date, all projects considered are solar or wind (both onshore and offshore) power plants, but the methodology is applicable to all electricity renewable PPA contracts.

Boundaries

As PPA contracting is a service, both emissions from the system to which the service relates and emissions from service provisioning must be accounted for.

Here the system to which the service relates to is an electricity supply system.

Ecosystem-level boundary: considering saved emissions during the whole duration of power purchase agreements compared to a situation without this project.

Definition of reference situation

Brownfield reference situation: Brownfield reference situation refers to the situation where the PPA contract replaces existing power capacity in the grid. As a conservative hypothesis, the methodology considers the average forward-looking electricity emission factor of the country where the contract is signed (see detailed discussion below on the choice of the relevant Brownfield emission factor).

The Brownfield percentage is calculated based on national electricity scenario planning by government agencies and defined as the ratio between the electricity capacities (in MWh of annual production volume) that will be decommissioned in the coming years and the capacities that will be installed over the same period.

Greenfield reference situation: Greenfield reference situation refers to the situation where the PPA contract contributes to answering electricity demand growth, without replacing existing power capacity in the grid. The Greenfield percentage is calculated based on national electricity scenario planning by government agencies (Greenfield scenario 3). The Greenfield reference emission factor is the average emission factor of future installed capacities in the country where the contract is signed.

Emission sources

Emissions of the electricity supply system change on all life stages thanks to the PPA.

	Schneider vs. BF	Schneider vs. GF	Comments
Production	🟢	🟢	Comparison in emissions is included through the "Infrastructure & supply chain" emission factor
Transport	🟢	🟢	Comparison in emissions is included through the "Infrastructure & supply chain" emission factor
Installation	🟢	🟢	Comparison in emissions is included through the "Infrastructure & supply chain" emission factor
Use	🟢	🟢	Energy Efficiency performance comparison for all situations. GF market reference is considered less efficient as Schneider offer
End of Life	—	—	Emissions are small compared to a whole life cycle

🟢	Emissions not equivalent and not negligible
●	Emissions not equivalent but negligible compared to whole life cycle
━	Emissions equivalent but not negligible
—	Emissions equivalent and negligible

Renewable LCA studies[10] show the significant impact of the construction phase (~90%) on life-cycle CO_2 emissions, and negligible CO_2 emissions during the use phase (due to operation and maintenance activities). End of life (EoL) CO_2 emissions are estimated around 10% of total life-cycle emissions. However, these emissions from EoL are considered negligible compared to CO_2 emissions of the reference situation. For instance, infrastructure emissions of onshore wind power (15 $kgCO_2e$ / MWh) represent less than 5% of reference situation emissions (340 $kgCO_2e$ / MWh, see details below). In this example, EoL CO_2 emissions represent less than 0.5% of total life-cycle CO_2 emissions, which is negligible. Similar magnitude of results can be derived from solar power plant LCAs[11].

Besides emission changes of the electricity supply system, emissions from service provisioning by Schneider Electric must be added to this analysis.

Calculation method for emissions outside of Schneider's service provisioning

Method 1, based on the installed capacity contracted (MW). Total saved emissions are cumulative over the lifetime of the PPA contract.

Calculation formula

$$\textbf{PPA Saved } \mathbf{CO_2} = \text{Brownfield (\%)} \times \left(\text{Installed capacity (MW)} \times \text{Use Case (hours/yr)} \times \text{Contract length (year)} \times \text{Country electricity EF } (kgCO_2e/kWh) \times \text{Renewable manufacturing emissions } (kgCO_2e) \right)$$

$$\textbf{PPA Avoided } \mathbf{CO_2} = \text{Greenfield (\%)} \times \left(\text{Installed capacity (MW)} \times \text{Use Case (hours/yr)} \times \text{Contract length (year)} \times \text{Country electricity EF } (kgCO_2e/kWh) \times \text{Renewable manufacturing emissions } (kgCO_2e) \right)$$

Calculation method for emissions of Schneider's service provisioning

See 'Calculating CO_2 emissions savings, STEP 5'

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[10] *The "Wind Energy – The Facts" – European project financed by the Intelligent Energy – Europe program of the Executive Agency for Competitiveness and Innovation, published a LCA of wind energy.*

[11] *Appendix B (Life Cycle Assessment of Solar Thermal Power Technology in China) of the publication "The power of renewables, Opportunities and Challenges for China and the United States", by National Academy of Engineering, National Research Council, Chinese Academy of Sciences and Chinese Academy of Engineering*

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Sales data (Installed capacity, Contract Length (yrs), Project Location)	Schneider sales database	Specific to each contract signed during the current year	Annual	Confidential
Use case (Load factor, operating time)	Schneider expert estimate, based on historical sales data	Load factor per technology (Wind, Solar)	Annual	Wind: 42% Solar: 28% Operating time = 365 days * 24h
% Brownfield	World: IEA, WEIO 2014			
USA: EPA, Outlook on Electricity Supply, 2018				
India: Ministry of Power, National Electricity Plan, 2017	Per country*	Every 3 years	Brownfield %: USA: 56% India: 26% World: 31%	

**95% of PPA sold by Schneider Electric are based in USA or in India, which is why a specific methodology has been developed for those countries. The World average is used for other contracts.*

Emission Factors

Several methodologies have been considered to define the electricity emission factor of the Brownfield reference situation.

The UNFCCC[12] prompts the use of Combined Margins (CM) emissions factors (EF) to evaluate CDM[13] project activities. The CM is the result of a weighted average of two emission factors pertaining to the electricity system: the "operating margin" (OM) and the "build margin" (BM). For the presented methodology, the CM emission factor has been considered but not chosen, due to the complexity of the calculation process, high volatility of the emission factor depending on the source and year of analysis, and overall high resulting EF.

Two other options have been considered to define the electricity emission factor of the reference situation:

- Country electricity EF, forward-looking to take into account evolution over the PPA contract duration (same as for other technologies in this methodology).
- Average EF of decommissioned capacities, based on energy scenario planning of government agencies. This EF is calculated as the average electricity emission factor of electricity capacities that will be decommissioned and replaced in the coming years.

This EF can only be used for new developing projects which allow an addition of renewable capacity on the grid.

The forward-looking country electricity EF is the lowest of the three emission factors considered above, for all geographies studied (World, USA, India). Considering that there is no agreement from CO_2 experts on which EF should be used in this case, this methodology uses the average forward-looking country electricity EF (over contract duration), as a preliminary conservative assumption.

For the Greenfield reference situation, the average emission factor of future installed capacities is taken into account, according to national electricity scenario planning.

The emission factor for the wind or solar capacities during use phase is equal to zero.

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[12] *United Nation Framework Convention on Climate Change*

[13] *Clean Development Mechanism*

Emission Factors

Emission factor	Source	Scope	Update frequency	Values
Electricity – direct emissions	IEA, electricity emission factors, 2017 edition (2014 data)	Country	Every 3 years	–
Electricity – upstream and T&D losses	DEFRA 2017	Country when available, or global average	Every 3 years	–
Brownfield: Electricity – forward-looking	Forward-looking discounting: ETP 2017, RTS scenario	Region	Every 3 years	–
Renewable manufacturing emissions	IPCC AR 5 WG3, Annex III Electricity: infrastructure & supply chain	World average	Every 3 years	Solar: 48 kgCO₂e / MWh Onshore wind: 15 kgCO₂e / MWh Offshore wind: 17 kgCO₂e / MWh
Brownfield: Average country electricity – replaced capacity (not used in this methodology as a preliminary conservative assumption)	USA – Energy Information Administration (EIA), 2018 India – Ministry of Power, National Electricity Plan, 2017 World – IEA, WEIO 2014	Country	Every 3 years	USA: 0.52 kgCO₂e / kWh India: 0.94 kgCO₂e / kWh World average: 0.43 kgCO₂e / kWh
Greenfield: average electricity emission factor reference situation	USA – Energy Information Administration (EIA), 2018 India – Ministry of Power, National Electricity Plan, 2017 World – IEA, WEIO 2014	Country	Every 3 years	USA: 0.14 kgCO₂e / kWh India: 0.52 kgCO₂e / kWh World average: 0.34 kgCO₂e / kWh

6. Building Management Systems

Definition of the offer

A building management system (BMS), also known as a building automation system (BAS), is a computer-based control system installed in buildings that controls and monitors the building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire systems, and security systems. A BMS is composed of both software and hardware, and it is a critical component to manage energy demand in buildings.

Building management systems are most commonly implemented in large sites with extensive mechanical, HVAC[14], electrical systems. Systems linked to a BMS typically represent 40% of a building's energy usage.

Considering the wide variety of products and software needed to install a full BMS, and the subsequent risk of multiple accounting, this methodology focuses on Automation and Enterprise server sales. Servers deliver data management and supervisory services core to BMS systems and are a good proxy to estimate the volume of BMS sold during the year. The number of buildings equipped with a BMS is estimated based on the number of servers sold, further enabling to estimate energy and CO_2 savings.

Boundaries

System-level boundary: considering saved emissions of the building in which the servers are installed.

Definition of reference situation

Brownfield reference situation: Brownfield reference situation distinguishes two cases:
- BMS installed on existing buildings, not previously equipped with such a system.
- BMS installed in new buildings, which are replacing demolished buildings.

The total Brownfield percentage is calculated as the sum of retrofit sales (%, provided by Schneider Electric's experts) plus the share of new buildings that allow to replace demolitions, based on building market forecast from IEA[15] (see formula below).

Greenfield reference situation: Greenfield reference situation refers to the installation of a BMS in a new site. Greenfield reference situation is defined as the situation where another BMS system is installed, providing similar energy efficiency benefits 0 (Greenfield scenario 3).

Emission sources

	Schneider vs. BF retrofit	Schneider vs. BF demolition	Schneider vs. GF	Comments
Production	🟢	🟢	—	Schneider induces additional emissions when the alternative does not require a new equipment
Transport	•	•	–	Schneider induces additional emissions when the alternative does not require a new equipment, but they are negligible
Installation	•	•	–	Schneider induces additional emissions when the alternative does not require a new equipment, but they are negligible
Use	🟢	🟢	—	Energy Efficiency performance comparison for all situations. GF market reference is considered less efficient as Schneider offer
End of Life	–	–	–	Emissions are small compared to a whole life cycle

🟢	Emissions not equivalent and not negligible
•	Emissions not equivalent but negligible compared to whole life cycle
—	Emissions equivalent but not negligible
–	Emissions equivalent and negligible

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[14] Heating, Ventilation, Air-Conditioning

[15] IEA (2013) Transition to Sustainable Buildings, Strategies and Opportunities to 2050

Relevant emission sources have been identified using Life Cycle Assessment results available in Product Environmental Profiles. The PEPs are publicly available on Schneider Electric's "Check a Product" website or via the PEP EcoPassport association website.

