CO_2 assessment methods for electric heating in France

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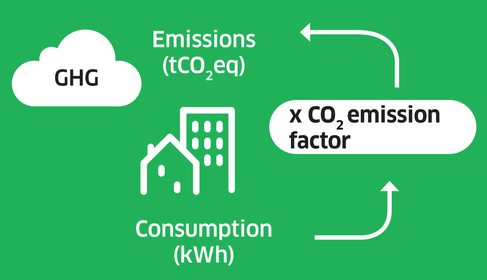
OBJECTIVES OF THE STUDY

As the building sector represents nearly a quarter of national GHG emissions, it is one of the key areas in the fight against global warming and the energy transition.

In order to reduce GHG emissions, the first step is to be able to account for them. This calculation is necessary for the CO_2 content of the electric kilowatt-hour, which corresponds to the CO_2 emissions generated by a consumer in kilowatt hours of electricity.

What is a CO_2eq emission factor?

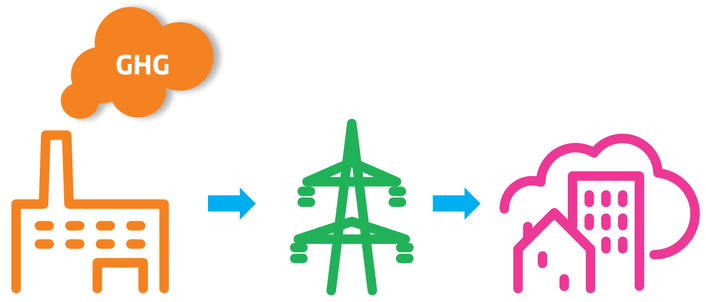


FOSSIL FUELS › Easy task
derives directly from combustion equations

ELECTRICITY › Much more complex
it is not a naturally available energy but an energy vector

Specific case for electricity

Electricity does not emit greenhouse gas (GHG) at the time of consumption, but during production.



- At a given moment, the kilowatt hour (kWh) consumed on the grid comes from a mix of the different energy sources used to produce it.
- The CO_2eq content of the electric kWh corresponds to the CO_2eq emissions generated by the production of this kWh of electricity.

To know the emissions related to the consumption of an electrical appliance, one question arises: **how the electrical system responds to the corresponding demand and by what means of production?**

GHG emissions depend on the plants called to meet the demand, and therefore the production mix: determining the exact relationship between electricity consumption and the corresponding CO_2eq emissions requires precisely associating a means of electricity production with this consumption. The electrons circulating freely on the electrical network, it is however impossible to know the exact origin of the current supplying electrical use at a given moment.

How to estimate the GHG emissions generated by an electrical appliance knowing that the means of production mobilized vary at each moment to respond to the variability of demand?

What calculation method can be used to evaluate the CO_2eq content of electricity?

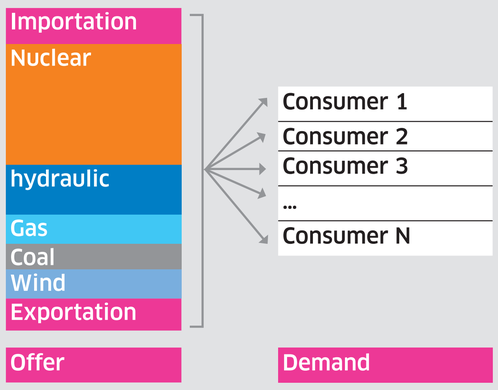
It depends on the objectif:

- the achievement of an overall measurement of GHG emissions
- the establishment of an long term action plan to reduce these emission

Each question involves selecting the most relevant allocation method:

AVERAGE CALCULATION APPROACH

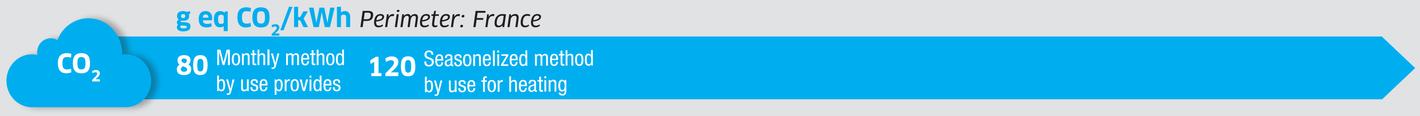
Objective: the achievement of an overall measurement of GHG emissions



All based on the simple principle of dividing GHG emissions from a given electricity production by all the electricity produced or consumed associated with that electricity production. Various variants are existing seasonal and per usage ones and with various time steps (yearly, monthly, ect).

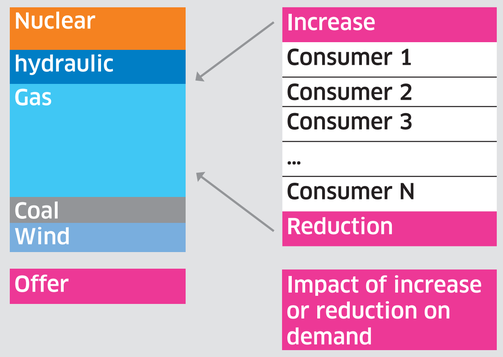
- Define an allover balance.
- Make possible to differentiate the CO_2eq content of a kWh according to its use and period.

- Structural limitations but also related to the integration of various renewables sources to the grid.
- Does not make possible to asset the effect of a variation in consumption, upwards or downwards, on the electric production plant.



MARGINAL CALCULATION APPROACH

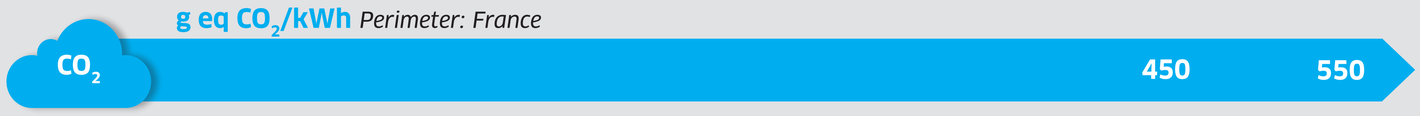
Objective: the establishment of a long term action plan to reduce these emissions



These approaches are used in specific actions and aim to measure the impact of a change in production or demand.
The marginal approach considers that if the energy demand is reduced (or increased), not all generation units (plants) are affected equally. Some approaches assume that the operation of "base load" plants may be unchanged and only the "peak load" plants may be affected the change. To identify the priority in the energy production, a "priority order" needs to be defined reflecting the switch-on/switch-off of the different plants. The marginal factor or coefficient considers only generation units that are affected (switch-on, switch-off, displaced,...) by the changes in energy demand (e.g. heating use) or production (e.g. exported energy by a building).

- Comparison between prospetive scenarii.
- Decisions guidance.

- No overall balance.



Conclusion To make proper investment decisions related to the energy policy framework, it is necessary to have a prospective vision and to take into account future changes in the generation system, the impacts on the power demand and their associated GHG emissions. As the marginal factor reflects the change in CO_2 emissions from a system due to a change in demand, it sends the right signal for generating actions to reduce GHG emissions.