Energy Efficiency of the Commerce Sector in Finland

Motiva

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Introduction

- Study financed by the Finnish Energy Authority.
- Steering group: Marja Ola (Finnish Commerce Federation, coordinator), Johanna Kirkinen (Finnish Energy Authority) Timo Järvinen (Stockmann Group), Antti Kokkonen (K Group/Kesko), Matti Loukola (S Group/SOK) and Katri Tuovinen (Lidl Finland).
- Study carried out by the government owned sustainable development company Motiva Oy in 2021. Waste heat sub-study carried out by Granlund Oy.
- Report available at: Motiva_Energy efficiency indicators

Objectives

What is the level of energy efficiency efforts in the commerce sector in Finland?

What is the waste heat potential and objectives and opportunities for its’ better usage in the commerce sector in Finland?

How energy efficiency of the commerce sector in Finland compares to other countries?

Which factors may lead to misinterpretations in comparisons based on energy efficiency indicators?

Approach

1. Collection of indicators and data
   - Data on energy use in the commerce sector in Finland
   - Odyssee energy indicator database
   - International benchmarking studies
   - Data on indicator and waste heat activities from Sweden
2. Study on waste heat recovery potential, barriers and opportunities
   - Sub-contracting from Granlund Oy
3. Analysis, conclusions and recommendations

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2.
Background Data

Commerce Sector Structure 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.
Almost 40 000 companies.
Consists of 1) grocery trade, 2) special articles and 3) technical trade.

Structure of the 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)

Rough Estimate of the Building Stock

Building type	pc	Average size m2	Total floor area, million m2
Small supermarkets	1165	560	0.65 million m2
Mid-sized supermarkets	875	2220	1.94 million m2
Hypermarkets	151	14350	2.17 million m2
Malls	112		2.5 million m2
Department stores			0.65 million m2

Source: Granlund Oy

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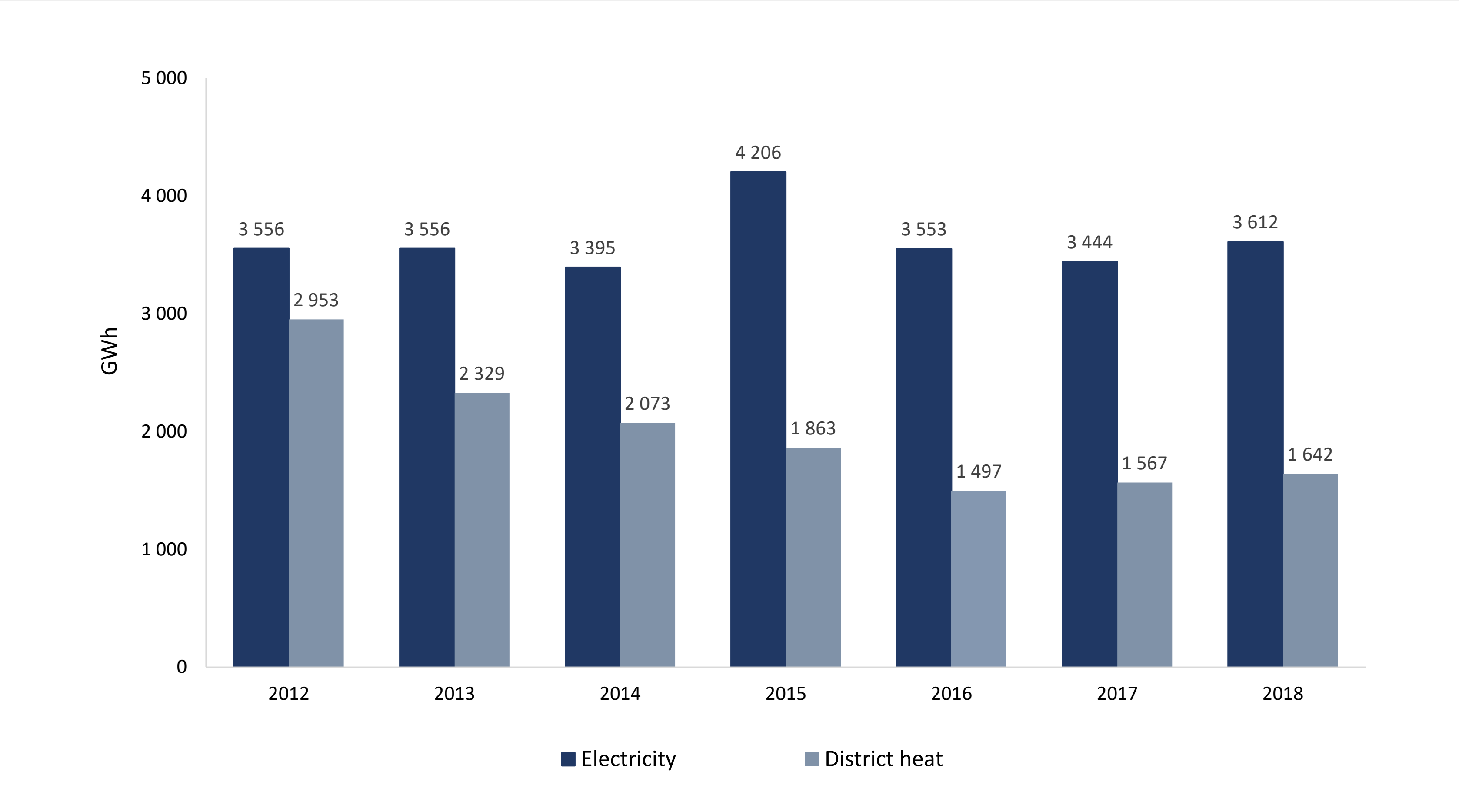
Electricity and District Heat Consumption in the Commerce Sector in Finland in 2012-2018