Calculation method for use-phase emissions

Method 1, based on the total volume sold of automation and enterprise servers per year. Total saved emissions are cumulative over the average lifetime of the products.

Brownfield and Greenfield shares are calculated based on prospective (future) market data. The methodology looks at the global share of buildings expected to be retrofitted, destroyed and newly built in the coming years, to estimate the share of Schneider Electric's sales for Brownfield and Greenfield markets.

Calculation formula

$$\textbf{Overall Brownfield (\%)} = \left(\text{Greenfield (\%)} \times \text{Share of additions that replace demolitions (\%)} \right) + \text{Brownfield (\%)}$$

$$\textbf{BMS Saved CO}_2 = \left(\text{Size of small buildings (m}^2\text{)} + \text{Size of medium buildings (m}^2\text{)} \right) \times \text{Overall Brownfield (\%)} \times \text{Energy intensity of buildings (kWh/m}^2\text{/yr)} \times \text{Average energy savings (\%)} \times \text{Share of energy source (\%, type energy)} \times \text{Electricity or fuel EF (kgCO}_2\text{e/kWh)} \times \text{Average Lifetime (years)}$$

$$\textbf{Size of small buildings (m}^2\textbf{)} = \frac{\text{Automation Servers Sales (n/country)} \times \text{Used for HVAC control (\%)} \times \text{Average m}^2 \text{ per small building (m}^2\text{)}}{\text{Average number of automation servers per building (n)}}$$

$$\textbf{Size of medium buildings (m}^2\textbf{)} = \frac{\left(\text{Enterprise serves sold (n)} - \text{Small buildings w enterprise servers (n)} \right) \times \text{Average m}^2 \text{ per medium building (m}^2\text{)}}{\text{Average number of enterprise servers per building (n)}}$$

Calculation method for production emissions

See 'Calculating CO₂ emissions savings, STEP 5'

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Automation Servers, Smartx Controllers and Entreprise Servers sales	Schneider Sales data	Country	Annual	Confidential
Share of Automation servers' sales used for HVAC control and for Field Control applications	Schneider expert estimates	World	Every 3 years	Confidential
Average number of automation and enterprise servers installed per building				
Share of small buildings equipped with Enterprise Server				
Average energy savings enabled by BMS – Brownfield				
Energy sources for commercial building	IEA (2015) Energy Technology Perspectives; IEA (2013) Transition to Sustainable Buildings, Strategies and Opportunities to 2050; Energy Information Administration EIA (2012) Commercial buildings energy consumption survey (CBECS)	World	Every 3 years	Electricity: -37% Natural Gas: -31% Oil & Coal: -24% Commercial Heat: -8%
Average size of small, medium and large buildings equipped with BMS (in m²)	Schneider expert estimate	World	Every 3 years	Small: 5,000 m² Medium: 50,000 m² Large: 100,000 m² Weighted average: 43,750 m²
Energy consumption of buildings (kWh/m²)	International Institute for Applied System Analysis, Global Energy Assessment (GEA), Chapter 10 Energy End-Use: Buildings; Carbone 4 expertise	Country	Every 3 years	–
Average lifetime of the offer	Schneider expert estimate	World	Every 3 years	10 years
% Brownfield sales with buildings' retrofit	Schneider expert estimate	World	Every 3 years	Confidential
% Brownfield sales with new buildings that replace demolitions	IEA (2013) Transition to Sustainable Buildings, Strategies and Opportunities to 2050	OECD, Non OECD	Every 3 years	OECD: 40% Non OECD: 30%

Emission Factors

Emission factor	Source	Scope	Update frequency	Values
Electricity – direct emissions	IEA, electricity emission factors, 2017 edition (2014 data)	Country	Every 3 years	–
Electricity – upstream and T&D losses	DEFRA 2017	Country when available, or global average	Every 3 years	–
Electricity – Infrastructure and supply chain-	IEA and IPCC, 2014	Country when available, or global average	Every 3 years	–
Electricity – forward-looking	Forward-looking discounting: ETP 2017, RTS scenario	Region	Every 3 years	–
Fuels	Bilan GES, Ademe, Europe data; Carbone 4 expertise	World	Every 3 years	Natural Gas: 239 gCO_2e / kWh Oil & Coal: 323 gCO_2e / kWh Commercial heat: 239 gCO_2e / kWh

7. Power Monitoring Systems

Definition of the offer

A power monitoring system (PMS) is a system that gathers energy and power data in a facility. Stand-alone or embedded meters measure, collect and deliver essential data from key distribution points across the entire electrical network. That gives users the ability to manage on-site operations, with day-to-day optimization of energy consumption. The PMS can be used for very different applications, such as buildings, marine vessels, industrial processes, etc.

Considering the wide variety of products and software needed to install a full PMS, and the subsequent risk of multiple accounting, this methodology focuses on edge control software sales. Edge control software delivers data management and supervisory services core to PMS systems and are a good proxy to estimate the volume of PMS sold during the year. The number of facilities equipped with a PMS is estimated based on the number of software licenses sold, further enabling to estimate energy and CO_2 savings.

Saved and avoided emissions are calculated based on average energy savings allowed by PMS, used in service buildings (such as commercial or healthcare building) and industrial facilities from various sectors (including data centres, utility, food and beverage, automotive, mining, minerals and metals, oil & gas, transportation, water and wastewater and other industries).

Boundaries

System-level boundary: considering saved emissions of the building in which the software is installed.

Definition of reference situation

Brownfield reference situation: Brownfield reference situation distinguishes two cases:

- PMS installed on existing facilities, not previously equipped with such a system.
- PMS installed on new facilities, are replacing replacing a demolished facility.

The total Brownfield percentage is calculated as the sum of retrofit sales (in %, provided by Schneider Electric's experts) plus the share of new facilities that allow to replace demolitions, based on market forecast provided by the IEA[16] (see formula below).

Greenfield reference situation: Greenfield reference situation refers to the installation of a PMS in a new site. Greenfield reference situation is defined as the situation where another PMS system is installed, providing similar energy efficiency benefits. Avoided emissions are therefore equal to 0 (Greenfield scenario 3).

Emission sources

	Schneider vs. BF retrofit	Schneider vs. BF demolition	Schneider vs. GF new building	Comments
Production	🟢	🟢	–	Schneider induces additional emissions when the alternative does not require a new equipment
Transport	•	•	—	Schneider induces additional emissions when the alternative does not require a new equipment, but they are negligible
Installation	•	•	—	Schneider induces additional emissions when the alternative does not require a new equipment, but they are negligible
Use	🟢	🟢	–	Energy Efficiency performance comparison for all situations. GF market reference is considered as efficient as Schneider offer
End of Life	—	—	—	Emissions are small compared to a whole life cycle

🟢 Emissions not equivalent and not negligible
• Emissions not equivalent but negligible compared to whole life cycle
– Emissions equivalent but not negligible
— Emissions equivalent and negligible

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[16] *IEA (2013) Transition to Sustainable Buildings, Strategies and Opportunities to 2050*

Relevant emission sources have been identified using Life Cycle Assessment results available in Product Environmental Profiles. The PEPs are publicly available on Schneider Electric's "Check a Product" website or via the PEP EcoPassport association website.

Calculation method for use

Method 1, based on the total volume sold of software per year. Total saved emissions are cumulative over the estimated average lifetime of the products.

Brownfield and Greenfield shares are calculated based on prospective (future) market data. The methodology looks at the global share of buildings expected to be retrofitted, destroyed and newly built in the coming years, to estimate the share of Schneider Electric's sales for Brownfield and Greenfield markets.

Calculation formula

$$\textbf{PMS Saved CO}_2 = \text{Overall Brownfield (\%)} \times \text{Savings per energy source (MWh)} \times \text{Electricity of fuel EF (kgCO}_2\text{e/kWh)} \times \text{Average Lifetime (years)}$$

$$\textbf{Overall Brownfield (\%)} = \left(\text{Greenfield (\%)} \times \text{Share of additions that replace demolitions (\%)} \right) + \text{Brownfield (\%)}$$

$$\textbf{Electricity Saved (MWh/yr)} = \underbrace{\text{Average installed electricity power capacity (MW)} \times \text{Weighted average loading factor (\%)} \times \text{Use Case (hours/yr)}}_{\text{Electrical consumption per year (MWh)}} \times \text{Energy savings per year (\%)} \times \text{Sales per facility type (n)}$$

$$\textbf{Fossil Fuel Saved (MWh/yr)} = \text{Sales in existing facilities - Brownfield (n)} \times \left(\text{Share of sales services buildings (\%)} \times \text{Fuel savings in existing services building (MWh/yr)} + \text{Share of sales for industrial facilities (\%)} \times \text{Fuel savings in existing industrial facilities (MWh/yr)} \right) + \text{Sales in new facilities that replace demolitions - Brownfield} \times \left(\text{Share of sales for sercies buildings (\%)} \times \text{Fuel savings in new services building (MWh/yr)} + \text{Share of sales for industrial facilities (\%)} \times \text{Fuel savings in new industrial facilities (MWh/yr)} \right)$$

$$\textbf{Fuel savings per type of building (MWh/yr)} = \text{Energy savings per year (\%)} \times \text{Fossil consumption per type of building (MWh/yr)}$$

Calculation method for production emissions

See 'Calculating CO_2 emissions savings, STEP 5'

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Volume of PMS sales	**Schneider Sales data**	**Country**	**Annual**	**Confidential**
Average energy savings enabled by PMS – Brownfield	Schneider expert estimate	World	Every 3 years	Confidential
Average energy savings enabled by PMS in new facilities – Greenfield				
Average installed electricity power capacity of facilities equipped with a PMS	Schneider expert estimates	World	Every 3 years	2 MW
Weighted average loading factor of facilities (including use case: hours of operations per year)				Confidential
Percentage of sales for services buildings (i.e. commercial and healthcare buildings)	Schneider expert estimates – sales data	World	Annual	Confidential
Percentage of sales for industrial facilities (i.e. Data center, Utility, Food and beverage, Automotive, Mining, minerals and metal, Oil and Gas, Transportation, Water and wastewater, and Other Industry)				Confidential
Average lifetime of the offer	Schneider expert estimate	World	Every 3 years	7.5 years
Energy sources for commercial building	IEA (2015) Energy Technology Perspectives; IEA (2013) Transition to Sustainable Buildings, Strategies and Opportunities to 2050;	World	Every 3 years	Electricity: 51% Natural Gas: 24% Oil & Coal: 16% Commercial Heat: 5% Biomass: 3% Other renewables: 1%
Energy sources for industrial facilities	Schneider expert estimates, based on Schneider own internal energy consumption profile	World	Every 3 years	Electricity: 71% Natural Gas: 27% Oil & Coal: 1% Commercial Heat: 2%
% Brownfield sales with facilities' retrofit	Retrofit sales: Schneider expert estimates	World	Every 3 years	Confidential
% Brownfield sales for new facilities that replace demolitions	IEA (2013) Transition to Sustainable Buildings, Strategies and Opportunities to 2050	OECD, Non OECD	Every 3 years	OECD: 40% Non OECD: 30%

