



Intelligent Energy  Europe



# **Energy Efficiency Policies and Measures in Denmark**

**Monitoring of Energy Efficiency in EU 27,  
Denmark (ODYSSEE-MURE)**

**Danish Energy Agency**

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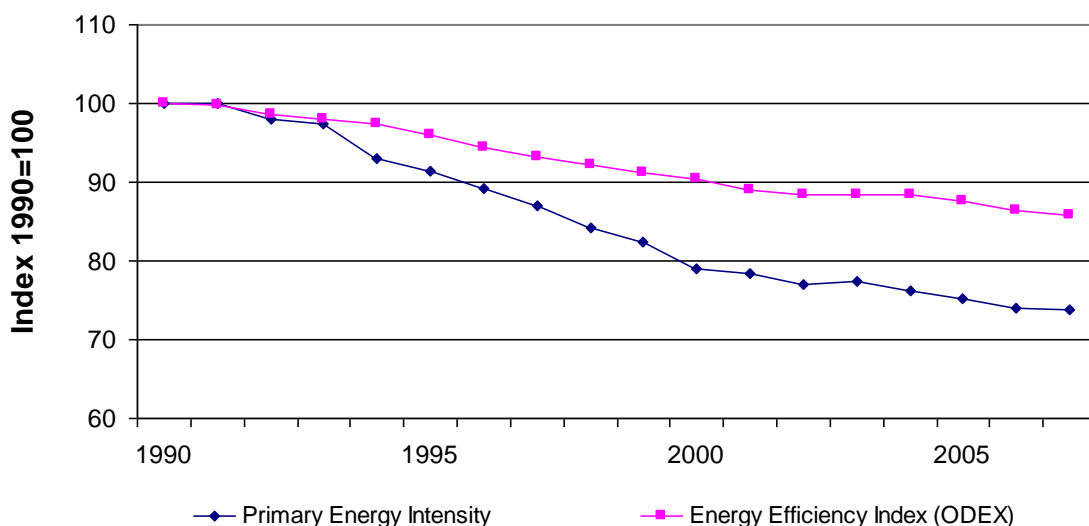
# 1 Executive summary

Since 1990, the energy efficiency has improved significantly in Denmark. A rough indicator for this is the development in the primary energy intensity which from 1990 to 2007 has declined by 26.3%.

The energy efficiency of final consumers (measured as a three-year moving average) improved by 14.1% from 1990 to 2007. The bottom-up index, referred to as ODEX, experienced a decrease from 100 in 1990 to 85.9 in 2007. All sectors have contributed to this significant improvement in energy efficiency. In the period 2000-2007, the energy efficiency has increased by 5.1%. Again, all sectors have contributed to the improvement.

Recently the improvement - as in other EU countries – has been modest. The Danish government has proposed a new energy strategy and implemented a new energy-saving plan which in the years to come will secure improvement of the energy efficiency.

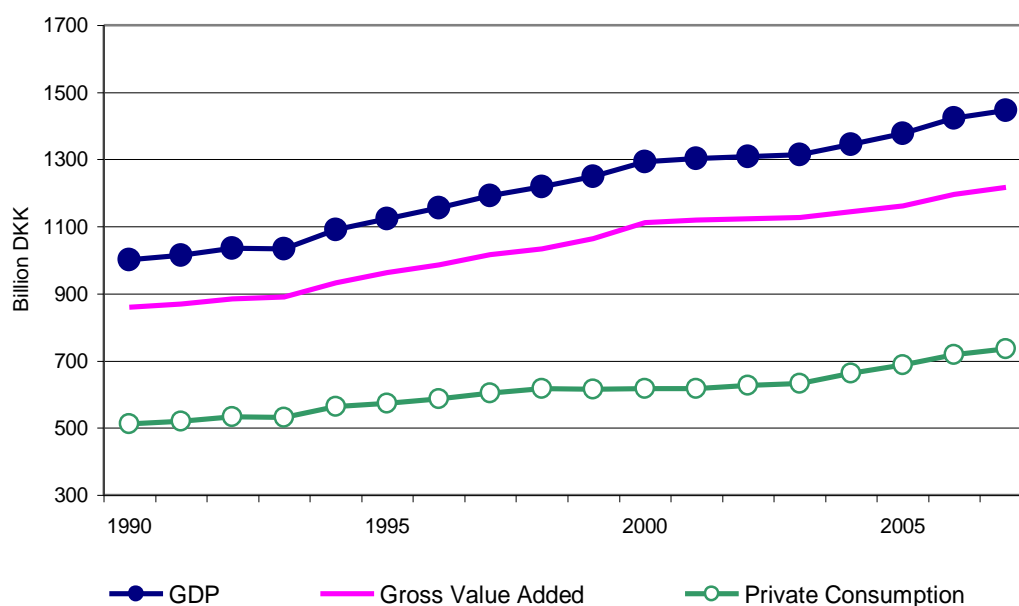
**Primary Energy Intensity and Energy Efficiency Index**



## 2 The background to energy efficiency

### 2.1 Overall economic context

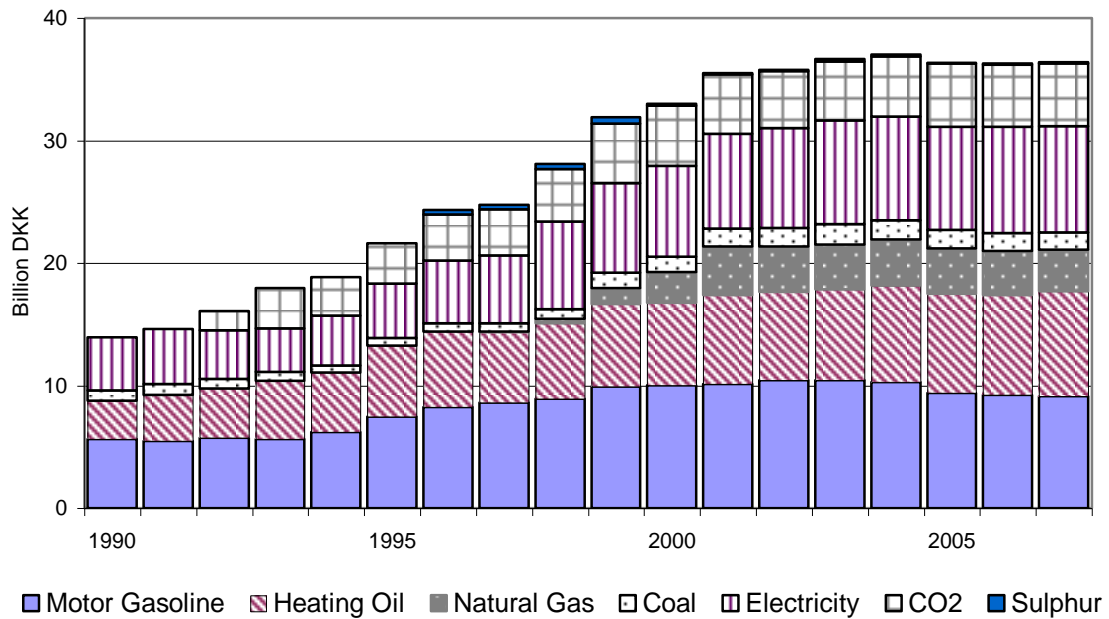
Figure 2.1.1 presents the trends of the main macro-economic indicators from 1990 to 2007. From 1990 to 2007, Denmark has experienced an increase of 44.5% in GDP at constant 2000-prices (chained values), corresponding to an average annual growth of 2.2%. In the period 2000-2007, the annual growth rates have been 1.6%. Since 2000, the Danish economy has experienced large fluctuations. After a soft beginning of the new millennium the economy in 2004 turned into a boom, which lasted until 2006. In 2007, the economy again slowed down and the annual growth in GDP fell from 3.3% to 1.6%.



