From Energy Efficiency Network to Climate Neutrality Networks

Concept paper in the framework of the OPTRES100 project

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Content

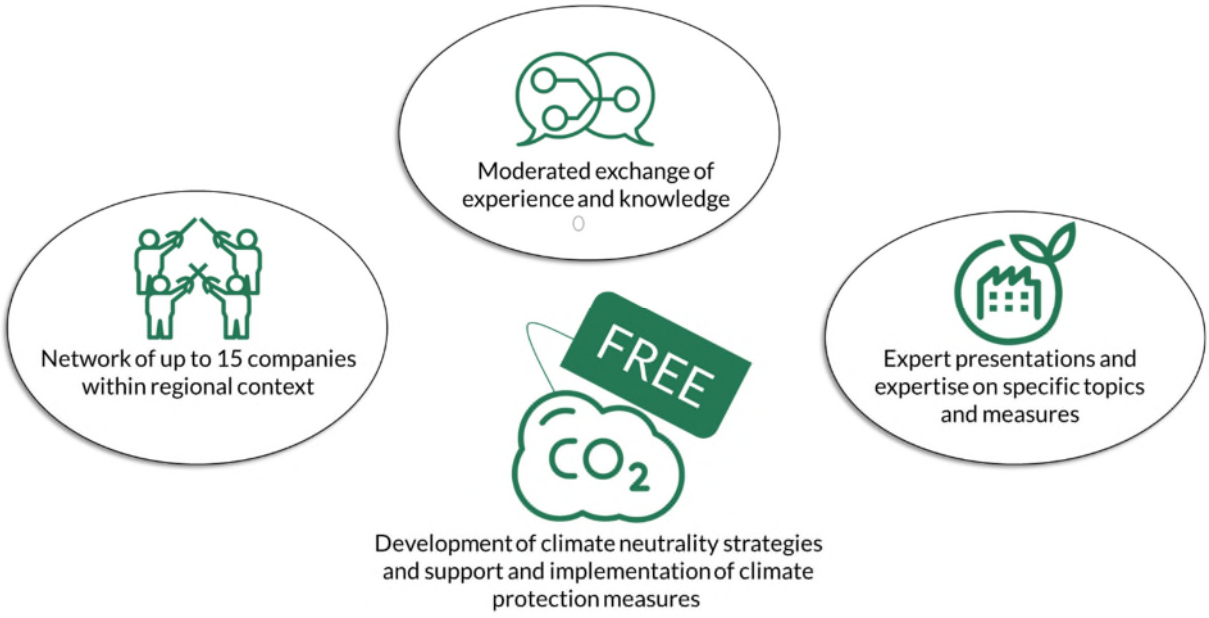
1 Goal for a Climate Neutrality Company Network

The following goals are being pursued with the concept of an energy efficiency network with a focus on climate neutrality

- Foster activities to implement climate protection measures and energy efficiency jointly
- Strengthen exchange and shared learning between companies
- Create a value proposition for companies to accompany them on the path to carbon neutrality

The Climate Neutrality Network is to build on the approach of the energy efficiency networks (EEN), but align it thematically and in terms of structure with today's requirements for companies and measures regarding sector coupling options such as demand side management, which provide flexibility to grids with large shares of renewables.

Figure 1: Goals and methodology of the Climate Neutrality Networks



Source: IREES

2 Why Climate Neutrality Networks

An adaptation of the original EEN approach is necessary in order to successfully continue the idea of a business network with binding goals and high motivation of participants to implement measures:

- **Pure focus on energy efficiency measures and energy audits not sufficient:** EEN are a very good approach to establishing energy efficiency and operational energy management and their structures in companies. The predefined system is no longer suitable for today's requirements regarding topics and the structure of approach. Many companies in industry and commerce have been involved in the more efficient use of energy for a long time. Companies have understood energy efficiency. There is hardly a company that has not yet conducted an energy audit.

- **Focus on faster implementation and ease of entry:** The relevant actors in the companies are under massive cost, time and innovation pressure. The classical approach of EEN is based on the idea that the first 6 - 12 months are used only for data collection and target setting. The duration of three further years is justified by the fact that measures can also be implemented and these can be recorded in the monitoring for the success of the network. However, both data collection at the beginning and monitoring of the network's success have not brought direct added value to the companies in a EEN so fare and led to delay in providing relevant data. By broadening the scope to GHG emission balances, data collection and monitoring brings a value proposition in terms of communication, e.g. by calculating and marketing the carbon footprint.

- **Climate neutrality as a highly relevant topic for market positing:** Energy efficiency and climate protection are increasingly perceived as a strategic measure for the business base. Direct cost savings through energy efficiency measures are no longer the driver to participate in an exchange format. Many companies set themselves a climate protection target (up to climate neutrality) for the next 10 to 20 years, driven by the worldwide move of governments towards climate neutrality. More and more often, the large end-customer-oriented companies require their Original Equipment Manufacturer (OEMs) to report carbon footprints and try to agree with them on commitments to reduce greenhouse gases.