Emission Factors

Emission factor	Source	Scope	Update frequency	Values
Electricity – direct emissions	IEA, electricity emission factors, 2017 edition (2014 data)	Country	Every 3 years	–
Electricity – upstream and T&D losses	DEFRA 2017	Country when available, or global average	Every 3 years	–
Electricity – Infrastructure and supply chain	IEA and IPCC, 2014	Country when available, or global average	Every 3 years	–
Electricity – forward-looking	Forward-looking discounting: ETP 2017, RTS scenario	Region	Every 3 years	–
Fuels	Bilan GES, ADEME, Europe data; Carbone 4 expertise	World	Every 3 years	Natural Gas – 239 gCO$_2$e / kWh Oil & Coal – 323 gCO$_2$e / kWh Commercial heat- 239 gCO$_2$e / kWh

8. Energy Performance Contracting

Definition of the offer

Energy performance contracting (EPC) is a mechanism the purpose of which is to unlock the potential of energy efficiency. Energy performance contracts are used as an alternative financing mechanism to accelerate investment in cost effective energy conservation measures in existing buildings, districts or industrial facilities. EPCs allow public and private actors to accomplish energy savings projects without up-front capital costs and following specific accounting and validation rules. EPC involves an Energy Service Company (ESCO) which provides financing and guaranteed energy savings. The remuneration of the ESCO depends on the achievement of the guaranteed savings. The ESCO stays involved in the measurement and verification process for the energy savings during the repayment period.

Boundaries

As EPC is a service, both emissions from the system to which the service relates and emissions from service provisioning must be accounted for.

Here the system to which the service relates to is a building energy system.

Ecosystem-level boundary: considering saved emissions of the building with the performance contract compared to a situation without energy efficiency measures.

Definition of reference situation

Brownfield reference situation: Given the nature of energy performance contracting, all contracts are considered to be Brownfield, where the reference situation refers to the absence of the EPC. The methodology considers the average emission factor of the country where the contract is signed, with forward-looking discounting over the duration of the contract.

Greenfield reference situation: Greenfield reference situation does not apply to this offer.

Emission sources

	Schneider vs. BF retrofit	Schneider vs. GF	Comments
Production	—	#NA	No impact of EPC on production
Transport	▬	#NA	No impact of EPC on production
Installation	▬	#NA	No impact of EPC on production
Use	🟢	#NA	Energy Efficiency performance comparison of the building
End of Life	▬	#NA	Emissions are small compared to a whole life cycle

🟢 Emissions not equivalent and not negligible

● Emissions not equivalent but negligible compared to whole life cycle

— Emissions equivalent but not negligible

▬ Emissions equivalent and negligible

An EPC is typically composed of several energy efficiency measures (such as insulation, double glazing, energy management systems, etc.). All Life Cycle Analyses (LCA) of such examples look alike: significant CO_2 impacts are found during the manufacturing and the use-phase. The emission sources illustrated below are based on this hypothesis.

Besides emission changes of the building energy system, emissions from service provisioning by Schneider Electric must be added to this analysis.

Calculation method for use-phase emissions

Method 1, based on the total volume of kWh savings contracted per year. Total saved emissions are cumulative over the lifetime of the EPC contract.

Calculation formula

$$\text{EPC Saved } CO_2 = \text{Contracted savings (MWh/year)} \times \text{Contract length (years)} \times \text{Country electricity or specific fuel EF } (kgCO_2e/kWh)$$

Calculation method for provisioning emissions

See 'Calculating CO_2 emissions savings, STEP 5'

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Sales data: – Contracted savings (MWh/year); – Contract length (yr); – Project location	Schneider Sales database	Specific to each contract	Annual	Confidential, specific to each contract

Emission Factors

Emission factor	Source	Scope	Update frequency	Values
Electricity – direct emissions	IEA, electricity emission factors, 2017 edition (2014 data)	Country	Every 3 years	–
Electricity – upstream and T&D losses	DEFRA 2017	Country when available, or global average	Every 3 years	–
Electricity – Infrastructure and supply chain	IEA and IPCC, 2014	Country when available, or global average	Every 3 years	–
Electricity – forward-looking	Forward-looking discounting: ETP 2017, RTS scenario	Region	Every 3 years	–
Emission Factors of fuels	Bilan GES, Ademe, Europe data; Carbone 4 expertise	World	Every 3 years	Natural Gas – 239 gCO_2e / kWh Oil & Coal – 323 gCO_2e / kWh Commercial heat-239 gCO_2e / kWh

9. Power SCADA Operations

Definition of the offer

Power SCADA Operation is a software that digitizes and simplifies complex electrical distribution systems. It is engineered to help facilities like hospitals, industrials, airports and electro-intensive operations maximize uptime, manage and control medium and low voltage networks with a flexible, secure, scalable, and redundant platform.

Boundaries

System-level boundary, considering saved emissions of the building in which the servers are installed.

Definition of reference situation

Brownfield reference situation:

- PSO installed on existing buildings, not previously equipped with such a system.

Greenfield reference situation:

- Greenfield reference situation refers to the installation of a PSO in a new site. Greenfield reference situation is defined as the situation where another PSO system is installed, providing similar energy efficiency benefits of 0 (Greenfield scenario 3).

Emission Sources

	Schneider vs. BF	Schneider vs. GF	Comments
Production	🟢	━	Schneider induces additional emissions when the alternative does not require a new equipment
Transport	●	—	Schneider induces additional emissions when the alternative does not require a new equipment, but they are negligible
Installation	●	—	Schneider induces additional emissions when the alternative does not require a new transformer, but they are negligible
Use	🟢	━	Energy Efficiency performance comparison for all situations. GF market reference is considered as efficient as Schneider offer
End of Life	●	—	Emissions are small compared to a whole life cycle

🟢	Emissions not equivalent and not negligible
●	Emissions not equivalent but negligible compared to whole life cycle
━	Emissions equivalent but not negligible
—	Emissions equivalent and negligible

Calculation method for use-phase emissions

Method 1, based on the total volume sold of servers per year. Total saved emissions are cumulative over the average lifetime of the solution.

Calculation formula

PSO Saved CO_2 = Brownfield sales (%) × Savings by PSO (MWh) × Consumption per facility type (MWh) × Electricity or fuel EF ($kgCO_2e/KWh$) × Average lifetime (years)

Calculation method for production emissions

See ‘Calculating CO₂ emissions savings, STEP 5’

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
PSO sales	Schneider Sales data	Country	Annual	Confidential
Average energy savings enabled by PSO – Brownfield				
Energy sources for commercial building	IEA (2015) Energy Technology Perspectives; IEA (2013) Transition to Sustainable Buildings, Strategies and Opportunities to 2050	World	Every 3 years	Electricity: -51% Natural Gas: -24% Oil & Coal: -16% Commercial Heat: -5% Biomass, waste, other renewables: -4%
Energy sources for light industry	Schneider expert, based on Schneider Electric energy profile	World	Every 3 years	Electricity: -71% Natural Gas: -27% Oil & Coal: -1% Commercial Heat: -2%
Energy sources for heavy industry	IEA, ETP 2015	World	Every 3 years	Electricity: -21% Natural Gas: -21% Oil & Coal: -49% Commercial Heat: -3% Biomass, waste, other renewables: -6%
Energy consumption of buildings (kWh/m²)	International Institute for Applied System Analysis, Global Energy Assessment (GEA), Chapter 10 Energy End-Use: Buildings; Carbone 4 expertise	Country	Every 3 years	–
Average lifetime of the offer	Schneider expert estimate	World	Every 3 years	7.5 years
% Brownfield sales with buildings' retrofit	Schneider expert estimate	World	Every 3 years	Confidential

Emission Factors

Emission factor	Source	Scope	Update frequency	Values
Electricity – direct emissions	IEA, electricity emission factors, 2017 edition (2014 data)	Country	Every 3 years	–
Electricity – upstream and T&D losses	DEFRA 2017	Country when available, or global average	Every 3 years	–
Electricity – Infrastructure and supply chain	IEA and IPCC, 2014	Country when available, or global average	Every 3 years	–
Electricity – forward-looking	Forward-looking discounting: ETP 2017, RTS scenario	Region	Every 3 years	–
Fuels	Bilan GES, Ademe, Europe data; Carbone 4 expertise	World	Every 3 years	Natural Gas: 239 gCO_2e / kWh Oil & Coal: 323 gCO_2e / kWh Commercial heat: 239 gCO_2 / kWh

10. Distribution and Energy Management Systems

Definition of the offer

ADMS (Advanced Distribution Management System) regroups several solutions used to optimize the management of energy grids (transmission, sub-transmission and distribution), inducing a reduction in energy losses and facilitating the integration of intermittent energy sources. Such solutions include in particular:

- Supervisory Control and Data Acquisition (SCADA)
- Outage Management System (OMS)
- Distribution Management System (DMS)
- Energy Management System (EMS)
- Distributed Energy Resource Management System (DERMS)

The current methodology covers DMS and EMS modules, with specific conditions: for DMS at least one of the following functions are to be installed by the customer: Network Reconfiguration and Volt-Var Optimization; for EMS the Optimal Power Flow function has to be installed. Such modules help to reduce energy loss in the distribution and (sub)transmission grids.

Other solutions part of the Advanced Distribution Management Systems are expected to deliver savings, but are not included in the methodology to date. For instance, the increased integration of renewable sources, allowed by DERMS modules, or the maintenance optimization allowed by OMS.

Boundaries

Ecosystem boundary, considering reduced electricity production on the grid thanks to the use of the ADMS solution. Energy savings are considered over the estimated lifetime of the ADMS solution.

Definition of reference situation

Brownfield reference situation:

- The reference situation is the average performance of energy grids, expressed in transmission and distribution losses (% of output), in similar countries (high, medium or low-income countries).

