Motiva

Energy Efficiency of the Commerce Sector in Finland

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Preface

The objective of this study is to find out how the energy efficiency of the commerce sector in Finland compares to other countries and which factors affect the comparisons of countries. Particular focus was on identifying factors which may lead to misinterpretations when comparisons are based on simplified energy efficiency indicators. Information is provided also on the energy efficiency policies and measures as well as efforts made by the sub-sector.

The use of energy indicators and benchmarking of energy efficiency of countries, sectors and sub-sectors is increasing at the international fora. This necessitates a thorough understanding of underlying factors affecting the comparisons and of the limitations to the interpretations which can be made from the data. Several studies have been made in Finland to better understand them. VTT Technical Research Centre of Finland Ltd carried out a study in 2018 on recently published energy efficiency country comparisons and decomposition analyses as well as ODYSSEE and MURE Scoreboards (Koreneff 2018). In 2019, VTT and Fisher International Inc. carried out another study on how the energy efficiency of the pulp and paper sector in Finland compares to other countries (Koreneff et al. 2019). In 2020, Motiva carried out yet another study in metals production (Gynther and Kiuru, 2020).

This project on the commerce sector was financed by the Finnish Energy Authority. The Steering Group of the project consisted of the following experts:

- Coordinator: Marja Ola, Chief Policy Adviser, Environment & CSR, the Finnish Commerce Federation
- Economist Bate Ismail, the Finnish Commerce Federation
- Technical Manager Timo Järvinen, Stockmann Group
- Senior Engineer Johanna Kirkinen, the Finnish Energy Authority
- Building Services Manager Antti Kokkonen, K Group/Kesko
- Manager of Energy Management Matti Loukola, S Group/SOK
- Energy Manager Katri Tuovinen, Lidl Finland

The Steering Group made a significant contribution both into the main report and the sub-study. The commerce sector companies represented in the Steering Group account for over 90% of the market volume of the grocery trade sector in Finland.

The study was carried out by Senior Expert Lea Gynther (project manager) and Senior Expert Harri Heinaro at Motiva Oy in 2021.

Granlund Oy (Kristian Martin, Juha Koikkalainen and Timo-Mikael Sivula) carried out a sub-study on waste heat recovery potentials as well as barriers and opportunities.

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1 Introduction

Study Objective

The objective of this study was to find out how the energy efficiency of the commerce sector in Finland compares to other countries, which factors affect the comparisons and what is the current level of energy efficiency efforts including policy making and energy efficiency work carried out by retailing companies.

Study Approach and Report Structure

The study was carried out in the following steps: data collection on indicators, international benchmarks, a study on waste heat potentials, and summary and conclusions.

Overview of The Commerce Sector in Finland (Chapter 2)
A brief overview of the characteristics of the commerce sector and its energy consumption is given in Chapter 2.

Indicator Data (Chapter 3)
Country level data for comparison was acquired from the European Odyssee energy indicator database. The Odyssee database[1], developed with EU funding over last decades, includes energy efficiency indicators for different sectors. While the Odyssee database has no "official" status in the EU, it is widely used in the European fora because of, e.g., the extensive data contents and its European origins.

Indicators for electricity and total final energy consumption are discussed in the chapter. For benchmarking purposes, data was derived also from a few recent international benchmarking studies.

Information was collected from Sweden on activities in energy indicators, as well as waste heat recovery in the commerce sector (mainly grocery stores).

Sub-study on Waste Heat Recovery Potential (Chapter 4)
One element of the overall report is a study on waste heat in the commercial sector. A summary of the waste heat recovery potentials as well as barriers and ideas for increased use is presented in Chapter 4.

Energy Efficiency Work (Chapter 5)
The report includes an overview of policy measures addressing energy efficiency in the commerce sector. Companies operating in the sector have actively undertaken measures driven both by policy as well as business needs to pursue sustainability. These efforts along with some case examples are described in the report.

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[1] The Odyssee database: https://www.odyssee-mure.eu/

Summary and Recommendations (Chapter 6)

Summary of findings as well as recommendations for future are given in this chapter. Recommendations are divided into those related to energy efficiency indicators and into those on promotion and facilitation of waste heat recovery.

2 The Commerce Sector in Finland – Characteristics and Energy Consumption

2.1 Commerce Sector Companies in Finland

The commerce sector is the largest employer with almost 270 000 employees. It accounts for about ten per cent of Finland's GDP. There are almost 40 000 companies operating in the commerce sector in Finland. The commerce sector is divided into 1) retail trade and 2) wholesale trade, and in terms of product selection, into 1) grocery trade, 2) special articles and 3) technical trade.

Large companies employing over 250 persons account for 86% of the sectoral turnover. As many as 91% of the companies are micro companies (<10 employees) and 8% small companies (10-49 employees). (Vanhanen et al. 2021)

Table 1 shows the structure of grocery trade in Finland; grocery trade makes up a major share of the whole commerce sector. Groups mentioned in Table 1 operate also in other areas of the commerce sector than just grocery trade.

Table 1 Grocery Trade Sector in Finland in 2020

Group	**Market share**	**Turnover in grocery trade, Million euros**
S Group (SOK)	46.0%	9 315
K Group (Kesko)	36.9%	7 457
Lidl Finland	9.5%	1 924
Tokmanni	3.2%	656
Minimani	0.6%	116
M-ketju	0.3%	69
Others	3.4%	694

Source: Finnish Grocery Trade Association (PTY)

Statistics Finland reports 32 million m^2 total area for the wholesale and trade sector at the end of 2019 and 30.6 million m^2 at the end of 2020[2]. Some examples of floor areas in certain establishment types are given here. Grocery trade companies report that the number of small supermarkets is 1165 (typical size 560 m^2), mid-sized supermarkets 875 (typical size 2 200 m^2) and hypermarkets 151 (typical size 14 400 m^2). This corresponds to total area of about 4.8 million m^2. The number of malls is 112 with total floor area of 2.5 million m^2. The total area of department

[2] A minor change in definitions took place in 2020. Statistic Finland's real estate data by building type is based on the population information system by the Digital and Population Data Services Agency. The data is maintained and checked in close cooperation with municipal building supervision authorities.

stores is estimated at about 0.65 million m^2. The higher total figure given by Statistics Finland is explained by, e.g., by technical trade.

2.2 Energy Consumption Data on the Commerce Sector

2.2.1 National Energy Statistics

The national energy statistics only provide total final energy consumption for the services sector as a whole, not for any subsectors because there is no data collection methodology at present. However, methodology and data will be created for sub-sectoral data in a couple of years as a development project on service sector energy statistics started in spring 2021.

2.2.2 A National Study

In a study by Gaia Consulting (Vanhanen et al. 2021) for the Finnish Commerce Federation, energy consumption in the commerce sector was estimated for the 2012–2018 period, although the main focus of the study was future electricity consumption. Total electricity consumption and district heat consumption in the services sector, as reported in the national statistics, was allocated to each sub-sector - and further to wholesales, retailing and car shops - based on their energy costs.

According to the study, normalized district heat consumption has declined clearly between 2012 and 2018. In electricity consumption there has been some annual variation, but the trend has not changed much over the period. While heat demand has declined, building statistics by Statistics Finland indicate that the surface area of commercial buildings has grown by 11% from 2012 to 2018.