3 Target group

Size of companies and relevance of energy consuption

The original concept of EEN focuses on large companies with high energy consumption. The Climate Neutrality Network is also a suitable concept for small and medium sized companies (SMEs) though. It might bring more added value for these companies than a classic EEN, as energy costs and energy efficiency play a subordinate role if companies are not energy-intensive industries. The importance of climate protection measures is not only determined by the energy consumption of the company, but to what extent the company has to deal with the topic of climate protection for internal or external reasons. In this respect, participation in the network might rather be considered **as training, networking and self-marketing on the topic of climate neutrality** whereas the main reason to participate in an EEN is to save energy cost. In this respect, the number of employees in a company or its revenues are the better indicators for the appropriate selection of the target group for a Climate Neutrality Network than the overall energy consumption.

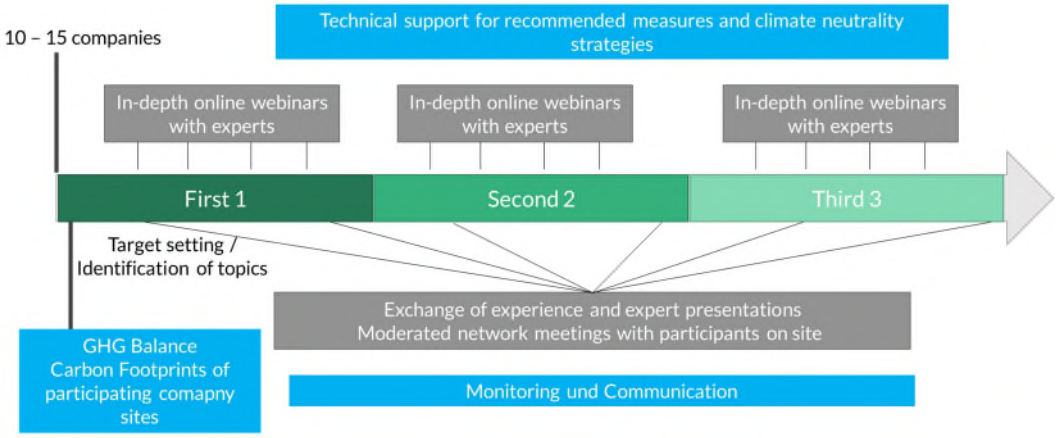
Geographical proximity of participating companies

The original concept of networks is that companies are brought together within a network whose locations are physically close to each other with maximum travel times of 1 to 2 hours. However, depending on the industries and businesses activities, a Climate Neutrality Network can be organized without or very few physical meetings as online network. Much experience has been gained on this over the past two years. Especially if the particpants are rather companies from the service or IT sector and the focus is rather on measures to reduce scope 3 emissions* (see Figure 3) as well as to implement organisational measures. With regard to production industry, a geographical proximity allows to organise regular site visits that have been proven to be essential regarding the implmentation of energy efficiency measures.

4 Structure and procedure

The procedure of the Climate Neutrality Network concept is similar to the EEN concepts. However, instead of an energy audit, it foresees to perform a GHG balance for each company at the beginning providing the respective carbon footprint. The first network meeting deals with the target setting for the network as well as the identification of topics (see 5) which are accompanied with expert input during the network meetings and during in-depth online webinars. Two physical network meetings with site visits and four webinars are foreseen in each year. Therefore, participating companies gain already a value added in the first year not only by the exchange within the network but also from the expert input. Therewith, they will be able to draft climate neutrality strategies already after one year of participation in the network. Whereas monitoring in the EEN concept has not been considered as value added by the participating companies, it is a central element in the Climate Neutrality Network. On contrary to an EEN that is all about energy savings, a Climate neutrality network is about achieving GHG savings and communicating them to customers and the public.

