



Energy Efficiency trends and policies in Denmark

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EXECUTIVE SUMMARY

Since 2000 the energy efficiency has improved in Denmark. This is clear when looking at the development in the primary energy intensity, which has declined by 34% from 2000-2019 as well as looking at the energy efficiency of final consumers (final energy intensity, PPP, climatic adjusted), which has improved by 25% from 2000 to 2019.

Calculations show that observed energy consumption in Denmark fell by 1.9 % between 2000 and 2019, while the adjusted energy consumption fell by 3.4%. At the same time, the level of economic activity as measured by gross domestic product (GDP) increased by approx. 28%. This means that energy efficiency (final energy intensity, PPP, climatic adjusted) improved by 25% in 2019 compared to 2000.

The Danish Energy Agency is responsible for the implementation of the energy efficiency measures in all sectors except transport sector. The following descriptions of energy efficiency policies and measures in Denmark is based on the MURE database for energy efficiency measures available on the internet (www.odyssee-mure.eu). The database provides comprehensive and detailed information on the energy efficiency measures by sector in almost all EU Member States.

1. ECONOMIC AND ENERGY EFFICIENCY CONTEXT

1.1. ECONOMIC CONTEXT

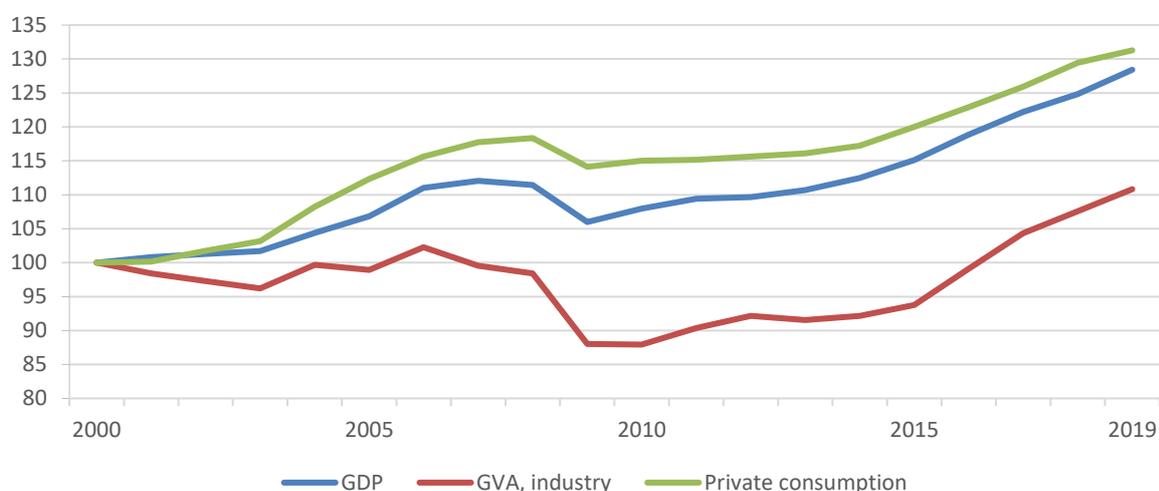


Figure 1 : Macro-economic development in Denmark. Years 2000 to 2019. Index 2000=100

Denmark's gross domestic product has been increasing in the period from 2000 to 2019 by 28 % when measured in 2010 prices. In 2008 the financial crisis also affected Denmark's economy in general by showing a drop of 5% and harder on the industry sector with a drop of 11% from 2008 to 2009. For the years 2009 to 2019, the GDP growth rate has been 1.9%/year. The GVA of the industry sector has had a growth rate of 2.3%/year and private consumption has had a growth rate of 1.4%/year in the same period.

%/year	2000-2019	2000-2007	2009-2019	2008-2009
Gross Domestic Product	1.3%	1.6%	1.9%	-4.9%
Gross Value Added, Industry	0.5%	-0.1%	2.3%	-10.6%
Private Consumption	1.4%	2.4%	1.4%	-3.6%

Table 1 : Growth rates for GDP, GVA and private consumption. Years 2000 - 2019

1.2. TOTAL ENERGY CONSUMPTION AND INTENSITIES

In Denmark total final energy consumption has decreased by 1.9% during the period 2000 to 2019.

However, due to the financial crisis in 2008, the pictures before and after this year are different. Up until 2007 the total final energy consumption increased. After 2007 the total final energy consumption decreased. In the period 2000 to 2007 there has been an increase of approx. 6.5% in total energy consumption. This is an average increase of 0.9%/year over the period. In the period 2007 to 2019 there has been a decrease of approx. 7.9 %. The average decrease is 0.7%/year in the period.

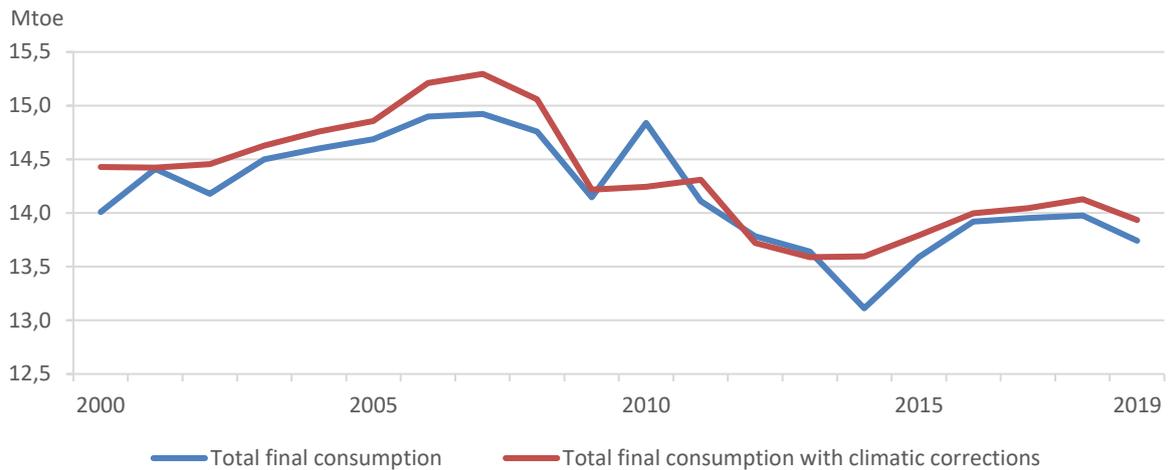


Figure 2 : Total final consumption in Denmark. Years 2000 to 2019. Mtoe. Source: Odyssee

Figure 2 shows the total final consumption in Denmark. It is clear that the trend changes in 2007 from an increasing trend up to 2007 to a decreasing trend from 2007. In 2010 there is an increase total final consumption (the blue line). The year 2010 had 18% more degree days than a year with normal degree days in Denmark. The lower temperatures meant an increase in the energy consumption. The total final consumption with climate correction has decreased by 3.4% from 2000 to 2019. The final energy intensity shows a steady decrease from 2000 to 2019. The energy intensity has decreased by 25% with an average of 1.5%/year. The primary energy intensity also shows a decrease from 2000 to 2019. The energy intensity has decreased by 34% with an average of 2.2%/year.