**Figure 2.1.1 Macro economic development in Denmark. 2000 prices**

A similar development is seen in the gross value added (GVA) figures. From 1990 to 2007, GVA increased by 41.7% corresponding to an average annual growth of 2.1%.

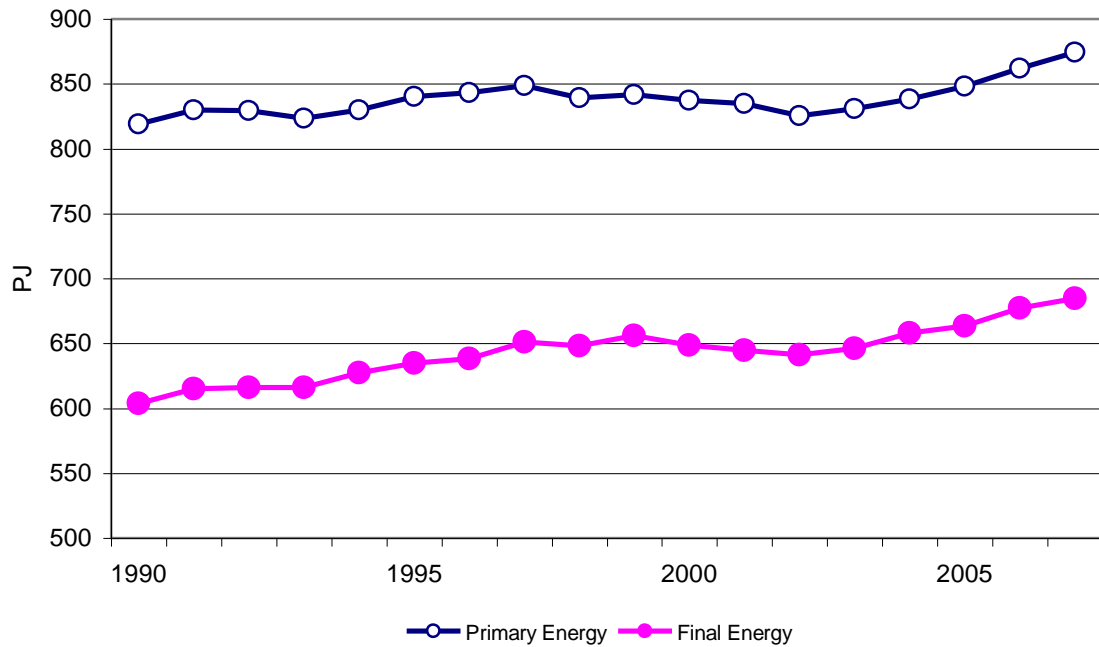
From 1990 to 2007 private consumption in households has increased by 43.9% corresponding to an annual growth of 2.2%. Since 2002, private consumption has expanded fast, i.e. by 3.3% per year.



**Figure 2.1.2 Revenues from energy, CO<sub>2</sub>, and sulphur taxes.** Current prices

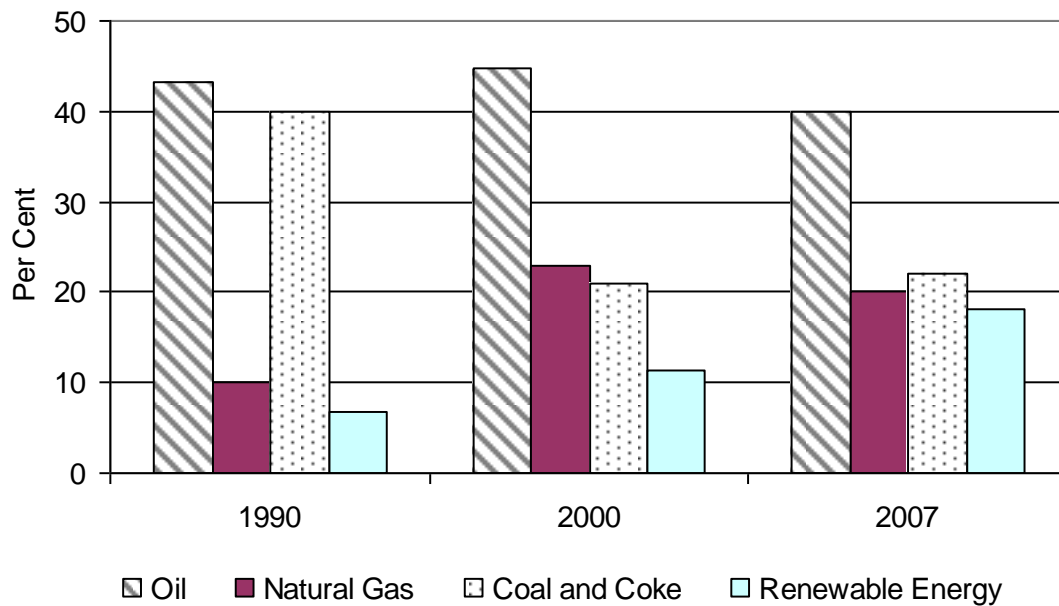
Energy taxes are an important political instrument in Denmark. In 2007, energy taxes amounted to DKK 36.4 billion, i.e. accounted for 4.4% of total tax revenues in Denmark. Revenues are stated in prices for the relevant year and include taxes on CO<sub>2</sub> and sulphur in addition to energy taxes proper. Since 1990, revenues have increased by 161%. Since 1990, revenues from taxes on motor gasoline, heating oil and electricity have gone up respectively by 62%, 173% and 101%.