Figure 2: Procedure of a Climate Neutrality Network

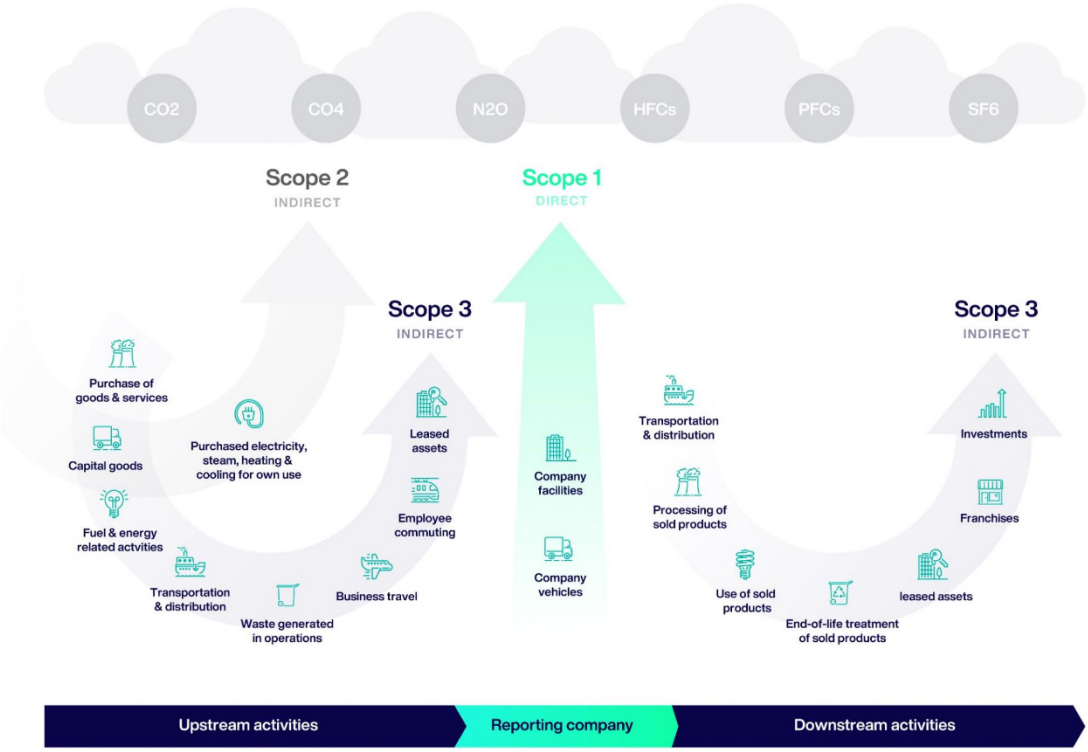


Source: IREES

5 Scope and measures

According to the GHG Protocol, GHG emissions from businesses can be categorized in three scopes (Figure 3). The original concept of EEN as well as the energy audit focuses mainly on measures that are directly linked to the onsite activities of company (Scope 1) as well as the emissions from used energy carriers (Scope 2). The Climate Neutrality Network on the other hand considers all upstream and downstream activities and enables companies to draft strategies and implement measures to reduce emissions in all three scopes.

Figure 3: Scope of Climate Neutrality Network



Source: https://ghgprotocol.org/

Scope 1	Scope 2	Scope 3
Fuel combustion Company vehicles Fugitive emissions	Purchased electricity, heat and steam	Purchased goods and services Business travel Employee commuting Waste disposal Use of sold products Transportation and distribution (up- and downstream) Investments Leased assets and franchises

Considering the broader scope of the Climate Neutrality Network, more topics need to be addressed by the expert inputs in order to enable companies to

identify and implement specific measures. Depending on the results of the GHG balances of the participating companies and the relevance of different Scopes, the main topics are defined. **Apart from energy efficiency measures, it involves measures in the field of demand-side-management, on-site renewable production and power purchased agreements, resource efficiency, corporate mobility management and climate neutral procurement of capital and purchased goods**.