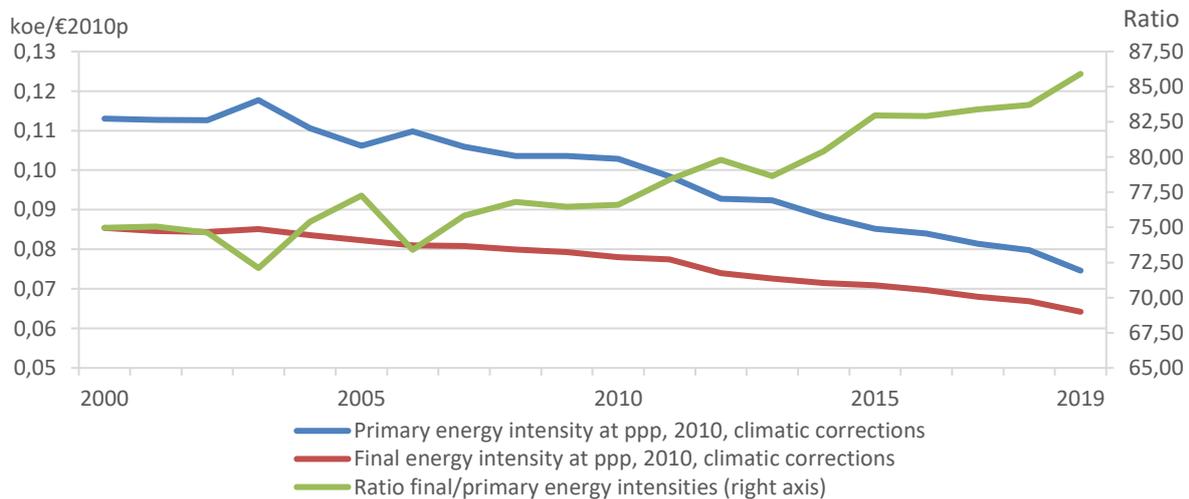


Figure 3 : Primary and final energy intensity in Denmark. Climatic corrections. Years 2000 to 2019. Koe/ €2010p. Source: Odyssee

The final and primary energy intensities are the energy consumption (climate corrected) over GDP converted into €2010 using ppp.

The ratio of the intensities has increased during the period. This indicates that, on average, less and less primary energy is needed per unit of final energy consumption.

In 2019 oil products were still dominant in final energy consumption in Denmark. During the period 2000 to 2019 primarily the share of oil products has decreased from approx. 45% to 38%. The share of renewables has doubled from approx. 5% to 13%. The share of heat (district heating) has increased from 16% to 18%. Electricity and natural gas decreased slightly. Coal has been on a low level, and more than halved in the same period.

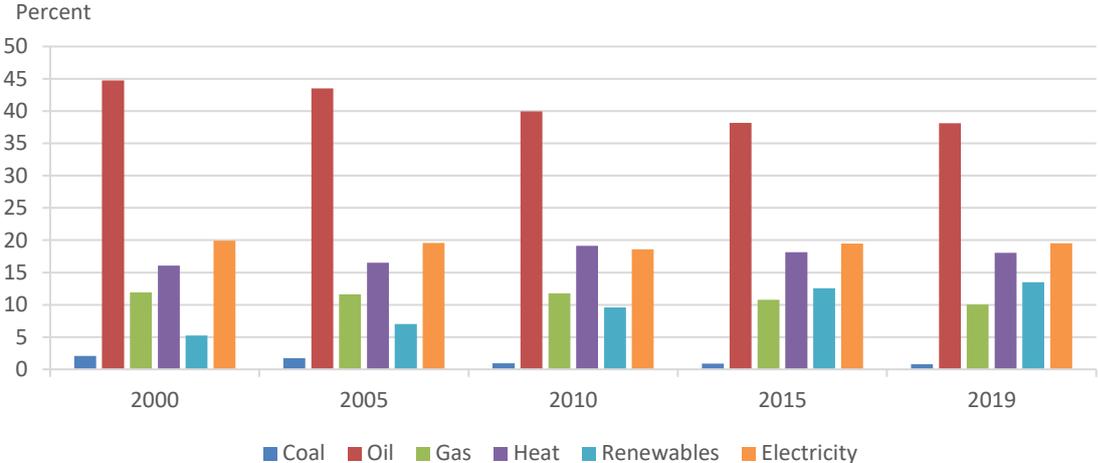


Figure 4 : Final energy consumption by fuel in Denmark. Climatic corrections for tertiary and residential. Years 2000, 2005, 2010, 2015 and 2019. Percent. Source: Odyssee

The composition of final energy consumption by end users is illustrated in Figure 5. In Denmark the two dominant sectors are residential and transport. In 2000 the transport and residential sectors’ shares were 28% and 32%, respectively; in 2019 the shares were 32% and 33%, respectively. In 2000 the tertiary sector’s share was 13% whereas in 2019 the share was 14%.

Industry and agriculture had decreasing shares of final energy consumption from 21% and 6.7% respectively in 2000 to 16% and 5.2% in 2019 respectively.

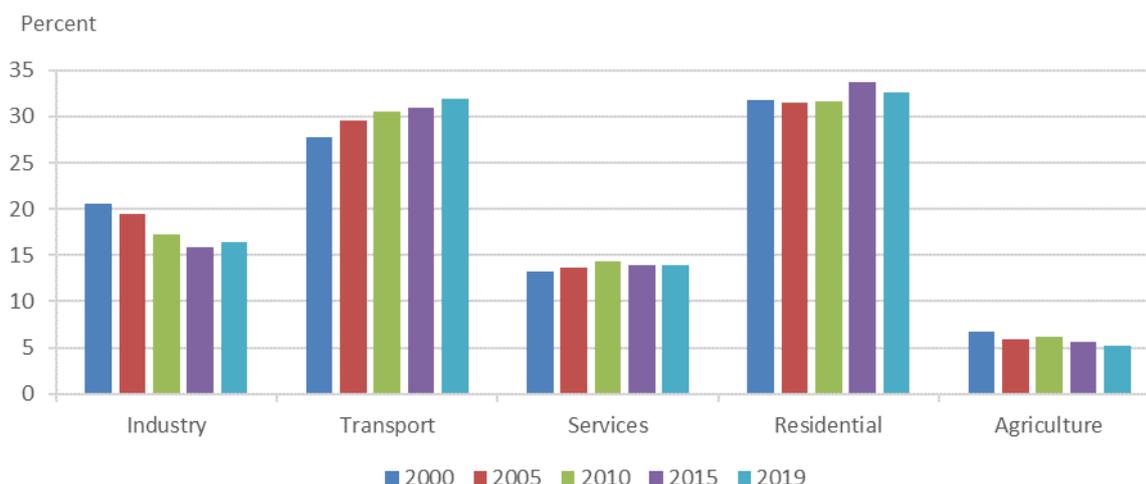


Figure 5 : Final energy consumption by sector in Denmark. Climatic corrections for tertiary and residential. Years 2000, 2005, 2010, 2015 and 2019. Percent. Source: Odyssee

When decomposing the development from 2000 to 2019 it shows that from the decrease of 0.57 Mtoe, primarily energy savings has driven the decrease. On the other hand, activity has contributed to the opposite direction with 2.78 Mtoe.

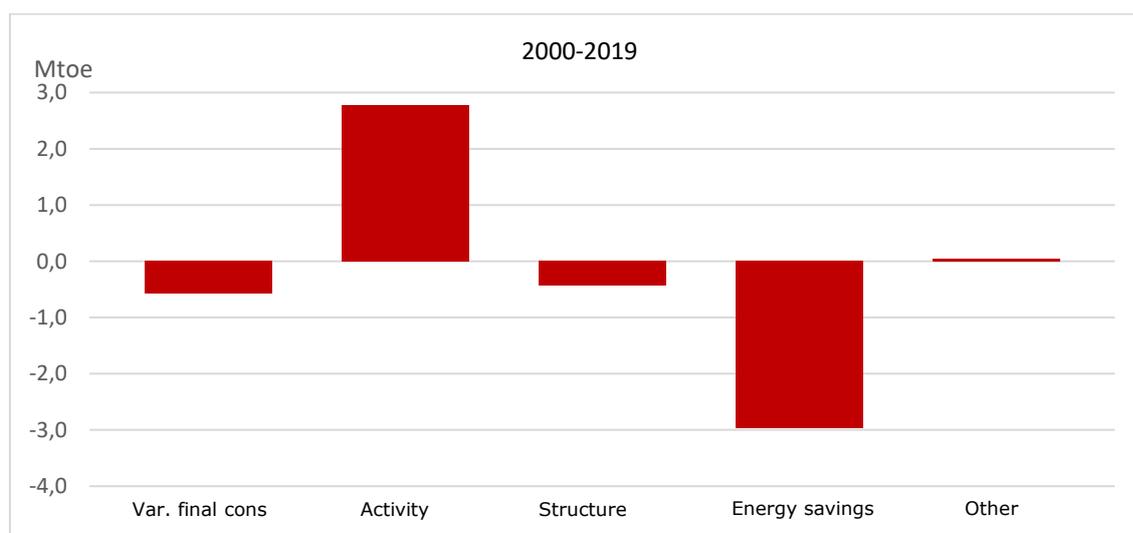


Figure 6 : Final consumption. Development from 2000 to 2019. Decomposition. Source: Odyssee

Each sectors’ energy consumptions are more detailed described in relevant sections.