## 2.2 Energy consumption trends



**Figure 2.2.1 Primary and final energy consumption in Denmark.** Climate adjusted

Figure 2.2.1 shows primary (or gross) and final energy consumption adjusted for climatic variations. From 1990 to 2007, primary energy consumption has increased by 6.7%, i.e. from 819 PJ to 874 PJ. In the same period, final energy consumption (incl. non-energy use) increased by 13.4% (from 604 PJ to 685 PJ) or by 0.7% per year.

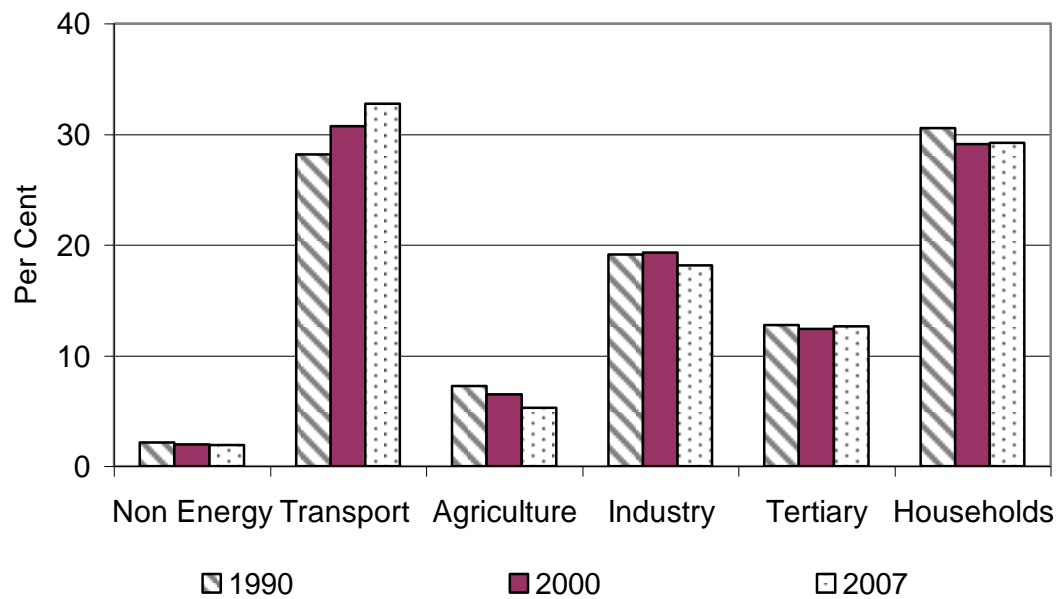


**Figure 2.2.2 Final energy consumption by fuel.** Climate adjusted

In 2007, oil was still the dominant fuel in final energy consumption due to the development in the transport sector. The share of oil was 46.3% compared to 53.3% in 1990. Other important fuels in final energy consumption are electricity and district heating. In 2007, the shares of electricity and district heating were 17.8% and 15.0 respectively. The shares of natural gas and renewable were 10.6% and 8.5% respectively.

Since 1990, final consumption of natural gas has increased by 45.3 per cent, while the consumption of electricity and district heating grew by 18.1 per cent and 25.9 per cent, respectively. Compared to 1990, consumption of renewable energy has gone up by more than 100 per cent.

## Energy Efficiency Policies and Measures in Denmark in 2007



**Figure 2.2.3 Final energy consumption by sector. Climate adjusted**

The composition of final energy consumption by end-users is illustrated in Figure 2.2.3. In Denmark, the two dominant energy consuming sectors are transport and households. In 2007, the share of transport was 32.8% compared to 28.2% in 1990. In 1996, transport became for the first time the most energy-consuming sector. The share of households fell from 30.5% in 1990 to 29.2% in 2007.

From 1990 to 2007, the share of industry has declined from 19.1% to 18.1%, The shares of agriculture fell from 7.3% to 5.3%, whereas the share of the tertiary sector has been fairly constant throughout the period.

## **2.3 The policy background to energy efficiency**

The last Energy Efficiency Action Plan was published in 2006. This action plan was also the main part of the Danish Energy Efficiency Action Plan delivered to the EU Commission as a part of the Energy Service Directive.

However, in the February 21st 2008 political agreement, the annual energy saving target has been increased to a level of 1.5 percent of the total final energy consumption. On that basis, several new measures have been introduced.

The Danish Government has also set up a long term goal of Denmark becoming completely independent of fossil fuels. The background is a combination of a reduction in CO<sub>2</sub> emissions and energy security. Over the next year or two the government must present a plan to meet this long term goal. It is clear that reducing energy consumption by improving energy efficiency will become a very important element in this plan.

### **Independent evaluation**

Following the political agreement of February 21<sup>st</sup> 2008 regarding energy policy, an independent evaluation of the overall energy saving efforts was completed in December 2008. The following initiatives and measures were included in the evaluation:

- Energy taxes and the CO<sub>2</sub> emissions trading scheme
- Saving activities delivered by the grid and distribution companies in the electricity, natural-gas, district-heating and oil sectors.
- Energy labeling of buildings
- The Danish Electricity Savings Trust
- The energy provisions of the building directive
- Energy labeling and standards in relation to electric appliances etc.
- Directives on energy savings in the public sector
- Voluntary energy efficiency agreements with the industrial sector
- The Danish Energy Associations energy savings fund

The evaluation shows that all the energy saving activities were cost-effective, except energy labeling of buildings. In addition, a large saving potential still remains.

Another conclusion of the evaluation was that the various energy saving activities are developed over a period of time as responses to very different challenges and under different conditions. As a result, the coordination between the various activities could be improved.

The evaluation has the following recommendations:

- Establish a long term program (ten years) for energy savings covering all sectors and energy forms.
- Enhance energy saving efforts in regards to the business sector.
- Establish a priority mechanism for energy savings including all energy goals and targets set by the political system.
- Reduce the costs of the energy labeling scheme of buildings.
- Promote energy savings in existing buildings.

### **Significant new policies and measure**

*Sustainable transport:* January 2009 the Danish government introduced the strategy 'Sustainable transport – Better infrastructure' with among others the objective of reducing transport associated CO<sub>2</sub> emissions. This strategy among others supports the introduction of electric vehicles by introducing a tax exemption until 2012 and subsequent reduced taxes in 2012-2015.

*Tax reform:* March 2009 a comprehensive tax reform was enacted. A central element of the reform is a tax increase on both pollution and energy consumption, which includes raised taxes on energy used for heating and cooling, increased green taxes on electricity in general, and a tax on different kinds of fuels used for production.