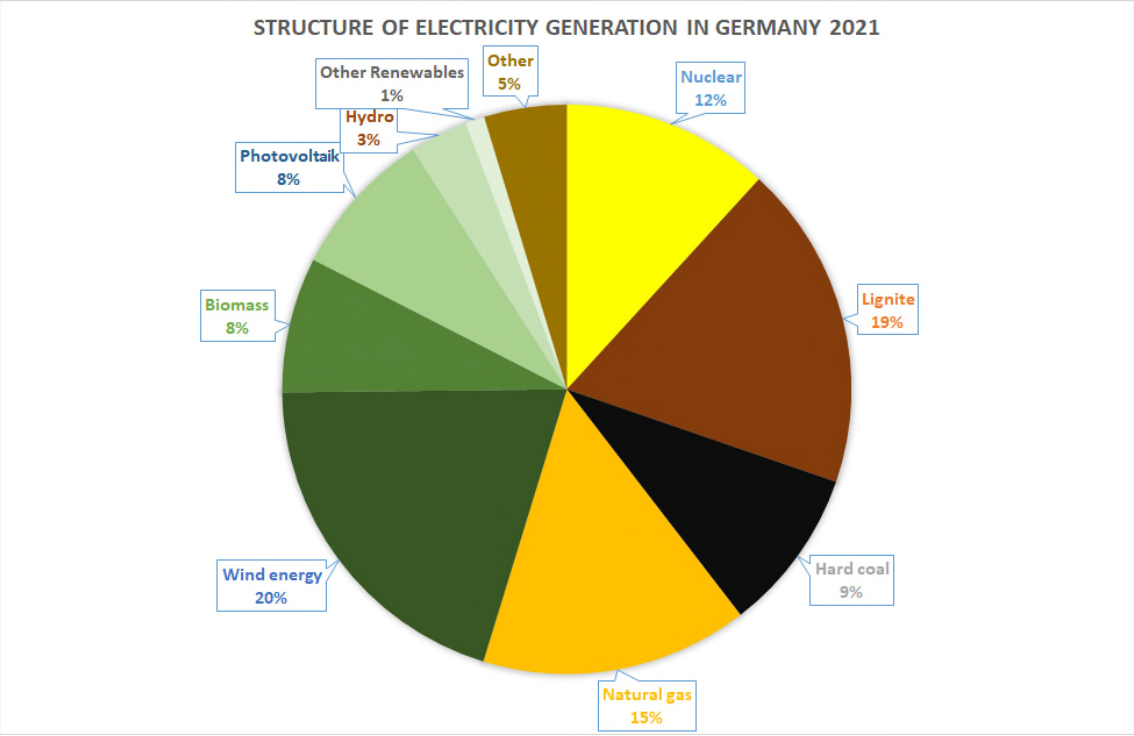
Figure 4: Topics and measures

Source: IREES

5.1 Demand side management

Demand-side-management measures are also important in an overall system perspective considering electricity markets with high shares of renewables. Germany has now reached over 40% of renewables in electricity generation (see Figure 5). The target for 2030 is 65% but the coalition agreement from December 2021 envisages 80%, and this considering higher demand for electricity due to electric cars, heat pumps and hydrogen production.

Figure 5: Electricity production Germany 2021 by energy carrier



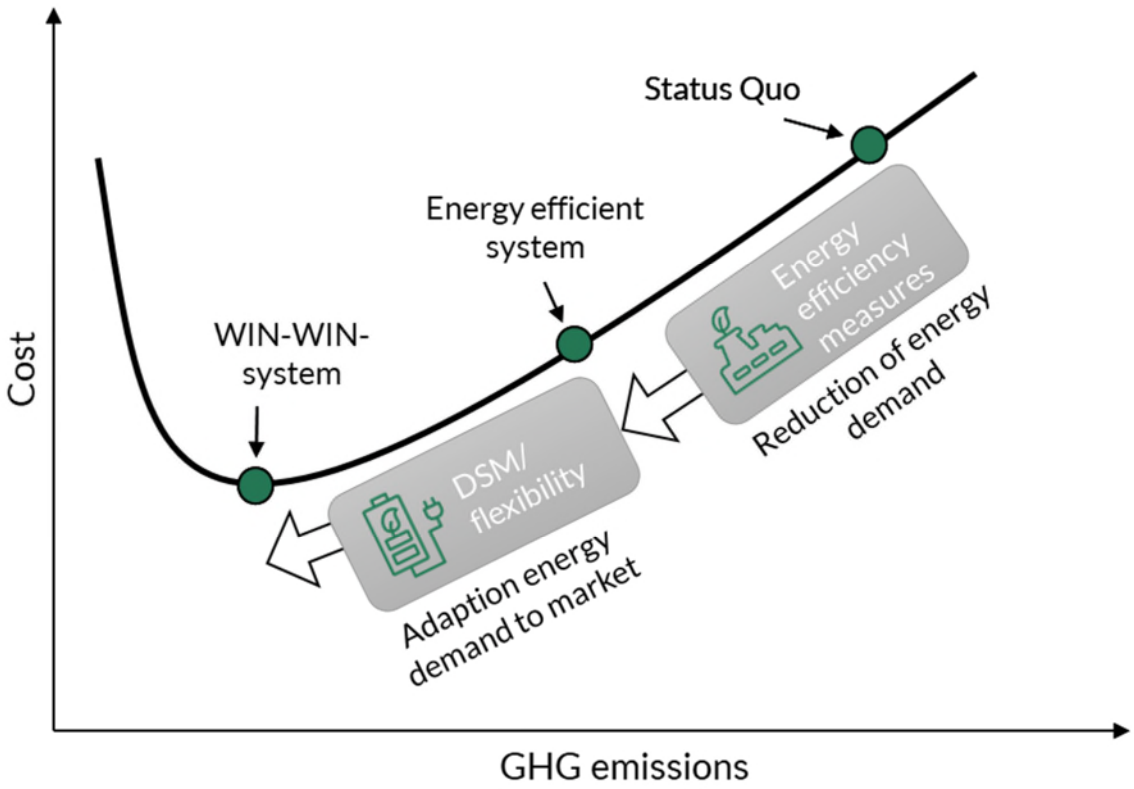
Source: AG Energiebilanzen 2021[1]