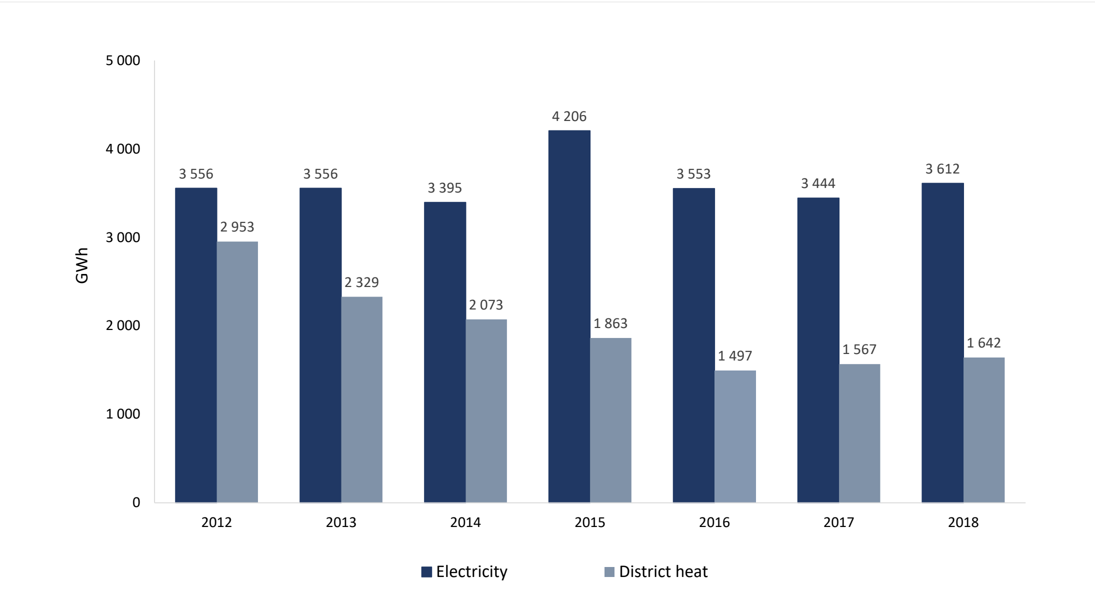

Figure 1. Electricity and district heat consumption in the commerce sector in Finland in 2012-2018. (Source: Vanhanen et al. 2021)

The study looked into the distribution of electricity consumption in the grocery trade for different end-uses. Based on interviews among the major grocery trade operators, lighting, refrigeration and freezing systems, heating and other uses each contribute about one quarter. In the past, the proportion of refrigeration and freezing was higher, around 30–40%. In other types of commercial establishments, the proportion of refrigeration and freezing is smaller, and that of lighting higher. (Vanhanen et al. 2021)

Figure 2 shows the distribution of electricity consumption between retailing wholesales and car sales in 2018.

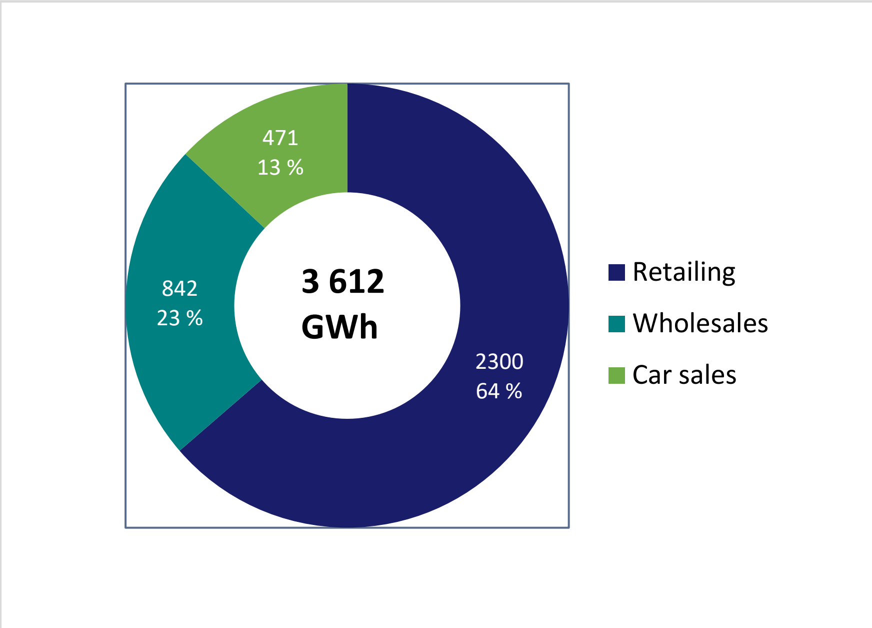

Figure 2. Electricity consumption in commerce subsectors in Finland in 2018. (Source: Vanhanen et al. 2021)

3 International Comparison

International comparison data (country level data) is derived from the European Odyssee database (See Chapter 3.1) Chapter 3.2. describes some findings of international studies on energy efficiency in grocery stores giving benchmarks. Chapter 3.3. provides information on the waste heat recovery potential in Sweden, activities to tap this potential and Swedish studies on energy indicators in the grocery trade sub-sector.

3.1 Odyssee Indicators

The Odyssee database[3], developed with EU funding over last decades, includes energy efficiency indicators for different sectors. While the Odyssee database has no "official" status in the EU, it is widely used in the European fora because of, e.g., the extensive data contents and its European origins. All data in the Odyssee database is based on regular data collection from national project teams; in Finland the data is provided by government-owned company Motiva Oy in co-operation with Statistics Finland.

The indicators in the Odyssee database for the wholesales and trade sub-sector are 'total final energy consumption per employee', 'electricity consumption by employee' and 'electricity consumption per m^2'. Data is not available for all countries and often missing for the indicator relating energy consumption to floor area. Energy or electricity consumption in Finland in this sector has not been reported to the Odyssee because it is not available from Statistics Finland. Instead, data provided by major commercial/grocery trade operators has been used to allow some comparison.

Indicators for Electricity Consumption

Figure 3 shows electricity consumption per square meter in wholesales and trade. Data is missing from a number of other countries. Data for Finland was collected from a few major commercial sector companies. These companies represent over 83% of the grocery trade in Finland but operate in also other types of commerce. The indicator values for Spain and Sweden are strikingly higher than in most other countries, which raises some questions about possible differences in data definitions or quality.

Monitoring electricity consumption indicators is becoming obsolete due heat recovery systems that use heat pumps making 'total energy consumption per floor area' the preferred indicator. The IEA Annex 44 project (IEA 2017) highlights that electricity consumption is interlinked with heat consumption when heat recovery systems are used. Heat recovery may increase electricity use but, in turn, reduces the total final energy consumption and improves energy efficiency.

[3] The Odyssee database: https://www.odyssee-mure.eu/

Electricity consumption in different countries is also affected to factors like opening hours (e.g., need for lighting) or heating needs. While electricity is not a primary heating source for heating in the services sector in most countries in Europe, particularly in cold climates electricity is needed for de-icing of ramps, eaves etc. structures for safety reasons.

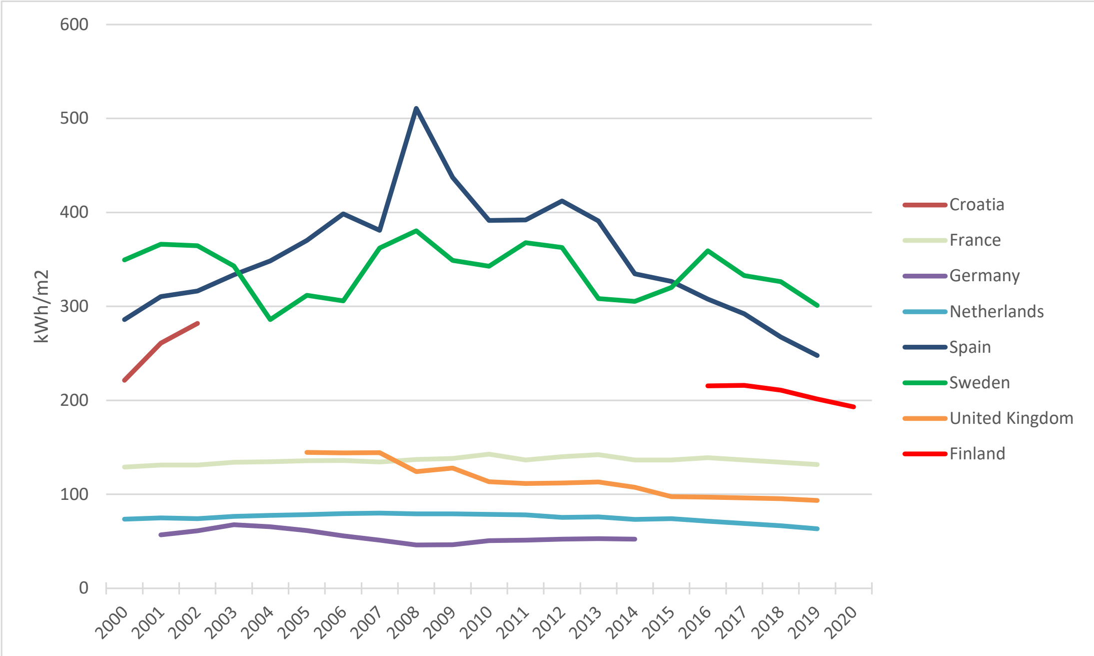

Figure 3. Electricity consumption per m^2 in wholesales and trade (Source: Odyssee database and commercial sector companies in Finland)

Figure 4 shows electricity consumption per employee for some North and Central European countries in the wholesales and trade sub-sector.