*Grid and distribution companies:* In Denmark the grid and distribution companies contribute to the realization of energy savings. As a result of the comprehensive saving targets in the energy agreement from February 21<sup>st</sup> 2008, the saving target of grid and distribution companies will be increased by 85 percent by 2010. By 2010 the grid and

distribution companies must ensure savings of 5.4 PJ/year. At present, the Danish Energy Agency is negotiating a agreement with the grid and distribution companies, specific energy saving targets for each energy sector and rules for calculation, documentation etc. of the savings.

*Reorganisation of the Danish energy saving efforts:* By the end of 2009 the government is expected to present a reorganisation of the collective Danish energy saving efforts, which is introduced as a long term energy savings program covering the period 2010 to 2020. The goal is to achieve a more coordinated, efficient, and effective approach to energy savings within all sectors except transport.

*Strategy for energy efficiency in buildings:* 40 percent of the energy consumed in Denmark is used in buildings. Therefore, April 2009 the government presented a strategy for the further reduction of energy use in buildings. The aim is to substantially reduce the energy use in existing as well as new buildings among others through a further tightening of the thermal building code, specifications of requirements on the use of components for renovations, more effective use of the energy labelling of buildings, etc.

*Eco-design:* Denmark highly prioritizes setting ambitious energy efficiency requirements for energy using products for a vast number of household and industrial energy using products. To ensure that the requirements are ambitious the Danish government closely follows and actively participates in the Eco-design legislation process. Energy efficiency requirements have already been adopted for eight product groups (e.g. TV, lighting, refrigerators and freezers, standby consumption, electrical motors etc.), and many more are currently underway.

### **Successes of energy efficiency policies and measures**

Denmark has been able to keep energy consumption stable over a very long period of time, and at the same time uphold a strong economic growth. Increased end-use energy efficiency is one of the main reasons for that. Another important element is a more efficient supply system with a large share of CHP.

The success stories on energy efficiency have in general been based on a combination of:

- Regulation including standards

## Energy Efficiency Policies and Measures in Denmark in 2007

- Economic incentives by introducing taxes on energy consumption, subsidy schemes, etc.
- Involvement of the consumers, awareness raising measures, etc.

Some of the conclusions from the Danish assessment of policy mix against the 25 recommendations from IEA are the following:

- Denmark is very good in relation to energy efficiency in buildings.
- In relation to appliances Denmark is very dependent on EU regulation. In addition to this, The Electricity Saving Trust is working with campaigns, market transformation, voluntary agreements, etc.
- Historically, Denmark has had very little focus on energy efficiency in the transport sector.
- Denmark has several measures, which are not very well covered by the 25 recommendations.

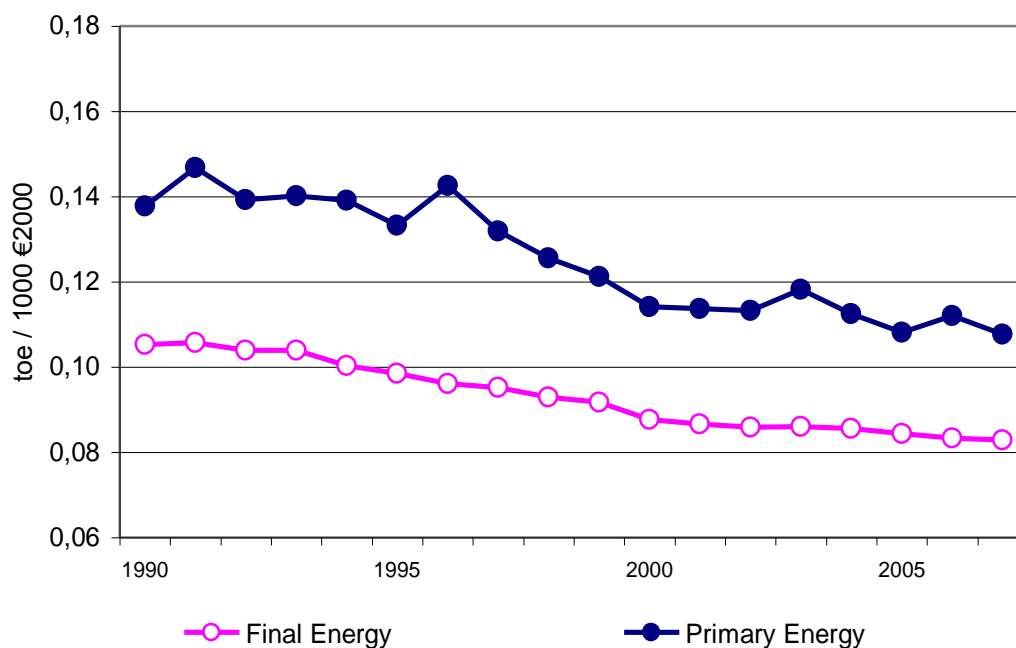
### 3 Overall assessment of energy efficiency trends

#### 3.1 Overall trends in energy intensity

The development in the energy intensities of primary (gross) energy consumption and final energy consumption during the period 1990 to 2007 is shown in figure 3.1.1. Energy intensity is defined as the ratio between energy consumption and GDP. The final energy intensity does not include non-energy consumption.

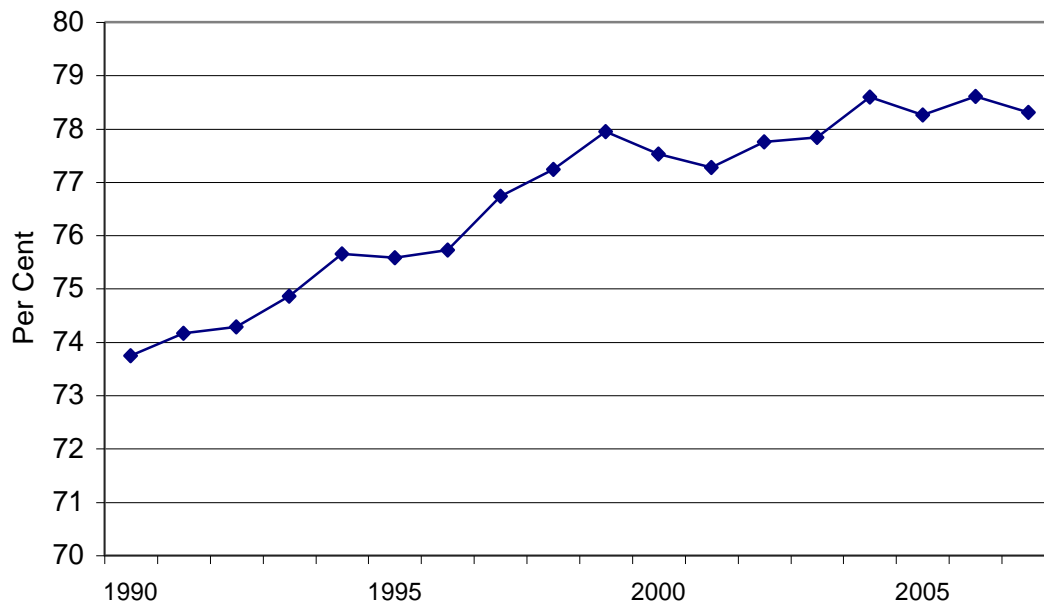
In the period 1990-2007, primary energy intensity fell 21.8% (corresponding to an average annual decline of 3.0%), whereas final intensity fell 21.4% (corresponding to an average annual decline of 2.6%).

