IRENA coalition FOR ACTION

COMPANIES IN TRANSITION TOWARDS 100% RENEWABLES:

FOCUS ON HEATING AND COOLING

About the Coalition

The IRENA Coalition for Action brings together leading renewable energy players from around the world with the common goal of advancing the uptake of renewable energy. The Coalition facilitates global dialogues between public and private sectors to develop actions to increase the share of renewables in the global energy mix and accelerate the global energy transition.

About this paper

This white paper has been developed jointly by members of the Coalition's Working Group on Towards 100% Renewable Energy. Building on several case studies and first-hand interviews with companies, the paper showcases the opportunities and challenges experienced by companies in the industrial sector that have a target for 100% renewable electricity supply, and a meaningful and/or ambitious target or activities to increase the share of renewable energy in their heating and cooling operations.

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ABBREVIATIONS

AEE INTEC	AEE Institute for Sustainable Technologies
°C	Degree Celsius
CHP	Combined heat and power
CO_2	Carbon dioxide
EPP	Elpitiya Plantations PLC
EUR	Euro
EV	Electric vehicle
GW	Gigawatt
GWh	Gigawatt-hour
hl	Hectolitre
HVO	Hydrotreated vegetable oil
IPCC	Intergovernmental Panel on Climate Change
kW	Kilowatt
kWh	Kilowatt-hour
kWh_{el}	Kilowatt-hour of electricity
LPG	Liquefied petroleum gas
LUT	Lappeenranta University of Technology (Finland)
MW	Megawatt
MWh	Megawatt-hour
MWh_{eq}	Megawatt-hour equivalent
NGO	Nongovernmental organisation
PPA	Power purchase agreement
PV	Photovoltaic
SDG	Sustainable development goal
TFEC	Total final energy consumption
TWh	Terawatt-hour
USD	United States dollar
UTS	University of Technology Sydney (Australia)

KEY FINDINGS

Driven by the cost-competitiveness of renewables and growing calls for sustainability amongst investors and consumers, renewables have become an attractive source of energy for corporate users around the world.

While companies are increasingly sourcing renewable electricity, the sourcing of renewable heating and cooling is still in the early stages of development due to, among other factors, its context-specific and decentralised nature.

With heating and cooling representing approximately 75% of energy used in industry, which accounts for more than 25% of the global final energy consumption, the sector will play a crucial role in the energy transformation towards 100% renewables. Currently, renewable energy only accounts for approximately 13% of total final energy consumption in industry.

To further scale up corporate sourcing of renewable heating and cooling in the industrial sector, the following key takeaways may serve as guidance and inspiration for governments and companies.

Key takeaways for governments

- **Setting national and subnational targets for 100% renewable energy across all end-use sectors, including heating and cooling, is key to driving the energy transformation in the industrial sector.**
- **Long-term government planning is particularly important for decarbonising heating and cooling in industry.**
- **Implementing ambitious regulatory, fiscal and financial policies and incentives will help increase the share of renewables in heating and cooling.**
- **Improving access to private capital for energy transition-related technologies will encourage essential long-term investments.**
- **Exploring innovative sourcing models for renewable heating and cooling will further scale up progress.**

Key takeaways for companies

- **Switching to renewable energy heating and cooling brings important benefits beyond emission reduction.**
- **Setting long-term corporate renewable heating and cooling targets and implementation strategies accelerates the decarbonisation of operations.**
- **Considering the local context is key when choosing among available pathways and technologies for renewable heating and cooling.**
- **Coupling renewable energy sourcing with measures to reduce energy demand and improve energy efficiency is crucial.**
- **Conducting further research and development across innovative renewable energy technologies and infrastructure for heating and cooling is needed.**
- **Improving data collection on companies' renewable heating and cooling operations can help monitor and adjust strategies in support of established decarbonisation targets.**
- **By working with local actors, such as governments, utilities, communities and NGOs, companies can further accelerate the energy transformation.**

INTRODUCTION

01

The objectives set out in the United Nations 2030 Agenda and the Paris Agreement can only be met through an urgent and complete decarbonisation of our entire energy system. This requires that all of our energy needs – power, heating and cooling, and transportation – are reliably met by 100% renewable energy, and are accessible to all people (see Box 1).

Renewable energy and related enabling technologies, as well as energy efficiency, have proven to be resilient and increasingly cost-competitive solutions for supplying a growing range of sectors and applications around the world. Today, the costs of solar and wind projects are competitive with coal- and gas-fired plants almost everywhere, and renewable power capacity growth has been outpacing new installed capacity in fossil fuels for the past decade (IRENA, 2020a).

Box 1 Definition of 100% renewable energy

The IRENA Coalition for Action has agreed on the following definition for 100% renewable energy:*

Renewable energy encompasses all renewable resources, including bioenergy, geothermal, hydropower, ocean, solar and wind energy. One hundred percent renewable energy means that all sources of energy to meet all end-use energy needs in a certain location, region or country are derived from renewable energy resources 24 hours per day, every day of the year. Renewable energy can either be produced locally to meet all local end-use energy needs (power, heating and cooling, and transport) or can be imported from outside of the region using supportive technologies and infrastructure such as electrical or gas transmission systems, hydrogen or heated water. Any storage facilities to help balance the energy supply must also use energy derived only from renewable resources.

*Companies featured in the case studies may apply different definitions when referring to 100% renewable energy.

While renewables account for approximately 25% of global electricity consumption, the share of modern renewables[1] in global demand for heating and cooling is just 10% (IRENA, IEA and REN21, 2020). **Decarbonising heating and cooling remains critical as these end-uses account for approximately 50% of total final energy consumption globally** (IRENA, IEA and REN21, 2020).

The industrial sector has a particularly important role to play, representing a considerable share of global heating and cooling use. In total, around 75% of final energy use in the industrial sector is for heating and cooling, which accounts for more than 25% of the global final energy consumption.

1 Modern renewables include all renewables with the exception of traditional uses of biomass for cooking and heating with negative environmental and socio-economic impacts.

More and more companies in the industrial sector are now seeing the need to decarbonise their operations in all end-uses by switching from fossil fuels to renewables, not only as a way to demonstrate corporate social responsibility but also to improve their financial performance and carbon footprint.

To accelerate the decarbonisation of heating and cooling, significantly scaled-up efforts are however required from both the public and private sectors. At the end of 2019, only 49 countries had national targets for renewable heating and cooling, compared to the 166 countries that had national targets for renewable electricity. As governments move forward with green recovery packages in response to the COVID-19 pandemic, they have a unique opportunity to accelerate and enable the transformation to 100% renewable energy in all end-uses, including heating and cooling. Stimulus packages targeting the industrial sector can increase the uptake of renewables. Besides making local industries resilient in the long-term, investing in renewables and related infrastructure will also bring much needed socio-economic, health, climate and environmental benefits. Although many companies are increasingly sourcing renewable electricity, setting targets in other end-uses, including heating and cooling, will be crucial to accelerate the energy transformation.

The Coalition for Action Working Group on "Towards 100% Renewable Energy" has produced a series of white papers and analyses that document case studies and best practices for achieving 100% renewable energy, including recommendations to policy makers on how to support an accelerated energy transformation (see Box 2).

This white paper examines the technical, economic and policy opportunities available to, and challenges faced by, companies in the industrial sector trying to integrate high shares of renewables into their heating and cooling operations. Companies featured as case studies in this paper have already set, or achieved, a 100% renewable energy target for the power sector and are engaged in ambitious activities to increase the share of renewables used in their heating and cooling operations.

Following this introduction, this white paper is organised as follows: Chapter 2 elaborates on the role of industrial players in the energy transformation, focusing on heating and cooling; Chapter 3 examines companies' drivers, barriers and target setting for renewable heating and cooling; Chapter 4 summarises key takeaways on how to scale up the share of renewables in heating and cooling operations; and finally, Chapter 5 presents company case studies based on first-hand interviews with representatives of the industrial sector.

Photo: Flemming Lynge Nielsen/Danfoss

CO_2 neutral district energy plant suppling Danfoss headquarters, Denmark

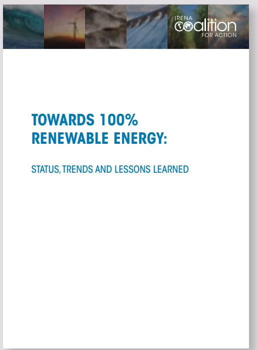
Box 2 IRENA Coalition for Action Towards 100% Renewable Energy Working Group

Established in 2018, the IRENA Coalition for Action Towards 100% Renewable Energy Working Group has produced a series of white papers and analyses that document case studies and best practices for achieving 100% renewable energy. These analytical outputs include a comprehensive mapping of 100% renewable energy targets at national and subnational levels, as well as key messages to policy makers on how to support an accelerated energy transformation.

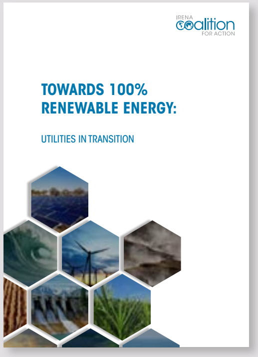
The Working Group's first white paper analysed the transformation to a 100% renewable energy system from the point of view of national and subnational governments (IRENA Coalition for Action, 2019). A second white paper followed, focusing on utilities in transition towards 100% renewable energy and addressing energy generation, transmission and distribution in the electricity sector (IRENA Coalition for Action, 2020).

This third white paper offers a logical follow-up to the previous two by exploring the barriers and necessary incentives for companies who have already set ambitions for 100% renewable electricity to specifically increase the share of renewables in their heating and cooling operations.

Coalition for Action white paper series – Towards 100% renewable energy



2019



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02 DECARBONISING HEATING AND COOLING IN INDUSTRY

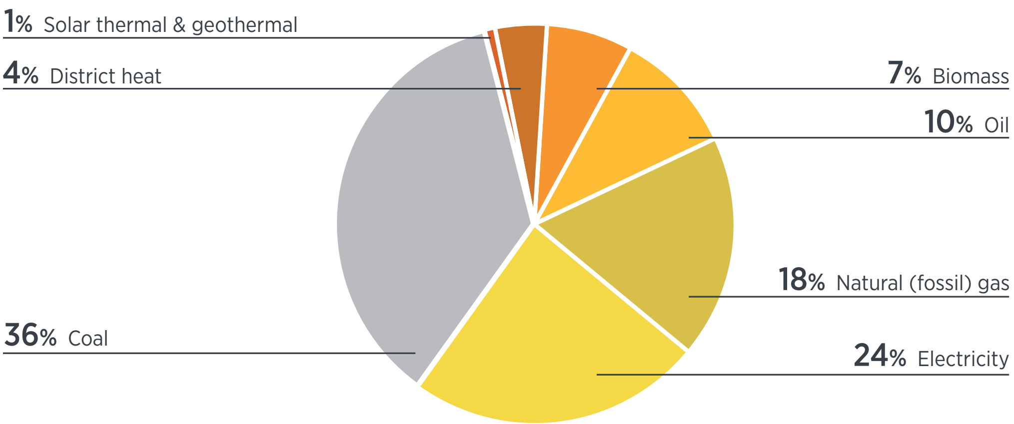
This chapter provides an overview of how renewable energy is or can be used for heating and cooling[2] in the industrial sector. Particular focus is placed on renewable energy technologies and applications for industrial operations, as well as options available to companies for sourcing renewable heating and cooling.

2.1 Industry: The largest energy consumer

The past two decades have seen increasing growth in the overall energy consumption of industry. In 2017, the sector was responsible for approximately **one-third of the world's total final energy consumption (TFEC)**, largely driven by rising demand for, and manufacturing of industrial products in a broad variety of subsectors. The industrial sector, including industrial processes, also accounts for approximately **one third of global energy-related carbon dioxide (CO_2) emissions** (IRENA, 2020b).

As illustrated in Figure 1, of the industry's TFEC in 2017, 36% came from coal, 24% from electricity, 18% from natural (fossil) gas and 10% from oil, with the rest coming from biomass, district heat, solar thermal and geothermal (IRENA, 2020b). **To accelerate the decarbonisation of our energy system, the 13% share of renewables in TFEC has to significantly increase.** Most of the renewables in the industrial sector are supplied by bioenergy in subsectors such as pulp and paper and other industries that produce on-site biomass waste and residues.

Figure 1: Total final energy consumption in the industrial sector, 2017



Source: IRENA (2020b)

2 Heating and cooling in this white paper refers to "applications of thermal energy, including space and water heating, space cooling, refrigeration, drying, and heat produced in the industrial process. It includes the use of electricity for heating and cooling" (IRENA, IEA and REN21, 2020).