There is no comparable data for electricity consumption and employment in the wholesale and trade sub-sector in Finland. However, when looking at the service sector as a whole, i.e., including all sub-sectors, Finland has typically had the highest indicator value for 'electricity consumption per employee'.

The 'electricity consumption per employee' indicator is extremely poor for several reasons:

- Usually in energy indicators, energy consumption is allocated to an output like tonne of product or square meter of heated area. Employees are a process input like energy, i.e., comparing employees and energy means comparing inputs to inputs.
- Heat recovery increases electricity consumption but improves total energy consumption indicators.
- It ignores the fact that when companies are developing their businesses, they often rather add technology and digitalization, and consequently electricity consumption, and reduce the number of staff, particularly in countries with high labour cost. If electricity consumption increases in the pursuit of better productivity, does this indicate worsening energy efficiency?
    - Self-service check-out is becoming very common, e.g., in Finland, making it possible for one person to handle up to 5–6 cash desks at the same time.

- ○ Data on employees per floor area is given in Figure 5 which illustrates the large differences in European countries. In Finland, the ratio 'employees per floor area' is among the lowest ones leading to a high level in the indicator 'electricity consumption per employee'.
- There is some uncertainty in the employment data:
  - ○ Some staff, like those filling the selves, are commonly outsourced in some countries like Finland, and not included in staff numbers. It is not clear if these practices are similar around Europe.
  - ○ According to Odyssee definitions employment data should be given in full-time equivalents so that part-time employment would be converted into full-time equivalents. While this is a good attempt towards data harmonization, it is not at all clear that countries have been able to follow this definition in their data submission.

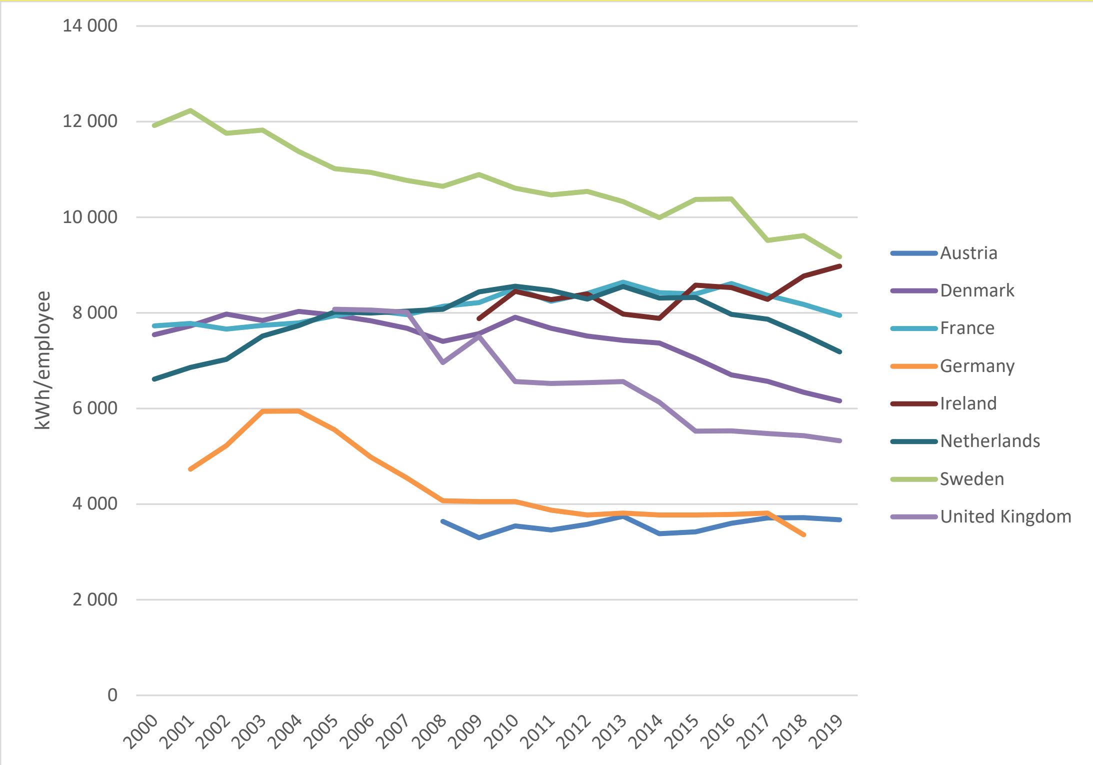

Figure 4. Electricity consumption per employee in wholesales and trade (Source: Odyssee database)

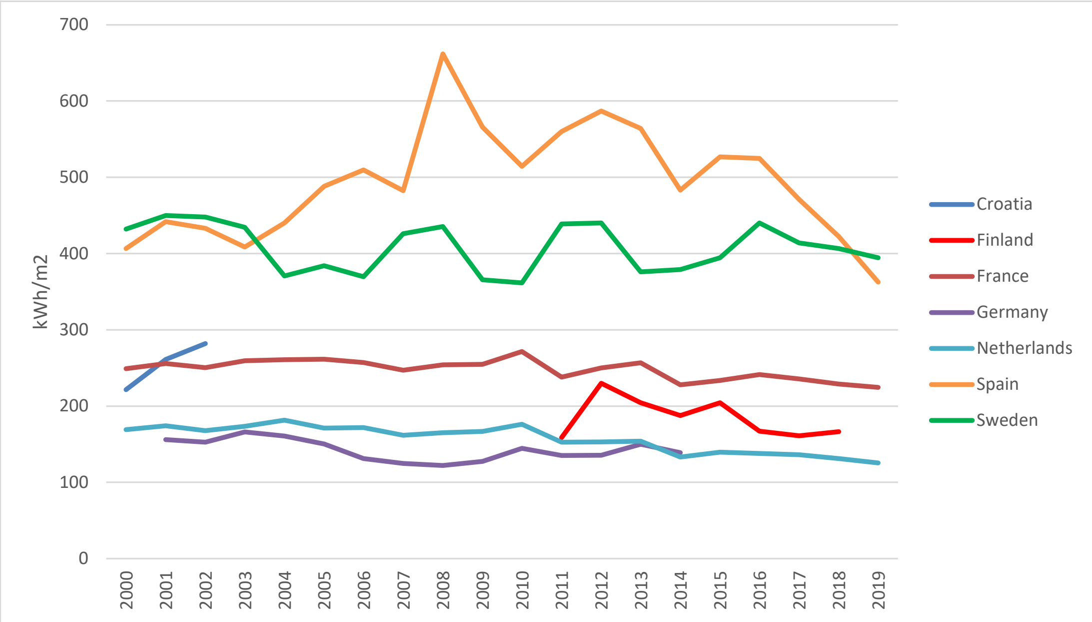

Figure 5. Employees per floor area in wholesales and trade (Source: Odyssee database)

Total Final Consumption per Floor Area

Figure 6 shows total final energy consumption per floor area in the wholesale and trade sub-sector using Odyssee data. This data is available only for a limited number of countries and the data is missing from Finnish national statistics, as well. Therefore, data on electricity and normalized heat consumption was collected from a few major commercial sector companies. These companies represent over 83% of the grocery trade in Finland but operate in also other types of commerce. Despite the cold climate, consumption in Finland is in the mid-range among the countries where data is available, and the five-year trend shows a declining development in specific consumption.