Since 2000 the decline in the energy intensity has been more moderate. From 2000 to 2007, primary energy intensity and final energy intensity have decreased by 5.7% and 5.6% respectively (corresponding to an average annual decline of 0.8%). In 2007, primary energy intensity and final energy intensity were 0.108 toe/1000 €2000 and 0.083 toe/1000 €2000 respectively.



**Figure 3.1.1 Primary and final energy intensities in Denmark.** Climate adjusted

Source: Odyssee



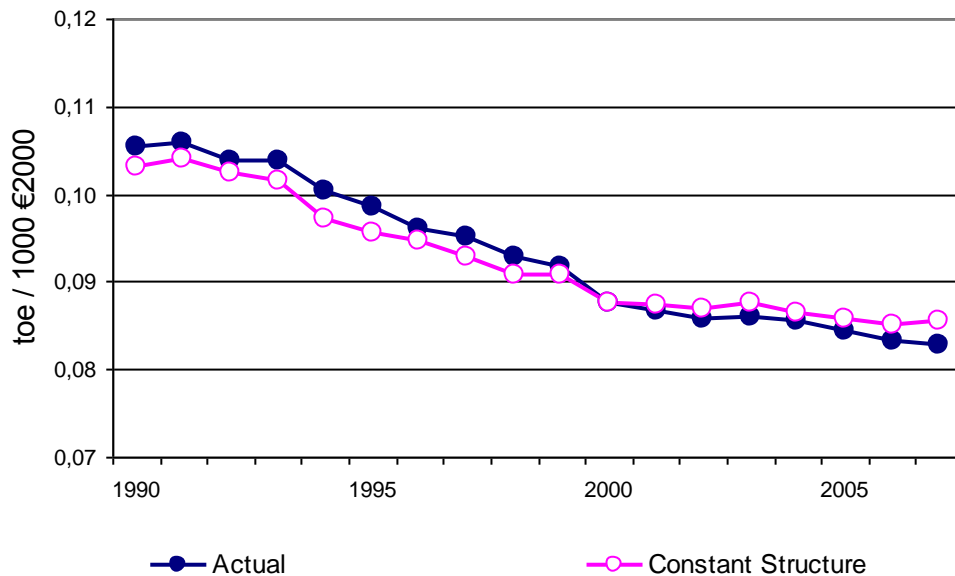
**Figure 3.1.2 Ratio of final energy consumption to primary energy consumption**

*Source: Odyssee*

The difference between final energy consumption and gross energy consumption represents the consumption by extraction and refining, transformation losses during production of electricity and district heating and losses in the distribution of energy.

The relationship between final energy consumption and gross energy consumption can therefore be regarded as an indicator of the efficiency of the total energy system. In the period 1990-2007 the efficiency has improved from 73.8% to 78.3%.

Efficiency in terms of the relationship between final energy consumption and gross energy consumption fell between 1980 and 1989 due to significant increases in the electricity consumption. Following this period, the efficiency increased again due to a fairly weak upwards trend in electricity consumption, and to the fact that an even larger proportion of electricity and district heating is being generated by combined heat and power production. Moreover, wind power has gained more and more significance. Since 2003, there have only been moderate fluctuations in the efficiency.



**Figure 3.1.3 Final energy intensity in Denmark at constant structure**

Source: Odyssee

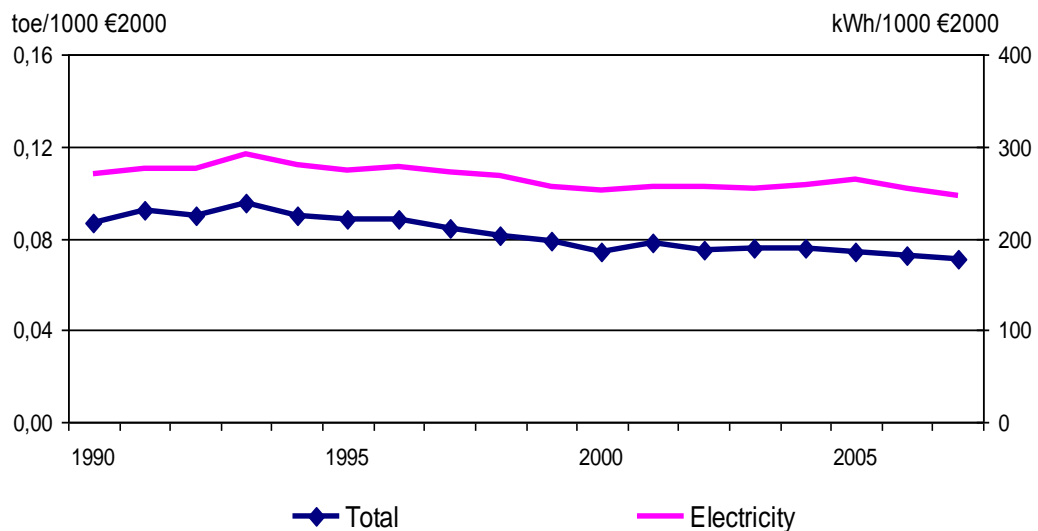
Changes in the economic structure have a more and more important effect on final energy intensity, cf. figure 3.1.3. From 1990 to 2007, the actual intensity fell 21.4%, whereas the constant structure intensity fell 17.0%. The latter indicator eliminates the influence of macro-economic structural changes (as an example the growing service sector), because current sector intensities are calculated at the economic structure level of 2000. Since 2007, the actual intensity fell 5.6%, whereas the constant structure intensity fell 2.5%. This implies that since 2000 more than half of the total fall in final energy intensity are not due to improved energy efficiency, but stems from structural changes.

### 3.2 Industry

Industry includes mining and quarrying (except oil and gas extraction), manufacturing (except oil refineries), and construction. As in all other EC countries manufacturing is the very dominating element in this sector. In 2007, the share of manufacturing was more than 90% of the energy consumption and 72% of the gross value added.