The Paris Climate Agreement, as well as the Intergovernmental Panel on Climate Change (IPCC), emphasise that countries should undertake urgent action to prevent global warming from exceeding 1.5°C (degrees Celsius) above preindustrial levels (IPCC, 2018). This will require the reduction of all greenhouse gas emissions to net zero by mid-century (IPCC, 2018). According to IRENA's Transforming Energy Scenario, outlining an energy pathway to "well-below 2°C", the share of renewables in the industrial sector must increase to 29% by 2030 and 62% by 2050 (IRENA, 2020b). However, the Transforming Energy Scenario still forecasts some energy-related greenhouse gas emissions at mid-century, including for the industrial sector. Under IRENA's Deeper Decarbonisation Scenario, in which emissions are projected to decrease to zero and limit temperature rise to 1.5°C, a significant additional increase in renewables' share will be needed (IRENA, forthcoming).

Other scenarios suggest even higher shares of up to 100% renewable energy use in industry. Both Lappeenranta University of Technology (LUT) in Finland, working in collaboration with the Energy Watch Group, and the University of Technology Sydney (UTS) in Australia show pathways to a fully renewables-based energy supply across all sectors by 2050 to remain within the 1.5°C target (Ram et al., 2019) (Teske, 2019).

While industry has traditionally relied on centralised systems to procure its mostly fossil-fuel based electricity supply, more and more companies in the industrial sector and beyond have started to increase the share of renewables in their operations. This is especially the case for electricity supply, for which a range of renewables sourcing options are available in the market (IRENA, 2018) (see more in Box 3 on corporate sourcing of renewable electricity). However, **the corporate sourcing of renewable heating and cooling is still in the early stages of development given its context-specific and decentralised nature**. With heating and cooling making up approximately 75% of energy used in industry, (90 exajoules), there is significant potential to accelerate the decarbonisation of industry through renewables (REN21, 2020).

Box 3 Corporate sourcing of renewable electricity

Companies in the commercial and industrial sector account for roughly two-thirds of the world's end-use of electricity. With increased electrification of the sector's heating, cooling and transport processes, the commercial and industrial sector is expected to continue consuming a large share of electricity going forward.

As early as 2017, corporates had sourced over 465 terawatt-hours (TWh) of renewable electricity and more than 70 countries had put specific enabling frameworks for corporate sourcing in place (IRENA, 2018). According to BloombergNEF, corporations are increasingly signing corporate power purchase agreements (PPAs) and have cumulatively purchased almost 80 gigawatts (GW) of renewable electricity globally since 2011 (BNEF, 2021). In 2020 alone, companies purchased 23.7 GW of renewable electricity through corporate PPAs, exhibiting momentum despite the impacts of COVID-19 (BNEF, 2021).

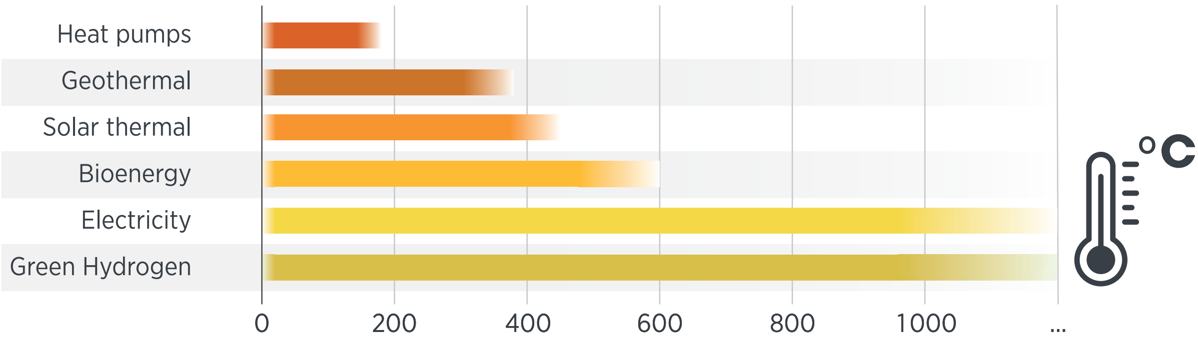
Several company-led initiatives have emerged to further facilitate corporate sourcing of renewable power. The global RE100 initiative, led by the Climate Group and the Carbon Disclosure Project, brings together over 280 of the largest companies in the world that have pledged to power their operations using 100% renewable electricity by 2050 at the latest. RE100 companies have a combined electricity consumption of over 315 TWh per year. BloombergNEF estimates suggest that these companies will need to purchase an additional 269 TWh of renewables by 2030 to meet their 2030 targets, which is equivalent to over USD 98 billion (US dollars) of investment in renewable electricity (The Climate Group, 2020; BNEF, 2021). In recent years, several other local initiatives have emerged, such as the US Renewable Energy Buyers Alliance (REBA, 2020) and the Indian Green Power Market Development Group (GPMDG, 2020).

2.2 Renewable heating and cooling technologies and applications

Alongside energy efficiency, renewable energy will play a key role in decarbonising heating and cooling operations. A broad range of renewable energy technologies and applications to meet industry's heating and cooling needs already exist, such as renewables-based electrification, renewable gases, the direct use of renewables through solar thermal or geothermal, and the sustainable use of biomass. Further, new technologies are being explored such as sea water air conditioning.

When identifying viable renewable heating and cooling solutions for a given industrial application, it is important to consider the variation in the energy intensity of industrial processes across subsectors. Iron and steel, cement, and chemicals production are among the most energy-intensive subsectors and the most challenging to decarbonise because they require high processing temperatures, whereas pulp and paper, wood products, and the food and beverage sectors use medium and low process temperatures (IRENA, IEA and REN21, 2020). Figure 2 provides an overview of the working temperatures for various renewable energy technologies.

Figure 2: Working temperatures for various renewable heat technologies



Source: IRENA, IEA and REN21 (2020)

Renewables-based electrification

An increasing number of industrial players are looking at **renewables-based electrification** of various end-uses, including **higher-temperature processes** where direct utilisation of renewables faces technical limitations (REN21, 2019). Renewable electricity is now employed to meet thermal demands of industrial processes such as drying, refrigeration, and packaging and hardening for metal production. This involves electricity use for energy-efficient **heat pumps, radiators, electric or hybrid hot boilers, refrigerators, and other equipment.** To achieve further efficiency gains and cost reductions, many companies combine efficient heat pumps and waste recovery. Under IRENA's Transforming Energy Scenario, renewable electricity is expected to account for a growing percentage of energy utilised in industry, reaching approximately 35% of overall energy consumed by the industrial sector by 2050 – an increase from just 7% today (IRENA, 2020b).

Renewable gases

Renewable gases have the potential to replace natural (fossil) gas (IRENA, 2020b) commonly used in high-temperature applications in the iron, steel, chemical and petrochemical industries, among others (IRENA, 2020c). Renewable gases – including **biogas, biomethane** and **green hydrogen** produced from 100% renewable electricity or biogas – can replace natural (fossil) gas in many of its uses by leveraging relevant parts of existing gas networks. One solution that has gained much attention lately is green hydrogen. Green hydrogen offers an alternative route to harness the potential of renewable electricity where direct electrification can be challenging (IRENA, IEA and REN21, 2020). Green hydrogen can produce high-temperature (>400°C) industrial heat (e.g., for melting, gasifying, drying) for which renewable alternatives to fossil fuels are currently limited. Green hydrogen, moreover, has an important role as substitute of "grey" and "blue" hydrogen (traditional hydrogen produced from fossil fuels) as a feedstock in the chemical industry (IRENA, IEA and REN21, 2020).

Direct use of renewables for heating

The electrification of industrial heating and cooling can be complemented by the direct use of renewable energy for heating (IRENA, 2020c). This includes the use of **solar thermal** and **geothermal** technologies. Solar thermal technologies have the potential to supply energy for temperatures between 20°C and 400°C and are used mainly for preheating water, drying and generating low-temperature steam in industries such as food and beverage production, textiles and agriculture (IRENA, IEA and REN21, 2020). Hot water from geothermal energy can supply process heat for pulp and paper processing, greenhouse heating, dairy processing, and wood curing for temperatures above 300°C (IRENA, IEA and REN21, 2020). In general, direct use of renewables for industrial process heat occurs mainly in lower-temperature applications (REN21, 2020).

Biomass

As of today, 90% of the renewable energy supplied for heat in the industrial sector comes from bioenergy, primarily derived from biomass. **Biomass** is predominantly used in the pulp and paper, forestry, wood products, and food industries. In these industries, biomass waste and residues are typically produced on-site and then re-used as fuels. Potential remains to extend the use of biomass and the efficiency with which it is used in industry. With some adaptations to ensure compatibility across production processes, biomass can be used not only for low-temperature heat, but also in high-temperature applications such as in the cement industry, where companies are turning to solid biomass to replace coal. In some countries, biomass is even used to produce cement and iron, processes that require temperatures ranging up to 600°C (IRENA, IEA and REN21, 2020). The extent to which bioenergy contributes to greenhouse gas emission reduction targets, and whether its widespread development would have positive or negative environmental, social or economic impacts – for instance related to biodiversity or landscape preservation – remains controversial for some forms of bioenergy. Sustainability of bioenergy sourcing and use is an important requirement for its widespread development (IRENA, IEA and REN21, 2020).

While electrification and the direct use of renewable energy technologies can cover a wide range of industrial heating and cooling processes and temperatures, the additional use of energy-efficient technologies further accelerates the deployment of renewables in heating and cooling by reducing the required process heat temperatures (IRENA, IEA and REN21, 2020).

2.3 Sourcing models for renewable heating and cooling

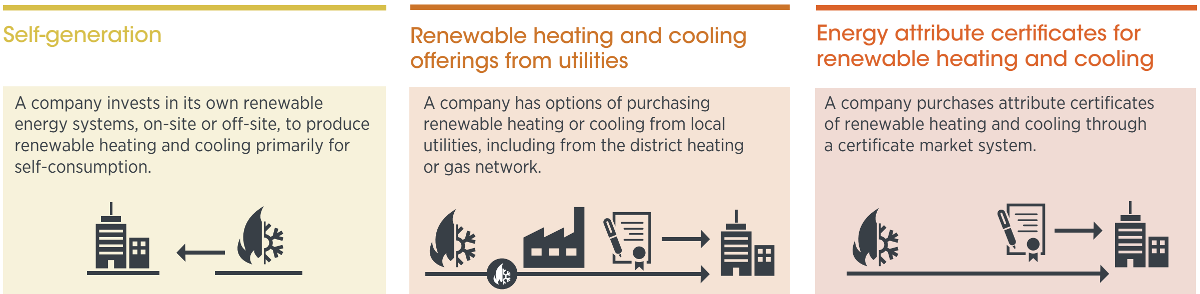
In an effort to decarbonise operations, many companies in the industrial sector are looking to increase the share of renewables in their energy supplies.

For companies that have started to shift industrial processes towards increased electrification, a growing range of options are available for sourcing renewables. In addition to self-generating renewable electricity or sourcing renewable electricity through unbundled energy attribute certificates, many companies are signing long-term corporate PPAs or purchasing renewable energy through utility green procurement green procurement programmes (see Box 3) (IRENA, 2018).

While the availability of sourcing models for renewable electricity has advanced significantly over the years, sourcing options for renewable heating and cooling are still in their infancy. They remain highly dependent on available infrastructure and renewable resources on-site or in close proximity. New sourcing mechanisms that facilitate easy access to renewable heating and cooling will be critical to scale up corporate sourcing of renewables and accelerate the rapid decarbonisation of industry.

Figure 3 illustrates existing and potential corporate sourcing models for renewable heating and cooling.

Figure 3: Existing and potential corporate sourcing models for renewable heating and cooling



Source: IRENA (2021)

Self-generation

Some companies **produce renewable energy on-site for their heating and cooling operations**. This model is particularly used in industries that generate biomass waste and residues on-site, which are subsequently re-used as fuels for production processes requiring heating and cooling operations. Companies like Elpitiya Plantations in Sri Lanka and Goess Brewery in Austria use on-site biomass, which meet 23% and 42% of their heat demand respectively (see Chapter 5 and case studies). Another option for self-generation includes the installation of heat pumps or converting self-generated electricity into heating or cooling. For example, Danish industrial Danfoss has installed heat pumps in order to recover heat from its water cooling processes (see Chapter 5 and case studies).