1.3. ENERGY EFFICIENCY POLICY BACKGROUND

Reducing energy consumption through increased energy efficiency and energy savings has traditionally been a priority for Denmark and is still an important part of Danish energy policy. The Danish Government has a long-term objective of being free of fossil fuels by 2050, and an important element in this objective is improving energy efficiency. It has been agreed in the Danish Climate Agreement for energy and industry 2020 to both expand and advance the launch of the subsidy scheme for private enterprises, the subsidy scheme for buildings, and finally also the

subsidy scheme to replace oil and gas boilers with heat pumps and district heating. Furthermore, there has been allocated funds for a focused, not yet specified, energy efficiency initiatives. Finally, as a follow up point to the agreement of better utilization of surplus heating, it has been agreed to remove the tax on surplus heating if the supplier enters a voluntary agreement on energy efficiency.

1.3.1. ENERGY EFFICIENCY TARGETS

Denmark has not set any overall energy efficiency or energy saving target.

Denmark's indicative target under Article 3 in the EED is an absolute primary energy consumption (gross energy consumption excluding consumption for non-energy purposes) of 741.08 PJ (17.70 Mtoe) in 2020. This equates to a 13 % reduction in primary energy consumption compared with 2006.

The corresponding target for final energy consumption (excluding consumption for non-energy purposes) is 610.4 PJ (14.58 Mtoe) in 2020.

The indicative target is derived from the Danish Energy Agency's 2014 baseline projection for energy consumption. The baseline projection takes account of the effects of adopted measures, which in this context are the 2012 Energy Agreement, the Finance Acts up to and including the 2014 Finance Act, the Danish Growth Plan and the 2014 Growth Package, including the Agreement on the abolition of the security of supply charge etc. and on PSO (Public Service Obligation) reductions.

2. ENERGY EFFICIENCY IN BUILDINGS

This chapter describes energy efficiency in the residential and the tertiary sectors.

2.1. ENERGY EFFICIENCY TRENDS

The following two sections describe the efficiency trends in the residential and the tertiary sectors. The main developments are that energy consumption has decreased.

For the tertiary and the residential sectors, the potentially strong influence of climatic variations should be taken into account when looking at the annual changes in energy consumption. The year 2014 was a mild year whereas 2010 was a cold year in Denmark.

2.1.1. RESIDENTIAL SECTOR

The final energy consumption of households decreased by 0.9% in the period 2000 to 2019. This is a decrease of 0.05%/year in average. The final energy consumption increased by 5.9% in the period 2000 to 2007 corresponding to 0.8%/year in average and decreased by 6.5% in the period 2007 to 2019 which is an average of 0.6%/year.

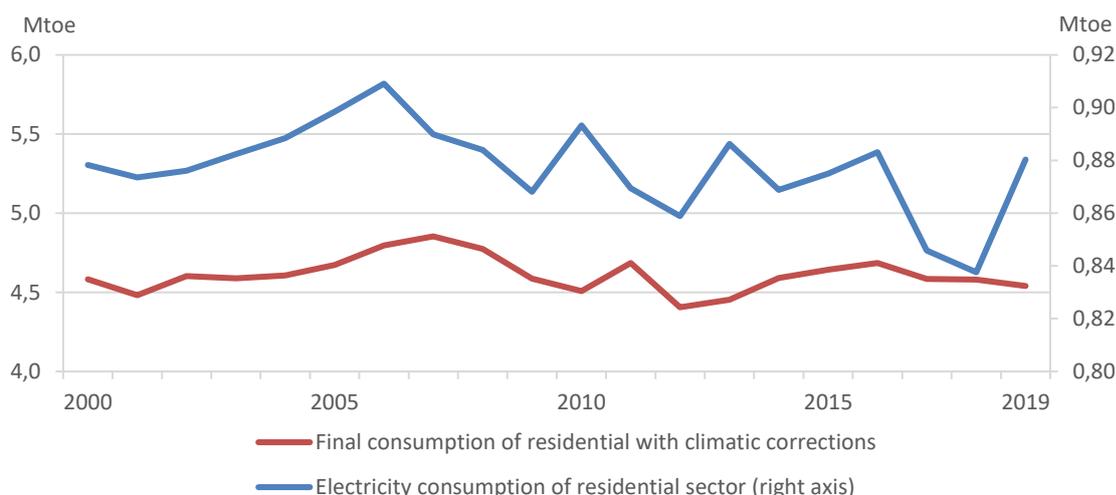


Figure 7 : Final energy consumption and electricity consumption by the residential sector in Denmark. Years 2000 - 2019. Mtoe. Source: Odyssee

The electricity consumption of households has shown a large variation from year to year. The consumption increased in the years 2000 to 2007 by 1.3% and decreased in the years 2007 to 2019 by 0.1%.

The rate of equipment ownership of electrical appliances are shown in Figure 8. The rates of refrigerators and washing machines have been almost constant in the years 2000 to 2019, while the rate of freezers has decreased by 13.3% and the rates of TV and dishwashers have increased by 35% and 51%. From the figure, it is seen that households in average have almost two TV's per household.

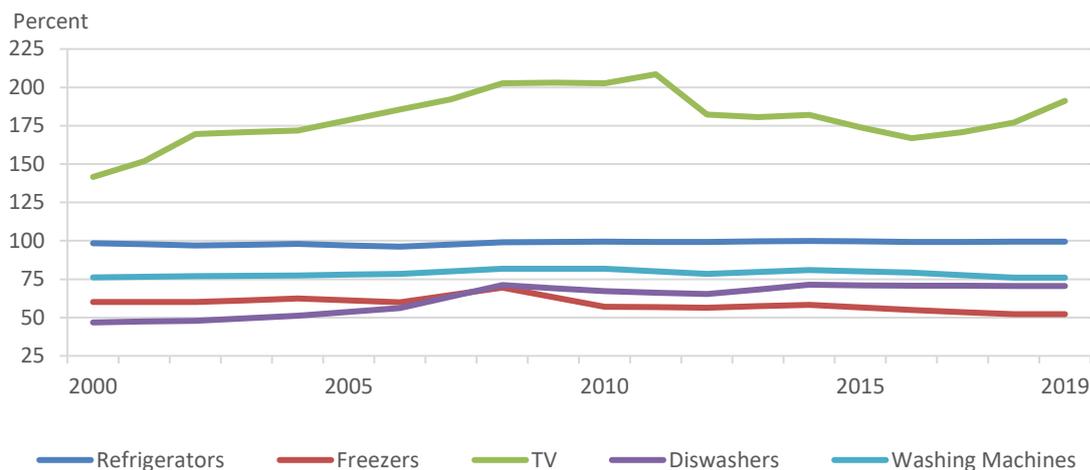


Figure 8 : Rate of equipment ownership. Years 2000 to 2019. Source: Odyssee

The energy consumption for space heating per m² has shown a decreasing trend during the period 2000 to 2019. The energy consumption has been at the same level from 2000 to 2008 whereas from 2008 to 2019 a decrease of 16% is observed.