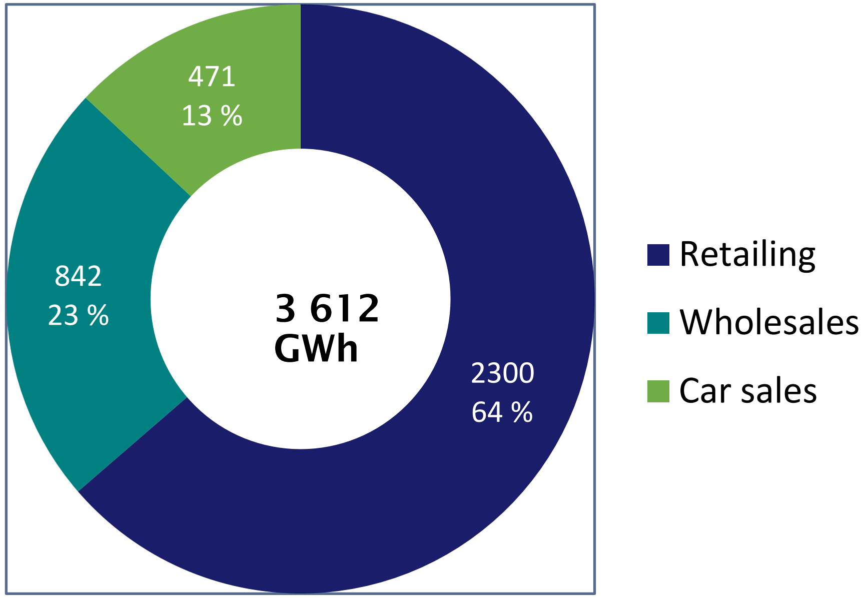


Consumption of district heat – which is the main heating form in the commerce sector – has been declining despite some growth in floor area.

Electricity consumption is not showing similar trend. While lighting improvements and installation of lids in cold appliances has progressed well, electricity consumption is increased by heat recovery with heat pumps, automation and digitalization.

Source: Gaia Consulting 2021

Electricity Consumption in the Commerce Subsectors in Finland in 2018



Retailing (including grocery trade) is the largest electricity consumer contributing 64% to the total in the commercial sector.