Renewable heating and cooling offerings from utilities

In some locations, options may be available for companies to **purchase renewable heating or cooling from local utilities**, including from the district heating or gas network. Several local environmental and renewable energy consumer labels have emerged for district heating, including "Bra Milijöval" in Sweden and "NatureMade" in Switzerland. These third-party labels not only impose criteria on the source of the heat itself, but also other aspects of heat production including transportation and process energy at the plant (IRENA, 2018). Based on these criteria, district heating providers can certify/label all or part of their heat production and offer this labelled district heating to their customers at premium rates – so called **"green premium products"** or **"green tariffs"**. While such options are broadly available for electricity already, they could be further scaled-up for renewable heating, to provide utility customers with additional procurement options. For example, Mölndal Energi in Sweden offers its customers (both households and businesses) both environmentally labelled electricity and district heating (IRENA Coalition for Action, 2020). The utility also recently announced a new collaboration that will supply the cities' life-science industry cluster with renewable heating and cooling (Energinyheter, 2020).

Energy attribute certificates for renewable heating and cooling

As companies move towards supplying their heating and cooling operations with renewables, it is important to create a **recognised accounting framework for renewable heating and cooling certificates** as well as a **market mechanism for trading** these. Being able to claim environmental sustainability effectively and efficiently is critical to companies, and therefore raises a need for a certificate market for renewable heating and cooling to promote certainty, prevent double-counting and enable regulators to oversee claims and activities related to the corporate sourcing of renewable heating and cooling.

While the procurement of certificates for renewable heating and cooling is still limited, it may become an important driver for companies to invest in the near future. For corporate sourcing of renewable electricity, many companies started off by purchasing renewable energy certificates, before progressing towards more complex additional sourcing models after gaining some experience and as markets had further evolved to accommodate increasing corporate demand. Similarly, **energy attribute certificates for renewable heating and cooling may increase demand for corporate sourcing**.

For example, the Guarantees of Origin certificate system for the European renewable electricity market is being revised jointly in mid-2021 by the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC) to include renewable heating and cooling, in an effort to support the objectives listed in the Renewable Energy Directive II – which falls under the European Green Deal actions (CEN CENELEC, 2020).[3] In North America, initiatives such as the Renewable Thermal Collaborative and Green-e are working with industry and policy makers to assess the feasibility of energy attribute certificates for renewable heating and cooling.

3 CEN and CENELEC are two private international nongovernmental organisations (NGOs) that convene the national standards agencies of 34 countries and provide a platform for the development of European Standards and other technical specifications across a variety of sectors.

03

ACCELERATING CORPORATE SOURCING OF RENEWABLE HEATING AND COOLING

This chapter provides an overview of how companies source renewables for their heating and cooling operations based on an analysis of companies that participated in a survey.[4,5] The purpose of the survey was to better understand corporate strategies, including target setting and ambitions, as well as drivers and barriers for renewable heating and cooling.

3.1 Corporate target setting and drivers

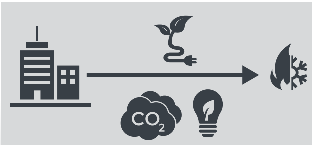
Corporate renewable energy targets play an important role in forecasting companies' medium- and long-term expectations and commitments to transitioning their operations towards sustainable processes in line with global and national climate objectives.

Even as an increasing number of companies commit to ambitious renewable energy targets for their electricity supply, target setting is not yet commonplace for heating and cooling.

IRENA's findings indicate that while only one-fifth of corporations in the commercial and industrial sector that source renewable electricity have committed to a renewable electricity target, it is even less common for companies to set specific renewable energy targets for other end-uses, such as heating and cooling (IRENA, 2018).

The companies surveyed reported having a combination of multiple targets that impacted their energy use for heating and cooling operations, as highlighted in Figure 4.

Figure 4: Corporate renewable energy targets

Direct targets	Renewable heating and/or cooling targets Renewable electricity targets Renewable energy targets	
Indirect targets	Decarbonisation targets Emissions targets Energy efficiency standards and targets	

Source: IRENA (2021)

4 The company survey jointly undertaken by IRENA and the Climate Group was launched in November 2020 and circulated to EP100 and RE100 member companies, as well as the companies featured as case studies in Chapter 5 of this white paper. EP100 brings together a group of 123 energy-smart companies committed to using energy more productively, to lower greenhouse gas emissions and accelerate a clean economy. RE100 is a global initiative bringing together over 280 of the world's most influential businesses driving the transition to 100% renewable electricity.

5 The reporting companies are private sector companies from a variety of countries around the world, with a range of 25 to 100 000 employees. The survey had 17 respondents. All survey responses have been used only in aggregated form to maintain the privacy of reporting companies' disclosed information. The survey was divided into three sections – target setting, drivers and barriers. Reporting companies' disclosed information uses data from 2019 and 2020.

Trends show companies adopt multiple targets simultaneously that cover a variety of sustainability and decarbonisation ambitions. In terms of **direct targets** impacting companies' heating and cooling operations, only one-third had set specific renewable heating and cooling targets. Almost 80% of companies surveyed had adopted at least one **indirect target**, including emissions targets, energy efficiency targets or standards, or decarbonisation targets. Overall, survey results indicate that companies wanting to decarbonise heating and cooling are more likely to set indirect targets with broader climate and sustainability objectives as opposed to direct renewable heating and cooling targets. This is in stark contrast to companies increasingly setting direct renewable electricity targets (IRENA, 2018).

From the companies surveyed, the main **drivers** for increasing the share of renewables in companies' heating and cooling operations can be grouped into five categories, as illustrated in Figure 5. Key drivers considered to be of importance to companies include, in descending order: environment and sustainability; corporate social responsibility and company reputation; customer, shareholder and staff demand; economical savings and price stability; policy incentives; and fiscal and financial incentives.

Figure 5: Drivers for increasing renewable heating and cooling in industry

- **Environment and sustainability**
- **Corporate social responsibility and company reputation**
- **Customer, shareholder and staff demand**
- **Economical savings and price stability**
- **Policy incentives**
- **Fiscal and financial incentives**

Source: IRENA (2021)

Environment and sustainability was ranked as one of the most important drivers by companies. With the industrial sector being the largest energy consumer with a significant climate impact, reducing greenhouse gas emissions has become a priority for companies (IRENA, 2020b) (IRENA, IEA and REN21, 2020). Furthermore, fossil fuel use and the inefficient burning of biomass for heating and cooling contribute significantly to air pollution, resulting in concerns over poor air quality and threats to public health. Transitioning to higher shares of renewable energy in companies' heating and cooling processes will become increasingly critical as companies act to address climate change and sustainability concerns.

Companies also highlighted **corporate social responsibility and company reputation** along with **customer, shareholder and staff demand** as critical drivers. These include maintaining a public image as an active agent in the energy transformation as well as demonstrating concrete actions addressing shareholder, customer and staff concerns with regard to companies' sustainable operations and processes. To this end, renewable energy target setting is a useful tool for companies to signal their sustainability performance as well as future investment and growth opportunities to investors, customers and governments (IRENA, 2015).

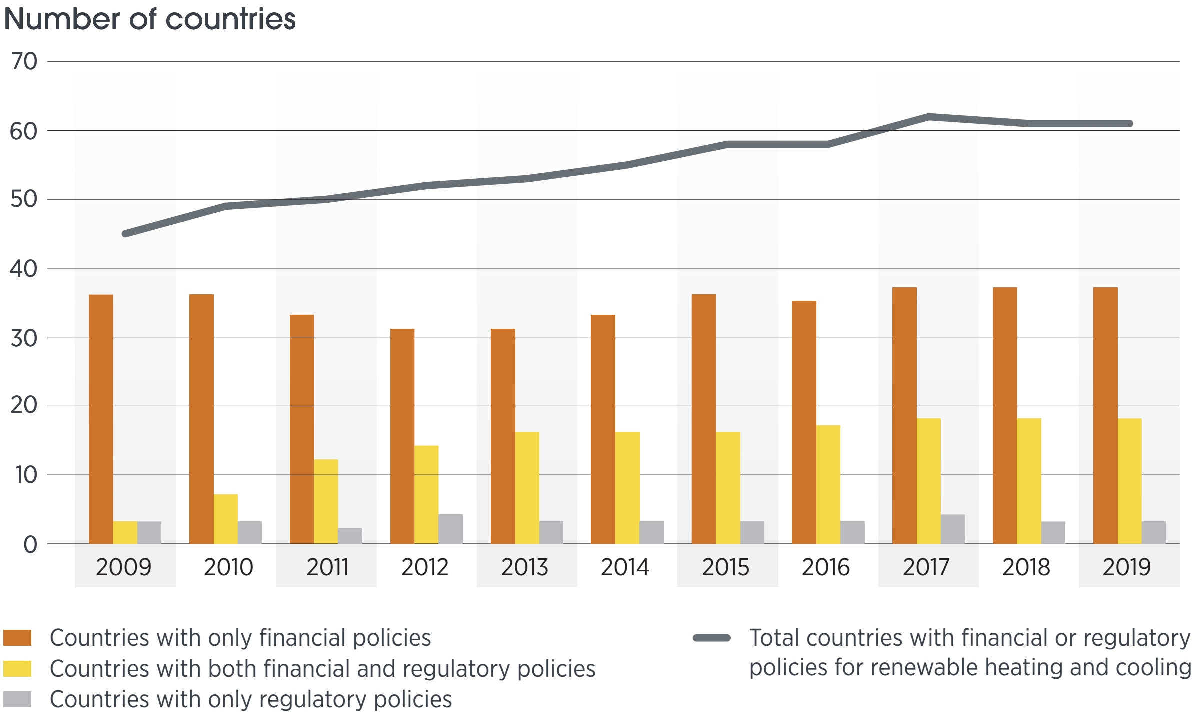
Economical savings and price stability also motivate companies to switch to renewables. More specifically, they include improved financial savings through reduced energy costs, energy efficiency savings, as well as less exposure to volatility in energy prices due to the price stability of renewable energy options. For instance, carbon pricing policies and emissions trading schemes have rendered biomass heating to be more cost-effective compared to fossil fuels (IRENA, IEA and REN21, 2020).

Furthermore, by setting new or more ambitious renewable heating and cooling targets and implementing supporting **policies**, governments can provide companies with clear and long-term policy signals that encourage them to set their own corporate targets.

Figure 6 illustrates existing renewable heating and cooling regulatory and financial policies across countries.

With companies facing high upfront investment costs, **fiscal and financial incentives** in the form of tax credits, and grants for renewable heating and cooling technologies and sustainability schemes – as well as widely-adopted renewable energy standards, certifications and regulations – further incentivise companies to invest in renewables.

Figure 6: Number of countries with policies for renewable heating and cooling, 2009-2019



Source: IRENA, IEA and REN21 (2020)

3.2 The renewable heating and cooling challenge

While companies are increasingly driven to set and achieve ambitious renewable energy targets, they also experience various barriers that hinder their progress towards scaling up renewable energy use in their heating and cooling operations. Figure 7 illustrates some of the key barriers considered by companies to be of importance in this context.

Figure 7: Barriers to increasing renewable heating and cooling in industry

Corporate barriers

- Fossil fuel lock-in
- Cost competitiveness of conventional energy solutions
- Lack of access to finance
- Competing internal priorities for capital expenditure
- Lack of available technologies
- New investments in cost-intensive advanced technologies
- Sparse information and data on renewable energy solutions for industrial processes
- Regulatory and policy uncertainty and complexity
- Lack of government support measures
- Structural and behavioural barriers

Source: IRENA (2021)

Survey respondents indicated that modifying industrial processes designed around fossil fuel-based energy sources was one of the main barriers to scaling up renewable heating and cooling. Historical investments in industrial processes create a **fossil fuel lock-in** effect, making the transition away from fossil fuels and investing in new enabling infrastructure for renewable heating and cooling more challenging. Furthermore, the **cost competitiveness of conventional energy solutions**, coupled with the **lack of access to finance** for renewable energy investment, increases the likelihood that companies need to make a choice between **competing internal priorities for capital expenditure**.

Given the context-specific nature of heating and cooling, renewable energy solutions often have to be customised to meet the unique needs of various industry subsectors. The **lack of available technologies** for renewable heating and cooling processes in industry is especially relevant for industrial heat processes requiring high temperatures and new investments in cost-intensive advanced technologies. Further, **sparse information and data** on renewable energy solutions for industrial processes make it challenging for companies to fully evaluate their energy needs and invest in the appropriate heating and cooling solutions. Companies indicated that these factors limit their abilities to effectively set renewable heating and cooling targets and make progress towards decarbonising their operations.