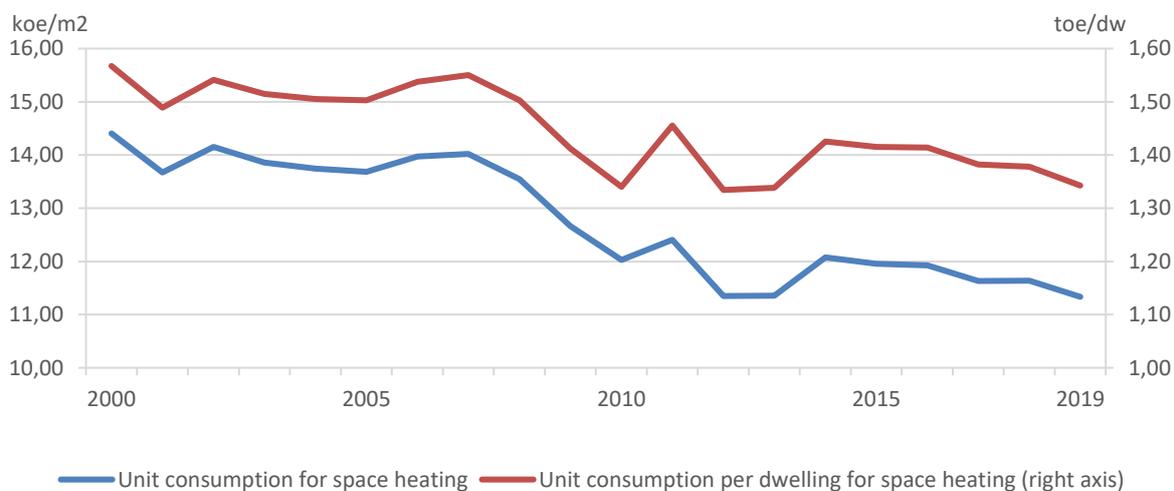


Figure 9 : Heating: Unit consumption per dwelling and per m² in the residential sector in Denmark. Climatic correction. Years 2000 - 2019. Source: Odyssee

The same pattern as for space heating per m² is seen for energy consumption per dwelling.

2.1.2. TERTIARY SECTOR

As for the residential sector, the tertiary sector is also highly dependent on climatic conditions since most of the energy is used for space heating. Climatic corrections are based on degree days.

The energy intensity, not climate adjusted, has decreased by 22% from 0.0131koe/€2010 in 2000 to 0.0102 koe/€2010 in 2019. The energy intensity, climate adjusted, has decreased by 24% from 0.0136 koe/€2010 in 2000 to 0.0103 koe/€2010 in 2019.

In 2019, the electricity intensity was 54.981kWh/€2010, which is 22% lower than in 2000.

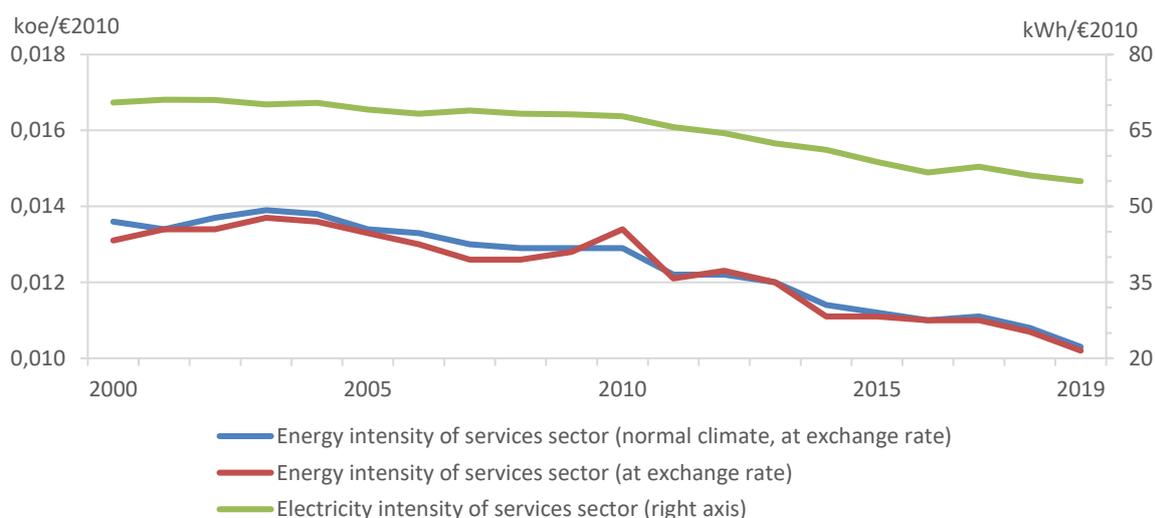


Figure 10 : Energy and electricity intensity in the tertiary sector. Climatic correction. Years 2000 - 2019. Source: Odyssee

The energy intensity in the service sector by branch is shown in Figure 11. The energy intensity is highest in Hotels and restaurants (0.049 koe/ €2010 in 2019) and lowest in Public and private offices (0.0042 koe/ €2010 in 2019).

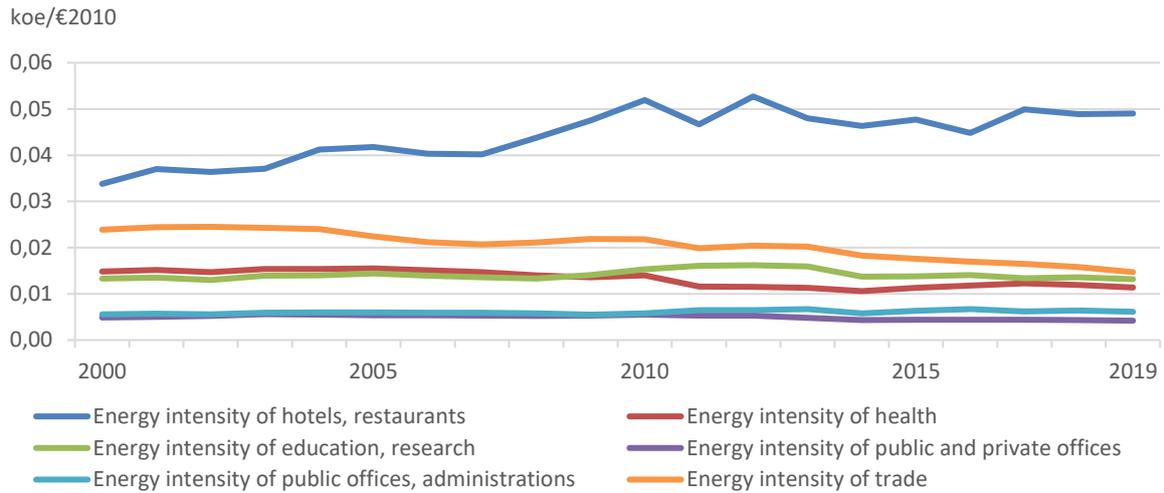


Figure 11 : Energy intensity in the tertiary sector by branch. Climatic correction. Years 2000 - 2019.

Source: Odyssee

In the period 2000-2019, the energy intensity has increased in the branches Public offices, administration and Hotels, restaurants as seen in Figure 11. In the branches Public and private offices, Trade and Health the energy intensity has decreased.

The electricity intensity in the service sector by branch is shown in Figure 12. The electricity intensity is highest in Hotels and restaurants (259 kWh/ €2010 in 2019) and lowest in Private offices (19 kWh / €2010 in 2019). The electricity intensities have decreased in trade, health and private offices in the period shown.