Source: Gaia Consulting 2021

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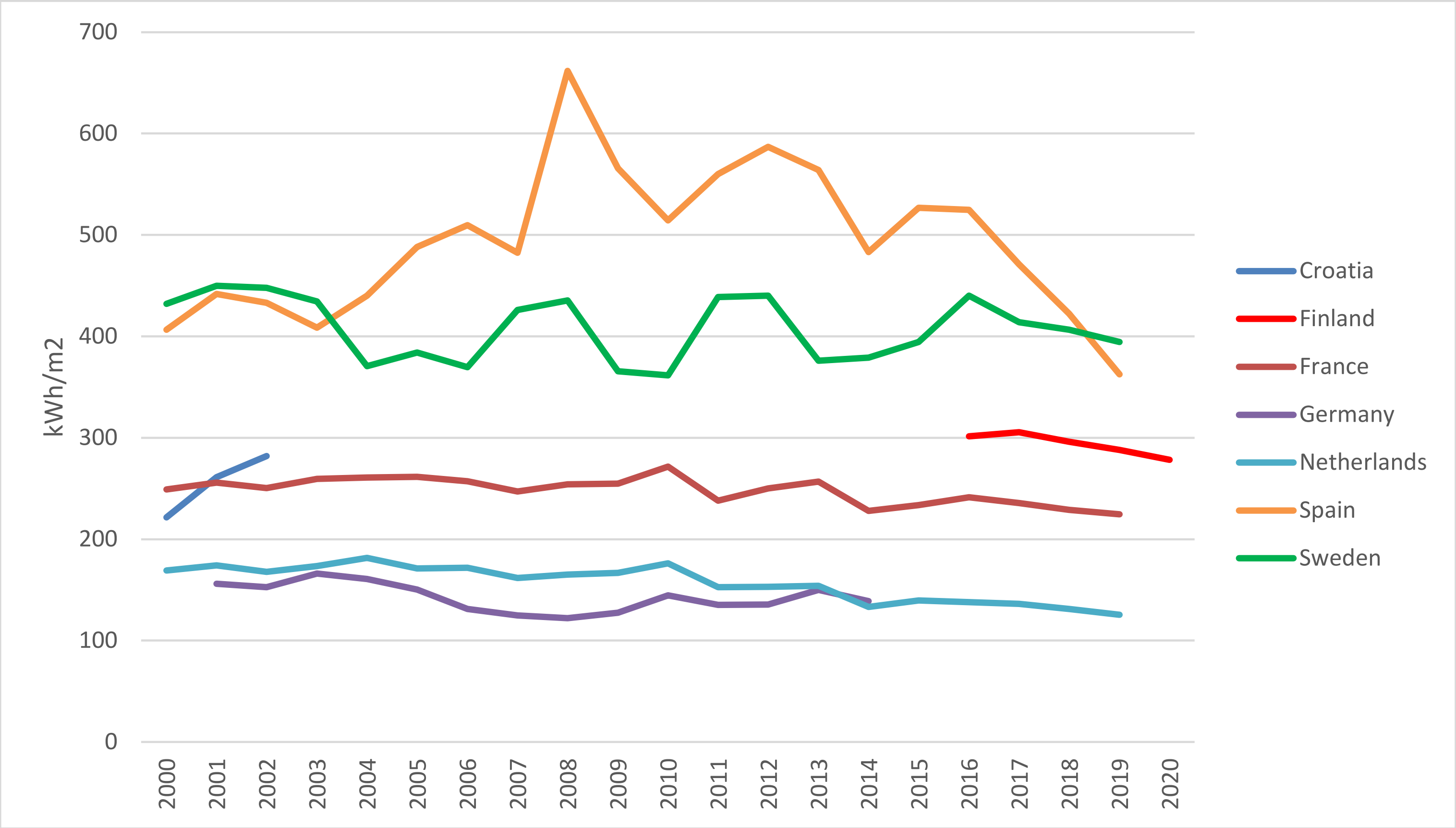
3.
Odyssee Indicators
International Benchmarking Studies
Activities in Sweden

Total Final Energy Consumption per Floor Area in Wholesales and Trade in 2000-2019/2020



Despite the cold climate, total final consumption per floor area in Finland is in the mid range-among countries. Trend over the last five years has been declining based on degree-day corrected data.