Demand side management (DSM) includes measures to control energy consumption, production and own electricity production units according to the requirements of electricity market without unfourable disruption of company's processes. Giving the goal of a Climate Neutrality Network, such measures are not considered isolated but in combination with energy efficiency measures as well as structural and operational optimations of on-site energy converters. Such a strategies is persued in the Win4Climate[2] project that generated digital twins and optimisation models for the participating industrial companies in order to derive a Win-Win system with energy efficiency measures, investment in electricity and heat storages, renewables (RES) installations and DSM control unit (Figure 6)

[1] https://ag-energiebilanzen.de/wp-content/uploads/2021/03/AGEB_Infografik_02_2021_Stromerzeugung_2021.pdf

[2] Win4Climate – Heat transition in Industry 2019 – 2022. https://win4climate.de/

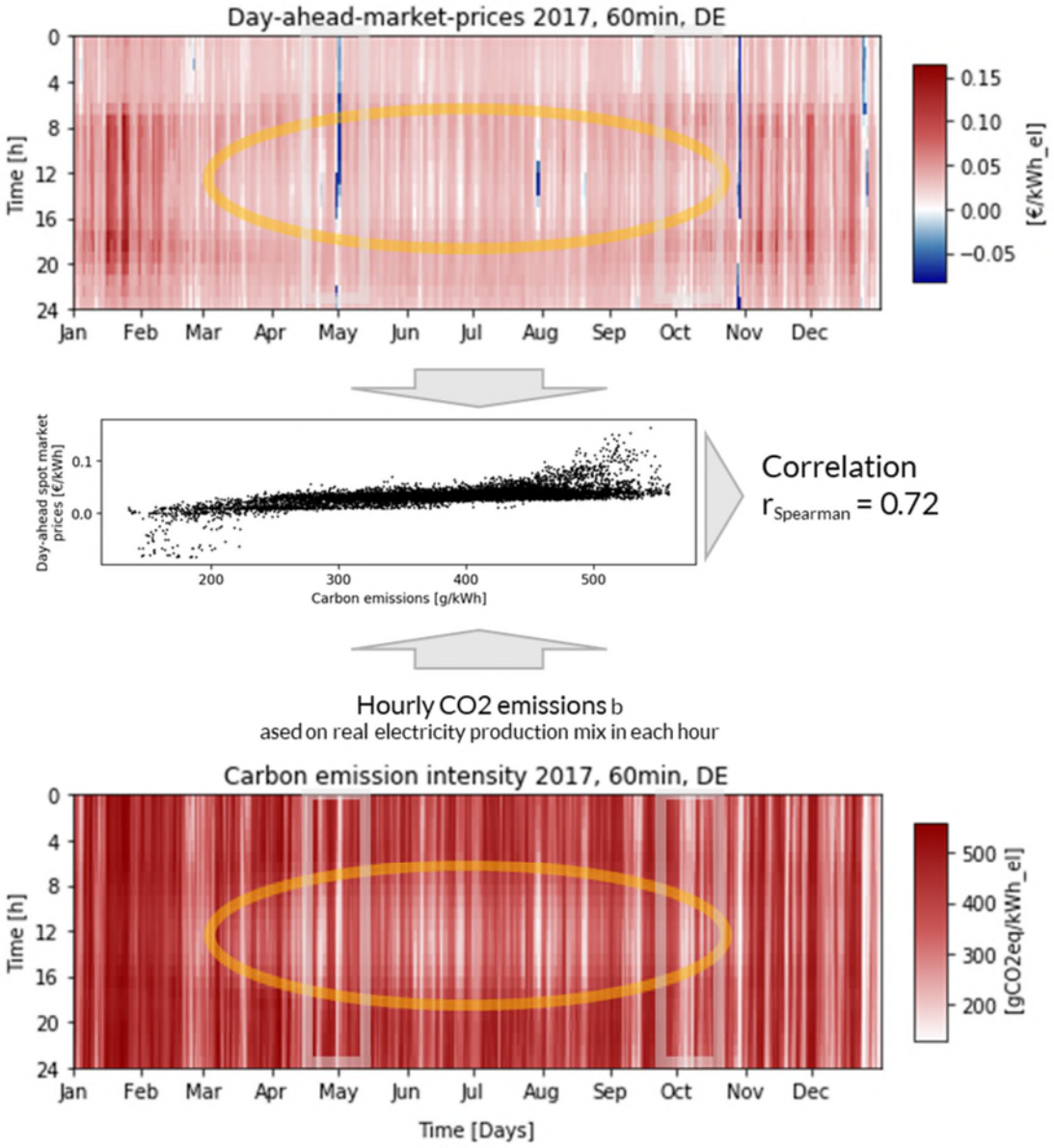
Figure 6: Concept of an integrated strategy for energy efficiency and DSM measures



Source: IREES and University of Applied Sciences / Win4Climate project[2]

In order to account for GHG emission savings at company level, GHG emission factors of electricity need to be provided in a timely manner in hourly resolution. Furthermore, real-time energy tariffs are a prerquiste for economic incentives of implementing DSM measures such as energy storages, control units as well DSM production strategies. Figure 7 reveals that market signals for a reduction of GHG emissions through DSM are already quite significant if utilities would offer real-prices based on day-head market prices. The analysis shows that there is a high correlation between hourly electricty market prices and the hourly CO_2 -emissions of the real electricity production in each hour.