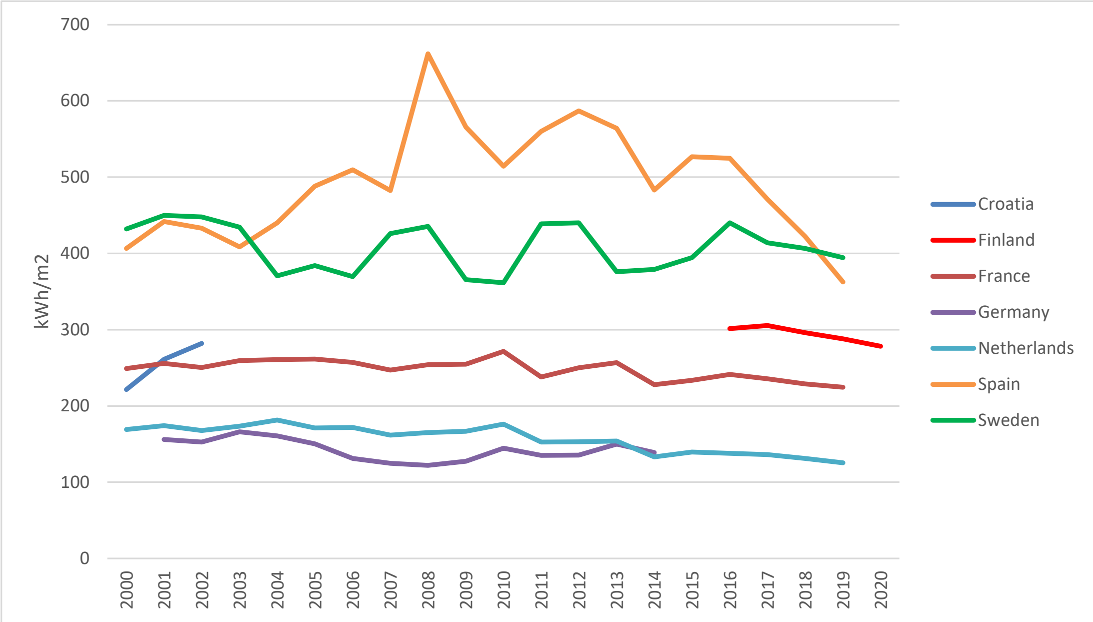

Figure 6. Total final energy consumption per m² in wholesales and trade (Sources: Odyssee database and commercial sector companies in Finland)

3.2 International Benchmarking Studies

One finding of the EU Horizon 2020 financed SuperSmart Project[4] (2016–2019) was that supermarkets have one of the highest annual specific energy consumptions among commercial buildings in Europe, typically in the range of 400-600 kWh/m^2, a. The largest energy consuming sub-system is the refrigeration system with the share of 35-50% of the total final energy use. (Royal Institute of Technology 2016)

One of the main objectives of the SuperSmart Project was to develop criteria for a European eco-labeling scheme for grocery stores. Draft criteria were developed, but the European Commission decided not to develop EU Ecolabel criteria for food and feed products at this time. The Commission could, however, revisit this question at some point in the future [5].

In the IEA Annex 44 project "Performance indicators for energy efficient supermarket buildings" a conclusion was made that a supermarket is energy efficient when its total final energy consumption is below 400 kWh/m^2, considering the total supermarket area. Data was collected from Denmark, Sweden and The Netherlands. (IEA 2017)

Figure 6 in Chapter 3.1 provides an estimate of the specific consumption in the commerce sector in Finland. However, this data includes also other types of commerce than supermarkets or grocery stores and is not directly comparable to the international benchmarks. Data provided by one major company operating grocery stores of different sizes (hypermarkets, supermarkets and small supermarkets) has had average normalized total final energy consumption of 360-

[4] http://www.supersmart-supermarket.info
[5] https://ec.europa.eu/environment/ecolabel/products-groups-and-criteria.html

390 kWh/m^2 over the last five years, i.e., in a very efficient range according to the international benchmarks.

Data for total final energy consumption for the commerce subsector is not available in Finland to calculate the specific consumption and to make comparison with these benchmarking figures. Statistics Finland has started a development project which may improve data availability in a couple of years.

Annex 44 mentions that it is mainly the total area and sales area that is used in indicators according to literature. It also states that there is a stronger correlation for energy use in relation to sales area than to total area, but that using the total area is still a good enough indicator. Furthermore, comparing specific consumption has proved possible only when comparisons are made between buildings within the same range of floor area. Annex 44 identified a connection between energy intensity and opening hours, as more electricity is needed for lighting, ventilation and equipment with increased opening hours. (IEA 2017)

3.3 Studies and Activities in Sweden

A series of pre-studies has been carried out by Belok, which is a co-operation body between the Swedish Energy Authority and Sweden's largest property owners. One of Belok's areas of focus is resource efficiency in the food chain (Relivs), a follow-up activity from former BeLivs (innovation cluster of the Sweden's food industry in 2011–2018).

3.3.1 Energy from the Tenant's Cooling Systems Used in the Property Owner's Heating Systems - A Contribution to Increased Energy Efficiency

This BeLivs 2018 study interviewed a number of players who own or rent properties where grocery stores with cooling systems available. The conclusions in the report show that there are:

- a large potential for increased energy efficiency by the property owner and grocery store tenants to work together on the use of waste heat: potential availability of waste heat from grocery stores was estimated at least 1.3 TWh/a in the country, which corresponds to 294 kWh/m^2,a ,
- a need for support materials in the form of, for example, templates for energy contracts or agreement between property owner and tenant, guidelines for measurement of recovered heat, stencils, etc., and
- a need for continued and in-depth work through case studies and demonstration projects where the parties together follow up and measure how the heat from the cooling system is recovered.

3.3.2 Waste Heat Project to Increase Co-operation between Grocery Trade and the Real Estate Sectors

A new project on the use of waste heat in daily grocery trade is running until the end of 2024[6]. The Swedish Energy Authority finances the study through the TERMO Programme. The study is part of Relivs activities, and it is carried out by the Royal Institute of Technology (KTH) together with CIT Energy Management. This project followed the pre-study study described in Chapter 3.3.3.

Numerous stakeholders, such as numerous supermarkets, real estate owners, energy companies and industrial companies, participate into the project. The objective is to show that co-operation of all these bodies can be mutually beneficial and cost-effective.

The project will include theoretical calculations, modelling, measurements, monitoring, reviewing technologies and development and evaluation of business models. Information on the optimization and integration of different heating and cooling systems will grow. Case studies will be carried out for individual stores, supermarkets in malls, supermarkets in residential buildings and supermarkets which sell heat to district heating networks.

3.3.3 Feasibility Study on Collaboration in Heat Recovery from Grocery Stores

This feasibility study, preceding the larger project described in Chapter 3.3.2, aimed to increase knowledge about how grocery stores and property owners can work together to take advantage of the excess heat from cooling systems in grocery stores, as well as to facilitate such collaboration. The feasibility study focused on collaboration between different actors (grocery store, property owners, energy companies). Six existing good examples of collaboration between grocery store and property owners/energy companies were documented and has two more new projects, where collaboration is likely to take place, were identified. The study was carried out by CIT Energy Management for Belok within the scope of its Relivs activity for resource efficiency in the food chain. (Belok 2020b)

Although the potential for heat recovery exists, it is in practice difficult to successfully establish collaboration between the store and the property owner. In many cases there is lack of technical know-how and/or lack of interest by the property owners. Excess heat is considered most often as "waste heat" with low or no value at all, although often it means an extra operating cost for the store. A collaboration where one party gets increased operating costs that the other party is not prepared to reimburse may not work. Therefore, there is a need to show that collaboration can be profitable for both parties at the right level of compensation and/or conditions.

There are business models that do not require immediate compensation for the delivered heat but become a "win-win" situation for both partners. Storing geothermal energy is an example: it means energy and cost savings for the store and the property owner gets stored energy at no extra cost.

Regardless of which collaboration model is chosen, it is extremely important that technical coordination takes place between the store and the property owner at an early stage of the project. The store's cooling system and the property's heating system must be synchronized.

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[6] http://relivs.se/forstudier/

3.3.4 Pre-Study on Key Indicators in Grocery Stores and in Commercial Kitchens

Overview

The objective of this pre-study (Belok 2020a) was to find out which key indicators are meaningful and most useful, and which are used and/or needed by grocery stores (and commercial kitchens). The aim was to get an idea of what key indicators are available today, and what needs there are to collect energy data and establish new key indicators and statistics. The study built on earlier work from STIL2-project with the objective to improve national energy statistics (Swedish Energy Authority 2010) as well as the IEA Annex 44 project (IEA 2017). Interviews were carried out among grocery trade companies to collect information on current practices and needs.

Considering factors such as comparability and easiness of production use, the study proposed the following set of indicators to be taken into wider use in grocery stores:

- total final energy and electricity consumption per floor area (kWh/m^2, a)
- total final energy and electricity consumption per heated area A_{temp}, (kWh/m^2, a), where A_{temp} is the indoor area which is heated above 10°C
- total final energy and electricity consumption per opening hour (kWh/h, a),

The study concluded that, on average, the total final energy consumption in grocery stores is around 400 kWh/m^2. This is the level indicated also by the Odyssee database for Sweden (see Figure 5 in Chapter 3.1).

One finding from operator interviews was that year 2010 marks a turning point in energy consumption in grocery stores. Specific energy consumption was growing until that time when installation of lids and doors to refrigeration and freezing units really took off and consumption started to stabilize and later decline.