Source: Odyssee Database September 2021 & commercial sector companies in Finland

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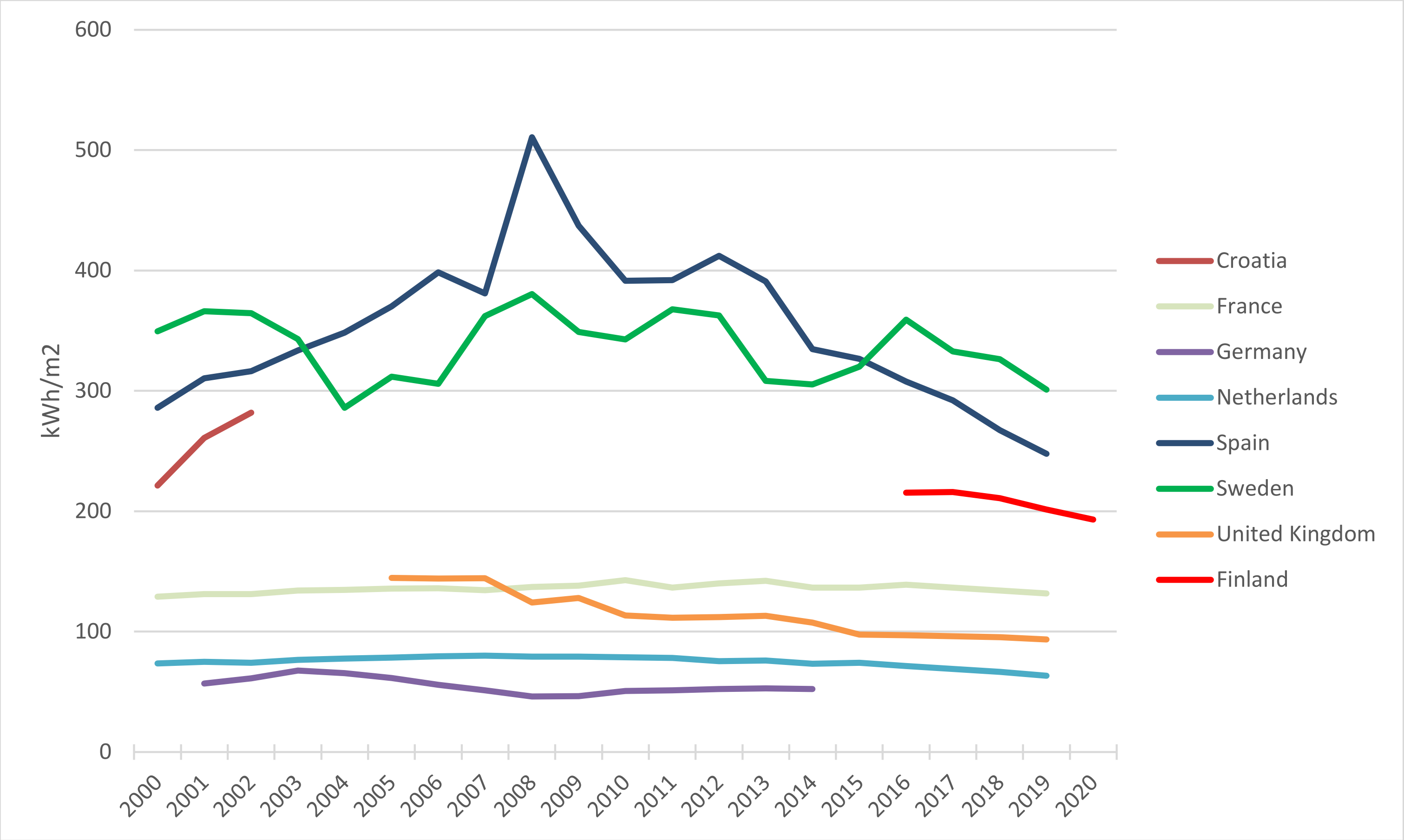
Electricity Consumption per Floor Area in Wholesales and Trade in 2000-2019/2020



Electricity consumption per floor area in Finland is in the mid-range among other countries. Level has been declining over the last five years.