Figure 7: Analysis of day-head market prices and hourly CO2 emissions of electricity production in Germany for the year 2017



Source: Win4Climate project, Fleschutz and Bull (2019)[3].

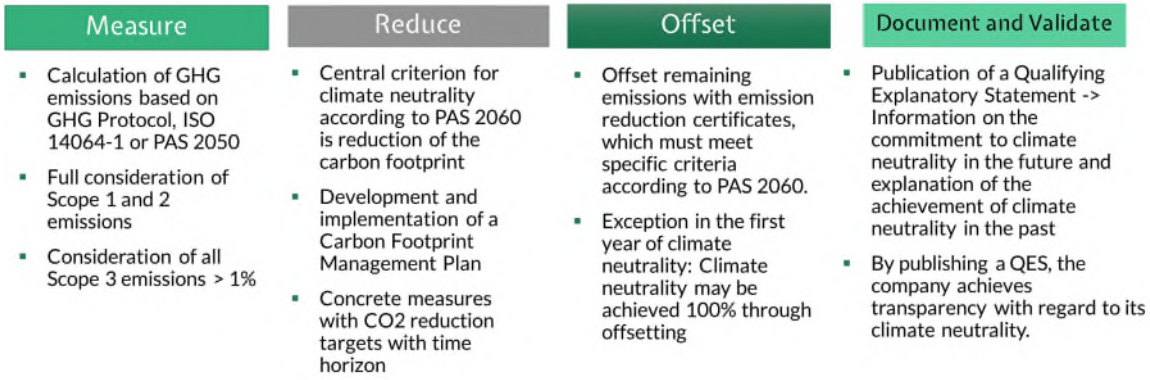
The saved GHG emissions of DSM measures might be allocated under Scope 3 of the carbon footprint of the company

[3] Fleschutz, M. and Bull, D. (2019). Ökologische und ökonomische Chancen industrieller Lastflexibilisierung. Vortrag im Rahmen der Veranstaltung Brennpunkt on Tour am 23. September 2019 von Fokus Energie.

6 Achieving climate neutrality

The Climate Neutrality Network concept will enable companies to implement energy efficiency and climate protection measures within the company. Thereby, reductions of GHG emissions shall be implemented within own scope of the company as fare as possible. Offsetting through GHG certificates need to be the last step and shall only be applied for residual emissions that cannot be reduced within the scope of the company. Figure 8 shows the steps to climate neutrality according to the PAS 2060 standards that might be applied within the Climate Neutrality Network to document and validate the achievement of climate neutrality.

Figure 8: Steps towards climate neutrality according to the PAS 2060 standard



Source: IREES based on BS PAS 2060:2014-04-30[4]

[4] British Standard Institution. BS PAS 2060:2014-04-30 - Specification for the demonstration of carbon neutrality. https://www.beuth.de/de/norm/bs-pas-2060/207911437

7 Case studies of selected measures focussing on DSM

7.1 DSM induced production planing

With 21 companies in 53 plants (VdZ 2022), the German cement industry is responsible for 3.4 % of industrial energy consumption. As an energy intensive industry, the transformation to climate neutrality is difficult and requires policy support. However, there is significant potential for DSM measures that can already reduce the carbon footprint of the companies and provide flexibility for the electricity sector. The majority of the plants produce clinker that offers potential for production shifting if there is a relevant price signal. Since plants have similar production process and production units, a Climate Neutrality Network of plants and companies provides the possibility, to develop the concept and spread experiences with implemented DSM measures. Furthermore, load shifting could be marketed jointly by the Climate Network on the energy market.

Source: VdZ (2022)[5]