From 1990 to 2007, the energy intensity in industry fell from 0.087 toe/1000 €2000 to 0.071 toe/1000 €2000 or by 18.0%, cf. figure 3.2.1. In the sub-period 1990-93, the energy intensity increased by 9.6%, whereas the energy intensity fell 6.4% in the following 5-years period. This development can be seen as an indication of the effectiveness of “The green tax package”, although an important part is due to a business cycle effect. Since 2000, the energy intensity has decreased by 4.1%.

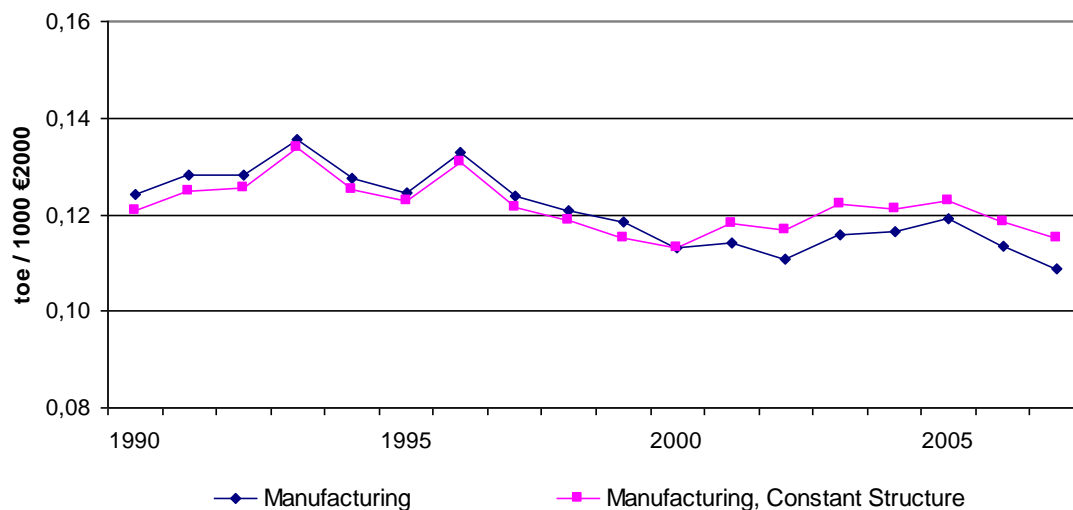
From 1990 to 2007, the electricity intensity fell from 269 kWh/1000 €2000 to 247 kWh/1000 €2000 or by 8.3%. After an increase at the beginning of the 90'ies - partly due to a continuation of a shift from fossil fuels to electricity - the electricity intensity fell 14.0% from 1993 to 2000. After 2000, the development in the intensity has changed again and the years until 2005 are characterized by growth. From 2000 to 2007, the electricity intensity has decreased by 1.8% due to falls in the two last years.



**Figure 3.2.1 Energy and electricity intensities in industry**

Source: Odyssee

From 1990 to 2007, the actual energy intensity in manufacturing has decreased from 0.124 toe/1000 €2000 to 0.109 toe/1000 €2000 equivalent to 12.5%, cf. figure 3.2.2. In the same period, the constant structure energy intensity has decreased by 4.8%. Changes in the structure of manufacturing have had a certain effect on the energy intensity. The latter indicator eliminates the influence of structural changes, because current branch level intensities are calculated at the structure level of 2000. The development toward less energy intensive branches - which can be explained by globalization and changes in the domestic demand for manufacturing goods - has accelerated in the last years. From 2000 to 2007, the actual energy intensity has decreased by 3.9%, whereas the constant structure energy intensity has increased by 1.6%.



**Figure 3.2.2 Final energy intensity in manufacturing**

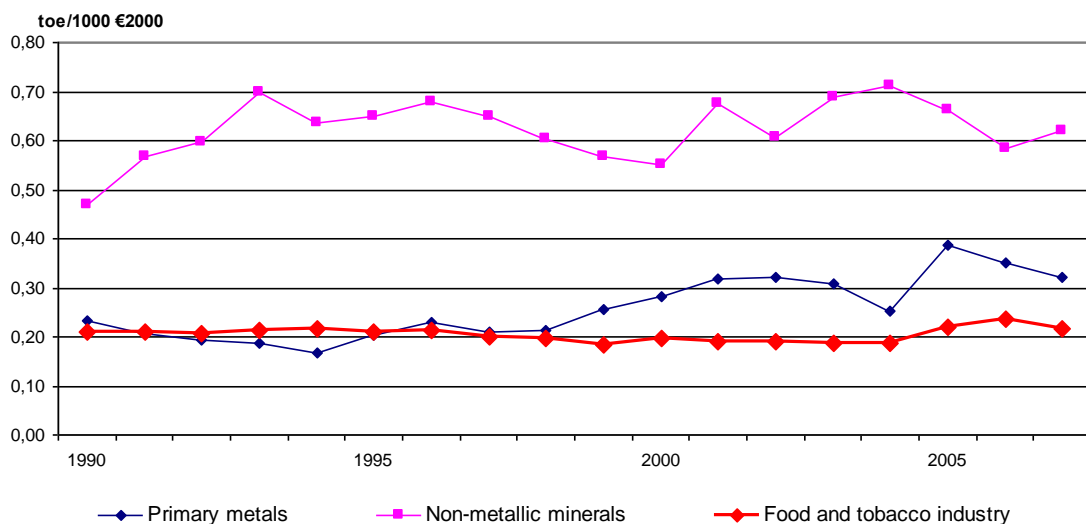
Source: Odyssee

Manufacturing industry can be subdivided into highly energy intensive branches and flow energy intensive branches. In addition to those branches there is a remaining category of minor importance (Other manufacturing).

The highly energy intensive branches comprise: Food, beverage and tobacco, Wood, Non-metallic minerals and Primary metals.

The low energy intensive branches comprise: Textile and leather, Paper industry, Chemicals, Machinery and Transport equipment.

*Non-metallic minerals* is in a class by itself concerning energy intensity, cf. figure 3.2.3. From 1990 to 1993, the energy intensity in Non metallic minerals increased from 0.468 toe/1000 €2000 to 0.699 toe/1000 €2000. After a decline, until 2002, the intensity reached a new peak in 2004 (0.712 toe /1000 €2000). In the whole period 1990-2007, the energy intensity has increased by 32.7%. The development in the first part of the 1990'ies is also found in most of the other branches. From 1990 to 2007, the energy intensity in *Food, beverage and tobacco* has increased by 2.6% due to an 0.197 toe/1000 €2000 increase at the end of the period. In the period 2000-2007, the energy intensity increased from 0.197 toe/1000 €2000 to 0.215 toe/1000 €2000 or by 9.1%. In *Primary metals*, the energy intensity has increased by 38.3% from 1990 to 2007 and 12.9% from 2000 to 2007. This branch is of minor importance in Denmark today.