Source: Odyssee Database September 2021 & commercial sector companies in Finland

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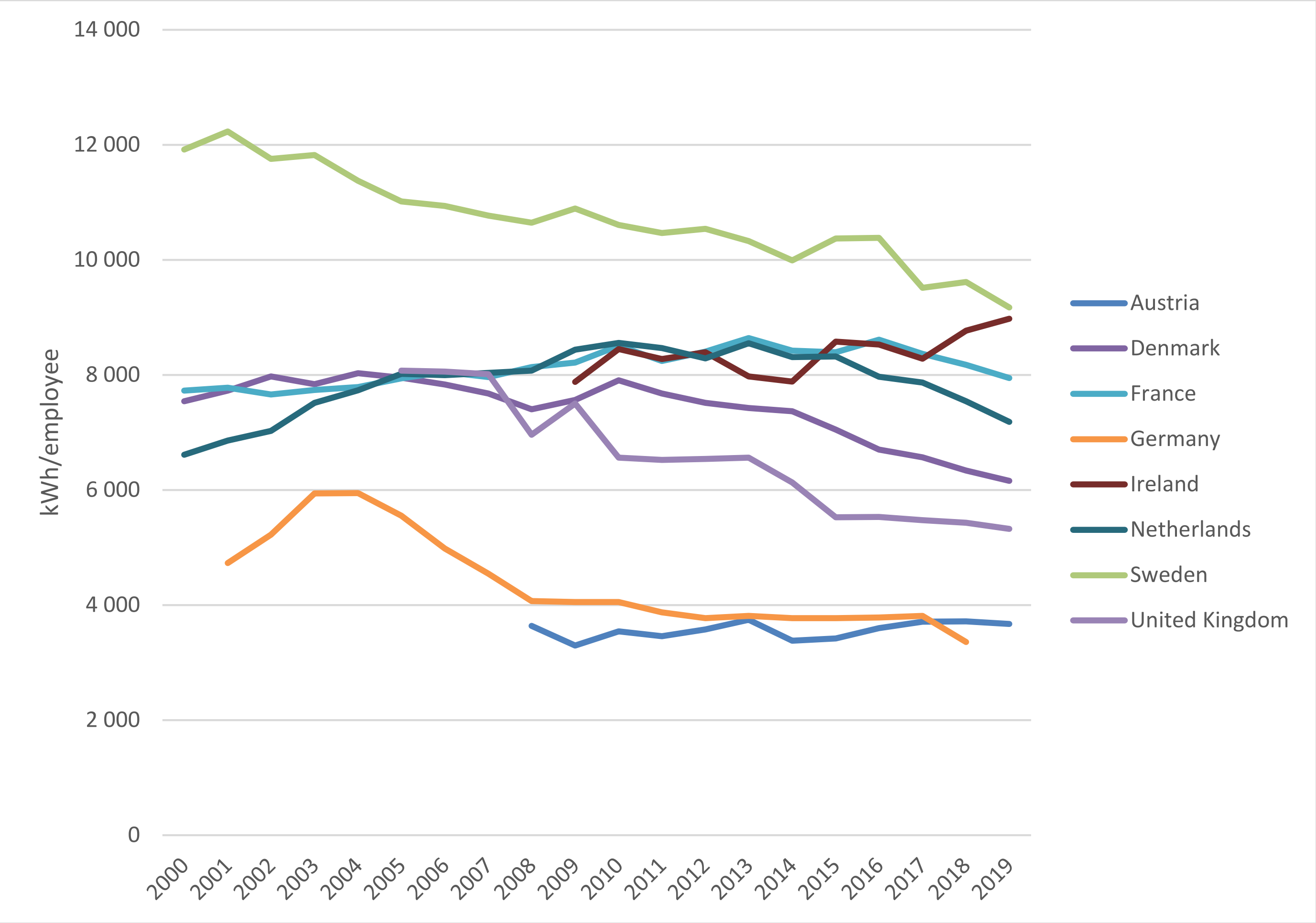
Electricity Consumption per Employee in Wholesales and Trade in 2000-2019



This is a commonly used indicator as data for better indicators is often missing. The question is, does this indicator measure energy efficiency at all? Digitalization, reduction of staff etc. have their impact on the ratio, particularly in countries with high labour cost. The indicator compares inputs (electricity) to other inputs (labour), not inputs to outputs like energy efficiency indicators normally do.

Source: Odyssee Database September 2021. Data not available for Finland.

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Issues in Odyssee Indicators

Floor area and total final consumption data on sub-sectoral level are missing from most countries leading to use of electricity consumption per employee as the key indicator although the information value of this indicator is zero:

- 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 energy consumption and improved energy efficiency.
- Usually in energy indicators energy consumption is allocated to an output like tonne of product or square meter of heated area. Labour is a process input like energy.
- When companies are developing their businesses, they often rather add technology and digitalization, and consequently electricity consumption, and reduce the number of staff. If electricity consumption increases in the pursuit of better productivity, does this indicate worsening energy efficiency?

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International Benchmarking Studies

EU Horizon 2020 financed SuperSmart Project (2016-2019): specific energy consumption in supermarkets in Europe is typically in the range of 400-600 kWh/m^2,a.

IEA Annex 44 project "Performance indicators for energy efficient supermarket buildings" (2017): a supermarket is energy efficient when its total energy consumption is below 400 kWh/m^2,a considering the total supermarket area.

- *Data provided by one major Finnish 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.*

Activities in Sweden

BeLivs (2018, in Swedish): waste heat potential from grocery stores is at least 1.3 TWh/a in Sweden, corresponding to 294 kWh/m^2,a

Ongoing project on the use of waste heat in daily grocery trade (-2024).