Greenfield reference situation:

- Greenfield avoidances are calculated as energy efficiency delivered on grid evolution (additional capacity on existing grid).

Emission Sources

	Schneider vs. BF	Schneider vs. GF	Comments
Production	🟢	🟢	Emissions associated to the manufacture of Schneider's hardware for the solution
Transport	●	●	Transporting the solution emits negligible amounts of GHG
Installation	●	●	Installing the solution emits negligible amounts of GHG
Use	🟢	🟢	Energy Efficiency performance comparison of the grid with and without the solution
End of Life	●	●	Emissions are small compared to a whole life cycle

🟢	Emissions not equivalent and not negligible
●	Emissions not equivalent but negligible compared to whole life cycle
—	Emissions equivalent but not negligible
—	Emissions equivalent and negligible

Calculation method

Method 1, project by project approach, based on the electricity distributed (and cover by ADMS) in one year by the client (TWh).

Calculation formula

ADMS Saved or Avoided CO_2 = **DMS Saved or Avoided CO_2** + **EMS Saved or Avoided CO_2**

DMS Saved or Avoided CO_2 = Total electricity distributed covered by DMS (KWh/customer/year) × Brownfield (%) or Greenfield (%) × Average energy loss in discribution (% of energy distributed) × Energy loss reduction (% of energy loss) × Forward looking emisssion factors (kgCO_2e/kWh) × Average lifespan of the product (years)

EMS Saved or Avoided CO_2 = Total electicity transmitted covered by EMS (KWh/customer/year) × Brownfield (%) or Greenfield (%) × Average energy loss in (sub)transmission (% of energy distributed) × Energy loss reduction (% of energy loss) × Forward looking emisssion factors (kgCO_2e/kWh) × Average lifespan of the product (years)

Calculation method for production emissions

See 'Calculating CO_2 emissions savings, STEP 5'

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Sales data: Total electricity distributed covered by DMS	Schneider Electric sales team and public sources	One line per client per country	Annual	Confidential
Average energy losses by country	World Bank	Per country. For the USA, detailed by State	Every 3 years	
Average energy losses of (sub) transmission grid	Based on the following literature: [1] Assessment of Transmission and Distribution Losses in New York, EPRI, Palo Alto, CA: 2012, PID071178 (NYSERDA 15464) [2] Transmission Losses, NGESO, 2019 [3] Jordan Wirfs-Brock: Lost In Transmission: How Much Electricity Disappears Between A Power Plant And Your Plug?, Inside Energy, 2015 [4] Ethiopia – Grid Management Support Program (GMSP) for System Operational Gap Analysis (SOGA), Nexant, [5] Raúl Jiménez, Tomás Serebrisky, Jorge Mercado: Power Lost: Sizing Electricity Losses in Transmission and Distribution Systems in Latin America and the Caribbean, Inter-American Development Bank, New York, Washington D.C., 2014 [6] C. C. B. Oliveira, N. Kagan, A. Méffe, S. Jonathan, S. Caparroz, J. L. Cavaretti: A New Method for the Computation of Technical Losses in Electrical Power Distribution Systems, Electricity Distribution	Global average on transmission and sub transmission, applied to national T&D losses	Every 3 years	2.2% transmission losses, of which 0.5% sub transmission
Energy loss reductions achieved by EMS	Expert estimate	World	Every 3 years	Confidential
Energy loss reductions achieved by DMS	Expert estimate	World	Every 3 years	Confidential
Lifetime	Expert estimate	World	Every 3 years	10 years

Emission Factors

Emission factor	Source	Scope	Update frequency	Values
Electricity – direct emissions	IEA, electricity emission factors, 2019 edition (2017 data)	Country	Every 3 years	–
Electricity – upstream and T&D losses	IEA, electricity T&D (transmission and distribution) emission factors, 2019 edition (2017 data) + IEA 2019 (2017 data) electricity production per source and per country, combined with IPCC emissions factors for upstream combustible extraction and losses emissions	Country when available, or global average	Every 3 years	–
Electricity – Infrastructure and supply chain	IEA 2019 (2017 data) electricity production per source and per country, combined with IPCC emissions factors for infrastructure and supply chain emissions	Country when available, or global average	Every 3 years	–
Electricity – forward-looking	Forward-looking discounting: ETP 2017, RTS scenario	Region	Every 3 years	–

11. Cooling machines

Definition of the offer

Cooling is an offer from Schneider Electric regrouping the sales of cooling machines, such as chillers and air conditioners. Many industrial and in particular mission critical applications need a cooling system, such as data centres, which must cool down the air in the IT room in order for the servers to work properly.

Schneider Electric cooling technologies can deliver efficiency by design and in the operation phase since Schneider Electric cooling technologies can deliver efficiency through their design specifically tailored to IT applications, but also during their use phase, matching completely with ASHRAE[17] operation guidelines.

A chiller is a machine that removes heat from a liquid and control its temperature using one or more refrigeration circuits. The heat can be dissipated using a hydraulic circuit (water-cooled chiller) or rejecting it directly in the external air (air-cooled chiller).

A room cooling air conditioner is a machine that removes heat and controls the humidity of air in an enclosed space to achieve a specific interior environmental temperature and humidity rate. The unit needs an external system which rejects the heat in the air.

An in-row cooling is a type of air conditioning system commonly used in data centers in which the cooling unit is placed between the server cabinets in a row for offering cool air to the server equipment more effectively.

Boundaries

Product boundary, considering electricity savings due to the installation of an efficient Schneider Electric cooling machine compared to the average market for cooling machines. Energy savings are considered over the entire lifetime of the product.

Definition of reference situation

Brownfield reference situation:

- A Brownfield reference situation refers to the situation where Schneider Electric cooling technologies are replacing a previous generation machine in a previous generation Data Center. The previous generation Data Center implies that temperatures (of both air and water) are lower; therefore the machines are less efficient, with respect to a new generation DC.

Greenfield reference situation:

- **Brownfield, increased capacity (= Greenfield vs old generation)**
  In case of retrofit (Brownfield), it is estimated that the data center increases its capacity by 25%. This increased capacity is therefore accounted as Greenfield, with a reference situation defined as in the Brownfield situation (old generation data centers).
- **Greenfield (more efficient)**
  A Greenfield reference situation refers to the situation where Schneider Electric cooling technologies are installed in a new, last generation data centers. The reference situation is defined by average competitors' machines, which are considered to be less efficient than Schneider's.
- **Greenfield (vs old gen)**
  A Greenfield reference situation refers to the situation where Schneider Electric cooling technologies are installed in a new Data Center. Nevertheless, a significant share of data centers in the world are not yet built according to latest generation standards, because energy is cheap and the ROI for higher efficiency is too long. The reference situation is therefore defined as the previous generation data center.

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[17] American Society of Heating, Refrigerating and Air-Conditioning Engineers

Emission Sources

	Schneider vs. BF	Schneider vs. GF increased capacity	Schneider vs. GF old generation	Schneider vs. GF new generation	Comments
Production	🟢	─	─	─	Schneider induces additional emissions when the alternative does not require new equipment
Transport	•	—	—	—	Schneider induces additional emissions when the alternative does not require new equipment, but they are negligible
Installation	•	—	—	—	Schneider induces additional emissions when the alternative does not require new equipment, but they are negligible
Use	🟢	🟢	🟢	🟢	Energy Efficiency performance comparison in all references. Schneider equipment is considered more efficient than current market equipment
End of Life	—	—	—	—	Emissions are very limited, compared to a whole life cycle

🟢	Emissions not equivalent and not negligible
•	Emissions not equivalent but negligible compared to whole life cycle
─	Emissions equivalent but not negligible
—	Emissions equivalent and negligible

Calculation method for use phase emissions

Method 1, based on the total volume of chillers sold during the year, in number of units sold by country and reference.

In the first batch of calculations, only air conditioning units Uniflair LE CW, Uniflair LE DX and Large (>400kW) chiller sales were taken into consideration.

Calculation formula (simplified)

$$\text{Cooling Saved } CO_2 = \text{Quantity of sales (kW cooling capacity/country)} \times \text{Brownfield installations (\% per family of product)} \times \text{Use Case (h)} \times \left(\text{EER*Schneider retrofit (kWh cooling/kWh used)} \times \text{EER previous generation (kWh cooling/kWh used)} \right) \times \text{Forward looking emission actor } (kgCO_2e/KWh)$$

$$\text{Cooling Avoided } CO_2 = \text{Number of sales (kW cooling capacity/country)} \times \text{Greenfield installations** (\% per family of product)} \times \text{Use Case (h)} \times \left(\text{EER Schneider (kWh cooling/kWh used)} \times \text{EER competitors*** (kWh cooling/kWh used)} \right) \times \text{Forward looking emission actor } (kgCO_2e/KWh)$$

** EER: energy efficiency ratio*

*** The % of Greenfield installations is differentiated in the calculation depending on the type of sales (IT or non-IT) and the type of infrastructure where they are installed (new or old generation). Therefore, the formula presented is simplified.*

**** The load factor and EER competitors depend on the type of sales (IT vs non-IT). Therefore, the formula presented is simplified. In the model, IT sales are differentiated from non-IT sales.*

Calculation method for production-related emissions

See 'Calculating CO_2 emission savings, STEP 5'

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Sales data	Schneider Electric sales database	Nb of units sold per product reference number and per country	Annual	Confidential
Cooling capacity (kW)	Schneider Electric technical database	Product reference number enables to know the cooling capacity of each cooling device, in kWatt	Every 3 years	Confidential
Energy efficiency ratio (= kWh of cooling provided / kWh of energy consumed by the machine to provide cold)	Expert estimate	For each type of cooling system (Chilled water air conditioner, Direct expansion air conditioners and chillers), for Schneider Electric and for equivalent machines for competitors	Every 3 years	Confidential
Load factor (= the usage of the products in terms of % of time over its lifetime)	Expert estimate	Load factor varying over the lifetime, increasing in charge over the first years and reaching its stable average load factor after one year and a half. Load factors for IT and non-IT use were distinguished, as well as IT Greenfield and IT Brownfield	Every 3 years	- See table below
Lifetime	Expert estimate	World average	Every 3 years	10 years
% Brownfield sales	Expert estimate	Brownfield (and Greenfield) are calculated based on technology and geographical approach. % of BF sales per technology minus the extension of IT capacity on data center (25%)	Every 3 years	– CW air conditioners: 15% – DX air conditioners: 26% – > 400kW chiller: 11% – Inrow CW: 15% – Inrow DX: 26% – Medium and small chillers: 15%
% Greenfield sales (vs latest gen)	Expert estimate	Greenfield is calculated as the difference between total sales and, either Brownfield or Greenfield with previous generation datacenter (28%)	Every 3 years	– CW air conditioners: 58% – DX air conditioners: 47% – > 400kW chiller: 61% – Inrow CW: 58% – Inrow DX: 47% – Medium and small chillers: 58%
% Greenfield sales (vs old gen)	Expert estimate	1-BF – GF (latest generation)	Every 3 years	– CW air conditioners: 27% – DX air conditioners: 27% – > 400kW chiller: 28% – Inrow CW: 27% – Inrow DX: 27% – Medium and small chillers: 27%
DataCenter IT increased capacity after a retrofit	Expert estimate	World average	Every 3 years	25%
% of non-IT sales	Expert estimate	Average per region (Europe, Asia, MEA, South Africa, North America) Only chillers models are sold for non-IT use. Only a Greenfield scenario is considered for non-IT use cases	Every 3 years	– Europe: 20% – Asia: 10% – MEA: 5% – South America: 15% – North America: 0%

Load factors

The load factors were given by an expert from Schneider Electric.