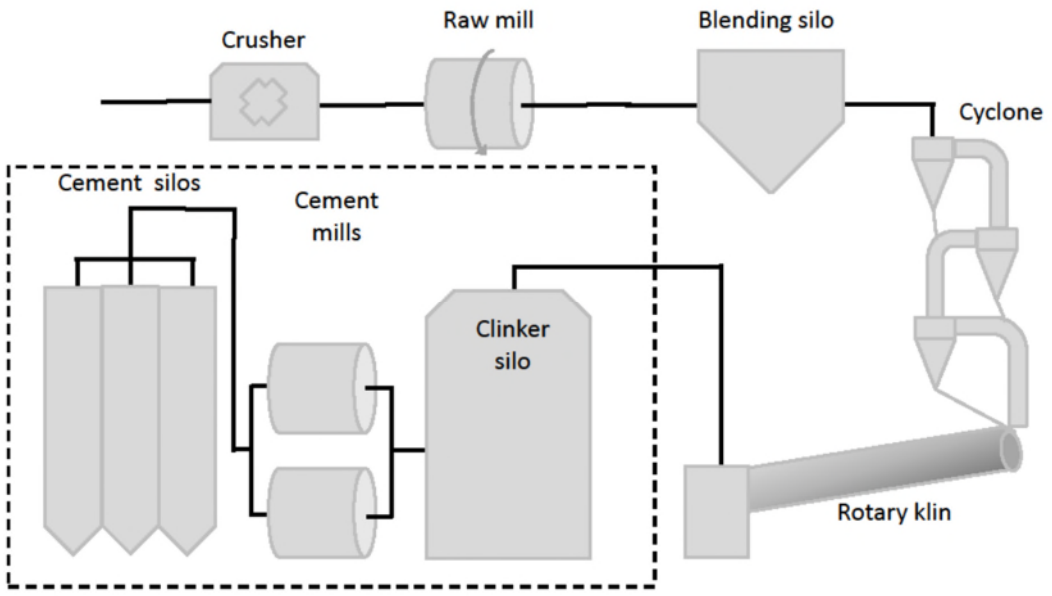
The typical production process of a cement plant with clinker production is shown in Figure 9. To realise DSM, existing cement silos as product storage facilities are essential. Within a case study for a cement plant, an optimisation of the production process has been performed with the goal to minimize electricity costs and thus specific GHG emissions considering the compatibility of different mills and cement type, start-up cost and revision time (Bohlayer et al. 2020[6]; Fleschutz et al. 2017[7])

[5] VdZ (2022). Cement plants in Germany. https://mitglieder.vdz-online.de/zementindustrie/branchenueberblick/zementwerke-in-deutschland/. Accessed 11th January 2022

[6] Bohlayer, Markus & Fleschutz, Markus & Braun, Marco & Zöttl, Gregor. (2020). Energy-intense production-inventory planning with participation in sequential energy markets. Applied Energy. 258. 113954. 10.1016/j.apenergy.2019.113954.

[7] Fleschutz, Markus & Bohlayer, Markus & Bürger, Adrian & Braun, M. (2017). Electricity Cost Reduction Potential of Industrial Processes using Real Time Pricing in a Production Planning Problem. https://www.researchgate.net/publication/349213821_Electricity_Cost_Reduction_Potential_of_Industrial_Processes_using_Real_Time_Pricing_in_a_Production_Planning_Problem

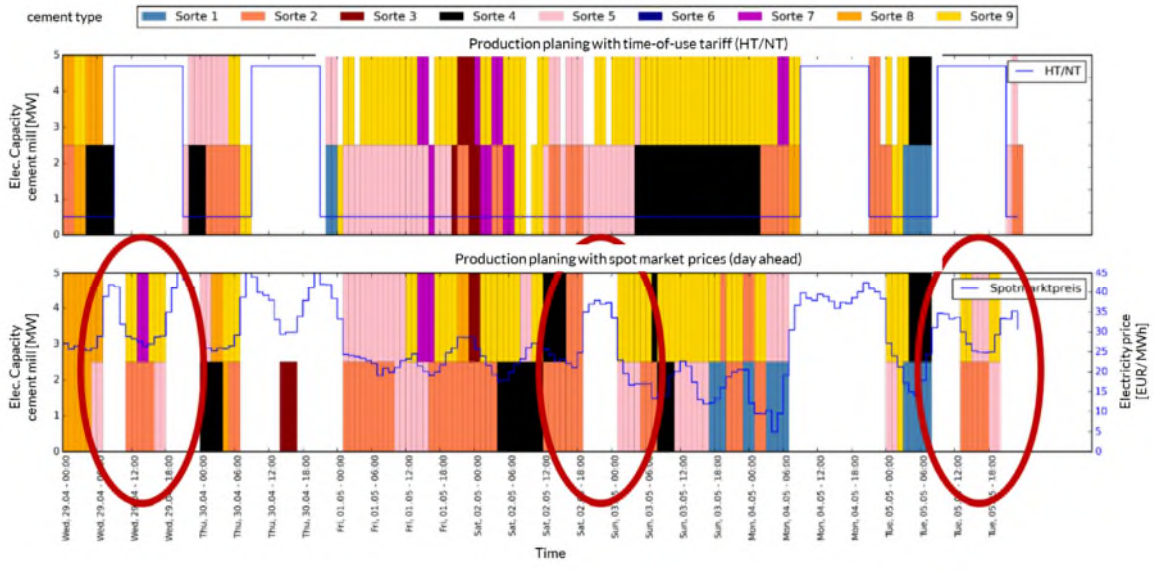
Figure 9: Production process of cement industry with clinker production



Source: IREES and University of Applied Sciences / Win4Climate project[2]

The results of the simulation show that with real-time tariffs and energy optimised production planning, significant electricity cost savings can be realised by shifting production within the period of one week. Figure 10 shows the difference in production planning between a time-of-use and a real-time tariff based on the day-ahead spot market prices.