Companies' survey responses also highlighted the importance of effective policies. **Policy uncertainty and complexity** coupled with a **lack of government support measures** have made it difficult for companies to invest. Without clear, long-term renewable heating and cooling targets from national governments backed by concrete energy transition roadmaps, companies are not incentivised or able to construct long-term renewable energy and sustainability strategies (see Figure 6). In the industrial sector, incentive schemes often also target heavy industry and fail to address small and medium-sized enterprises.[6]

Delivering the energy transformation will require fundamental shifts in companies' investments, planning processes, attitudes and behaviours. By overcoming structural and behavioural barriers, companies can help unleash additional renewable energy deployment and its associated socioeconomic benefits such as gross domestic product growth, job creation and welfare gains. This calls for closer collaboration between policy makers and companies to align sustainability and climate objectives.

6 Small and medium-sized enterprises are non-subsidiary, independent firms which employ fewer than a given number of employees. The upper-limit for employees in these enterprises varies across countries, but is often 250 employees.

04 KEY TAKEAWAYS AND LESSONS LEARNED

Renewable energy investments in all sectors and end-uses must grow significantly and jointly as an integrated energy transformation to meet the Paris Agreement objectives. As companies around the world increasingly prioritise sustainability within their operations, many have set and even achieved 100% renewable electricity targets and are scaling up the share of renewable energy in their heating and cooling operations. This growing momentum within industry presents an important opportunity for policy makers to affirm their renewable energy commitments and implement strategies and policy frameworks that effectively encourage and incentivise the use of renewable energy beyond the power sector and into the heating and cooling sector.

Based on case studies as well as a survey of companies' renewable energy use for heating and cooling operations, the following key findings may serve as guidance and inspiration for governments and companies.

Key takeaways for governments

Setting national and subnational targets for 100% renewable energy across all end-use sectors, including heating and cooling, is key to driving the energy transformation in the industrial sector. As a growing number of companies prioritise sustainability and strive to reduce greenhouse gas emissions, they look to national and subnational governments to provide clear policy signals through long-term renewable energy targets. However, as of today, less than a third of national governments have adopted renewable energy targets for heating and cooling in comparison to 166 countries that have targets for renewable electricity. This trend can also be observed in corporate target setting, with companies setting renewables targets for electricity to a larger extent than for heating and cooling. Companies tend to have broader targets (i.e., energy efficiency, emissions, decarbonisation) that only indirectly impact the uptake of renewables for heating and cooling. Policy and regulatory clarity by governments can help companies make informed decisions that are competitive and cost-effective in the long term.

Long-term government planning is particularly important for decarbonising heating and cooling in industry. In addition to national target setting, integrated long-term planning is crucial when it comes to heating and cooling. Companies seeking to decarbonise their heating and cooling operations are faced with complex decisions given the context-specific and infrastructure-dependent nature of heating and cooling solutions. Whether a company chooses to electrify a portion of its heating operations, switch fuels or rely on direct thermal heat depends heavily on national and local government plans. Such plans may include developing or expanding central solutions – such as district heating networks or gas grids utilising renewable gases – as well as resource availability and costs. For example, access to cost-competitive renewable electricity can be a strong driver for electrifying processes, whereas the availability of sustainable biomass can be a incentive for switching fuel from coal, oil or natural (fossil) gas to biogas or biomass combustion.

Implementing ambitious regulatory, fiscal and financial policies and incentives will help increase the share of renewables in heating and cooling. Regulatory policies – including renewable heat obligations, feed-in tariffs, and bans on the use of fossil fuels/price on carbon and other negative externalities of conventional energy production – can help further stimulate renewables uptake for heating and cooling. Given the high upfront capital costs of renewable heating and cooling solutions, appropriate policy frameworks fostering research, development, quality standards, certifications and deployment programmes (private and public-private partnerships) are needed to lower their cost and to increase acceptance of new technologies. Long-term fiscal and financial support programmes also remain key to accelerating the transition to renewables. Companies that have successfully installed decentralised heating and cooling technologies such as solar thermal or heat pumps have typically received some sort of financial or fiscal support in the form of a subsidy, grant or tax credit.

Improving access to private capital for energy transition-related technologies will encourage essential long-term investments. Although falling renewable energy costs have significantly lowered up-front capital costs, financing renewable energy heating and cooling projects remains difficult in many parts of the world due to limited access to capital, elevated by underlying market barriers and real or perceived risk. This is particularly relevant in developing markets. Through the strategic use of public funds such as incentive programmes, governments can help mobilise private capital and reduce investment risks by sending clear signals to the financial sector that they support the shift away from fossil fuel-dependent processes, as well as providing de-risking loan guarantees and grants and risk insurance funds. Regulatory environments that encourage green lending practices – both public and private – can further lower financing costs for renewable heating and cooling.

Exploring innovative sourcing models for renewable heating and cooling will further scale up progress. New and innovative sourcing models (i.e., corporate PPAs and utility green procurement programmes) have been put forward in the market for renewable electricity, underpinned by the availability and effective tracking of energy attribute certificates. Lessons learned from the development of renewable electricity sourcing models can be leveraged to develop sourcing models for other end-uses. In addition to creating a recognised accounting framework for renewable heating and cooling certificates that will help create transparency and efficiently track attributes, governments should explore new mechanisms that facilitate easy access to renewable heating and cooling sources, such as green utility programmes.

Key takeaways for companies

Switching to renewable energy heating and cooling brings important benefits beyond emission reduction. In the transition to a climate-safe future, decarbonising heating and cooling operations plays a major role. Alongside significant emission reductions, shifting companies' energy supply towards renewables provides a competitive edge by reducing their risk exposure to volatile fossil fuel supply and costs. The importance of corporate social responsibility and reduced reputational risks is also becoming more prominent as shareholders and clients increasingly demand sustainability as a core practice.

Setting long-term corporate renewable heating and cooling targets and implementation strategies accelerates the decarbonisation of operations. Committing to a renewable energy target is an important tool to measure company performance and progress. Setting a target also communicates a clear signal to shareholders, investors and customers of a company's dedication and ambition towards sustainability and the energy transformation. Any target should be supported by a strategy outlining how the company will meet its energy demand through renewables, including milestones towards the target, sourcing models and planned projects.

Considering the local context is key when choosing among available pathways and technologies for renewable heating and cooling. Many companies already source renewable electricity through models such as corporate PPAs and utility procurement to power some or all of their industrial heating, cooling and transport processes. In addition to or as an alternative to expanded electrification of industrial heating and cooling operations, companies can consider exploring locally available thermal renewable resources for direct use. Companies have a variety of factors to consider when determining whether to favour electrification, fuel switching away from fossil fuels to biofuels, biogas or green hydrogen, producing direct thermal energy from renewables (solar thermal, geothermal), or using waste heat from industrial processes. Companies should consider the local context, government priorities, and their particular heating and cooling requirements when choosing pathways and technologies for decarbonising their operations.

Coupling renewable energy sourcing with measures to reduce energy demand and improve energy efficiency is crucial. Industrial players are uniquely positioned to establish synergies between renewable energy and energy efficiency. Companies can reduce energy demand, increase energy efficiency and reduce their carbon footprint through measures such as process changes, behavioural adaptations, relocation to areas with cost-competitive sustainable energy supply, and the adoption of circular economy and recycling principles.

Conducting further research and development across innovative renewable energy technologies and infrastructure for heating and cooling is needed. Cost differences and knowledge gaps between renewable energy technologies and established fossil fuel processes (often highly subsidised) are a key barrier for companies attempting to increase the share of renewables in their heating and cooling operations. Corporate investment in research and development of innovative renewable energy technologies is essential when considering the replacement of conventional heating and cooling operations, as well as when improving operational costs, efficiency and performance.

Improving data collection on companies' renewable heating and cooling operations can help monitor and adjust strategies in support of established decarbonisation targets. While company data regarding corporate procurement of renewable electricity are readily available, similar data for renewable energy use for heating and cooling operations are often lacking or incomplete. As data collection improves, further assessments of renewable energy sourcing trends and procurement options for heating and cooling will be possible. Furthermore, changes in resource availability, investment trends and operation costs, market development, as well as public support and framework conditions are relevant indicators for the adjustment of strategies.

By working with local actors, such as governments, utilities, communities and NGOs, companies can further accelerate the energy transformation. Companies can influence and continue to inform supporting policies needed to scale up renewables in their heating and cooling operations by working with governments and utilities on available sourcing models. When companies' energy transformation strategies require new infrastructure and changes to local environments, early communication, demonstrating a readiness to adapt installations to address citizen concerns, taking measures to reduce impacts, and highlighting visible benefits are also important steps to take with local stakeholders.

CASE STUDIES: COMPANIES IN TRANSITION

05

To further illustrate and understand the role of industrial players in the transformation to 100% renewable energy, this white paper analyses a selected number of companies in the industrial sector that are moving towards 100% renewable electricity and have committed to ambitious heating and cooling targets.

The case studies cover a diverse range of geographies, industrial subsectors, technologies and levels of operation and build on first-hand data obtained through interviews with senior representatives of the respective companies.

Table 1 below provides an overview of the selected case studies and is followed by the detailed case studies, including interviews, of each company. Key takeaways and lessons learned from the findings of the case studies are presented in Chapter 4.

Table 1: Overview of featured company case studies*

COMPANY HEADQUARTERS	**TARGET**	**TARGET ACHIEVEMENT REPORTED BY COMPANY (2020)**
Danfoss **Denmark**	100% renewable electricity by 2030 Carbon neutral energy use – including for heating and cooling – across global operations	21% renewable electricity 11% renewable heat
Elpitiya Plantations PLC **Sri Lanka**	100% renewable electricity by 2025 100% renewable thermal energy by 2030	100% renewable electricity, 20% renewable electricity fed into the grid 87.5% renewable heat
Florida Eis **Germany**	Carbon neutrality	Carbon neutral production processes since 2013
Goess **Austria**	70% renewable energy by 2030	98% renewable electricity 23.2% renewable thermal energy
Mars **United States**	Net zero emissions by 2040, sourced from 100% renewable electricity and thermal energy	58% renewable electricity 2% renewable thermal energy
TINE Group – Bergen Dairy **Norway**	100% renewable energy by 2025 across all operations in Norway	85% renewable energy across all production processes

*Data were compiled by the IRENA Coalition for Action based on case studies featured in Chapter 5.

DANFOSS

Danfoss heat exchangers for district energy

Company overview

Danfoss is the largest industrial company in Denmark focusing on the engineering and manufacturing of energy efficiency technologies for households and industries. With headquarters in Denmark, Danfoss has 72 factory sites in more than 20 countries and employs about 28 000 people.

As a company offering heating, cooling, drives and power solutions, Danfoss works actively to manage its own energy use, including by increasing energy productivity and the share of renewables in its electricity and heating and cooling supply. **The company is committed to sourcing 100% renewable electricity by 2030 under the Climate Group's RE100 initiative, as well as ensuring that all energy use, including for heating and cooling processes, is carbon neutral across its global operations by 2030.** These targets are part of a broader climate strategy that the company started working with in 2008.

In 2020, Danfoss' overall annual electricity demand was 430 gigawatt-hours (GWh), with renewables accounting for a 21% share that was sourced passively through local power companies. Danfoss aims to enter into PPAs to purchase green electricity from utilities to decarbonise its electricity processes. A small share of Danfoss' renewable energy is self-generated – up to 3.2 GWh in 2020. Its heat demand for both production processes and buildings was 170 GWh, with renewable energy accounting for 11%, coming mainly from green district heating and recovery. Danfoss has installed heat pumps to recover heat energy from the process cooling water and heat recovery on air compressors making compressed air for production. Danfoss is further in the process of transforming its factories and operations away from conventional energy sources and towards the electrification of heating processes, which currently rely on fossil fuels.

Of Danfoss' overall energy consumption, half is used for buildings, including ventilation, air conditioning, lighting and other utilities, and the other half for manufacturing and process heat. In total, process heating accounts for 70% to 80% of overall heat demand, with some facilities using a large amount of natural gas for hardening processes in metal processing plants.

While Danfoss has gained considerable energy savings since its climate strategy was first developed in 2008 (the company's energy productivity increased by 80% globally as of 2020, compared to baseline levels in 2007), the company needs to develop concrete roadmaps to reach its ambitious renewable energy and carbon neutrality targets. An initial phase of Danfoss' roadmap involves decarbonising its headquarters in Nordborg, Denmark, which hosts the company's largest production facility and has 3 000 employees. The headquarters project aims to use district energy from municipal district heating facilities put into operation in mid-2020 next to the headquarters. Utilisation of excess heat from Danfoss' own processes and from a newly built data centre is also being implemented, and the heating demand not covered by these solutions is expected to be covered by heat pumps.