Equipment	Load Factor – first 6 months	Load Factor – following 6 months	Load Factor – after one year	Load Factor – after one year and a half
Greenfield IT	20%	50%	80%	90%
Retrofit	90%	90%	90%	90%
Non-IT	50%	50%	50%	50%

Emission Factors

Emission factor	Source	Scope	Update frequency	Values
Electricity – direct emissions	IEA, electricity emission factors, 2019 edition (2017 data)	Country	Every 3 years	–
Electricity – upstream and T&D losses	IEA, electricity T&D (transport and distribution) emission factors, 2019 edition (2017 data) + IEA 2019 (2017 data) electricity production per source and per country, combined with IPCC emissions factors for upstream combustible extraction and losses emissions	Country when available, or global average	Every 3 years	–
Electricity – Infrastructure and supply chain	IEA 2019 (2017 data) electricity production per source and per country, combined with IPCC emissions factors for infrastructure and supply chain emissions	Country when available, or global average	Every 3 years	–
Electricity – forward-looking	Forward-looking discounting: ETP 2017, RTS scenario	Region	Every 3 years	–

12. Microgrids

Definition of the offer

Microgrids are single entity power systems designed to provide reliable and independent power supply to sites of various sizes. They can either be connected to the national grid to support existing power supply, or operate independently, thus replacing the grid completely. They are smart local interconnected energy systems that integrate decentralized energy sources, storage, and control systems to ensure:

- optimized energy supply from different sources (solar PV[18], wind, natural gas, etc.);
- and reduced the price of energy in the concerned area by integrating local energy production and storage equipment, limiting the risks of grid failure.

Boundaries

Ecosystem boundary, considering the increased connectivity and managing capabilities enabled by the addition of the microgrid to the existing grid, providing a cleaner source of energy than the country mix (connected mode) or autonomous generator (off-grid mode).

Definition of reference situations

Brownfield reference situation:

- The microgrid is installed to supply an existing site, replacing (partially or totally) the national grid or autonomous diesel generator. It is assumed that the consumption of the site remains similar after the installation of the microgrid.

Greenfield reference situation: Two different possibilities:

- Additional capacity on existing site: the microgrid is installed on an existing site, replacing (partially or totally) the national grid or autonomous diesel generator; this can be the occasion for the site to expand its operations and therefore its energy consumption. The described situation corresponds to Greenfield reference situation (avoided emissions).
- New project: The microgrid is installed to supply a new site, electricity production is used in (partial or total) replacement of electricity consumption from the grid.

Emission Sources

	Schneider vs. BF	Schneider vs. GF	Comments
Production	🟢	🟢	Emissions associated to the manufacture of Schneider's hardware for the microgrid
Transport	●	●	Transporting the solution emits negligible amounts of GHG
Installation	●	●	Installing the solution emits negligible amounts of GHG
Use	🟢	🟢	Carbon emissions comparison of between the grid and the microgrid
End of Life	●	●	Emissions are very limited compared to a whole life cycle

🟢 Emissions not equivalent and not negligible

● Emissions not equivalent but negligible compared to whole life cycle

— Emissions equivalent but not negligible

— Emissions equivalent and negligible

Calculation method for use-phase emissions

Method 2, based on the revenues generated by Schneider Electric's Microgrid offer per year per region.

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18 Photovoltaic

Calculation formula

$$\boxed{\text{Microgrid Saved and Avoided } CO_2} = \begin{matrix}\text{Greenfield (\%)}\\\text{or}\\\text{Brownfield (\%)}\end{matrix} \times \begin{matrix}\text{Sales}\\\text{(€/country)}\end{matrix} \times \begin{matrix}\text{Ratio W/€}\\\text{installed}\end{matrix} \times \begin{matrix}\text{Used Case}\\\text{(h)}\end{matrix} \times \begin{matrix}\text{Installed capacity by tech*}\\\text{(\% per region)}\end{matrix} \times \left(\begin{matrix}\text{Forward looking}\\\text{emission factor}\\(kgCO_2e/KWh)\end{matrix} \times \begin{matrix}\text{Emission factor}\\\text{by technology}\\(kgCO_2e/KWh)\end{matrix} \right)$$

** The load factor and microgrid capacity installed depend on the electricity production source (both region and energy technology)*

*** Electricity emission factor depends on the country of the microgrid and evolve in time according to IEA ETP RTS scenario*

Calculation method for production emissions

See 'Calculating CO₂ emissions savings, STEP 5'

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Sales data	Schneider Electric sales database	Sales (in €) per region	Annual	Confidential
Ratio € of CA per W installed	Schneider Electric experts	World average	Every 3 years	Confidential
Capacity installed of the different electricity production sources	Public studies (Woodmac)	By region. Public values are only available for the North American market, therefore, only North American sales are accounted for in the model*	Annual	For North America: – Solar: 41% – Wind: 1% – Natural Gas: 5% – CHP: 30% – Diesel generator: 5% – Fuel Cell: 10% – Storage: 8%
Load factor (= the usage of the production sources in terms of % of time over a year)	AIE, ETP 2017 and IEA (for diesel and CHP)	By region. Load factor of each electricity production source (considered identical in a microgrid than in a national grid)	Every 3 years	– See table below
Lifetime	Expert estimate	World average	Every 3 years	10 years
% Greenfield sales	Expert estimate	World average. Share taking into account both new sites and average increased consumption of existing sites	Every 3 years	58%
% Brownfield sales	Expert estimate	1 – Greenfield sales	Every 3 years	42%

** Storage was not considered as implying any avoided or saved emissions since the electricity from the grid is stored to be consumed later. Even though it is possible to store grid electricity when emissions from the grid are lower and then consumed it when emissions from the grid are higher, this was not taken into account.*

Load factors

	Solar	Wind	Natural Gas	CHP	Diesel	Fuel Cell	Biomass	Storage
North America	14%	32%	28%	58%	8%	8%	48%	0%
Europe	12%	22%	24%	44%	8%		39%	0%
Africa	30%	10%	0%	44%	8%		10%	0%
South East Asia	14%	11%	49%	44%	8%		40%	0%
China	10%	18%	18%	44%	8%		38%	0%
India	30%	10%	26%	44%	8%		54%	0%
Russia		11%	45%	44%	8%			0%
Mexico	9%	29%	66%	44%	8%		33%	0%
Brazil	0%	29%	63%	44%	8%		47%	0%
ROW	10%	18%	18%	44%	8%	0%	38%	0%

Fuel Cell load factor couldn't be found: Fuel Cell is considered as a backup technology, therefore the load factor was considered as equal to the diesel load factor.

Emission Factors

Emission factor	Source	Scope	Update frequency	Values
Electricity (national grid) – direct emissions	IEA, electricity emission factors, 2019 edition (2017 data)	Country	Every 3 years	–
Electricity – upstream and T&D losses	IEA, electricity T&D (transport and distribution) emission factors, 2019 edition (2017 data) + IEA 2019 (2017 data) electricity production per source and per country, combined with IPCC emissions factors for upstream combustible extraction and losses emissions	Country when available, or global average	Every 3 years	–
Electricity – Infrastructure and supply chain	IEA 2019 (2017 data) electricity production per source and per country, combined with IPCC emissions factors for infrastructure and supply chain emissions	Country when available, or global average	Every 3 years	–
Electricity – forward-looking	Forward-looking discounting: ETP 2017, RTS scenario	Region	Every 3 years	–
Combustion and upstream emissions per electricity production source	ADEME or Carbone 4 expertise (for CHP* and Fuel cell**) or OpenEI LCA for biomass	World average	Every 3 years	– Generator: 1266.8 gCO$_2$e/kWh – Solar: 55 gCO$_2$e/kWh – Wind: 14.1 gCO$_2$e/kWh – Geothermal: 45 gCO$_2$e/kWh – Natural gas: 418 gCO$_2$e/kWh – CHP: 313 gCO$_2$e/kWh – Diesel: 730 gCO$_2$e/kWh – Fuel Cell: 645 gCO$_2$e/kWh – Biomass: 140 gCO$_2$e/kWh

**CHP emission factor calculation based on 807 gCO$_2$/kWh for CHP (based on Ecoinvent and Carbone 4 calculations) with an allocation made based on a use of gas to produce 35% of electricity, 55% heat, 10% losses*

***Fuel cell emission factors are based on steam reforming hydrogen (world average), including the electrolyser and the fuel cell manufacturing.*

13. Power Quality equipment

Definition of the offer

Power Quality is an offer from Schneider Electric aiming at improving the quality of the power signal received by machines. It helps customers to run their equipment optimally and protect them from damages due to poor power quality.

Power Quality offers from Schneider Electric help customers to immediately improve the power availability through Power Factor Correction (PFC) solutions and improve long-term network and asset performance through Harmonic Mitigation and Voltage correction solutions, through its Safe, reliable and high-performance PFC and Harmonics Solutions.

Reactive Energy Management and Power Factor Correction

Reactive power is the portion of electricity that helps establish and sustain the electric and magnetic fields required by alternating current equipment. The amount of reactive power present in an AC circuit will depend upon the phase shift or phase angle between the voltage and the current. In other words, Reactive power is the unused power generated by reactive components in a system.

Reactive power is used by most types of electrical equipment which use a magnetic field, such as motors and other inductive loads. Reactive power is also required to supply the reactive losses on overhead power transmission lines. Often the Reactive power is represented by Power Factor, the ratio of the Active Power (kW) to the apparent Power (kVA) thus management of Reactive Power is often known as Power Factor Correction.