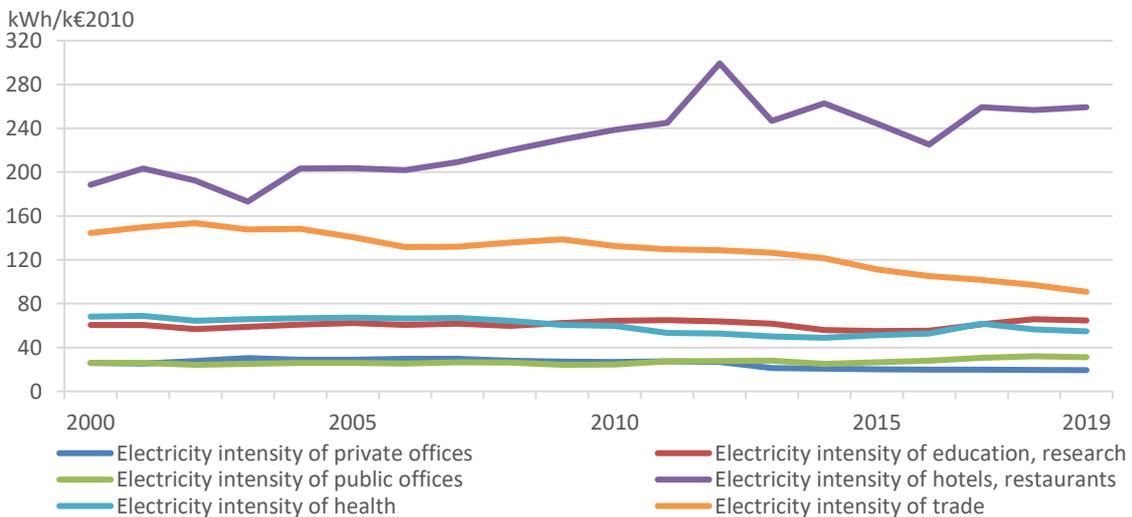


Figure 12 : Electricity intensity in the tertiary sector by branch. Climatic corrected. Years 2000 – 2019. Source: Odyssee

The fuel mix in the tertiary sector is shown in figure 13. Heat (district heating) and electricity are the primary energy sources in this sector. The share of oil in the tertiary sector has decreased by 5.1 percentage point, heat has increased by 5.8 percentage point and gas consumption has increased by 0.46 percentage point. The share of electricity has increased by 1.1 percentage point and the share of wood is almost the same.

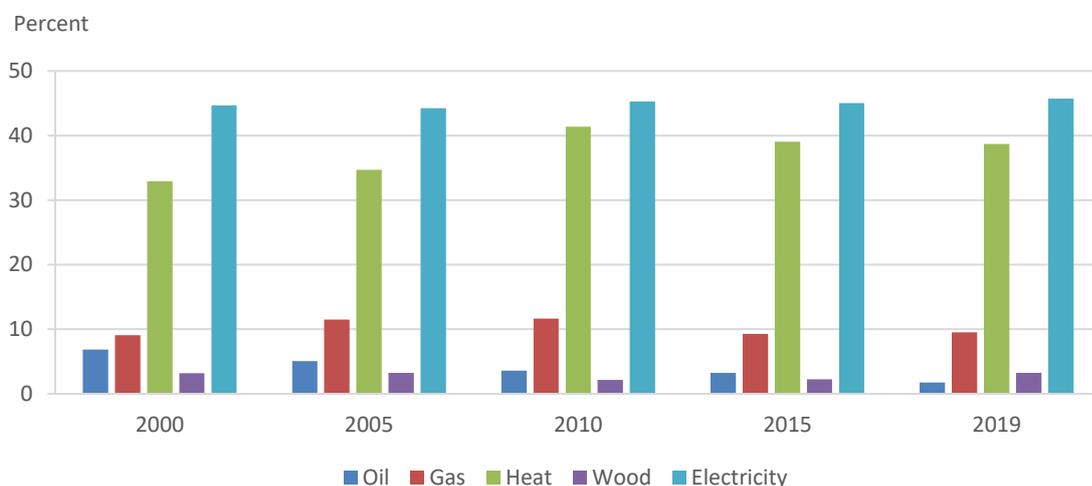


Figure 13 : Consumption in the tertiary sector by fuel. Climatic corrected. Years 2000, 2005, 2010, 2015 and 2019. Source: Odyssee

2.2. ENERGY EFFICIENCY POLICIES

Nearly 40 % of the Danish energy consumption is used in buildings. To meet the long-term challenges, with higher prices and securing our energy of supply, it is important to reduce the energy consumption in buildings.

Building codes

The energy requirements for new buildings have been strengthened quite considerably the last 25 years. According to the EU's Buildings Directive, the energy provisions must be reviewed with regular intervals which shall not be longer than five years. The latest revision of the Building Codes was in 2020 where, among other things, the energy requirements for windows and exterior doors were tightened. The building codes have also strong requirements in relation to components in existing buildings. However, there is also requirements for indoor climate, such as daylight and indoor temperatures.

Implementation of Energy performance certificates (EPCs) for buildings

For energy savings in existing buildings, the government has implemented a system of certification of the energy performance of buildings into Danish law. The purpose of the EPC is to make the energy specifications of buildings visible for e.g. the owners and the buyers, expressed by a rating from A-G, and to deliver a plan showing the potential for reducing the energy demand of the building. The

rating, plan and documentation are composed by an Energy consultant and are paid by the owner of the building.

Energy efficient products and appliances

Improvements in energy efficiency of products and appliances are primarily regulated by EU legislation Ecodesign and Energy Labelling. Currently, more than 30 products groups are regulated under Ecodesign and Energy Labelling (though not all are energy labelled), covering consumer products such as computers, lighting, heat pumps and refrigerators as well as products in the building sector such as ventilation, pumps and air conditioners. Ecodesign and Energy Labelling are estimated to have delivered 50 pct. of the EU 2020 energy efficiency target as well as 25 pct. of the EU 2020 CO₂-reduction target. The IEA has found that while products have become more energy efficient, purchase prices have fallen steadily (appr. 2-3 pct. pr. year [1]).

Consumer information programmes and training

According to the EU Energy Efficiency Directive, Member States are obliged to focus on and strengthen consumer information, and information and training about energy efficiency. The Danish Energy Agency has drawn up an action plan and strategy for the information campaign on energy efficiency at end-user level. The aim of this information campaign is to promote energy-efficient solutions and purchasing and energy-efficient behaviour among end users. The information campaign focuses on end users, with home owners, the public sector and commercial enterprises as specific focus areas.

Improving the energy efficiency of buildings and modifying behaviour in connection with buildings is a priority in the Danish public and consumer information campaign. This involves preparing material on energy-efficient solutions, information on building regulations, and better access to information and knowledge about energy renovation. The Danish Energy Agency's website www.spareenergi.dk is the backbone of the Agency's communications with end users concerning energy-efficient solutions both in private households and in public and private enterprises.

Subsidy schemes

In June 2020, the Danish Government reached a Climate Agreement on Energy and Industry including several measures targeting energy efficiency up until 2030. The Danish Government has with a broad majority in the Danish parliament adopted a target of 70 percent CO₂e reduction target in 2030 (compared to 1990). It allocates a further total of approximately 667 m. EUR for measures to promote energy efficiency and especially to reduce the use of oil and gas for heating.

Overall, The Danish government has implemented six subsidy schemes supporting a transition towards green energy and an increased energy efficiency in buildings and in industry. Among these are three competitive subsidy schemes to promote energy renovations in all households and public sector buildings, while simultaneously promoting the replacement of oil burners and gas furnaces with electric heat pumps and district heating. The subsidy schemes are distributed into the following three sub-schemes:

- I. **Sub-scheme for households:** Targets energy savings in private year-round housing, such as private building owners, owners associations, cooperative housing associations, public housing associations, colleges and landlords. Among others, the subsidy pool supports

insulation of the building envelopes and optimization of the operation of the buildings with a poor energy label (E-F-G). 60 per cent of the pool is targeted projects, which include conversion to heat pumps under the condition that the building is located outside an area, where it has been decided to establish district heating.