Interview with Rikke Skou Melsen, Global Public Affairs Manager; Flemming Lynge Nielsen, Director Energy Efficiency and Sustainability; and Martin Oredson Haugaard, Head of Technical Consultancy Group Real Estate - Danfoss

What is your main strategy to achieve your renewable energy targets for heating and cooling?

When we build new factories, we aim to recover the heat generated by the production equipment and use it for heating the building, ventilating the air and production processes. The main objective is to obtain hydronic heating and cooling systems that enable us to recover energy and move it to where it is needed.

In new and existing factories, we install air handling units using heat recovery with high efficiency as well as heat pumps to recover heat from process cooling water. Instead of installing natural gas boilers as backup, we prefer to install electric boilers or, alternatively, aerothermal, or geothermal heat pumps powered by renewable electricity.

For process heat, we aim to use electricity. We intend to use heat pumps to recover the surplus heat generated in various processes. In processes where high temperatures are needed, we look at using electricity. We have not yet found a solution for hardening processes in metal processing plants. Here, process technicians must investigate if biogas, hydrogen, or other liquid fuels can be an alternative to natural gas.

What are your motivations and expected benefits for setting and progressing towards your renewable energy ambitions?

Going carbon neutral or working with reducing our energy consumption or process heating impacts our competitiveness, positively or negatively. Our motivation for doing this is to be seen as a company delivering on its ambitions to make a change in the world and to drive a green transformation. We have an obligation as the largest industrial company in Denmark to lead the way.

We have high ambitions for the results that we have next to our logo, “Engineering tomorrow to create a better future”. It is possible to save costs and become more resilient with regard to changes in taxation systems and potential energy shortages. Getting rid of fossil energy is one of the main drivers and what we are advocating for when speaking to decision makers, politicians, and mayors. It is a rather complex picture, but overall, our ambition is to make a difference and to impact the world.

Which parts of your heating and cooling demands are most challenging to decarbonise and shift to renewable energy and why?

Decarbonising our cooling operations is not a problem because they are generated by electrically driven chillers, and we can buy renewable electricity.

Heating for buildings is more difficult because in two-thirds of our factories we depend on natural gas with indirect gas heaters in the air-handling units and have no hydronic infrastructure for our heating system. Here we face a big challenge because it is a huge investment to replace all air-handling units and at the same time install hydronic heating systems. Where our company has a presence, there are also no biogas facilities, so we cannot just switch fuels. We are looking into electrifying the heating by installing heat pumps in new air-handling units.

Some of our facilities use large amounts of natural gas for process heating, especially for hardening processes in metal processing plants. Converting those from gas consumption to electricity is not done quickly.

A key barrier is cost. We need to balance investments so that we do not spend more money than is necessary. We still need to make a business out of this, so investing billions of euros is not the way forward.

Are there particular policy barriers that your company faces when attempting to achieve renewable energy targets?

In general, and across countries, the policy environment is important and can act as a barrier or lend a helping hand. When a government puts out ambitious targets and strategies, it is helpful in creating predictability and stability for us to make the necessary investments. It is also a good signal that the government is ready to consider the right policy changes to realise their targets, meaning any policy barriers that will arise may be overcome. Conversely, the lack of a clear strategy and ambitious targets from government creates uncertainty for us.

More concretely, tax policies play a big role – either as barriers or supporters. For example, in Denmark, the use of excess heat – produced in the cooling process in supermarkets, in industrial production and from data centres – has so far been taxed, creating a barrier to sector integration and further decarbonisation of heating. In Denmark, this tax is thankfully now being cancelled. The regulatory environment concerning the taxation of electricity and incentives for energy efficiency is very volatile within and across markets, making long-term planning a challenge.

Based on your company's experiences, what can policy makers do to drive progress and encourage similar companies to set renewable energy targets for their heating/cooling processes?

Policy makers have an important role to play in setting the general direction. As a business we are operating within a framework, so if we know that policies are moving towards emissions reductions and the country is setting targets for renewable energy, that makes it easier and it increases investor confidence. Also, creating the right infrastructure on the supply side, e.g., by increasing the amount of renewable energy in the grid, makes it easier for companies to set a target.

In terms of specific policies, taxation, standards and regulation, as well as CO_2 pricing can all incentivise companies. A company can be very progressive and try to find ways to contribute to sustainability on its own initiative, but it is easier and faster if the whole society is moving in the same direction. Companies who are not motivated now might be motivated if the incentives were right.

Key to any policy and to encourage investment in renewables is stability. If companies are not aware of the outlook for the next five to ten years when it comes to taxation, grid expansion, or wind or solar subsidies, it is very difficult for them to invest. They might even be reluctant to initiate activities because they are uncertain of the risks they are facing.

We are now looking at how to engage with power companies on PPAs and the uncertainty of energy prices in the coming ten years. It is like looking into a crystal ball, but you cannot really see anything. The more visibility or clarity policy makers can add in the fields of energy and climate, the easier it is for companies to see themselves as players and take calculated risks on what to invest in to decarbonise or to drive down their energy consumption.

How has COVID-19 impacted your company and its renewable energy targets/ambitions?

COVID-19 has not impacted our ambitions. It has set us back a little because a lot of employees were sent home on leave during the spring, so we are three to four months behind schedule because of COVID-19. Our ambitions regarding climate and our decarbonisation target remain unchanged. There will be more discussions on how to finance all this if the crisis continues, and it will impact our economy over several years – yet our ambition remains unchanged.

ELPITIYA PLANTATIONS


Tea pluckers at Elpitiya Plantations

Photo: Elpitiya Plantations

Company overview

Elpitiya Plantations PLC (EPP), a regional plantation company in Sri Lanka, focuses primarily on manufacturing tea and crepe rubber. The company operates 13 estates and provides direct employment opportunities to over 5 000 people, of which 54% are women (Eplitiya Plantations PLC, 2020).

EPP adopted a company-wide sustainability goal in 2017 to drive local efforts in support of the sustainable development goals (SDGs). **Specifically, the company has a 100% renewable electricity target to be met by 2025 through hydropower and solar power generation. Similarly, the company also has a target of sourcing 100% of its thermal energy consumption through estate-grown sustainable biomass sources by 2030.**

In 2020, EPP's total energy consumption was 51 149 megawatt-hours equivalent (MWh_{eq}), of which 96% was sourced through renewable means. A breakdown of EPP's total energy consumption in FY 2019/20 can be seen in Table 2.

Table 2: Elpitiya Plantations energy generation and consumption by source, FY 2019/20

GENERATION		CONSUMPTION	
Source	Energy generated (MWh_{eq})	Source	Energy consumed (MWh_{eq})
Biomass	44 759	**Biomass**	44 759
Electricity generated & sold	4 689	**Electricity (from grid)**	3 917
Hydro	3 670	**Diesel**	1 988
Solar	1 018	**Petrol**	394
Total electricity	4 689	**Liquefied petroleum gas (LPG)**	92
Total	**49 447**	**Total**	**51 149**

Source: Annual Report FY 2019/20 of Elpitiya Plantations PLC

EPP's annual electricity consumption at the company level in 2020 accounted for 7.6% of the company's energy consumption. From April 2019 to March 2020, the company consumed 3 917 megawatt-hours (MWh) of electricity and supplied 4 689 MWh of renewable electricity to the national grid. Accordingly, the renewable electricity generated and supplied to the grid was 120% of the electricity consumption, thereby enabling EPP to meet its renewable electricity target and achieve a negative carbon footprint. In addition to operating seven solar ground-mounted farms with a capacity of 1.25 megawatts (MW), EPP scaled up solar pumps to deliver water for production processes as well as for the development of hydropower generating plants using remaining water streams that flow through the plantation.

EPP's thermal requirements are entirely sourced through biomass-based fuel such as fuelwood, with annual consumption of biomass for thermal applications in 2020 equivalent to about 87.5% of EPP's energy consumption. To meet heat requirements, 23% of EPP's biomass consumption is met from sources grown on the company's plantations from uprooted rubber trees and eucalyptus, among other sources. The remaining 77% is purchased from sustainable third-party biomass suppliers. EPP's thermal energy consumption is predominantly required in the plantation factories to generate hot air for withering and drying tea leaves. Thermal requirements for withering and drying processes are generally supplied from fuel combustion (using biomass or oils) and transferred to processing air through heat exchangers. Operating temperatures for thermal processes in tea production range between 50°C and 100°C. For rubber production, heat is used to evaporate the surface moisture of crepe rubber. No cooling applications are involved in EPP's tea and rubber manufacturing processes.

Interview with Ishafir Izzadeen, Senior General Manager, and Priyantha Dissanayake, Senior General Manager of Engineering & Projects and Head of Business Sustainability - Elpitiya Plantations PLC

Which parts of your heating and cooling demands are most challenging to decarbonise and shift to renewable energy and why?

We are trying to decarbonise our current operations by fuel switching to biomass burners and boilers and growing sustainable biomass. However, this requires additional infrastructure, changes to the plant layouts and training of the operational staff, which encompass additional investments and time. It is challenging to meet the 100% thermal energy target within our own lands, which are mainly meant for commercial crops. Due to the high financial capital requirements, it is also expensive to make process improvements from conventional air heaters to efficient steam boilers or hot water generators.

What are the main barriers your company is facing in achieving your heating/cooling renewable energy targets/ambitions? How have you overcome these barriers?

The key challenge we experience in achieving our renewable heating and cooling targets is from our competitors, who may rely on biomass harvested from non-sustainable sources at a lower cost while we resort to sustainable biomass as the key source of heating energy. These barriers have made it challenging to realise our ambitions, but we are managing to achieve our targets despite these challenges. This is aggravated by the difficulties in obtaining necessary approvals from different government authorities in regard to the laws of harvesting, transporting and storing biomass, among others. We also face land limitations and capital requirements in the context of a dilemma between choosing to allocate land for commercial crops which generate direct revenue, or fuelwood plantations which do not.

Are there particular policy barriers that your company faces when attempting to achieve renewable energy targets?

The major policy barriers we encounter are inconsistent government policies and policy implementation. For instance, the national energy policy promotes increasing energy supply from renewable energy resources in the country's energy mix, while the Long-Term Generation Expansion Plan for 2020-2039 prepared by the Ceylon Electricity Board indicates heavy reliance on high carbon-emitting technologies for power generation. Further, while the plant Gliricidia has been declared as the fourth national fuelwood plantation crop in Sri Lanka, no significant measures or programmes have yet been made by the government towards this endeavour. There is a lack of co ordination between different government entities at the national and provincial levels. We are also confronted with the non-availability and lack of awareness of financial support schemes available for sustainability projects.

What are your motivations and expected benefits for setting and progressing towards your renewable energy ambitions?

There are many drivers that motivate us to set 100% renewable energy targets. National-level policies are conducive to moving towards renewable energy and sustainability. We also have board-level support and backing on sustainability and environmental initiatives. For example, EPP invested in a solar photovoltaic (PV) roof system in 2017, as well as in rainwater harvesting and composting. As noted above, our sustainability strategy is embedded in the company's overall business growth strategy. From the perspective of meeting the thermal energy needs of our factories through self-grown biomass, we increase the quality, adequacy and reliability of our biomass supply using an uninterrupted lower-cost energy source, which thereby positively impacts our costs and long-term competitiveness.

Sustainability and environmental initiatives also bring considerable economic benefits, especially with attractive feed-in-tariffs for power generated and fed into the national grid from renewable sources, as well as a concessionary consumer tariff that applies to the electricity consumed by factories. Engaging in sustainability elevates the company's credit ratings, which also help in obtaining attractive loan funding. From a social point of view, this also creates more employment opportunities by providing jobs to communities around the plantation. Apart from greenhouse gas mitigation efforts, renewable sources of energy such as sustainable biomass also support biodiversity, which is a major interest of our business as a plantation company.

How is your company measuring progress towards its heating and cooling renewable energy targets and ambitions?