- Financed by The Swedish Energy Authority through the TERMO Programme. Implemented by the Royal Institute of Technology (KTH) and CIT Energy Management.
- 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.
- Preceded by Feasibility Study on Collaboration in Heat Recovery from Grocery Stores (Belok 2020, in Swedish)

Pre-Study on Key Indicators in Grocery Stores and in Commercial Kitchens (Belok 2020, in Swedish)

Energy Labelling of Grocery Stores: A Pre-study on Environmental Labelling of Grocery Stores – With Focus on Energy (Belok 2021, in Swedish)

4.
Energy Efficiency Work in Finland: Policies and Measures Addressing the Sector Good Examples from Major Retailers in Finland

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Energy Efficiency Policies for the Commerce Sector

Voluntary energy efficiency agreement scheme established in 1997:

- Savings from measures implemented in 2017-2020 totalled 237 GWh/a in 2020 in the commerce sector and additional 8 GWh/a in car retailing. Corresponding investments were 58+2 million euros.
- The commerce sector and car sales were the first sectors to reach their target in the 2018-2025 period.

Voluntary energy audit programme (replaced in 2015 by mandatory audits for large companies)

Subsidies for energy efficiency investments and non-mandatory energy audits

Also the provisions in the Energy Performance of Buildings and Eco-Design Directive apply

Taxation as a steering instrument

Low-carbon road map for the commerce sector

Energy Efficiency and Climate Commitments

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% improvement.

S Group/SOK: The climate objective 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. The energy efficiency objective is 30% improvement between 2015 and 2030

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

Stockmann Group: Emissions are monitored but no announced emission reduction target for the department stores. Lindex fashion chain within the Group 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 is 7.5% in 2018–2025 covering operations both in Finland and the Baltics.

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K Group/Kesko: 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%.

S Group/SOK: 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.

Lidl Finland: Virtual Power Plant

In September 2020 all 136 Lidl stores and one of its three distribution centers 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).

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Stockmann Group: Energy Efficiency Measures in Distribution Functions

Stockmann operates one distribution center in Finland. It serves the on-line sales as well as department stores in all countries of operation. Concentrating operations in one distribution center enabled optimization of warehouse functions, reduced internal transport, and improved the energy efficiency of logistics.

The distribution center 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.

5.
Study on Waste Heat Potential, Barriers and Opportunities

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Study Approach

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, mid-sized supermarkets and hypermarkets.

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 (S Group, K Group and Lidl Finland) to make an estimate of the whole waste heat potential as well as tapped potential.

Waste Heat Potential

Total unharnessed waste heat potential in grocery trade was estimated at 930 GWh/a.

- supermarkets and hypermarkets 797 GWh/a
- malls 113 GWh/a
- department stores 20 GWh/a.

The largest waste heat potential can be found in mid-sized supermarkets.

Corresponding total emission reduction potential 138 kt $_{CO2\text{-}ekv}$/a

- calculated with the average emission factor of heating in Finland: 148 $tCO_{2\text{-}ekv}$/GWh

Waste heat is already used:

- in small supermarkets about 10% of the total potential is and 15-16% in mid-sized supermarkets and hypermarkets.

Barriers and Opportunities

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.

6.
Summary and Recommendations

Summary and Conclusions

Data collected from grocery trade companies suggests a very efficient level of energy consumption.

Sizeable savings have been achieved among participants to the voluntary energy efficiency agreements. In addition to traditional energy efficiency measures, innovative measures such as artificial intelligence, virtual power plants and heat accumulators taken into use.

Large actors have committed themselves to ambitious climate targets.

Total unharnessed waste heat potential in grocery trade was estimated at 930 GWh/a. Already recovered waste heat 10-16% depending on store size. It should be noted that it is not cost-effective to take full technical waste heat potential into use.

Recommendations/Indicators and Benchmarking

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 products 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 have energy consumption and floor area data in service sub-sectors; the national statistical offices have a key role in this development.

Total final energy consumption per floor area is the best indicator in the sector in terms of information value. Monitoring electricity consumption is outdated due to development in the sector.

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.

Recommendations/ Waste Heat Recovery

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.

- Model contracts and national operation model for two-way district heating networks needed.

Using electricity tax system (lower tax group) to promote investments in heat recovery.

Setting up guarantee of origin legislation for district heat.

Sustaining energy efficiency investment subsidies.

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Thank you!

Contact:
lea.gynther@motiva.fi