In electrical networks, reactive energy results in increased line currents for a given active energy transmitted to loads. The main consequences are:
- Need for oversizing of transmission and distribution networks by utilities;
- Increased voltage drops and sags along the distribution lines;
- Additional power drawn due to increased overall kVA demand;
- Increased energy consumption within the installations.

Reactive energy management or Power Factor Correction aims to optimize your electrical installation by reducing energy consumption, and to improve power availability. Reactive energy management ensures better utilization of electrical machines, optimized electrical conductor sizes and reduced penalties from the utilities, and improve the availability of energy at utilities.

Reactive power is measured in kilovolt ampere reactive (kVAr) or MVAr The greater the reactive power for the same active power, the greater the amount of energy required. The optimization of kVAr, reduce the energy supplied for the same amount of power demanded, therefore it **generates energy savings**.

Schneider Electric Power Quality offers regroup 3 categories of products:
- PFC LV Components: PF correction capacitors, detuned reactors, PF controllers
- PFC LV Solutions: Power Factor Correction Capacitor Equipment
- PQ Active Correction: Active Harmonic Filters and Dynamic Voltage Restorer

The savings generated by Active Correction solutions, except Power Factor Correction are often intangible, hence it’s not considered in this first step of savings calculation. Active Solutions help to improve network management and asset performance.

Boundaries

System boundary, considering electricity savings allowed by the installation of power quality device. Energy savings are considered over the entire lifetime of the product.

Definition of reference situations

Brownfield reference situation:
Power quality components are installed in existing infrastructures; the reference situation is represented either by the absence of power quality solutions or the existence of an old power quality solution.

Greenfield reference situation:

- Expansion in the retrofit phase are accounted as Greenfield reduction of CO_2 emissions.
- Components installed in new facilities in countries with no regulation concerning power quality (voluntary initiative by customer).
- Components installed in new facilities in countries with regulation concerning power quality (voluntary initiative by customer). In this case, it is assumed that the market performance is the same as Schneider's, and avoided emissions are 0.

Emission Sources

	Schneider vs. BF no PQ	Schneider vs. BF old PQ	Schneider vs. GF increased capa	Schneider vs. GF regulation	Schneider vs. GF no regulation	Comments
Production	🟢	🟢	🟢	▬	🟢	Schneider induces additional emissions when the alternative does not require a new equipment
Transport	•	•	•	—	•	Schneider induces additional emissions when the alternative does not require a new equipment, but they are negligible
Installation	•	•	•	—	•	Schneider induces additional emissions when the alternative does not require a new equipment, but they are negligible
Use	🟢	🟢	🟢	▬	🟢	Energy Efficiency performance comparison in all references. Schneider equipment is not considered more efficient than current market equipment
End of Life	•	—	•	—	•	Emissions are small compared to a whole life cycle

🟢	Emissions not equivalent and not negligible
•	Emissions not equivalent but negligible compared to whole life cycle
▬	Emissions equivalent but not negligible
—	Emissions equivalent and negligible

Calculation method for use phase emissions

Method 2, by calculating the total reactive energy compensation products and solutions installed, based on the total yearly revenues of power quality components and solution sales per country.

Power Quality Saved and Avoided CO_2 = Sales (€/country) × Greenfield (%) or Brownfield (%) × Ratio kVar/€ × Ratio kW/kVar installed* × Use Case (h) × Forward looking emission factor ($kgCO_2e/KWh$) – Induced emissions scope 1+2+3 ($kgCO_2e$)

Calculation formula

** The ration of kWh saved per kVar installed depends on the region.*

Calculation method for production emissions

See 'Calculating CO_2 emissions savings, STEP 5'

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Sales data	Schneider Electric sales database	Revenues per country/region	Annual	Confidential
Total number of kVAr installed	Schneider Electric sales database	World total value Combined with the total amount of sales, it allows to determine a ratio of kVAr installed per € of revenue	Annual	Confidential
kWh saved per kVAr installed	Expert estimate	Regional values (based on case studies)	Every 3 years	Confidential
Lifetime	Expert estimate	World average	Every 3 years	15 years

Emission Factors

Emission factor	Source	Scope	Update frequency	Values
Electricity – direct emissions	IEA, electricity emission factors, 2019 edition (2017 data)	Country	Every 3 years	–
Electricity – upstream and T&D losses	IEA, electricity T&D (transport and distribution) emission factors, 2019 edition (2017 data) + IEA 2019 (2017 data) electricity production per source and per country, combined with IPCC emissions factors for upstream combustible extraction and emissions resulting from losses	Country when available, or global average	Every 3 years	–
Electricity – Infrastructure and supply chain	IEA 2019 (2017 data) electricity production per source and per country, combined with IPCC emissions factors for infrastructure and supply chain emissions	Country when available, or global average	Every 3 years	–
Electricity – forward-looking	Forward-looking discounting: ETP 2017, RTS scenario	Region	Every 3 years	–

14. Data Center Design & Science

Definition of the offer

When it comes to Data Centers (DCs), Schneider not only offers the electrical equipment necessary to the operations, but also some engineering services around the design of the facility.

The energy efficiency gains from Schneider Electric's value proposal around Data Centers thus come from:

- The inner energy efficiency of the equipment sold. That part is already captured by previous models for each specific piece of equipment. These models factor in the induced emissions of Schneider's offers.
- An efficient design of the Data Center layout itself. By understanding the sources of energy loss in a DC, it is possible to mitigate them through proper geometry of the Center. This part of the energy savings is the subject of the model described below.

Boundaries

System boundary, considering reduced electricity consumption of the Data Center as a whole thanks to optimal design. Energy savings are considered over the estimated lifetime of the Data Center.

Definition of reference situations

The reference situation depends on the nature of the project being sold, i.e. whether it is a Brownfield or a Greenfield project. To calculate the macro BF/GF ratio, Schneider Electric uses in its model a method based on life expectancy and market CAGR. This top-down method gives **ratio of GF projects due to net market growth by construction**. It is thus unnecessary to make any assumptions about capacity expansion thanks to retrofitting for instance. However, it is necessary to account for Greenfield projects here to replace old installation. This ratio of additional GF project is created thanks to expert estimates.

Two (BF) reference situations are possible:

- The reference situation for Brownfield is that of an older generation Data Center being retrofitted. Both equipment and design are less efficient than what would be built today, leading to an overall higher energy consumption. Saved energy is calculated from a total energy efficiency gain ratio, and an attribution of these savings between equipment and design.
- A Brownfield situation in which a new Data Center is indeed built, but only to replace an older generation DC that is decommissioned at the same time. In the situation, the reference is the same as is the previous Brownfield scenario.

A unique (GF) reference situation is chosen:

- A Greenfield situation in which the new Data Center is built only to increase the net capacity of Data Centers worldwide. In this case, the reference situation is the energy savings obtained from design by Schneider's competitors.

Emission Sources

	Schneider vs. BF retrofit	**Schneider vs. BF replacement**	**Schneider vs. GF**	**Comments**
Production	🟢	🟢	–	Schneider induces additional emissions when the alternative does not require new equipment
Transport	●	●	—	Schneider induces additional emissions when the alternative does not require new equipment, but they are negligible
Installation	●	●	—	Schneider induces additional emissions when the alternative does not require new equipment, but they are negligible
Use	🟢	🟢	🟢	Energy Efficiency performance comparison in all references. Schneider equipment is considered more efficient than current market equipment
End of Life	—	—	—	Emissions are small compared to a whole lifecycle

🟢	Emissions not equivalent and not negligible
●	Emissions not equivalent but negligible compared to whole life cycle
–	Emissions equivalent but not negligible
—	Emissions equivalent and negligible

Calculation method for use phase emissions

Method 2, sales approach, based on an average price per W of Data Center capacity. A Data Center capacity corresponds to the net power capacity of the DC's servers. For example, a Data Center of a 10MW capacity is a Data Center which servers would consume 10MW of electricity if they were used at 100% of their potential.

$$\boxed{\text{DCD Saved }(\text{kgCO}_2\text{e})} = \text{Total sales of DC offers (€)} \times \text{Average DC capacity to price ratio (W/€)} \times \text{Brownfield ratio (\%)} \times \left(\text{Actual yearly energy consumed compared to DC capacity in reference situation* (kWh/W)} \times \text{Actual yearly energy consumed compared to DC capacity in Schneider offer (kWh/W)}\right) \times \text{Share of saving due to design (\%)} \times \text{Electricity emission factor (kgCO}_2\text{e/kWh, varying in time)} \times \text{Data Center lifetime (years)}$$

$$\boxed{\text{DCD Avoided }(\text{kgCO}_2\text{e})} = \text{Total sales of DC offers (€)} \times \text{Average DC capacity to price ratio (W/€)} \times \text{Greenfield ratio (\%)} \times \left(\text{Actual yearly energy consumed compared to DC capacity in reference situation* (kWh/W)} \times \text{Actual yearly energy consumed compared to DC capacity in Schneider offer (kWh/W)}\right) \times \text{Share of saving due to design (\%)} \times \text{Electricity emission factor (kgCO}_2\text{e/kWh, varying in time)} \times \text{Data Center lifetime (years)}$$

Calculation formula

Calculation method for production emissions

See 'Calculating CO₂ emissions savings, STEP 5'

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Sales data: Total revenues from Data Center segment	Schneider Electric sales team	One piece of data per country per Schneider client class	Annual	Confidential
DC Capacity to price ratio	Schneider Electric sales team	One piece of data per DC size	Every 3 years	Confidential
Brownfield/Greenfield ratio	Expert Estimate	One piece of data per DC type	Every 3 years	GF: 72% BF: 28%
Yearly actual energy consumption compared to DC capacity in BF reference scenario	Expert estimate based on [1],[2]	One piece of data per DC size	Every 3 years	Confidential
Yearly actual energy consumption compared to DC Capacity in GF reference scenario	Expert estimate based on [1], [2]	One piece of data per DC size	Every 3 years	Confidential
Share of energy savings from Schneider offer imputable to Design	Expert estimate based on [3],[4]	Distinction BF/GF	Every 3 years	GF: 50% BF: 10%
Lifetime	Expert estimate	World	Every 3 years	15 years

[1] https://aws.amazon.com/fr/blogs/aws/cloud-computing-server-utilization-the-environment/

[2] https://www.nrdc.org/sites/default/files/data-center-efficiency-assessment-IP.pdf

[3] http://www.climateaction.org/images/uploads/documents/NRAN-6LXSHX_R1_EN_-_schneider_electric.pdf

[4] https://www.csloxinfo.com/csl-files/pdf/Best-practice-and-Infrastructure-Guideline-FOR-On-Premise-Data-Center.pdf

Emission Factors

Emission factor	Source	Scope	Update frequency	Values
Electricity – direct emissions	IEA, electricity emission factors, 2019 edition (2017 data)	Country	Every 3 years	–
Electricity – upstream and T&D losses	IEA, electricity T&D (transmission and distribution) emission factors, 2019 edition (2017 data) + IEA 2019 (2017 data) electricity production per source and per country, combined with IPCC emissions factors for upstream combustible extraction and losses emissions	Country when available, or global average	Every 3 years	–
Electricity – Infrastructure and supply chain	IEA 2019 (2017 data) electricity production per source and per country, combined with IPCC emissions factors for infrastructure and supply chain emissions	Country when available, or global average	Every 3 years	–
Electricity – forward-looking	Forward-looking discounting: ETP 2017, RTS scenario	Region	Every 3 years	–

15. SF_6 Recovery services

Definition of the offer

SF_6 is one of the most potent greenhouse gases in the world and is used in low voltage to high voltage switchgears as an insulator. To prevent this gas from being released into the atmosphere at the end of the switchgear's lifecycle, SF_6 can be extracted from the piece of equipment to be recycled or disposed of adequately.