- II. **Sub-scheme for industries:** Targets energy savings in all private-owned production. Full description in section 4 'In industry'.
- III. **Sub-scheme for municipalities and regions:** Targets buildings owned and used by municipalities and regions, including nursing homes etc.

Additionally, the Danish government has implemented three subsidy schemes targeted replacement of oil burners and gas furnaces with electric heat pumps and district heating from renewable sources in all households. The schemes are expected to reduce CO₂e emissions by 0.04 Mt CO₂e in 2025 and are distributed into the following three sub-schemes:

- I. **Sub-scheme for district heating:** Provides a subsidy at 20.000 DKK per converted oil burner or gas furnace. The subsidy is paid to the district heating companies that redistribute it to the consumers. The subsidy is expected to lower the costs for those consumers who are connected to the district heating grid, because it can induce a higher connection share to the district heating grid and provide a better business case for district heating.
- II. **Sub-scheme for decoupling:** When decoupling from the gas network, the Danish state gas distribution company EVIDA normally charges a fee of approx. 8.000 DKK to cover the cost of decoupling. This fee can be covered through the scheme.
- III. **Sub-scheme for heat pumps on subscription:** Provides a subsidy amounting to 25.000 DKK per heat pump for companies that offer heat pumps on subscription for private year-round housing. The scheme is designed to support citizens who wish to convert to a heat pump but who have limited financing opportunities, for example because of low property values.

3. ENERGY EFFICIENCY IN TRANSPORT

3.1. ENERGY EFFICIENCY TRENDS

A macroeconomic view of the dependency of energy efficiency in transport can be given by the indicator energy intensity in transport – measured as energy consumption in the transport sector per total GDP unit.

In the period 2000-2019, the energy intensity in transport has declined 14%, which means that the amount of energy used for transport needed to produce one unit of GDP has declined 14% since 2000.

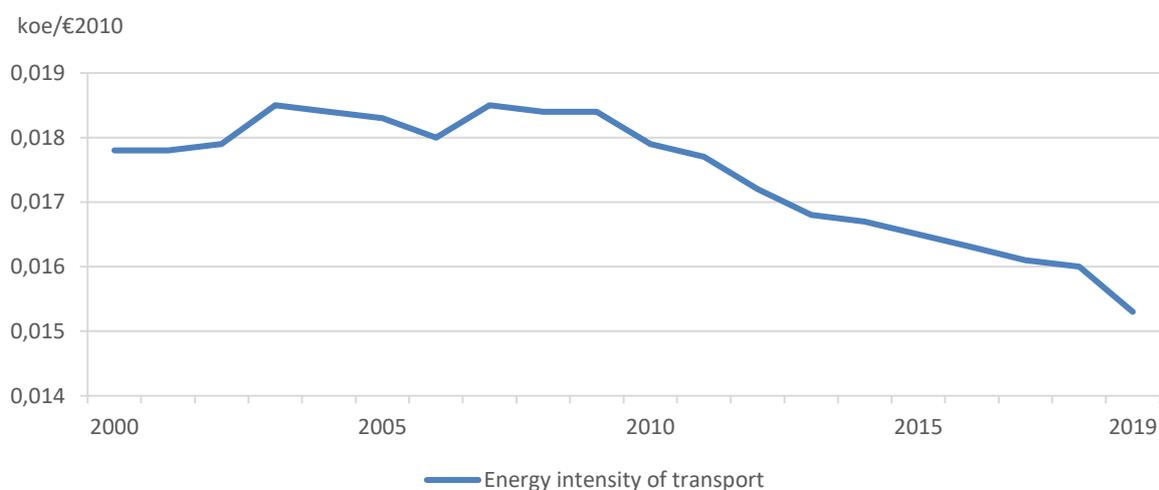


Figure 14 : Energy intensity of transport. Development from 2000 to 2019. Source: *Odyssee*

ODEX measures the energy efficiency progress and is calculated as a weighted average of the transport modes. The technical energy efficiency index of transport improved by 9% in the period 2000 to 2019 and 0.5%/year. The technical ODEX considers the situation where equipment is used less efficient, e.g. in times of recession¹.

¹ [Definition of ODEX indicators in ODYSSEE data base \(odyssee-mure.eu\)](https://odyssee-mure.eu)

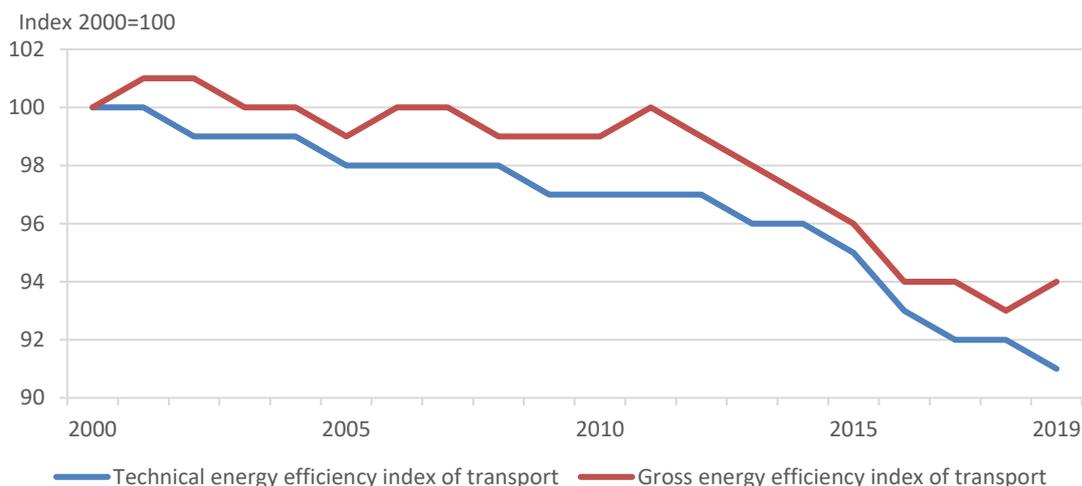


Figure 15 : ODEX of transport. Development from 2000 to 2019. Source: Odyssee

When looking at the final energy consumption for transport in 2000 to 2019 the development has been increasing from 2000 to 2007 and decreasing from 2007 to 2013, and then again increasing from 2013 to 2018. In 2019 there is a small drop. Road transport is the primary consumption category in the transport sector with an increase in fuels consumption of 13% from 2000 to 2019.

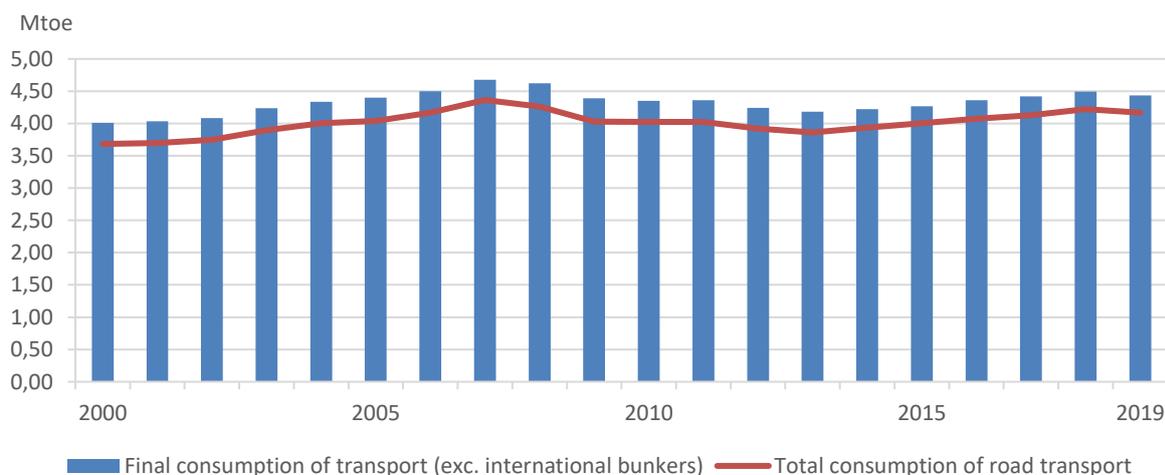


Figure 16 : Total energy consumption of transport compared to energy consumption of road transport from 2000 to 2019. Source: Odyssee

3.2. ENERGY EFFICIENCY POLICIES

EU regulation has had a big influence on the Danish transport sector towards 2020 and further up to 2030. CO₂-emissions standards for cars and vans, together with the Danish taxation scheme, have resulted in a more energy efficient car fleet in Denmark with an increased number of electrical vehicles. In the coming years it will support the electrification of the car fleet further. The Danish

purchase tax is designed to promote the sales of electrical vehicles – and is expected to result in an increased sale in this decade.