Current Practices

Key Figures Used by Interviewees

Interviews of grocery trade companies confirmed that all grocery stores use some key figures. The list of commonly used ones is partly similar to that recommended by the project but includes some additional indicators:

- Electricity and energy use per area and year (some made a distinction between total and sales area)
- Electricity and energy use per month and per year
- Electricity and energy use per turnover and year
- Electricity and energy use for heating (district heating and electric heating) per month and per year
- Electricity use divided into different systems:
    - Cooling system
    - Heat recovery
    - Other (this includes plug-in refrigerators / counters, ovens, IT equipment)
    - Lighting
- Production of solar power (for stores where this is used) and energy recovery.

Views on Usability of Key Figures

Interviewees pointed out that stores differ a lot meaning that you cannot compare them directly. They are complex systems and energy use is not just affected by one indicator, but is affected by several such as the floor area, building age, opening hours, amount of refrigeration equipment etc. Smaller stores have higher consumption per square meter as there are proportionally more energy intensive areas (small grocery stores usually have the same amount of refrigerated counters as larger grocery stores).

Using the total floor area may be misleading then also spaces like, for example, storage rooms and basement rooms. But look only at the sales area can also be misleading as it in turn depends on how the sales area is interpreted, and the risk that the interpretations differ greatly is high.

Using turnover as indicator can lead to breaks in data series because the buildings and operations are developing and evolving.

Stores are in quite different positions regarding the possibilities to monitor their consumption. The possibilities are weaker for those operating in rented properties or, particularly, if they rent only a part of a property. Those owning their premises are in a better position to monitor energy consumption.

The most commonly sub-metered technical systems were refrigeration and other food cooling (e.g., plug-in coolers/counters), ovens (but not bakeries) and electric heating. In new stores it is also possible to get information on the electricity consumption of lighting.

Monitoring Practices

Motivation for monitoring indicators ranges from having follow-up statistics to spotting outliers among stores to know where to take energy efficiency measures, and to international comparisons.

The stores' energy monitoring systems for collecting key figures vary. Most collect the statistics themselves and compile it into Excel. Some stores have computer systems where automated energy monitoring is possible. In new buildings there is typically more sub-metering providing more detailed data.

The frequency of data collection varies, but collecting monthly statistics is most common. Hourly and weekly values can usually be obtained but are not considered relevant in the follow-up if there is no need to have extra control over something. Many mention that they have a long tradition with energy management and, today, the key use for the data is to identify if someone stores stand out; these usually appear to be older stores.

The key figures are used for internal use and are not compared with other grocery trade chains. To comparing with external ones is seen as difficult as there is no standardized way to produce data on and thus comparability would be compromised.

Needs and Proposals for Further Action

Interviews revealed some development points:

- <u>Comparison guidelines:</u> The players mainly want to compare the total electricity and energy use per square meter and year with other grocery store chains. However, making meaningful comparisons is complex. Different categories are needed to take into account building age and size. Comparison guidelines would be needed.

- Working with property owners: Some interviewees mentioned the importance of working with property owners on energy efficiency of the premises. Examples mentioned were heat recovery, ventilation and installation of solar panels into a building the operator does not own.
- Communication: Key figures should be communicated internally and externally. Possibly also some kind of incentive would be needed, such as publishing key figure rankings on the Swedish Energy Agency's website. While this could be part of external communications, it would simultaneously put on pressure internally for further consumption reduction.
- Practicality: Finally, the real-life possibilities for reaching the finish line was emphasized. This would require the key figures/indicators to be so easy and practical that most can submit them, and they can be in used in further work.

3.3.5 Energy Labelling of Grocery Stores: A Pre-study on Environmental Labelling of Grocery Stores – With Focus on Energy

The objective of this pre-study was to increase knowledge and understanding of the various environmental and energy labels and certifications that are currently used by grocery stores in Sweden. The focus of the labelling study was limited on energy use, not other environmental considerations. The feasibility study also evaluated whether existing labels and certifications are well adapted to the conditions of the stores or if there is a need for further development. (Belok 2021)

Identified labels and their characteristics are summarized in Table 2. The most obvious difference between the identified systems is whether it is the building or business being certified. In BREEAM-SE[7], Miljöbyggnad[8] and NollCO$_2$[9] are the focus is on the building and in Good Environmental Choice (Bra Miljöval)[10], KRAV[11] and the Nordic Swan Ecolabel[12] the focus is on the business.

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[7] International labelling scheme. https://www.sgbc.se/certifiering/breeam-se/ (in Swedish); https://www.breeam.com/ (international site)
[8] Swedish labelling scheme. https://www.sgbc.se/certifiering/miljobyggnad/ (in Swedish)
[9] Swedish labelling scheme. https://www.sgbc.se/certifiering/nollco2/ (n Swedish)
[10] Swedish labelling scheme. https://www.bramiljoval.se/in-english/ (in English)
[11] Swedish labelling scheme. https://www.krav.se/en/ (in English)
[12] Nordic labelling scheme. https://www.nordic-ecolabel.org/ (in English)

Table 2 Comparison of Energy-Related Environmental Labels in Sweden (Belok 2021)

Label	Grading system	Points system	What is certified	Overall purpose	Energy criteria	Number of stores
Good Environmental Choice (Bra Miljöval)	No	No	Business	Good Environmental Choice is based on the needs to save natural resources and that biological diversity and human health must not be threatened.	All electricity used must be marked Good Environmental Choice. Energy use is reported annually, an energy manager and an energy plan are required, and the store must streamline its energy use.	215
BREEAM-SE	Yes	Yes	Building	BREEAM-SE reduces the impact of buildings on the environment throughout the life cycle.	Requirements for building energy class, energy monitoring systems as well as energy-efficient lighting, cold storage and equipment.	10
KRAV	No	No	Business	KRAV contributes to long-term sustainable and trust-inspiring production of high-quality food	All electricity must be from renewable energy sources. The store will work to streamline energy use and reduce the use of fossil fuels.	750
Miljöbyggnad	Yes	Yes	Building	Miljöbyggnad-labelled building ensures that the building is good for users and the environment.	Requirements for thermal power demand, solar heat load, energy class of the building, share of renewable energy and management routines.	25
NollCO_2	No	Yes	Building	NollCO_2 consists of criteria for reduced climate impact and criteria for climate measures that reduce the remaining climate impact to net zero.	Energy class B or better. CO_2 emissions must be compensated through renewable electricity production, energy efficiency in other buildings or climate compensation (e.g., tree planting).	1
Nordic Swan Ecolabel	No	Yes	Business	Nordic Swan Ecolabelled stores have a holistic view of their environmental work.	Energy consumption must not be more than twice as high as in a reference store where everything works almost optimally.	165

Grading system: The certification can be obtained with different grades, e.g., gold, silver and bronze.

Points system: Poorer performance in one area can to some extent be offset by better performance in another, provided that minimum requirements are met.

To some extent, the systems overlap in the division to buildings and businesses. For example, BREEAM-SE includes a set of energy efficiency requirements for lighting, cold storage, equipment, etc. Similarly, the Nordic Swan Ecolabel includes criteria for energy use for heating, ventilation, etc. In other cases, there is a risk that significant part of the energy use is not covered by the labelling scheme.

In four schemes, energy criteria are formulated as a maximum limit (in BREEAM-SE, Miljöbyggnad and NollCO_2 expressed as energy class in the Buildings Energy Performance Certificate system and in the Nordic Swan Ecolabel in relation to a reference store). Good Environmental Choice and KRAV have no maximum limits. Instead, a store must streamline its energy use (Good Environmental Choice), or a store must work for to streamline its energy use (KRAV).

Most certification systems do not set specific requirements for the sub-systems. Two exceptions are Miljöbyggnad, which sets criteria for thermal power demand (W) and solar heat load (W/m2), and BREEAM-SE, which gives points for low condensing temperatures, high-efficiency fans, demand-controlled lighting, optimized defrosting methods, etc.

Interviews with sector companies revealed that the advantage of certification is that it helps the store in its energy efficiency work as one is forced to monitor and streamline their energy use. The certification also gives ”a stamp of quality” which can be used to show that energy and environmental matters are taken seriously. Credibility was said to be a crucial parameter when choosing a certification system, both in terms of building trust with customers and in helping with actual energy efficiency work. It also emerged that the energy requirements in some certification systems were not ambitious enough to influence the stores' energy work as they were already far ahead. Furthermore, customers do not care at all about the energy efficiency work done in stores.