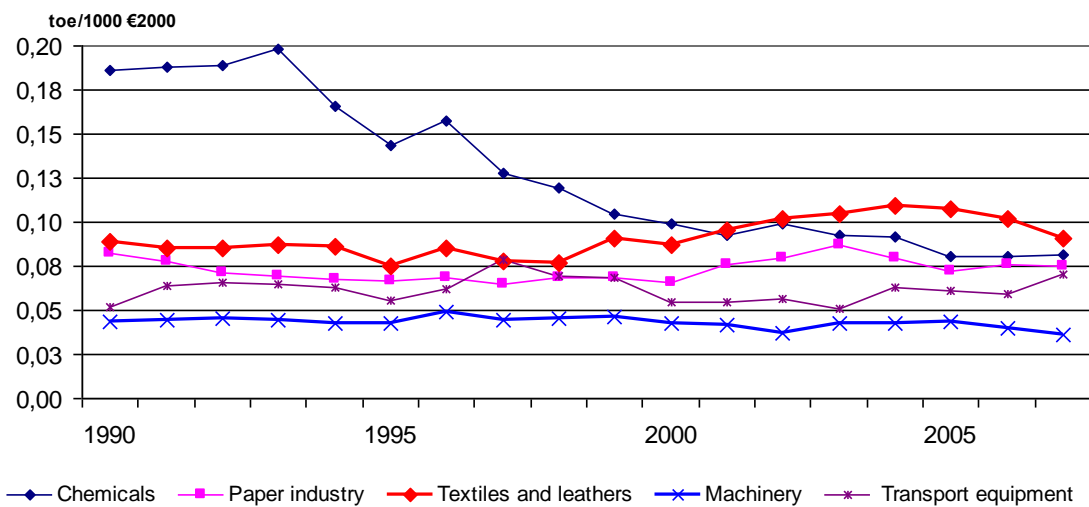
**Figure 3.2.3 Energy intensity in manufacturing in highly intensive branches**

Source: Odyssee

Figure 3.2.4 depicts the tendency in the low energy intensive branches. In *Chemicals* one again finds different developments in the sub-periods 1990-93 and the preceding years. In 2009, the energy intensity was 0.082 toe/1000 €2000, which is 56.1% lower than in 1990. Since 2000, the energy intensity is decreased by 17.1%. In 2007, the energy intensity in *Pulp, paper and printing* (production of pulp is not important in Denmark) was 0,075 toe/1000 €2000, which is an decrease of 8.3 % compared to 1990.

The energy intensity in *Textiles and leather* increased by 2.1% from 1990 to 2007 due to an increase in the last part of the period. In 2007, the energy intensity was 0,091 toe/1000 €2000. Since 2000, the energy intensity has increased by 4.4%.

The lowest energy intensity is found in *Machinery* fluctuating around 0.04 toe/1000 €2000 until 2005. Because of significant falls in 2006 and 2007 (where the intensity was 0,036 toe/1000 €2000), the energy intensity was 18.0% lower in 2007 compared to 1990.



**Figure 3.2.4 Energy intensity in manufacturing in low intensive branches**

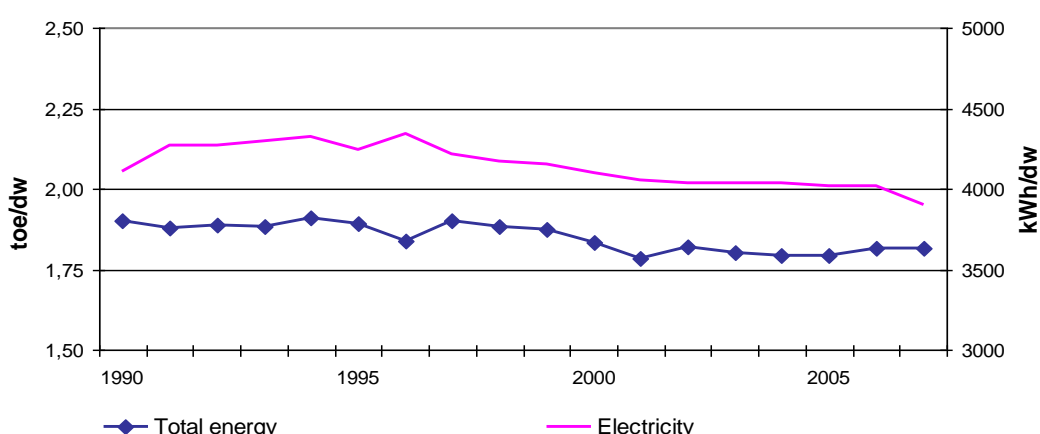
Source: Odyssee

### 3.3 Households

Looking at the annual changes in energy consumption, the potentially strong influence of climatic variations should be taken into account. 1990 and 2000 were exceptionally mild years, whereas 1996 was an exceptionally cold year. It has to be born in mind that it is very difficult for climate adjustment procedures to handle such extreme years.

The development of unit energy consumption per dwelling has been very different especially in the periods 1990-2001 and 2001-2007. From 1990-2001, unit energy consumption per dwelling experienced a fall from 1.90 toe/dw to 1.78 toe/dw, which corresponds to a fall of 6.1%. In the preceding period, the unit energy consumption per dwelling has increased by 1.9%. The different developments can partly be explained by opposite fuel shifts effects in the two periods. In the first period there was a shift from oil to the more efficient sources natural gas and district heating. The second period has been dominated by a shift towards firewood and wood pellets – renewable fuels with relatively low efficiency. For the whole period 1990-2007, the unit energy consumption per dwelling fell 4.3%. In 2007, the unit energy consumption per dwelling was 1.82 toe/dw.

From 1990 to 2007, the unit electricity consumption per dwelling fell from 4108 kWh/dw to 3900 kWh/dw or by 3.7%. Again, the development has been different in the two sub periods 1990-2001 and 2001-2007. In the first period, the unit electricity consumption fell 1.4%, whereas the decline in the preceding period was 3.7%. The faster decline in 2001-2007 is due to a reduction of electricity to space heating and electricity saving politics.