Different supporting measures are put in place, e.g. financial support for charging infrastructure, support to heavy duty vehicles on alternative fuels (electricity, hydrogen and bio methane), and financial support to ferries (electric) etc. Bus tenders for public transport is mainly with a demand for electrical, bio methane or hydrogen driven busses.

The electrification of the railway network converting the trains from diesel to electricity will be completed in the mid-2020s and is expected to lead to an annual reduction in CO₂ emissions of over 0,2 mill. ton.

The Renewable Energy Directive and the Fuel Quality Directive sets targets/obligations for the use of renewable energy in the transport sector with focus on the use of biofuels. These directives have been (over-)adopted in the Danish legislation towards 2030.

The measures on transport are expected to provide a basic development with continued slackening of the transport sector's energy consumption up to 2030.

4. IN INDUSTRY

4.1. ENERGY EFFICIENCY TRENDS

The industry sector includes manufacturing, mining, quarrying and construction. For the manufacturing sector, the energy efficiency has improved by 33% from 2000 to 2019. The decrease has been steady over the period. The average decrease has been 2.1%/year. In Figure 17 the ODEX and technical ODEX is shown. ODEX measures the energy efficiency progress and is calculated as a weighted average of the manufacturing branches. The technical ODEX considers the situation where equipment is used less efficient, e.g. in times of recession².

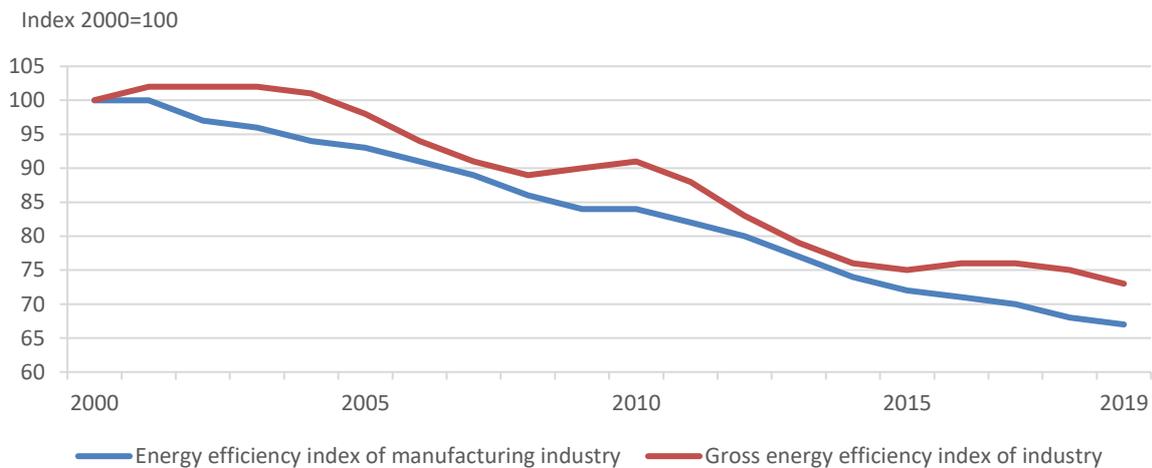


Figure 17 : Energy efficiency index of manufacturing industry, gross and technical. Years 2000-2019.

Source: Odyssee

In the manufacturing sector the shares of oil consumption and heat have decreased by 8.6%-points and 2.2%-points, respectively. The share of electricity, biomass, coal and natural gas has increased by 5.1 %-points and, 3.3%-points, 1.7%-points and 0.8%-points.

² [Definition of ODEX indicators in ODYSSEE data base \(odyssee-mure.eu\)](https://odyssee-mure.eu)

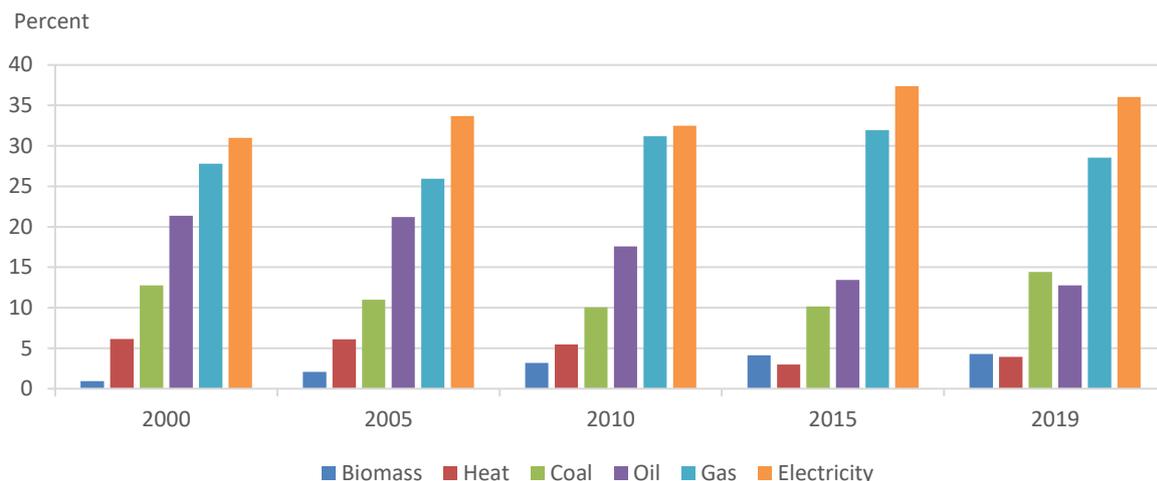


Figure 18 : Energy consumption in manufacturing sector by fuel. Years 2000, 2005, 2010, 2015 and 2019. Source: Odyssee

In Figure 19 final consumption of four branches in the industry sector is shown. These are the branches with the most final energy consumption in the industry sector. From 2000 to 2019 the energy consumption in the food industry decreased by 22.8%, in the chemical industry the final consumption fell by 11.8%, in non-metallic minerals industry by 20.1%, and in the machinery industry by 8.9%.