The company has adopted many ways to measure progress towards its renewable energy targets, beginning with embedding the sustainability strategy into the company's overall business growth strategy. The company's sustainability strategy is formulated by choosing the six most relevant SDGs: clean water and sanitation (SDG 6), affordable and clean energy (SDG 7), decent work and economic growth (SDG 8), industry innovation and infrastructure (SDG 9), responsible production and consumption (SDG 12), and partnerships for the goals (SDG 17). Goal leaders who take charge of measuring and monitoring sustainability performance against targets and plans have been assigned to each of the relevant SDGs. We have also introduced Sustainability Awards and a rewarding scheme for best sustainability practices.

In addition to these internal arrangements, the company undergoes external assessment audits conducted by a third-party professional body at an identified frequency. Further external inputs are added through collaboration with academia, NGOs and government organisations in formulating and implementing sustainable programmes, including renewable energy project implementation.

How have your partners, consumers and investors responded to or engaged with your renewable energy targets and ambitions?

We have had positive interactions and engagement with government authorities such as the Sri Lanka Sustainable Energy Authority, NGOs and international organisations such as the United Nations Development Programme, United Nations Industrial Development Organisation, and Asian Development Bank in implementing renewable energy-related projects. However, as we are engaged mostly in activities of a business-to-business nature, the involvement of end-user customers or consumers is minimal.

Since the company's financial performance has been consistent, financial institutions are comfortable considering our company for financing. Further, foreign and local investors are highly attracted to investing in sustainable projects, including renewable energy-related projects, with our company.

Based on your company's experiences, what can policy makers do to drive progress and encourage similar companies to set renewable energy targets for their heating/cooling processes?

Policy makers should ensure consistent national-level policies backed by proper co-ordination among relevant authorities and institutions. National-level policies should provide attractive financial assistance with long tenors and low interest schemes, impose lower taxes, and provide duty levies for renewable energy (sustainable programmes) investments, as well as incentivise high performers with tax rebates. Further, effective communication and co-ordination between national and provincial government authorities are vital.


Photo: Elpitiya Plantations

Elpitiya Plantations tea estate and factory

FLORIDA EIS

Florida Eis EV truck

Photo: Olaf Höhn/Florida Eis

Company overview

Florida Eis is an artisanal ice cream manufacturer based in Berlin. Starting out as an ice cream parlour at a local cinema back in 1927, Florida Eis was taken over by its present owners, in 1985 when it was still a small business. Today, Florida Eis produces about 45 types of ice cream available throughout Germany via an online shop and 2 180 retail partners. The company also runs its own cafés in Berlin. Thanks to strong growth over the last decade, the medium-sized company now has 105 employees in its factory. It employed an additional 140 staff members in its cafés[7] in 2019, before the start of the pandemic.

Beginning with the installation of its own PV system, Florida Eis has set itself the goal of continuously optimising its production through new and innovative technologies, some of which are unique. **The company has operated a CO_2-neutral production process since opening a new production site in 2013, becoming Germany's first ice cream manufacturer to do so** (Florida Eis, 2018). Florida Eis relies heavily on cooling technologies for the production, processing and transportation of its products. Because the company continues manufacturing by artisanal methods rather than industrial processes, the demand for energy is relatively low compared to that of industrial ice cream producers.

Although its production area increased from 600 to 4 000 square metres in 2013, the company has mantained the same electricity costs (BMWi, 2020). Currently, its energy costs account for around 3% of annual revenue. Florida Eis relies on an intelligent and well-integrated energy system and is able to cover all of its electricity and heating/cooling requirements through renewable energy. As ice cream production peaks during the summer months, solar energy has become a key source of energy for the company. To meet its electricity needs of about 1.1 million kilowatt-hours (kWh), Florida Eis relies on a mix of own production (26%) and external energy (74%). With an installed capacity of 182 kilowatts (kW), the company's own PV system produces about 298 000 kWh annually, of which an average of 5% is fed into the grid. In addition, the company purchases about 820 000 kWh of renewable grid electricity.[8]

For heating and cooling, Florida Eis mainly relies on its own solar thermal system with a capacity of 90kW (about 48 000kWh/year) and an integrated adsorption cooling system with a capacity of 60 kW. The company has installed innovative cooling technologies that include a freezer cell with a permafrost floor and eutectic cooling in its electrically powered deep-freeze trucks, which are the first of their kind. The company's refrigeration technology is connected to a system that takes off the heat and uses the adsorption system to generate cold water for air conditioning as well as for direct cooling of four ice machines. When the storage capacity of 6 000 litres of water and the solar thermal system do not provide enough heat during the winter months, the company relies on wood pellets. An electronic filter system specifically designed for the company's pellet heating reduces emissions from fine particulates by 85%.[9]

7 Interview with Olaf Höhn, November 2020.
8 Interview with Olaf Höhn, November 2020.
9 Interview with Olaf Höhn, November 2020.

While planning to increase its production capacities by about 30% in coming years, Florida Eis will also implement a number of measures to move closer to CO_2-free production. These include replacing its current PV plant with a higher-capacity system, substituting an additional five combustion engine vehicles with EVs, and switching to more sustainable packaging and ingredients for its products.

Interview with Olaf Höhn, Managing Director, Florida Eis

Which parts of your heating and cooling demands are most challenging to decarbonise and shift to renewable energy and why?

When we planned the new production facility and eventually put it into operation, there was little experience to draw on to help realise such an integrated combination of innovative technologies. Decarbonising our cooling demand was one of the most challenging undertakings. The building of the permanently operating freezer was a difficult decision, as refrigeration experts believed that the technology we now use was wrong. I took up the challenge and created a so-called permafrost floor for the freezer cell – a concrete floor that does not require additional underfloor heating, as is usually the case to prevent cracks from the cold in the concrete. Using heating as part of the refrigeration process is not only counterproductive and wastes energy, but also more expensive than using a permafrost floor made of glass foam gravel. So, we have taken the opposite approach and are now keeping the floor permanently under frost conditions.

This example highlights that finding the right technology for a given purpose can be a major challenge and that energy efficiency measures should also be considered when shifting to renewable energy, e.g., by taking the entire insulation, as well as cable cross-sections, short distances and gravity, into account.

Moving our transport demand towards decarbonisation seemed more straightforward, as a number of options for electric mobility are readily available, but the installation of the cooling technology in the trucks was also a challenge. Our EV fleet offers CO_2-free delivery to supermarkets and cafés within Berlin. During summer days, our trucks – powered through the PV system at our production site – do not require any external energy sources due to our pioneering efficient deep-freeze and eutectic cooling technology.

Are there particular policy barriers that your company faces when attempting to achieve renewable energy targets?

Politicians are far too hesitant; I often notice that policy making is hampered by those who want to slow down climate protection. We will never achieve the necessary goals without more pressure. We need more consistent and far-reaching decisions for climate protection. At the moment, we face too many regulations and specifications that make everything more expensive and inefficient, while at the same time we are supposed to become more efficient. Many regulations are not aligned, which impedes progress. All of this makes efficient and fast implementation of renewable energy technologies difficult.

What are your motivations and expected benefits for setting and progressing towards your renewable energy ambitions?

When committing to climate protection, a significant goal is the reduction of CO_2 emissions. This can lead to a passion: a task may bring you more satisfaction with every tonne of CO_2 saved. The process is not yet complete; other areas, including transportation, are also being gradually evaluated to realise further emission savings. But the efficiency and the environmental contribution are increasing every year thanks to new technologies available on the market and the smart integration of these solutions in our premises.

How is your company measuring progress towards its heating and cooling renewable energy targets and ambitions?

We have calculated that we save 0.0113 grammes of CO_2 per second compared to fully automated industrial production processes that rely on conventional technologies and energy.

Since switching to CO_2-neutral production in 2013, we have saved more than 251 tonnes of CO_2. At the same time, our turnover has grown by an annual average of 15% over the last seven years. These numbers show very clearly that we can protect our climate while still growing our business, providing a high-quality product and increasing jobs. This is a message that policy makers also need to promote in their words and actions.

How have your partners, consumers and investors responded to or engaged with your renewable energy targets and ambitions?

When I initially presented the concept of CO_2-neutral production to the public, the response was cautious. But every year that we made progress and communicated about it, interest and support have grown. Today, I am regularly invited to share our experiences and give presentations on our sustainable business model. Retailers approach us to include our ice cream in their offerings, and we are visited by many international guests. We are certified as one of Germany's "climate protection companies" that play a pioneering role in climate protection and energy efficiency through constantly implementing innovative technologies. Currently, we are involved in a research project for trucks from the German Ministry for the Environment. Another research project on adsorption cooling is pending. Given this response and engagement, our transformation can be described as a success story.

Being 100% committed to reducing CO_2 emissions results in a positive effect on all other aspects of our everyday business. Our clients support and encourage our goals. We can see and measure this through social media and purchasing behaviour. In the last few years, the interest in artisanal, high-quality and environmentally friendly products has grown. We can serve these demands of the food retail trade and make a significant contribution to the reduction of CO_2 – which we share publicly on our website.

Based on your company's experiences, what can policy makers do to drive progress and encourage similar companies to set renewable energy targets for their heating/cooling processes?

We need a more open and honest political approach to climate change and more progressive legislation that supports rather than hampers climate protection efforts. Decision makers should recognise those who speak out and act to address climate change., Companies' practical experiences – for example, in terms of best practices or technical challenges – should be recognised and reflected in political decisions.

Florida Eis is often mentioned as an example of best practices, especially at the policy level. Companies with similar concepts are entering the market, but there are fewer imitators than might be expected. The reason is often that the question of amortisation is at the forefront. The financial issue has been a recurring challenge for us in advancing our targets over the last decade, given that the costs of new, innovative technologies were still relatively high and commercial solutions were difficult to achieve. Yet today costs are decreasing while financial assistance and accompanying support measures are becoming increasingly available. These measures need to be further improved, expanded and made better known.

Fortunately, Germany now has very good support schemes in place from which our company has benefitted. Over the last decade, we have invested about EUR 6 million in our renewable energy system, of which EUR 974 000 was covered by federal grants. We are also involved in a number of pilot projects with the German government and universities.

How has COVID-19 impacted your company and its renewable energy targets/ambitions?

COVID-19 did not affect our goals; the pandemic just moved the schedule. In recent years, including 2020, attention to climate-friendly businesses such as ours has increased. There will be and there must always be businesses that are committed to climate-friendly policies and that gain supporters through this commitment. But of course, more must follow suit. It will not be enough if only a few act.

GOESS BREWERY

Goess Brewery solar thermal plant

Company overview

The Brewery Goess is part of the Brau Union Österreich AG, the biggest brewery company in Austria, with 2700 employees producing 19 brands and 100 beer types. Brau Union is owned by Heineken group. In 2019, Brau Union had a share of 98% renewable energy for electricity production and 23.2% for thermal energy. **Brau Union is aiming at 70% renewable energy by 2030 and at significantly reducing energy consumption for beer production and reducing CO_2 via 100% Green Fridges for gastronomy clients**. These objectives are major elements of the "Green Brewery" concept, which was developed and introduced in several breweries in 2006 and successfully implemented since then together with local partners. It has become a vision for an increasing number of breweries in Austria and for the whole Heineken group.

The Brewery Goess is one of the biggest Austrian breweries, with an annual production of more than 1.4 million hectolitres (hl) of beer. The brewery employs 68 people directly for production and packaging. The company promises sustainable consumption based on sustainable resources for energy use, packaging and logistics, and the whole brewing process. Following the Green Brewery concept, the value chain was improved and modernised (Gösser, 2020).

The brewery's actual energy demand per hl is about 45 MJ_{th} and 5.2 kWh_{el} (kilowatt-hours of electricity), which amounts to about 6 gigajoules thermal output/year and 6 GWh/year.[10] The brewery's electricity demand is fully covered by certified renewable electricity from the local electricity company. A major share is produced from hydropower, but other renewables such as wind, solar and biomass are also included. In addition, the brewery produces electricity on-site from biogas, which is fed into the grid.

The brewery uses heat with temperatures above 80°C mainly for the brewing process and packaging. In the brewhouse, the malt and hops are digested in water and heated up in several steps. For packaging, thermal energy is needed to clean the bottles, sterilise the kegs and pasteurise the beer. To heat the buildings, temperatures above 60°C are required for nearly half the year.

Since 2016, only renewable energy has been used in the whole brewing process. About 45% is from district heating running on biomass, 42% is from biomass used on-site, 10% is biogas from wastewater and 3% is solar thermal.[11] Heat supplied by biogas is from anaerobic digestion of the spent grains, a wastewater purification installation and waste heat from a sawmill of a neighbouring woodworking company. Biogas not needed for on-site heat supply is converted to electricity production in a cogeneration installation and fed into the local grid.