Figure 10: Simulation of DSM induced production planing

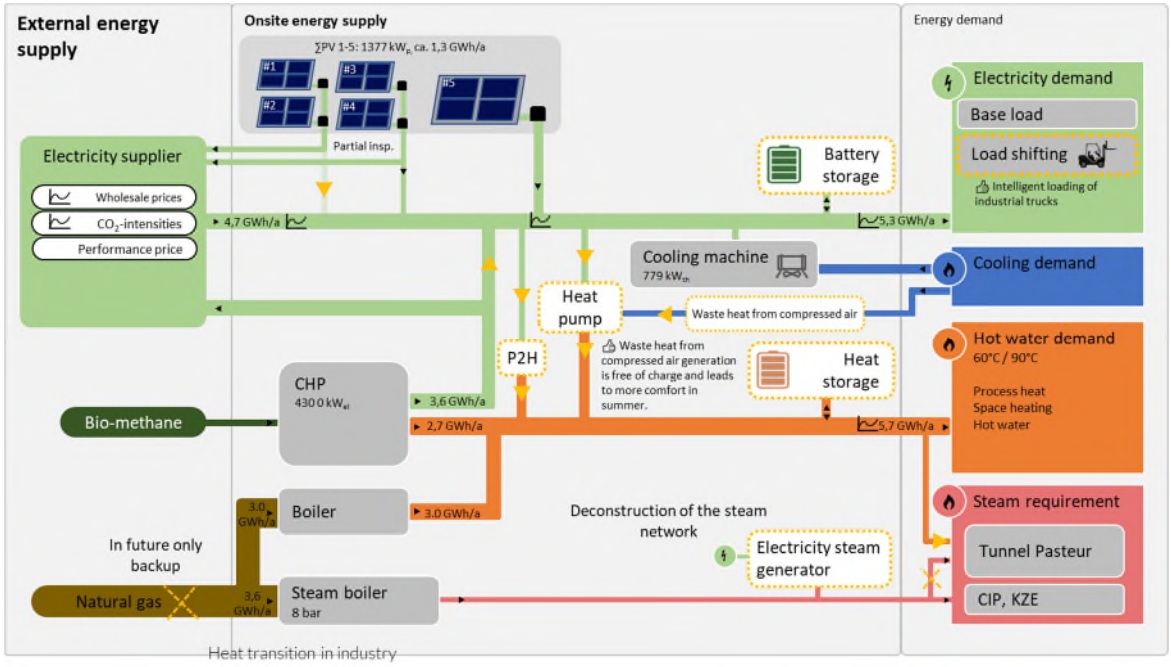


Source: Fleschutz et al. (2017) / Bohlayer et al. (2020)

7.2 Climate neutrality of scope 1 and scope 2 emissions

Figure 11 shows the results of an optimised energy system for a company in the food and beverage industry that have been conducted within project Win4Climate. The company has already conducted energy efficiency measures to reduce electricity, process heating and cooling demand. The goal is to reduce all scope 1 and 2 emissions by changing the on-site energy supply systems. Based on a digital twin of the status quo energy system, an optimised energy system with zero GHG emissions has been derived. The resulting changes in the company's energy structures are marked with yellow dotted lines in Figure 11. The concept investments in battery and heat storage, the use of waste heat from compressed air with a heat pump, the installation of a power-to-heat unit as well as the replacement of the existing gas fired steam boiler with an electric steam generator. The remaining gas consumption for the CHP unit is replaced by bio-methane. The target of the company is to reduce all scope 1 and 2 emissions to zero by 2030 with this concept. Compared to the current GHG emissions that would result in a overall saving of 3431 t CO2eq.

Figure 11: Case study on the climate neutrality concept for a company in the food and beverage industry



Source: Case Study results of Win4Climate project[8]

The results of the case study shows the importance of electricity in replacing fossil fuels as well as the efficient and flexible use of electricity by installation of heat pumps and

[8] IREES and University of Applied Science Karlsruhe. Results within the project Win4Climate – Heat transition in industry supported by the National Climate Initiative (not published yet). https://win4climate.de/. Results of the case study have been presented by Steinbach (2021). Heat transition in Heat transition in industry through waste heat utilisation and demand side management. German Japanese expert workshop on industrial excess heat. https://www.ecos.eu/de/veranstaltungen/details/abwaermenutzung.html

heat storages. As further DSM measure, smart loading of forklifts is also considered in the resulting climate neutrality concept