One goal of the feasibility study was to investigate whether there is a need for a new labelling system for smaller stores. None of the interviews raised such a need. In addition, launching a completely new labelling system can be difficult because customers might not recognize or trust it. Actually, KRAV has decided to discontinue its certification of grocery stores indicating that there are some issues.

However, there is potential for improvement in all certification systems. Certification systems could help stores in energy efficiency work even more by setting more detailed criteria or tips, e.g., that refrigerators and freezers should have doors and lids.

4 Waste Heat Recovery – Potentials, Barriers and Opportunities

4.1 Objective of the Waste Heat Sub-Study

Refrigeration and freezing systems are major sources of waste heat in the commercial sector, particularly in the grocery trade segment. Although significant effort has been made use waste heat, there is still a considerable untapped potential. Therefore, a sub-study was made to estimate the size of this potential as well as factors which hamper or help on the way to increased usage.

4.2 Approach for Estimation of the Waste Heat Potential

Waste heat potential was estimated in three main categories: stand-alone supermarkets, malls and department stores. Individual supermarkets were further classified in three different size categories, namely small supermarkets (1 165 pc, typical size 560 m^2), mid-sized supermarkets (875 pc, typical size 2 220 m^2) and hypermarkets (151 pc, typical size 14 350 m^2). The number of malls is 112 with total floor area of 2.5 million m^2. The total area of department stores is estimated at about 0.65 million m^2.

In each category, data was collected on the average waste heat potential and implemented waste heat usage in a typical case. Part of the case data was based on prior measurements on site, part on calculations. Significant amount of case data was acquired from one of the operators, which had carried out a comprehensive study on its energy usage. The cases were scaled up to the whole building stock of all major grocery trade operators to make an estimate of the whole waste heat potential, as well as tapped potential.

4.3 Waste Heat Potential

Total Potential

Total unharnessed waste heat potential in the grocery trade was estimated at **930 GWh/a**. The share of supermarkets and hypermarkets is 797 GWh/a, malls 113 GWh/a, and department stores 20 GWh/a. Corresponding total emission reduction potential was estimated at 138 kt CO_2-ekv/a. The largest waste heat potential can be found in mid-sized supermarkets.

Potential in Stand-Alone Supermarkets

In supermarkets total condensate energy production of from refrigeration and freezing systems was estimated at 917 GWh/a of which untapped waste heat potential was estimated at 797 GWh/a.

The share of waste heat already used is about 10% in small supermarkets, 15% in mid-sized supermarkets and 16% in hypermarkets.

Potential in Malls

The unused waste heat potential was estimated at 113 GWh/a in malls. In malls, the main sources of waste heat are ventilation and air conditioning. The share of ventilation was estimated at 22 GWh/a while cooling energy need was estimated at 91 GWh/a.

Both form a potential for energy recovery by heat pumps, but the issue is that most waste heat is generated during the summer months when there is least need for it. It is also possible that waste heat is generated in multiple different areas in the mall reducing the cost-effectiveness of harnessing it.

Potential in Department Stores

The unused waste heat potential was estimated at 20 GWh/a in department stores. In them too, the main sources of waste heat are ventilation and air conditioning. The share of ventilation was estimated at 6 GWh/a while cooling energy need was estimated at 14 GWh/a.

Again, the problem is that most waste heat is generated during the summer months when there is least need for it. It is also possible that waste heat is generated in multiple different areas in the department store reducing the cost-effectiveness of harnessing it.

Waste Heat Case Example from a Large Mall in Finland

This real-life case example features a very large mall with two hypermarkets and numerous shops and restaurants.

The energy recovery system is based on two heat pumps. They use waste heat from the hypermarkets' condensate from refrigeration and freezing systems, from the roof-installed extractors in the ventilation system, and from the cooling network of the mall. In addition to the heat pump investment, there was a need to provide the refrigeration/freezing systems in the hypermarkets with heat exchangers, which allow the circulation of waste heat to the heat pumps. Furthermore, there was a need to replace the roof-installed extractors to allow heat recovery. Recovered waste heat is used within the mall.

Unused waste heat potential before the project was 6700 MWh/a, and after the project 3400 MWh/a, i.e., it was cut by half, but it was not cost-effective to use the whole technical potential. District heat consumption declined by 75% due to the investment.

The total investment cost after 20% energy efficiency subsidy was 1.32 million euros. The simple payback time was 9.6 years, and the discounted (11%) payback time was 8.6 years. Without the energy efficiency subsidy, the simple payback time would have been 11.9 years, and the discounted (11%) payback time would have been 10.6 years.

4.4 Barriers and Opportunities

Overall, there are few insolvable barriers to use of waste heat. On the contrary, harnessing the potential within a building is often economically feasible. In many – but not all - organisations, the payback period requirement for this type of investments is ten years.

The first and usually most economically attractive option is to use waste heat in the same building it is created. While feeding excess/surplus heat, i.e., heat not needed in the building, into the district heating network is environmentally sound option, it may not be as economical. Excess/surplus heat is generated mainly during the warm season, when there is low demand for district heat. Therefore, the district heat company may not be willing to pay enough to make the additional investment profitable for the heat seller. In addition, it is not always straightforward to find common ground and operation model between the real estate and district heating company.

The study identified a number of policies and measures which could help to maximize the use of waste heat within the building:

- An obligation for building owner to use waste heat generated within the building, e.g., from a supermarket operating within the premises, provided that the investment to energy recovery is economically feasible.
    - Model contracts are needed to provide options for equitable profit sharing between the building owner and tenant company.
- Categorization of energy recovery systems into the lower electricity tax class (there are two electricity tax classes in Finland). To be applied, e.g., to heat pump systems using heat from condensate systems.
- Sustaining energy efficiency investment subsidies because they are an important "carrot" in making investment decisions.
- Impact of waste heat utilization on emissions should be taken into account.
    - This refers to situations where electricity consumption may grow but savings are achieved in total final energy consumption and respective emissions. For example, heat pumps may use green electricity which replaces possibly more CO_2 intensive district heat.

The study also identified a number of policies and measures which could help to increase the usage of surplus heat in district heat networks:

- Categorization of electricity use in heat pumps feeding into the district heating network into the lower electricity tax class (there are two electricity tax classes in Finland).
    - This would make use of summertime surplus heat more economically feasible even if the district heat company would not be willing to pay adequately for the heat.
- Lowering the temperature requirements in district heating networks.
    - Temperatures of waste heat can be increased, but this requires additional investments which reduce the economic feasibility of waste heat projects.
- An obligation for district heating companies to take in waste heat from buildings.
- Creating national operation models for two-way district heating network.

Guarantee of origin legislation is applied to electricity generation. Buyer knows if procured electricity is produced with renewables or other sources and can make a conscious choice. In heat, similar regulated system does not exist yet. District heating companies have their own methods to classify certain proportion of their heat supply of waste heat origin, which can hamper comparisons. Preferably, all district heating companies should use the same regulated method and a guarantee of origin system could be set up. This could help also those district heating companies procuring and selling waste heat in their marketing. Similarly, real estate using waste heat could market their operation as more ecological.

European Union's ''Fit for 55'' policy package is likely to lead to quickly growing ambition level in energy efficiency requirements and use of waste heat. Proposed recast to the Energy Efficiency Directive (Art 24)[13] sets requirements for the use of waste eat in heating and cooling (see the text box). In Finland, the share of renewable energy in district heat production was 40% in 2019 (cogeneration according to the energy method).

Proposal for Revision of Energy Efficiency Directive, Art. 24

1. In order to increase primary energy efficiency and the share of renewable energy in heating and cooling supply, an efficient district heating and cooling system is a system which meets the following criteria:

a. until 31 December 2025, a system using at least 50% renewable energy, 50% waste heat, 75% cogenerated heat or 50% of a combination of such energy and heat;
b. from 1 January 2026, a system using at least 50% renewable energy, 50% waste heat, 80% of high-efficiency cogenerated heat or at least a combination of such thermal energy going into the network where the share of renewable energy is at least 5% and the total share of renewable energy, waste heat or high-efficiency cogenerated heat is at least 50%;
c. from 1 January 2035, a system using at least 50% renewable energy and waste heat, where the share of renewable energy is at least 20%;
d. from 1 January 2045, a system using at least 75 % renewable energy and waste heat, where the share of renewable energy is at least 40%;
e. from 1 January 2050, a system using only renewable energy and waste heat, where the share of renewable energy is at least 60%.