10 Interview and correspondence with Andreas Werner (Brewmaster at Goess Brewery), September 2020.
11 Interview and correspondence with Andreas Werner (Brewmaster at Goess Brewery), September 2020.

The heat supply is complemented by a 1500 square metre solar thermal installation including 200 cubic metres of pressurised solar thermal storage. The solar thermal plant is used to provide heat at different temperature levels (more than 90°C in summer and about 60°C in winter) for different applications, e.g., preheating of wastewater to improve the yield of biogas in the treatment and for feeding two steam-supplied anaerobic vessels (mash tuns).[12] When solar thermal is not available, the hot water is supplied by waste heat from a nearby biomass combined heat and power (CHP) plant. After spending some time for optimisation in terms of quantity and availability for other uses in the brewery, processes were further optimised and are operating smoothly now.

Interview with Andreas Werner, Brewery Manager at Region South - Brau Union Austria

What is your main strategy to achieve your renewable energy targets for heating and cooling?

We want the whole brewery to be run sustainably and supplied by renewable energy only. We started by increasing the efficiency of processes by employing innovative technologies and optimisation. We thus achieved energy savings of at least 10% over the last five years. Our electricity consumption is 100% renewable – we buy certified renewable electricity from the grid. We plan to install rooftop solar PV for about 20% of the brewery's electricity demand, probably in 2021, and we plan to use more renewables for our logistics. We are gradually introducing electric-powered transporters and forklifts in the brewery and for short-haul transport in general. We are also beginning to replace the fossil gas used for our cars with biogas produced in our own facilities. The lessons learned from Goess Brewery will serve as a blueprint for other breweries of Brau Union and the whole Heineken group.

Which parts of your heating and cooling demands are most challenging to decarbonise and shift to renewable energy and why?

The most difficult part was the change in processes that need temperatures above 100°C. Finding suitable technologies and sourcing enough biogas to cover peak demand whenever needed were among the biggest challenges. We solved these problems by diversifying heat sources and biomass supplies. Today, we produce a surplus of biogas, which we use for electricity production to be fed into the local grid.

What are the main barriers your company is facing in achieving your heating/cooling renewable energy targets/ambitions? How have you overcome these barriers?

Because becoming a green brewery is part of Heineken's and Brau Union's sustainability strategy, it was relatively easy to get started. However, we had to deal with the fact that sustainable investment involves longer investment cycles. A standard grid connection is always the cheapest solution. Building a pipeline for district heating or a biogas plant for spent grain fermentation entails higher investment, because energy prices are always compared with standardised fossil fuel costs. This had to be included in our financing strategy. Based on solid planning and supported by local partners, we were able to overcome the barriers and move forward, which is also in line with Austria's renewable energy policies objectives.

Are there particular policy barriers that your company faces when attempting to achieve renewable energy targets?

Given the Austrian government's long-term commitment to renewable energy, we did not face major policy barriers. We did, however, face some local opposition, particularly against including biogas production in the brewery. The brewery is situated close to a residential area, and neighbours were concerned about foul-smelling emissions. Intensive discussions with the neighbours and our willingness to install effective filters solved the problem, and the green brewery is very well accepted and supported locally.

12 E-mail correspondence with Christoph Brunner, AEE INTEC (AEE Institute for Sustainable Technologies), (13 August 2020) and Andreas Werner (28 September 2020).

What are your motivations and expected benefits for setting and progressing towards your renewable energy ambitions?

Green marketing and striving for sustainability in all our processes is part of the DNA of our brewery and of the whole Heineken group. We are strongly motivated by Goess being a lighthouse project – with more breweries in Austria and around to world to follow suit – and by the support of the local population and our partners. The Goess model is replicable in its various elements in other breweries. This has been done already – always considering the specific opportunities of each individual case. The Green Brewery concept and its implementation have positively impacted the company's image and thus our competitiveness in a market which is increasingly demanding sustainability. Given the stable framework conditions and continuously decreasing costs for renewable energy technologies, there has been no negative impact in this regard. On the contrary, in terms of competitiveness, sustainable production is an advantage. In the long run, sustainable production and investment will pay off for the environment and the future.

How is your company measuring progress towards its heating and cooling renewable energy targets and ambitions?

We monitor monthly, and progress is analysed in annual environmental reports. We are proud to have been awarded prizes for our Green Brewery concept – for example, the "Green Brand," the "Energy Globe Austria" and the "International Energy Agency Solar Heating Programme Award" in 2016. In addition, a cross-functional Brau Union team oversees target fulfilment and thinking bigger for the future.

How have your partners, consumers and investors responded to or engaged with your renewable energy targets and ambitions?

We have worked with local partners from the beginning, and we have consulted with citizens potentially impacted by the changes in the brewery. You might say the process of developing a green brewery was started by local initiatives.

Customers appreciate our ambition to be a green brewery, and various local partners are eager to co-operate with us. For example, our biogas facility was jointly planned with a local developer and is now operated in good partnership, and the solar thermal plant was also developed and established with a partner.

Based on your company's experiences, what can policy makers do to drive progress and encourage similar companies to set renewable energy targets for their heating/cooling processes?

Stable and reliable policies are important. Decision making in politics should be as efficient as possible. Pollution and climate change should be included in prices. Fully implementing the polluter-pays principle across all government support policies and on taxation levels is especially important. However, this is not enough. Public support and public money should be shifted away from fossil and polluting energy to renewable energy. There should be plans to accelerate the transformation towards renewable energy.

How has COVID-19 impacted your company and its renewable energy targets/ambitions?

The lockdown of gastronomy and the absence of big events and festivals had an essential impact on our company. It led to some changes in immediate priorities, and there were some delays in implementation. However, it did not and does not have a major impact on our renewable energy projects, and it did not change our strategy, targets and ambitions to move towards more green breweries powered by renewable energy sources. In 2021, at least one more brewery of the Heineken group in Austria will be turned into a green brewery. There will be more in the years to come.

MARS

Photo: AWinston Chen/Mars

Mars factory with biomass pellets

Company overview

Mars, Incorporated is a private, family-owned company based in the United States, focusing on four business segments: Mars Petcare, Mars Wrigley, Mars Food and Mars Edge. As one of the leading food manufacturers in the world, Mars has global operations in over 80 countries, 3 000 factory and pet hospital sites, and more than 130 000 employees.

With a company-wide target of achieving net zero emissions by 2040 sourced from 100% renewable electricity and thermal, Mars is actively working towards decarbonising its operations. Mars is a member of the Climate Group's RE100 initiative, under which it has committed to sourcing 100% renewable electricity by 2040. Other important focuses include internal targets for reducing the energy intensity of various projects to improve energy efficiency levels.

Electricity accounts for 40% of Mars' energy consumption, while thermal use from natural gas for steam production accounts for the other 60%. Mars' annual electricity consumption in 2019 was 2 266 GWh, of which renewables accounted for 58% through a variety of sourcing options such as wind and solar PPAs with direct off-site grid-connected generators as well as small-scale on-site solar generators owned by third parties. Mars' thermal demand for its production processes in 2019 was 3 922 GWh, of which renewables accounted for 2% through sourcing methods such as on-site biomass, biogas recovered from a wastewater treatment plant and steam PPA. Furthermore, Mars is developing energy efficiency projects and testing new technologies such as electrification through the use of heat pumps, waste heat recovery and solar thermal steam in renewable thermal energy.

Mars' energy demands vary across the company's different business segments, factory size and product type. The company's heating and cooling processes require a broad range of temperatures, from freezing temperatures for ice cream production to process steam of up to 175°C. Chocolate and gum production require very high amounts of energy for cooling processes in particular, with cooling demand peaking at up to 20 MW. Pet food production, in contrast, is more heat intensive, with steam requirements peaking at up to 20 tonnes per hour. Renewable energy solutions used to supply these demands include biomass boilers in countries such as India, biogas generated in Mars' wastewater treatment facilities in Poland, and electric heat pumps.

With factories all over the world, the incentives and challenges faced by Mars in achieving electricity and thermal targets differ from country to country depending on local policy incentives and costs. Mars' strategies to decarbonise operations are tailored to the policies, energy costs, regulations, market risks and benefits, and financial feasibility of solutions in specific countries of operation.

Interview with Winston Chen, Renewable Energy Manager, and Paul Simons, Global Technology Lead for Utilities & Buildings - Mars

What is your main strategy to achieve your renewable energy targets for heating and cooling?

Our solutions and strategies vary across the different countries in which we operate. We are successfully using biomass in some of our factories in countries where biomass from locally sourced wood and agriculture waste is available. For example, biomass is readily available in India, where we are generating steam with biomass boilers. In Poland, biogas is captured in our own wastewater treatment facilities. This biogas is then re-used in our boilers or CHP, a successful technology development that we have implemented in a few factories. We also use heat pumps as a part of electrification in multiple sites across our networks. However, this depends heavily on electricity and gas prices. Our efforts to decarbonise our thermal footprint include collaboration with equipment suppliers and other companies in sharing best practices and testing emerging technologies in renewable thermal energy. This collaboration is intended to help us achieve our Scope 1, 2 and 3 targets faster and on a bigger scale.[13]

In terms of renewable electricity, we have implemented PPAs from large-scale off-site wind projects in the United States, Mexico, and the United Kingdom. We will also sign on to a large-scale solar project in Australia. Instead of several on-site projects, we are able to cover the electricity demand of multiple sites using one project in the same country – a successful approach that we will follow going forward. We also partner with other companies in markets where we see value added and complementarity.

Which parts of your heating and cooling demands are most challenging to decarbonise and shift to renewable energy and why?

In some countries, decarbonising heating and cooling processes is relatively easy. However, in other countries that is not the case for multiple reasons, such as cost and feedstock availability. For example, it makes sense to buy biomass in India, but this may not be feasible elsewhere for logistical reasons such as transporting biomass. These are some of the challenges we are trying to overcome.

For electricity, we work with developers to build renewable energy projects to power our sites. For thermal, the infrastructure is not as well developed. In some cases, biogas can be injected into a pipeline, but this is costly in most parts of the world. Consequently, we are in the early stages of decarbonising the thermal parts of our business. Our biggest challenge in the next 10 to 15 years is decarbonising our thermal footprint at scale. With more than 140 sites, achieving site-by-site decarbonisation of our thermal supply would be a long process. Scaling it to cover multiple sites can be done; however, we still face challenges in this regard.

Generating fossil-free steam remains our biggest challenge to decarbonising because there are limited economical solutions to replace fossil fuel. Biogas is an option, but it is not cost-competitive in most countries. Similarly, high electricity prices and cheap natural gas mean electrical boilers are not cost-competitive in most countries. The low-temperature heat, such as hot water, that is needed in some of our factories can be supplemented through waste heat recovery.

Are there particular policy barriers that your company faces when attempting to achieve renewable energy targets?

Policies that encourage the development of the renewable energy projects vary significantly not only from country to country, but also amongst different provinces and local governments within a country. In certain countries we work with local governments to achieve an enabling policy that can be cost-effective and scaled.

13 The Greenhouse Gas Protocol categorises greenhouse gas emissions into three scopes. Scope 1 refers to direct emissions from owned or controlled sources, such as company facilities and company vehicles. Scope 2 refers to indirect emissions resulting from the generation of purchased electricity, steam, heating and cooling consumed by a company. Scope 3 refers to all remaining indirect emissions from a company's supply chain, such as transportation and waste disposal.

For example, in China we have been trying to scale up feasible on-site projects such as rooftop solar, but large-scale off-site projects are more challenging. As a starting point, we have undertaken small-scale pilot projects in key markets to test and learn – a long and painstaking process. In cases where larger policy changes are required, we engage and collaborate with policy makers through our region's corporate and government affairs team and NGOs.

What are your motivations and expected benefits for setting and progressing towards your renewable energy ambitions?

The key driver is our commitment to making a positive environmental impact as part of our "Sustainability in a Generation" corporate target. Mars has committed to investing up to USD 1 billion in activities as part of our "Healthy Planet" initiatives that will impact our total value chain.

Cost and market risks are of course part of the decision-making factors that we try to address when we go into a particular market. In terms of thermal energy, we are trying to create cost-competitive solutions. Paying a premium and electrifying our processes is a solution in some markets, but it is not a financially sustainable one. We focus on markets that are financially viable and have favourable policies. In some cases, if incurring additional costs is the only feasible way to reach a target, then we make a business decision and a commitment. The incremental benefits from a good corporate reputation as well as a stable and longer-term business environment will help offset the incremental cost in the long run. As a family-owned private company, we do not need to make decisions on a short-term basis; we think in terms of generations. For example, when we invest in efficiency projects or projects to re-use waste heat, these projects always have a payback that can range from three to six years. However, since utility systems can last for 20 to 40 years, over time there is always a benefit in using energy-efficient equipment, even with a lower payback.