Schneider Electric offers to its customers SF_6 recovery services, guaranteeing switchgears have a limited impact on the environment when disposed of.

Boundaries

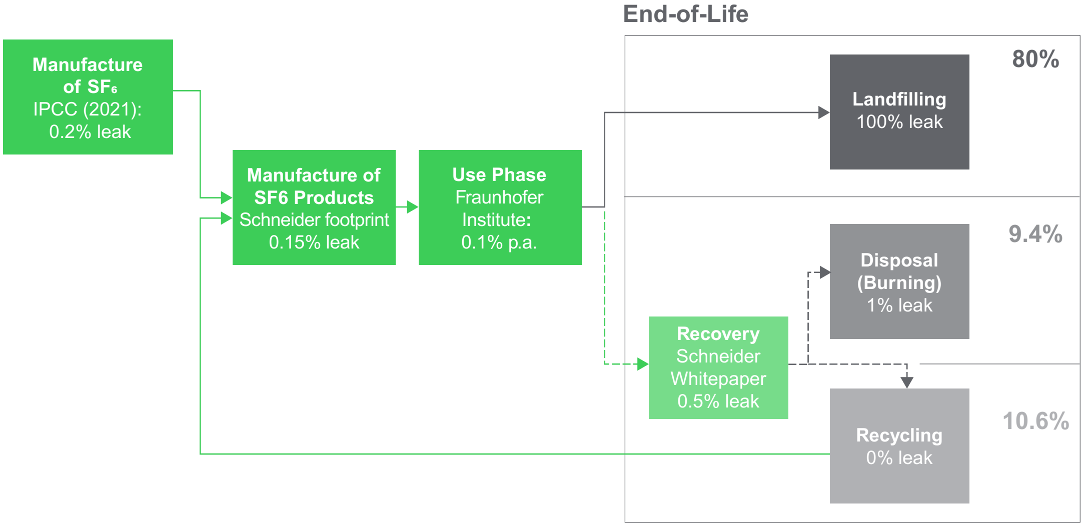
As SF_6 Recovery is a service, both emissions from the product to which the service relates and emissions from service provisioning must be accounted for.

Here, the product to which the service relates, is a switchgear.

The CO_2 emissions boundary is the product boundary, as the offer enables a more circular and environmentally friendly management of the switchgear itself. The offer also saves emissions that would have been emitted for the production of new volumes of SF_6 now replaced with recycled SF_6.

Definition of reference situations

Brownfield scenario:
The reference situation is the average handling of SF_6 products in the industry worldwide, expressed in % of SF_6 leaked into the atmosphere from equipment, and after that, in CO_2eq emissions. This average handling is based on external research papers as well as benchmarks conducted by Schneider's operations. It is part of a broader set of assumptions used across the company when it comes to SF_6 leaks throughout the lifecycle of a piece of equipment.



Greenfield scenario:
There is no Greenfield scenario to consider since the service only applies to existing equipment.

Emission Sources

	Schneider vs. BF	Schneider vs. GF	Comments
Production	🟢	#N/A	Savings with respect to the reduced need for new SF_6 production for new switchgears
Transport	●	#N/A	Negligible
Installation	●	#N/A	Negligible
Use	●	#N/A	No significant savings from the maintenance or modernization of the equipment
End of Life	🟢	#N/A	Savings with respect to a better handling of SF_6 and reduced atmospheric leakages

🟢	Emissions not equivalent and not negligible
●	Emissions not equivalent but negligible compared to whole life cycle
—	Emissions equivalent but not negligible
—	Emissions equivalent and negligible

Besides emission changes of SF_6 handling and production, emissions from service provisioning by Schneider Electric must be added to this analysis.

Calculation method for Switchgear end of life (EoL) and production emissions

Method 1, based on the total volume of SF_6 recovered by Schneider each year, country by country.

Calculation formula

$$\text{SF}_6\text{ Recovery Saved CO}_2 = \text{CO}_2\text{ Saved on EoL handling} + \text{CO}_2\text{ Saved by not producing new SF}_6$$

$$\text{CO}_2\text{ Saved on EoL handling} = \text{Total volume of SF}_6\text{ recovered by Schneider} \times \left(\text{SF}_6\text{ leaked in average EoL handling (\%)} - \text{SF}_6\text{ leaked with Schneider EoL handling (\%)} \right) \times \text{Global Warming Power of SF}_6$$

$$\text{CO}_2\text{ Saved by not producing new SF}_6 = \text{Total volume of SF}_6\text{ recovered by Schneider} \times \left(\text{SF}_6\text{ recycled with Schneider EoL handling (\%)} - \text{SF}_6\text{ recycled in average EoL handling (\%)} \right) \times \text{Emission factor of SF}_6\text{ production}$$

Calculation method for emissions relating to service provisioning

See 'Calculating CO_2 emission savings, STEP 5'

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Sales data: Total SF_6 volume recovered by Schneider service	Schneider Electric sales team	One line per country	Annual	Confidential
Average SF_6 leaks from recovery operation	Schneider experts	World	Every 3 years	0.5%
Average SF_6 EoL handling leaks in the industry	Schneider experts and industry benchmark	World	Every 3 years	See table above

Emission factors and GWP

Emission factor	Source	Scope	Update frequency	Value
Production of SF_6	IPCC, Emission Factors Data Base (EFDB), 2021	World	3 years	50.4kgCO_2eq/kgSF_6
Global Warming Power of SF_6	IPCC AR6	World	At each Assessment Report (AR)	25,200kgCO_2eq/kgSF_6
Service provisioning emissions as a % of gross CO_2 emissions savings	Production emissions methodology	Schneider	3 years	7%

16. AirSeT products

Definition of the offer

Today, distribution networks and installations commonly rely on SF_6 gas. It has outstanding dielectric properties, which allows for safe and compact equipment. This is critical in many buildings and applications where space is scarce. The downside is that it is a potent greenhouse gas with Global Warming Potential 23,500 higher than that of CO_2 (by unit of mass) and produces toxic by-products in the process of breaking. As such, it is subject to strict regulations and must be recycled properly to avoid negative impact on the environment. Regulators are increasingly considering the adoption of new measures to limit the use of SF_6.

The AirSeT range brings sustainable innovation to support the transition to greener energy systems and installations. It combines pure air for insulation and vacuum technology for breaking in an ingenious arrangement called Shunt Vacuum Interruption (SVI)™. AirSeT products are thus 100% SF_6 free.

Boundaries

Product-level boundary: The boundary is set to the product itself, looking mainly at GHG released directly or indirectly over the product's lifetime in comparison to a reference scenario. Given that switchgears are passive devices and that SF_6 is so much more potent than CO_2, it is assumed that GHG emissions are dominated by SF_6 leakages into the atmosphere.

Definition of reference situations

Brownfield reference situation:
The reference situation is based on the behavior and parameters of existing switchgears that are being replaced with AirSeT Solutions.

Greenfield reference situation:
The Greenfield situation is based on the average behavior and parameters of switchgears sold nowadays as additional capacity.

Emission sources across the lifecycle

	Schneider vs. BF	Schneider vs. GF	Comments
Production	●	🟢	For Brownfield, the Schneider offer induces emissions compared to doing nothing, but they are negligible compared to SF_6 leaks saved during use. For Greenfield, producing SF_6 full switchgears emits much more than AirSeT ones
Transport	●	—	Negligible
Installation	●	—	Negligible
Use	🟢	🟢	Significant savings compared to equipment leaking SF_6.
End of Life	–	🟢	For Brownfield, the existing Switchgear will still emit SF_6. For Greenfield, AirSeT avoids the handling of SF_6 in the future

🟢	Emissions not equivalent and not negligible
●	Emissions not equivalent but negligible compared to whole life cycle
–	Emissions equivalent but not negligible
—	Emissions equivalent and negligible

Calculation method

Method 1, based on the total volume of AirSeT equipment sold

Calculation formula

CO_2 Saved by AirSeT = Total number of AirSeT equipment × Brownfield (%) × SF_6 Content of historical Switchgears × SF_6 leaked during use phase (%) × Global Warming Power of SF_6

CO_2 Avoided by AirSeT = Total number of AirSeT equipment × Greenfield (%) × SF_6 Content of historical Switchgears × (SF_6 leaked in EOL handling + SF_6 leaked in use-phase (%) + SF_6 leaked in production (%)) × Global Warming Power of SF_6

Calculation terms: source, frequency of update and value

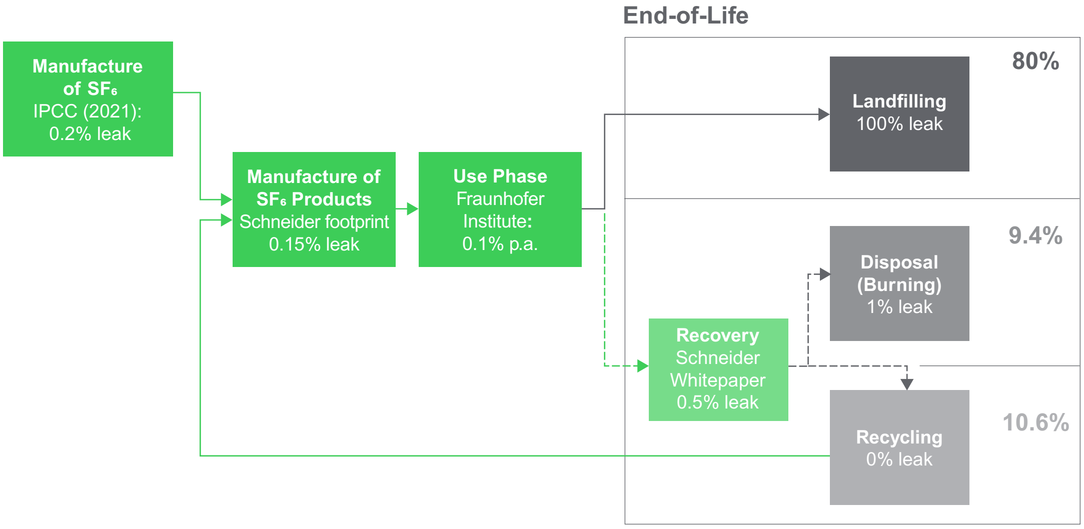
Calculation term	Source	Granulometry	Update frequency	Value
Average lifetime of AirSeT equipment	Schneider expert	Per type of equipment (SM, RM, GM)	Every 3 years	30 years
Average lifetime of SF_6 equipment	Schneider expert	Per type of equipment (SM, RM, GM)	Every 3 years	20 years
Average mass of SF_6 in equipment	Schneider expert	Per type of equipment (SM, RM, GM) per generation	Every 3 years	Confidential

Emission factors

Emission factors for SF_6 products are standardized across Schneider's entities to provide as much consistency as possible. They are based on various sources, detailed in the table below.