2. Member States shall ensure that where a district heating and cooling system is built or substantially refurbished it meets the criteria set out in paragraph 1 applicable at such time when it starts or continues its operation after the refurbishment. In addition, Member States shall ensure that when a district heating and cooling system is built or substantially refurbished, there is no increase in the use of fossil fuels other than natural gas in existing heat sources compared to the annual consumption averaged over the previous three calendar years of full operation before refurbishment, and that any new heat sources in that system do not use fossil fuels other than natural gas.

[13] Commission's proposal for EED recast, COM/2021/558 final, 14 July 2021

3. Member States shall ensure that as from 1 January 2025, and every five years thereafter, operators of all existing district heating and cooling systems with a total energy output exceeding 5 MW and which do not meet the criteria set out in paragraph 1(b) to (e), prepare a plan to increase primary energy efficiency and renewable energy. The plan shall include measures to meet the criteria set out in paragraph 1(b) to (e) and shall be approved by the competent authority.

5 Energy Efficiency Efforts

This chapter gives an overview of both policies and measures as well as various commitments and activities taken by major companies in the commerce sector.

5.1 Policies and Measures

There are both European and national energy efficiency measures in place addressing energy efficiency in the private services sector, including the commerce.

A long-running national policy measure have been the voluntary energy efficiency agreements[14] first introduced in 1997. The current third generation of agreements is running from 2017 to 2025 and it is one of Finland's main measures to fulfil the obligations set in Energy Efficiency Directive's Article 7.

All largest supermarket chains have joined the agreement as well as a number of other operators in the commerce sector. Monitoring results show that savings of 237 GWh/a savings were achieved through 3 629 individual measures implemented in 2017–2020 in the commerce sector. Corresponding investments in energy efficiency measures totaled 58 million euros. In addition, total savings of 8 GWh/a were achieved over the same period in car shops from 91 individual measures with associated investments of 1.9 million euros.

In comparison, savings achieved in the commerce sector totaled 177 GWh/ at the end of the 2008–2016 agreement period. After four years of active measures in the current agreement period, the savings already exceed the previous results.

Out of all the different sectors (industries, private and public services and the real estate sector), the commerce sector and car shops have been the first sub-sectors to achieve their savings target in this agreement period – well in advance of the target year 2025.

The monitoring system of the voluntary energy efficiency agreement scheme provides information on energy savings from different end-use measures. Figure 7 shows that largest energy savings have been arising from lighting improvements in 2017–2020, followed by refrigeration and freezing systems, ventilation and heating.

[14] Energy Efficiency Agreements (in English): https://energiatehokkuussopimukset2017-2025.fi/en/agreements/

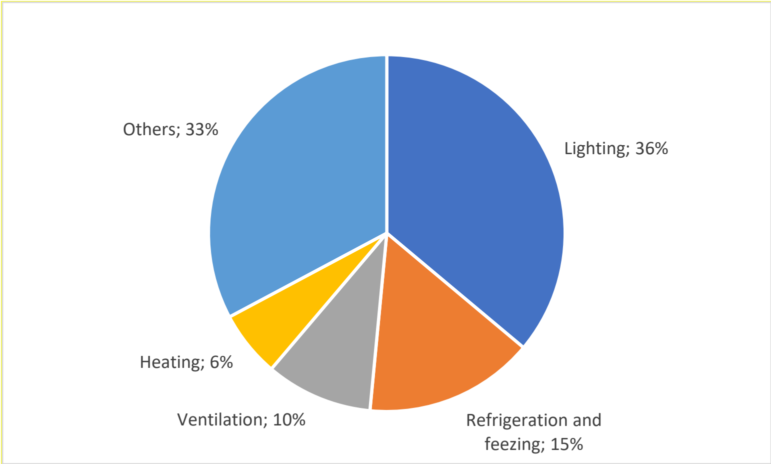

Figure 7. Energy saving from different end-use measure types implemented in the commerce sector in Finland in 2017–2020. (Source: Motiva Oy)

The Energy Audit Programme started in 1992 and subsidised energy audits were implemented by trained professionals widely in the services sector. The scheme is still in operation but has been by and large replaced by the mandatory energy audits required by the Energy Efficiency Directive among large companies. Investment subsidies are available for the implementation of energy efficiency measures and for investments in renewable energy.

Energy taxation is an important steering instrument in Finland. At present, the revision of the energy tax scheme is underway.

Measures implemented in the building sector in general, such as building regulations, energy performance certificates, and eco-design requirements all apply in the commerce sector as well. Information measures to improve energy efficiency of heating, ventilation and air conditioning are implemented in accordance with the Energy Performance of Buildings Directive.

In line with the carbon-neutrality objective of Finland in 2035, low-carbon road maps have been prepared in a number of sectors in co-operation by the government and industry companies. One of the road maps is for the commerce[15]. The results of the roadmap work will be utilized in the preparation of the Government's climate and energy policy, the targeting of RDI investments and the preparation of a sustainable recovery.

5.2 Energy Efficiency Work at the Company Level

5.2.1 K Group (Kesko)

The climate objective of Kesko is to be carbon neutral by 2025. Remaining emissions will be compensated in 2025–2030 and the aim is to have zero emissions from its own operations and goods transport by 2030. Kesko's energy efficiency objective for 2018–2023 is 10% corresponding to cumulative energy savings of about 105 GWh over the target period.

[15] Summary of sectoral low-carbon road maps (in English): https://julkaisut.valtioneuvosto.fi/handle/10024/162851

Good Practice
Use of Artificial Intelligence to Identify Energy Saving Opportunities

Kesko has nearly real-time information on the energy and water usage of its stores. From late 2020 this data has been used more extensively by analyzing it with artificial intelligence (AI) which combines the data with weather data and information on the usage of buildings. The objective is to clarify whether AI can be used to identify deviations, which can lead to energy efficiency actions. This kind of analysis appears to be at its best when the focus is on multiple similar buildings, such as supermarkets. This allows benchmarking of buildings of the same size, age and technological solutions. First AI analysis results indicate that energy savings in individual stores can be up to 5–10%.

5.2.2 S Group (SOK)

The climate objective of the S Group is to reduce carbon emissions in its own operations by 90% from 2015 to 2030. Carbon negativity will be achieved by 2025 in its own operations. This means that the S Group aims to reduce carbon emissions in its own operations by investing in energy efficiency and carbon reduction first, and consequently only compensating for the remaining emissions. The energy efficiency objective is 30% improvement between 2015 and 2030.

Good Practice
Waste Heat Recovery from Supermarkets to Apartment Buildings

A new block of flats in Pasila in Helsinki uses waste heat from Alepa Supermarket on the ground floor. Also heat from wastewater in the building is recovered into the system and the scheme is supplemented by a ground-source heat pump. Heat is stored in the summertime.

A block of flats constructed in Munkkiniemi in Helsinki in 1967 has switched from the use of district heat to ground-source heat pump and the use of waste heat from Alepa Supermarket on the ground floor. Heat recovery from Alepa has been 112 MWh in six months. Investment subsidies covered about a quarter of the costs. In the summertime excess heat is stored.

5.2.3 Lidl Finland

The climate objective of Lidl Finland is to be carbon neutral by 2022. The energy efficiency objective is 20% improvement between 2016 and 2025. Lidl Finland started to use only renewable electricity in 2019.

Good Practice
Virtual Power Plant

In September 2020 all 136 Lidl stores and one of its three distribution centres started to operate as virtual power plants, i.e., they automatically adjust their electricity consumption according to the needs of the national electric grid. Virtual power plants improve demand-response which is particularly important as weather dependent renewable energy production grows. The transmission network operator Fingrid pays for demand-response services.

The establishment of the virtual power plant required updating of building automation in every store at the state-of-the-art levels and investment in metering and smart control which all allow energy efficiency improvements. Ventilation and air conditioning of stores is automatically changing hour by hour depending on the needs of the electric grid. Periodical cutbacks in these services also save energy. Additional opportunities could be found in lighting and snow-melt systems (e.g., ramps).

5.2.4 Stockmann Group

Stockmann Group consists of Stockmann department stores and Lindex fashion stores. Emissions have been monitored for ten years for the entire Group. However, there is no announced emission reduction target for the department stores, but Lindex aims at carbon neutrality in its own operations by the end of 2023 and aspires to cut emissions in its entire value chain by 50% between 2017 and 2030.