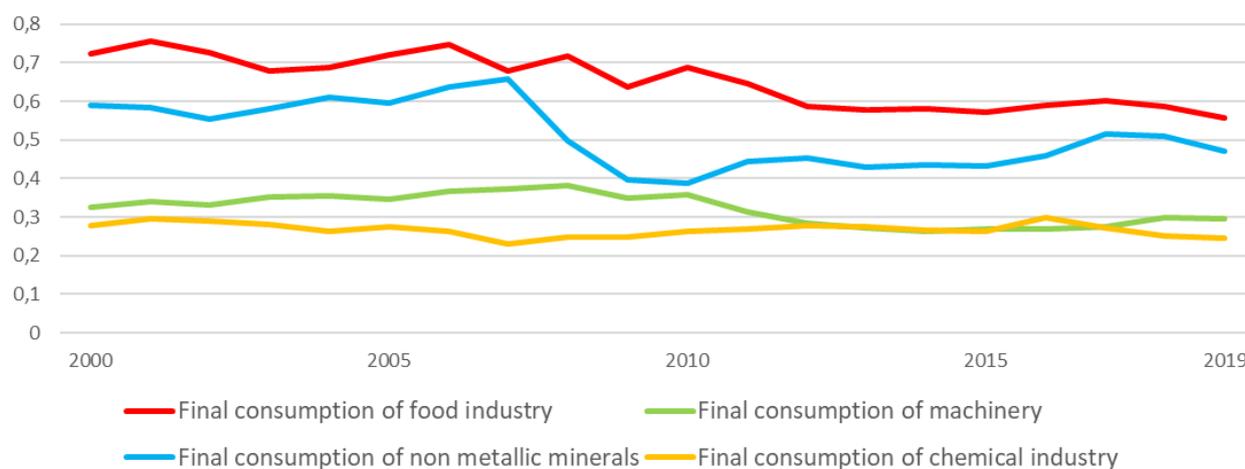


Figure 19 : Energy consumption in manufacturing sectors with largest energy consumption by branch. Years 2000 - 2019. Mtoe. Source: Odyssee

4.2. ENERGY EFFICIENCY POLICIES

Competitive subsidy scheme related to private enterprises

The scheme allocates around 4 billion DKK in the period 2020-2029, with highest yearly amounts available in the first half of the period. The scheme is implemented as a subsidy scheme with a

competitive bidding procedure. Subsidy is granted based on the bidding of subsidy per saved kWh in the individual projects. Subsidies are first granted to the project with the lowest costs per saved kWh, then to the second lowest costs per saved kWh, and so forth. The scheme aims at achieving energy savings in businesses, and is open to end user energy saving projects in all types of energy in most of the private sector in Denmark and most types of activities. Road transportation, shipping, and savings in the IT sector are not eligible for subsidy under the scheme.

Energy audit and management system

On 29 January 2014, the Danish Government presented a bill to the Danish Parliament containing the general rules for the implementation of the EU Energy Efficiency Directive's requirement for mandatory energy audits, Article 8(4). The Act was adopted by the Danish Parliament on 1 April 2014. It contains an obligation for enterprises to carry out a mandatory energy audit every fourth year. The enterprise can also satisfy the obligation by using and maintaining a certified energy or environmental management system that includes an energy audit as part of the management system. The Act also provides a legal basis for the Minister for Climate, Energy and Building to lay down detailed rules on, among other things, the content of energy audits and qualification requirements for the experts who are to carry out the energy audit.

Continued focus on energy efficiency in industry

Energy efficiency is still a primary focus in energy policies in Denmark. The latest climate agreement on energy and industry from June 2020 included funds to increase energy efficiency in industry. The funds will be aimed at conversion away from fossil fuels, subsidies to increase energy efficiency of processes that are unable to convert to electricity, and targeted action on energy efficiency in non-road transport e.g. fork lifts and agricultural tractors etc. in the manufacturing and agricultural sectors.

5. ENERGY EFFICIENCY IN AGRICULTURE

5.1. ENERGY EFFICIENCY TRENDS

The agricultural sector includes agriculture, horticulture, forestry and fishing. The energy intensity has been fluctuating over the years 2000 to 2019. In the period from 2000 to 2006 the energy intensity was at the same level of about 0.31 koe/€2010, in 2007 the intensity dropped and from 2007 to 2009 the intensity increased to 0.38 koe/€2010 and in 2019 the intensity was around 0.22 koe/€2010.

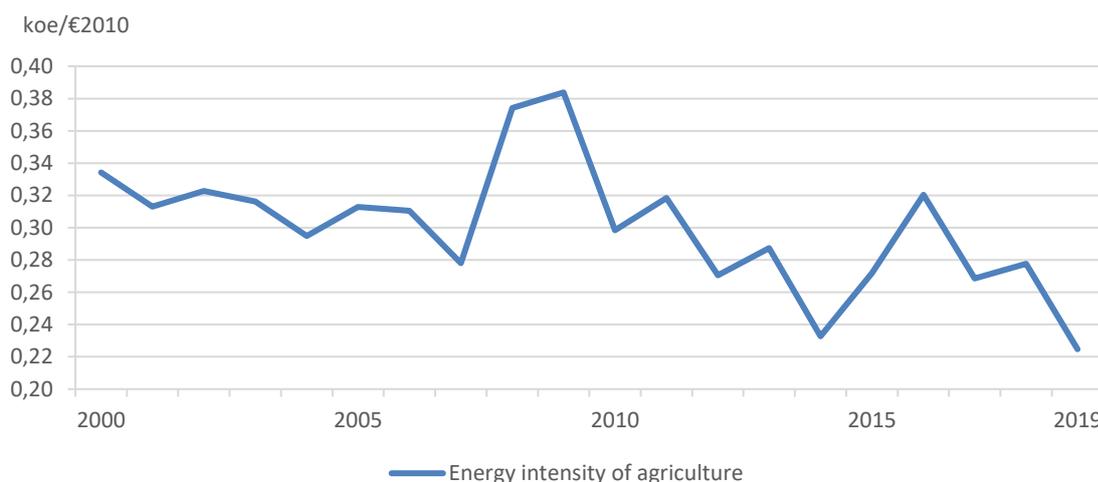


Figure 20 : Energy intensity in agricultural sector. From 2000 to 2019. Source: Odyssee

Looking at the energy consumption by fuel in the period from 2000 to 2019 the distribution has not changed much. Oil share has decreased by 7.2 percentage points over the period and wood has increased by 5.4 percentage points. The electricity share has increased from 17.3% to 21.9% of the energy consumption.

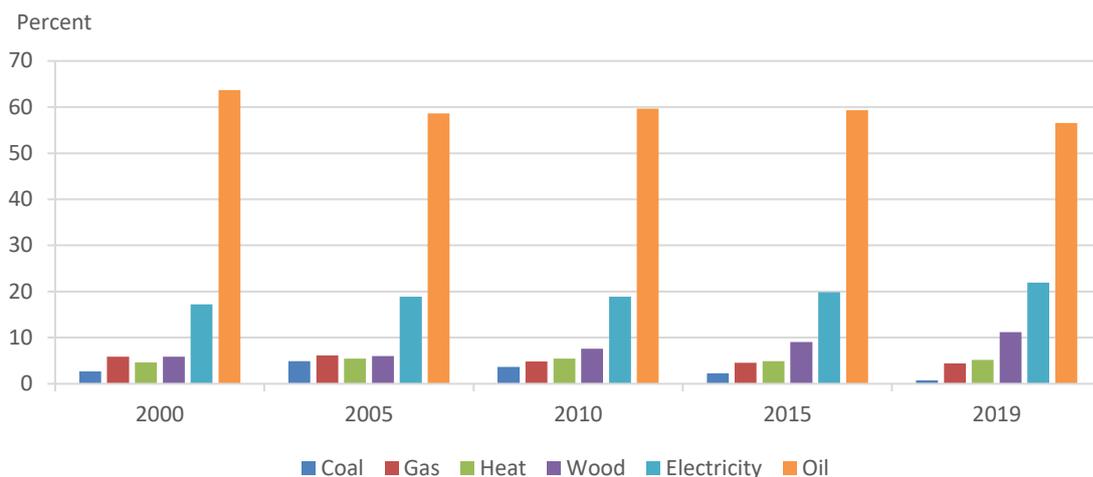


Figure 21 : Energy consumption in agricultural sector. Years 2000, 2005, 2010, 2015 and 2019.

Source: Odyssee

5.2. ENERGY EFFICIENCY POLICIES

Renewable energy for production processes

The most recent Danish energy agreement from 2020 includes a subsidy scheme targeting conversions away from the use of fossil energy. This includes subsidies for energy efficiency investments, as well as electrification and energy efficiency of internal transport (forklifts, tractors, etc.) in manufacturing, agriculture, etc.