How is your company measuring progress towards its heating and cooling renewable energy targets and ambitions?

Our overall goal is to achieve zero emissions by 2040. Our progress is tracked based on the implementation of our projects and whether we have enough projects in the pipeline to develop and achieve our targets. We have near-term targets to reduce our greenhouse gas emissions as well (42% reduction by 2025). We have a robust pipeline of different electricity- and thermal-related projects to execute in the next five years. While not all our projects end up being developed, new projects are always emerging, and we therefore have a moving pipeline of projects which keep us on track to achieve our targets.

Furthermore, every site reports on its absolute consumption of water, gas and electricity. This enables us to internally track absolute consumption, as well as globally track the percentage of renewable energy that is consumed. This also applies for gas – when we invest in biogas generation technologies on-site, we see our natural gas consumption decrease.

How have your partners, consumers and investors responded to or engaged with your renewable energy targets and ambitions?

The Mars Family and board members are very supportive of projects with a sustainability focus. Renewable energy programmes are one of the most important ways to achieve our ambitions.

Many of our customers and suppliers have similar sustainability goals, and we collaborate with them to support our common targets. In most cases, what we achieve has an impact on their targets as well. For example, our Scope 2 might be part of their Scope 3 target. We also engage with our large retailers/supplier customers to promote our renewable electricity and thermal energy activities. Furthermore, we work closely with our equipment suppliers on developing technologies and testing equipment, such as for waste heat recovery solutions.

We believe that being a sustainable company will bring an incremental value to our consumers, so we want our achievements in reducing greenhouse gas emissions to indirectly influence consumer behaviour in a positive way. We have increased our marketing and public relations communications about our sustainability initiatives. For example, our M&M's brand ran a promotion called "Fans of Wind" that educated customers about the use of renewable electricity to produce our products in the United States.

Based on your company's experiences, what can policy makers do to drive progress and encourage similar companies to set renewable energy targets for their heating/cooling processes?

To encourage the development of renewable energy projects, an environment with supportive policies is required. For example, without subsidies a lot of projects would not be financially feasible. Governments should therefore consider redirecting subsidies away from fossil fuels and towards renewables.

The good news is we can see that such change is coming. A lot of companies are setting mandates to switch to 100% renewables. Despite pushback from the fossil industry to discourage the progress made in switching to non-fossil fuels, policy makers need to understand that there is a desire by both consumers and companies to make change happen. The renewables industry will create more jobs than the fossil fuel industry. It may take some time, but this change is going to happen no matter what. Policy makers need to understand this and act accordingly.

How has COVID-19 impacted your company and its renewable energy targets/ambitions?

COVID-19 has not impacted our ambitious long-term target – COVID-19 is a temporary delay or barrier that we are all trying to overcome. Obviously, operational delays may happen because of travel limitations, permitting processes, etc., but our overall strategy, progress and commitment have not changed over the longer term.

TINE GROUP - NEW DAIRY BERGEN

TINE Group industrial heating and cooling operations

Kim Andre Løvås/TINE Group

Company overview

TINE Group, one of Norway's largest food companies, is a co-operative owned by more than 10 000 dairy farmers. With a business concept aiming at producing healthy food, TINE Group runs 30 dairies and 4 storage locations and terminals in Norway and owns or partly owns subsidiaries in several other European countries, as well as Australia and the United States. The group sells its products to 16 countries, including Norway. At the end of 2018, the group had 5 355 employees. Operating revenues amounted to about USD 2.5 billion (TINE, 2019).

TINE Group is committed to contributing to the Norwegian Climate Act by reducing its emissions, with a target of 45% by 2030 compared to 1990 levels. TINE Group is also committed to contributing to the broader European Union energy and climate targets. In line with these targets, TINE Group has developed climate protection and environmental strategies and set a target for all operations in Norway to use 100% renewable energy by 2025, including all logistics. At present, the Group has achieved a share of 85% renewable energy for its production processes, of which 64% is electricity from hydropower and 20% is renewable district heating (TINE, 2020a).

TINE Group's New Dairy in Bergen was inaugurated in 2019. In the first half of 2020, its overall energy demand amounted to 5.5 GWh, out of which 4.7 GWh was electricity from the grid, 0.6 GWh was on-site solar power and 0.2 GWh was heat from district heating. The New Dairy in Bergen was built as a carbon-free production facility, sourcing all its electricity needs from green electricity. The major share of this comes from the grid, which in Norway supplies close to 100% renewable power, [14]plus on-site solar PV producing 0.5 GWh per year, which equals 10-15% of the New Dairy in Bergen's electricity consumption (TINE, 2020b). The New Dairy has already achieved 100% renewables for its production processes.

The facility employs 200 people and produces milk, cream and juice products with a capacity of 300 000 litres daily. The heating and cooling needs for all temperature levels required at the New Dairy in Bergen are supplied by heat pumps and cooling machines and are therefore considered 100% renewable energy supplied. The New Dairy in Bergen operates without fossil or direct electric heating for all production processes (pasteuriser), heating and cooling of products, CIP (clean in place), cold storage, and heating of buildings. As a backup for the dairy, a district heating network supplied by waste incineration is connected. Energy consumption is about 40% lower than the old plant it replaces. By using new technology, most of the waste heat is reused and thereby reduces the total energy demand by almost 5 GWh.

14 The Norwegian power mix is 98% renewable energy (Government of Norway, 2016). Although this is technically true, the economic reality is different. Nearly 80% of the electricity purchased in Norway is grey electricity, because the green quality is sold to customers in other countries through green certificates/guarantees of origin (Norwegian Energy Regulatory Authority, 2020).

Interview with Kim Andre Lovas, Energy Expert - TINE Production, Improvements and Projects

What has been your company's progress so far in achieving its renewable electricity and renewable heating and cooling targets/ambitions?

At the end of 2019, TINE's total greenhouse gas emissions were 68 424 tonnes of CO_2 equivalent. Since 2007, greenhouse gas emissions have been reduced by about 15 500 tonnes, a decrease of 18%. During 2019, greenhouse gas emissions were reduced by 3 783 tonnes. This was achieved by using renewable energy in our production processes and by increasing the efficiency of these processes. Decarbonising these processes was relatively easy.

Reducing greenhouse gas emissions from transport continues to be challenging, especially since almost 50% of TINE's transport is undertaken by external companies. This is primarily due to limited access to and the cost of biodiesel based on waste (hydrotreated vegetable oil, or HVO). Further, renewable fuels such as biogas and hydrogen for heavy good vehicles remain in scarce supply and are not yet cost-competitive. We forecast that over the next years, the availability of biodiesel should improve. Our objective is to only use renewable fuel for transport operations by 2025, involving a combination of various technologies such as biogas, electricity and green hydrogen.

What is your main strategy to achieve these renewable energy targets, in particular for heating and cooling?

At present, only a small share of the total energy TINE uses in production is from fossil sources: 1.3% comes from fossil fuel oil and 13.4% from natural gas. TINE will significantly increase the share of district heating and bioenergy it uses as an energy source. Electrification of processes and new technologies, such as heat pumps, add to the transformation. The New Dairy in Bergen, which we see as 100% renewable energy, shows how this can successfully be done. Cooling of products produces waste heat at above-ambient temperatures, which can be upgraded using a heat pump to satisfy the process heating requirements. Coupling process heating and cooling needs through the use of a heat pump results in high process efficiencies, and by means of a high-temperature heat pump, we achieve heat above 100°C.

Which parts of your heating and cooling demands are most challenging to decarbonise and shift to renewable energy and why?

The New Dairy in Bergen is a relatively small site. Our biggest challenge was to make an energy-effective factory at a small site without production every day and with no production at night. When our main energy source is waste energy, the system needs to be working 100% of the time. The challenge is to reduce the wasted surplus heat, although it is not always available in the necessary quantity and at the necessary temperature levels. We must therefore ensure the systems have dimensions which correctly maintain stability. The pasteuriser is the hardest process to optimise because of the precise temperatures required. A small oscillation of the temperature could stop production, costing time and possibly spoiling the product.

What are the main barriers, including policy barriers, your company is facing in achieving your heating/cooling renewable energy targets/ ambitions? How have you overcome these barriers?

Local constraints are important barriers. Lack of appropriate space in existing facilities and limited availability of suitable technology were also relevant constraints. In our New Dairy in Bergen, and also in other facilities, we overcame barriers by adapting existing installations and technologies and by introducing new technologies and finding new solutions. Using excess heat and cold with heat pumps as we do in Bergen is one of the examples.

The New Dairy in Bergen has been realised thanks to support from the Norwegian government through the Enova agency. We consider the electricity supply as well as heating and cooling needs fully covered from renewable energy. However, government aid will continue to be necessary for future decarbonising of our factories. It will be particularly demanding to decarbonise in rural areas.

Up to 2022, biodiesel (HVO) will form a basis for eco-friendly heavy goods transport, as it will take time and considerable investment to phase in liquid biogas, hydrogen and electricity. Unfortunately, policies for electric cars are not in place for heavy transport. Access to certified, sustainable biodiesel is not easily available. Toll exemptions for biogas or green hydrogen on par with EVs would be a powerful instrument. Incentives for production plants for biogas based on manure are needed, including incentives for supplying manure for biogas production and delivering bio-residue back to farms.

What are your motivations and expected benefits for setting and progressing towards your renewable energy ambitions?

Consumers, customers and authorities are questioning society's ability to cope with climate change. I believe this is why we are not facing local opposition. These trends create business opportunities for TINE, and in the medium and long term they will improve our competitiveness.

The future winners will be those who develop and produce products and services in a manner that is both responsible in a global social and environmental context, as well as profitable.

Our goal is financial and sustainable value creation where we contribute positively to our environmental and social surroundings. Our ambition is to make TINE the most sustainable company in the Norwegian food industry. Our New Dairy in Bergen is significantly more energy efficient now. Its production processes were designed with utilities in mind, and we can optimise it further than we could a brownfield facility. While it is an energy-efficient plant, its complexity has increased considerably. This means increased demand for expertise and monitoring, which we achieved with our existing staff by re-prioritising tasks.

How is your company measuring progress towards its heating and cooling renewable energy targets and ambitions?

TINE's annual climate accounts follow the standards and guidelines of the Global Reporting Initiative, a widely recognised greenhouse gas protocol. The protocol divides climate accounts into three levels, where Scope 1 relates to direct sources of emissions, which for TINE includes oil, natural gas, diesel and refrigerants.[15] Within Scope 1, we see the New Dairy in Bergen as 100% renewable. TINE in total has a renewable energy share of 85%. We report our sustainability work, which includes the New Dairy in Bergen, as part of our annual report, which is published on the TINE website.

How have your partners, consumers and investors responded to or engaged with your renewable energy targets and ambitions?

The decision to make the New Dairy in Bergen the most efficient plant in the Nordic region was made as a result of regular communication and market research, showing that efforts towards climate neutrality will be valued by our customers. We have received a lot of attention around the project, which helps to motivate us for the next challenges. In the Sustainable Brand Index, consumers named TINE Norway's most sustainable company in 2019. The New Dairy in Bergen received the European Heat Pump Award 2019.

15 The Greenhouse Gas Protocol categorises greenhouse gas emissions into three scopes. Scope 1 refers to direct emissions from owned or controlled sources, such as company facilities and company vehicles. Scope 2 refers to indirect emissions resulting from the generation of purchased electricity, steam, heating and cooling consumed by a company. Scope 3 refers to all remaining indirect emissions from a company's supply chain.

Based on your company's experiences, what can policy makers do to drive progress and encourage similar companies to set renewable energy targets for their heating/cooling processes?

Clear goals set by governments and management decisions are important to set our own targets and timelines. State aid programmes and incentives are helpful for innovations that are not yet cost competitive, but which have good potential to play a major part in future markets.

How has COVID-19 impacted your company and its renewable energy targets/ambitions?

The COVID-19 crisis has affected all of TINE Group's business areas. Catering sales have declined significantly, driven by, among other things, closed restaurants, kiosks and schools. However, increased home consumption has led to sales growth in the grocery sector. Throughout our value chain, we have implemented, both in Norway and internationally, measures to ensure high delivery capacity with a markedly changed sales pattern, and to adapt costs in the short and long term. These changes also impacted some of our renewables projects. It is too early to say what the long-term ramifications will be.

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