The energy efficiency objective of Stockmann was 4% energy saving in the operations in Finland in 2016–2020 and the objective is 7.5% in 2018–2025 covering operations both in Finland and the Baltics.

Good Practice
Energy Efficiency Measures in Distribution Functions

Stockmann operates one distribution centre in Finland. It serves the on-line sales as well as department stores in all countries of operation. Concentrating operations in one distribution centre enabled optimization of warehouse functions, reduced internal transport, and improved the energy efficiency of logistics. The distribution centre has the LEED Gold environmental certificate. Significant amount of heating and cooling demand is covered by a ground-source heat pump and LED lighting has been implemented. Only renewable electricity has been used since the beginning of 2020.

6 Summary and Recommendations

6.1 Energy Efficiency Status of the Commerce Sector in Finland

Multiple policies and measures, both national and European, are in place to pursue energy efficiency in the commerce sector. European measures include those stipulated by the Building Energy Performance Directive, the Energy Efficiency Directive and the Eco-design Directive.

All major daily grocery trade chains participate into the long-running national Voluntary Energy Efficiency Agreement Scheme, hence having committed to energy efficiency targets and reporting their energy savings into the national monitoring system. In recent years, monitoring results show that savings of 237 GWh/a savings were achieved in 2017–2020 in the commerce sector and additional 8 GWh/a in car shops. Energy saving investments are encouraged by investment subsidies and energy audit subsidies for those outside the scope of mandatory energy audits.

Daily grocery trade companies have established at least climate neutrality targets. There is also a low-carbon road map in place for the commerce sector, prepared in co-operation by the sector and the government.

Operators do not limit themselves to implementing traditional energy efficiency measures - such as investing in more efficient appliances, installing lids in cold appliances or starting to use LED lighting - but have adopted numerous innovative approaches. These include the use of artificial intelligence to identify energy efficiency actions and setting up virtual power plants facilitating demand-response. New up-scalable energy efficient supermarket concepts have adopted, and heat storage is developed where ground is used as heat accumulator during summertime when excess waste heat is generated.

A major area where considerable additional efficiency potential can be found is waste heat recovery. Total unharnessed waste heat potential in grocery trade was estimated at 930 GWh/a. The share of supermarkets and hypermarkets is 797 GWh/a, malls 113 GWh/a, and department stores 20 GWh/a. The largest waste heat potential can be found in mid-sized supermarkets. Some waste heat is already used; in small supermarkets about 10% of the total potential is now recovered while this share is 15-16% in mid-sized supermarkets and hypermarkets. Chapter 6.3. provides some recommendations which could facilitate further use as the commerce sector alone cannot overcome all barriers.

Sector operators also report that there is some energy efficiency potential in areas like better optimization of automation. Increasing measurement and monitoring can help to identify new opportunities for efficiency and any abnormalities in operations are spotted quickly.

Today, district heating is the most common heating method in the real estate occupied by commercial sector companies. In the future, more hybrid systems with highly integrated heating, cooling an electricity consumption – along with electric transport solutions and use of solar energy - are expected to become common.

6.2 International Comparisons

6.2.1 Energy Efficiency Benchmarks

International benchmarks (IEA Annex 44 project "Performance indicators for energy efficient supermarket buildings" and EU Horizon 2020 financed SuperSmart Project) indicate that supermarkets is energy efficient when its total final energy consumption is below 400 kWh/m^2, considering the total supermarket area. For the time being, data available from Statistics Finland does not allow the comparison with this benchmark but sectoral data is expected in a couple of years following from an ongoing development project. Data provided by one major company operating grocery stores of different sizes (hypermarkets, supermarkets and small supermarkets) has had average normalized total final energy consumption of 360–390 kWh/m^2 over the last five years, i.e., in a very efficient range according to the international benchmarks.

6.2.2 Odyssee Indicators

The European energy indicator database Odyssee includes some indicators applicable to the commerce sector: total final energy consumption and electricity consumption per floor area and electricity consumption per employee in the sector. For the time being, data available from Statistics Finland does not allow the calculation of total final energy consumption or electricity consumption per floor area. Vanhanen et. al. 2021 provided data on electricity and district heat consumption in the commerce sector but the study did not collect data on floor area which would allow the calculation of the specific consumption indicators. Fortunately, sectoral data is expected in a couple of years following from an ongoing development project by Statistics Finland.

Most European countries, including Finland, have data to calculate electricity consumption per employee. Therefore, the indicator is being used quite widely despite its extremely poor information value. The IEA Annex 44 project highlights that electricity consumption is interlinked with heat consumption when heat recovery systems are used. Heat recovery may increase electricity use but, in turn, reduces the total final energy consumption and improved energy efficiency.

The indicator also ignores the fact that when companies are developing their businesses, they often rather add technology and digitalization (and consequently electricity consumption), which leads to reduced need for labour. If electricity consumption increases in the pursuit of better productivity, does this indicate worsening energy efficiency? Lastly, usually in energy indicators energy consumption is allocated to an output like a tonne of product or a square meter of heated area. Labour is a process input just like energy.

6.2.3 Waste Heat Potential

While waste heat potential from supermarkets and hypermarkets was estimated at 797 GWh/a (with additional potential of 113 GWh/a in malls and 20 GWh/a in department stores) in Finland, heat recovery potential in grocery stores in Sweden has been estimated at 1.3 TWh/a. Sweden has 84% larger population than Finland and considerable part of largest cities in Swedish are geographically located more south than Finland. Therefore, the estimates of the potential appear to be well in line.

6.3 Recommendations

Indicators and Benchmarking

The following recommendations are made based on the findings in the study for energy efficiency indicator and benchmarking work:

- Indicators are at their best when used for monitoring progress within one country, not in country comparisons. System boundaries and differences in definitions very often hamper comparability. Operating conditions have an impact too. Climates vary dramatically, making heating and cooling needs quite different and affecting the possibilities for heat recovery. Simple heating decree day corrections are not adequate to fully compensate for the differences and only few countries report cooling degree days. It is also not clear how applicable decree day corrections are in the grocery trade sector where conditions need to be adjusted both to ensure product quality and client comfort.
- Because country comparisons are made anyway, it is very important to use indicators which actually measure energy efficiency. Lack of data for better indicators should not be used as an excuse to use indicators, such as energy per employee, which do not measure energy efficiency. Because the core issue is lack of data, it would be desirable to improve data availability on energy consumption and floor area in the service sub-sectors; the national statistical offices have a key role in this development.
- When any comparisons are being made, the analysis should be extremely transparent in regard to the underlying uncertainties and factors, such as system boundaries in the analysis, should be conscientiously reported.
- In the commerce sector, attention should be paid to not comparing units from different size categories with each other.
- While many commerce sector companies have committed to energy efficiency targets and continue to take action, the focus is somewhat sifting to limiting carbon emissions. As electricity consumption per floor area may grow in this process, a much better indicator is total final energy consumption per floor area. Another trend emphasizing the importance of total final energy indicators is increased us of electricity in heat recovery using heat pumps.

Waste Heat

European Union's ''Fit for 55'' policy package is likely to lead to quickly growing ambition level in energy efficiency requirements and use of waste heat. Proposed revision to the Energy Efficiency Directive (Art 24) of July 2021 sets ambitious requirements for the use of waste eat in heating and cooling.

The waste heat sub-study for the commercial sector identified numerous policies and measures which could help both in maximizing the use of waste heat within the building, where it is generated, as well as feeding surplus heat into the district heating network:

- An obligation for building owner to use waste heat generated within the building as well as an obligation for the district heating companies to take in surplus heat from buildings provided that this is cost-effective. It is usually more cost-effective to use waste heat within the building.

  - Model contracts are needed to provide options for equitable profit sharing between the building owner and tenant company.
  - Creating national operation models for two-way district heating network.

- Categorization of energy recovery systems into the lower electricity tax class (there are two electricity tax classes in Finland).
- Sustaining energy efficiency investment subsidies because they are an important "carrot" in making investment decisions.
- Lowering the temperature requirements for waste heat in district heating networks.
- Impact of waste heat utilization on emissions should be taken into account. This refers to situations where electricity consumption may grow but savings are achieved in total final energy consumption and respective emissions. For example, heat pumps may use green electricity which replaces possibly more CO_2 intensive district heat.
- Guarantee of origin legislation, as applied to electricity generation, could be applied to heat so that all district heating companies use the same regulated definitions and methods.

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