Emission factor	Source	Scope	Update frequency	Value
Manufacture of SF_6 gas	IPCC 2021	Worldwide	Every 3 years	Equivalent to 0.2% leakage
Use Phase SF_6 emissions	Fraunhofer Institute	Global average	Every 3 years	0.1% per year
Global Warming Power of SF_6	IPCC AR6	World	At each Assessment Report (AR)	25,200 $kgCO_2eq$/ $kgSF_6$
Average SF_6 EoL handling leaks in the industry	Schneider experts and industry benchmark	World	Every 3 years	See graph below

SF_6 leakages across an equipment's lifecycle with an average End-of-Life handling



17. Field Services

Definition of the offer

The Field Services organization focuses on supporting equipment installed on customers' premises by providing services related to:
- Maintenance and recurring services (corrective and preventive)
- Supply of spare parts
- Modernization of the installed base (assets, digital monitoring, remote analytics)
- Site audits and consulting services
- Installation and commissioning
- Circularity activities (take-back, recycling, reuse)

The CO_2 impacts for all those activities result from:
- Energy efficiency gains
- Extension of the life of assets delaying replacement

The quantified CO_2 savings by this methodology are related to:
- Maintenance + recurring services + spare parts, generating assets life extension
- Modernization minimizing full replacement, generating an extension of the life of assets. Schneider Electric's retrofit solutions consist in replacing LV and MV switchgear components to renew, refurbish, upgrade or add new functionalities, like connectivity / monitoring. This is typically performed on outdated components, such as circuit breakers, contactors and protection relays, and as such, enable the extension of the life of the switchgear. Since a retrofit solution replaces only a portion of the existing electrical equipment, fewer waste materials need to be processed compared to a complete replacement.
- Lead battery recovery for recycling

It is to be noted that Field Services leverages the full portfolio of Schneider Electric' solutions, as one of the channels to sell and install these at the customer sites.

The hereby described methodology quantifies the "incremental" savings compared to previous offers, ensuring consistency with the existing methodologies and avoiding double counting with solutions already covered in this same quantification methodology. This offer's description is thus subdivided to reflect the specificities of the three services described.

17.1 Maintenance, recurring services, spare parts, and electrical distribution modernization

Boundaries

As maintenance and modernization are services, both emissions from the system to which the service relates and emissions from service provisioning must be accounted for.

Here the system to which the service relates is the modernized equipment.

We focus on product-level boundary, considering saved emissions resulting from modernization or maintenance activities that increase the longevity of the equipment.

Definition of reference situations

Brownfield reference situation:

- The reference situation corresponds to considering Schneider's assets installed on customer sites to function up to their nominal life.

Greenfield reference situation:

- There is no applicable Greenfield reference situation as such services only relate to Brownfield.

Emission Sources

	Schneider vs. BF	Schneider vs. GF	Comments
Production	🟢	#N/A	Savings with respect to the reduced need of new equipment
Transport	●	#N/A	Negligible
Installation	●	#N/A	Negligible
Use	●	#N/A	No significant savings from the maintenance or modernization of the equipment
End of Life	—	#N/A	Negligible and comparable End of Life emissions

🟢 Emissions not equivalent and not negligible

● Emissions not equivalent but negligible compared to whole life cycle

— Emissions equivalent but not negligible

— Emissions equivalent and negligible

Emissions from service provisioning must be added to this analysis. Here, these emissions come from the production of spare parts, transport of operators, etc.

Calculation method

For **maintenance, recurring services, spare parts (method 1)**, based on the installed base and tracked assets (for spare parts and maintenance).

For **Electrical Distribution Modernization (method 2)**, based on the total sales volume per solution per year. Total saved emissions for a given year are the complete saved emissions calculated, as the benefits are a one-off.

Calculation formula for production phase emissions for maintenance, recurring services, spare parts

CO_2 saved is calculated based on the extension of the lifespan of assets generated by:

- Access to spare parts
- Maintenance of assets on the identified installed base
- Digital-enabled condition-based maintenance enabled for assets under such plan (ESP)

This calculation is differentiated by:

- product ranges (Power/Industrial Automation/Secure Power), and only focuses on serviceable assets
- type of service (only spare parts for untracked installed base, condition-based maintenance for ESP managed assets, classical maintenance for the rest) allowing to quantify Schneider's contribution and overall CO_2 impacts in a relevant way

$$\text{Maintenance \& SP Saved CO}_2 = \left(\text{Number of installed assets} \times \text{Production phase emissions of assets} \times \frac{\text{Asset life increase thanks to maintenance (years)}}{\text{Nominal life (years)}} \times \text{Contribution of Schneider Field Services to Maintenance (\%)} \right) \Big/ \text{Prolonged life}$$

Calculation formula for production phase emissions for **Electrical Distribution Modernization**

$$\text{Saved emissions modernization} = \frac{\text{Modernization revenues (€/yr)}}{\text{Average unit price of modernization}} \times \text{Average CO}_2\text{ saved by modernization effort}$$

As in these MV and LV applications, there is limited technology shift. Any energy efficiency brought by new assets vs old is expected to be negligible, hence is not included in the calculation.

Calculation for the CO₂ savings are done through the footprint calculator which has already been certified by EY in parallel, and the referential is available upon request.

Calculation method for emissions of Schneider's service provisioning

See 'Calculating CO₂ emissions savings, STEP 5'

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Number of installed assets	Schneider Installed Base Data Base	Per type of equipment	Annual	Confidential
Lifetime of asset with and without maintenance	Schneider Expert and Data Base	Per type of equipment	Every 3 years	Confidential
Contribution of Schneider to life prolongation	Schneider Expert	Products are classified depending on their criticality	Every 3 years	Confidential
Modernization revenues	Schneider Sales data	Per type of product	Every year	Confidential

Emission Factors

Emission factor	Source	Scope	Update frequency	Values
Production phase emissions from assets	Schneider Environment team, consistent with 'Calculating CO₂ emissions savings, STEP 5'	Per type of equipment	Every 3 years	–
Service provisioning emissions as a % of gross CO₂ emission savings	Provision emissions methodology	Schneider	3 years	7%

17.2 Battery recycling

Boundaries

As battery recycling is a service, both emissions from the system to which the service relates and emissions from service provisioning must be accounted for.

Here the system to which the service relates is the lead battery.

We focus on product-level boundary, considering saved emissions resulting from using recycled lead for future batteries instead of traditional sources.

Definition of reference situations

Brownfield reference situation:

- In the absence of batteries recovery and recycling by Schneider, the batteries would go to landfill and the equivalent quantity of lead would come from traditional sources.

Greenfield reference situation:

- Not applicable as such services only relate to Brownfield.

Emissions from service provisioning must be added to this analysis. Here, these emissions come from the production of spare parts, commuting of operators, etc.

CO_2 Saved by Battery recovery = Total mass of lead recovered × Lead mass that is recyclable (%) × This lead resulting from primart smelting (%) × (Emission factor of primary mining and smelting − Emission factor of recycling)

Emission sources

	Schneider vs. BF	Schneider vs. GF	Comments
Production	🟢	#N/A	Savings with respect to the reduced need for new lead
Transport	●	#N/A	Negligible
Installation	●	#N/A	Negligible
Use	●	#N/A	No significant savings
End of Life	—	#N/A	CO_2 emissions from landfilling are not considered

🟢	Emissions not equivalent and not negligible
●	Emissions not equivalent but negligible compared to whole life cycle
—	Emissions equivalent but not negligible
—	Emissions equivalent and negligible

Emissions from service provisioning must be added to this analysis. Here, these emissions come from the commuting of operators, etc.

Calculation method for emissions from lead recycling

Method 2, based on the total kilograms of batteries recycled per year. Total saved emissions for a given year fully accounted the same year as the saving is a one-off.

Calculation formula

By professionally collecting and recycling lead batteries, Schneider Electric ensures that the collected lead is re-used into the sourcing and manufacturing processes for new batteries/new lead-dependent applications.

The CO_2 savings is the comparison between the typical CO_2 embedded into traditional lead sourcing (which is already a mix of primary and recycled) and a fully recycled lead.

Calculation method for emissions resulting from Schneider’s service provisioning

See ‘Calculating CO_2 emissions savings, STEP 5’

Calculation terms: source, frequency of update and value

Calculation term	Source	Granulometry	Update frequency	Value
Battery volumes recovered	Schneider Sales data	World	Annual	Confidential
Share of recyclable lead out of all collected lead	Schneider Expert	World	Every 3 years	70%
Share of the total world lead production that results from lead secondary smelting	R. Jolly, C. Rhin, The recycling of lead-acid batteries: production of lead and polypropylene	World	Every 3 years	47%

Emission factors

Emission factor	Source	Scope	Update frequency	Values
Emission factor of primary lead production	Ecoinvent: primary lead production from concentrate	World	Every 3 years	2,243 $kgCO_2$/ tonne
Emission factor of recycled lead production	Ecoinvent: treatment of scrap lead acid battery, remelting	World	Every 3 years	503 $kgCO_2$/ tonne
Service provisioning emissions as a % of gross CO_2 emissions savings	Production emissions methodology	Schneider	3 years	7%

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