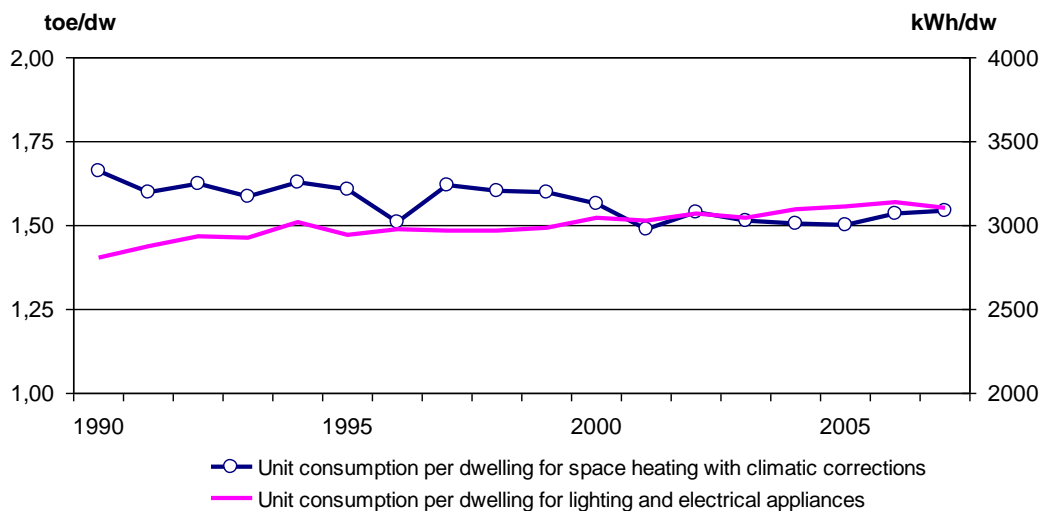
**Figure 3.3.1 Unit consumption per dwelling in households.** Climate adjusted

Source: Odyssee

Figure 3.3.2 focuses on the development of unit consumption for space heating and unit consumption for electricity for lighting and appliances. In the period 1990-2007, the unit consumption for space heating fell from 1.98 toe/dw to 1.54 toe/dw equivalent to a decline of 7.1%.

In the same period, the unit consumption for electricity for lighting and appliances increased from 2524 kWh/dw to 3100 kWh/dw equivalent to an increase of 10.5%.

From 1990 to 2001, the unit consumption for space heating and the unit consumption for electricity for lighting and appliances developed very differently; while the former fell 10.6% the latter increased 7.7%. From 2001 to 2007, the development has been almost similar with increases of 3.9% and 2.5% respectively.



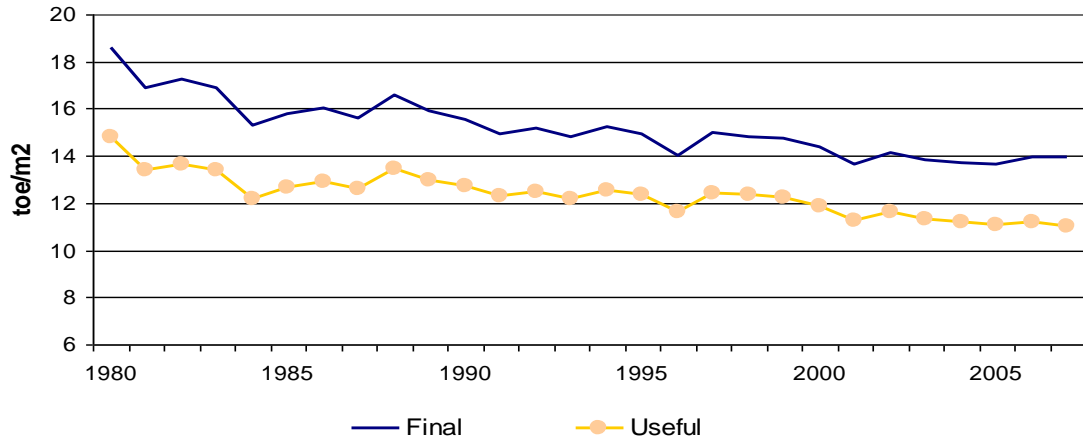
**Figure 3.3.2 Unit consumption for space heating in households. Climate adjusted**

Source: Odyssee

Figure 3.3.3 shows the trend in climate adjusted unit consumption for space heating per dwelling. The development is shown for final energy consumption and useful energy, i.e. energy consumption less local losses.

In the period 1990-2007, the unit consumption for space heating fell from 15.53 koe/m<sup>2</sup> to 13.97 koe/m<sup>2</sup>, i.e. with 10.1%. Unit consumption for space heating – measured as useful energy - fell in the same period 13.3%. From 2001 to 2007, the unit consumption for space heating measured as final energy and useful energy grew 2.3% and fell 2.1%

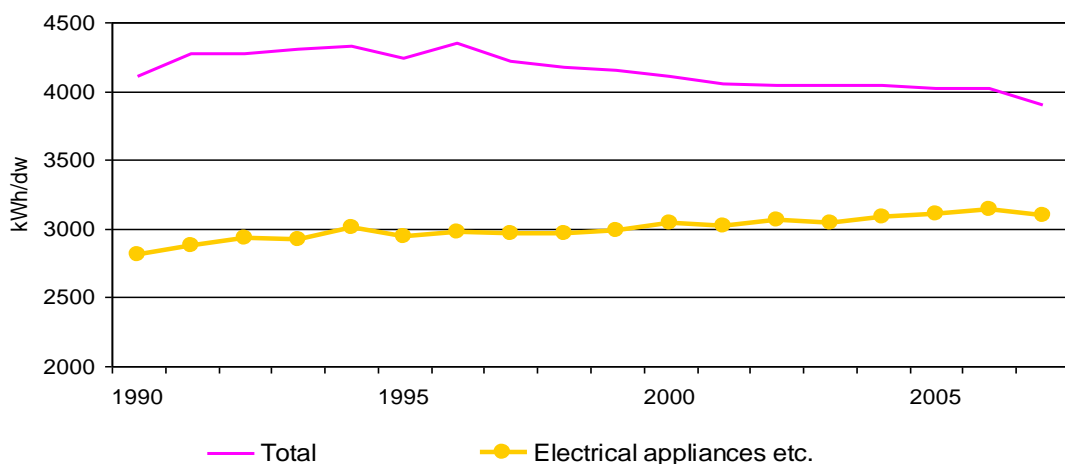
respectively. As mentioned before, this is due to a significant shift towards firewood and wood pellets.



**Figure 3.3.3 Unit consumption per m<sup>2</sup> for space heating.** Climate adjusted

Source: Odyssee

Looking at the development in electricity consumption in households, electricity for space heating is crucial important, cf. figure 3.3.4. From 1990 to 2007, the unit consumption for electricity fell 5.1% (from 4108 kWh/dw to 3900 kWh/dw). Looking only at electricity consumption for lighting and electrical appliances, unit consumption in the same period has increased by 10.5% (from 2806 kWh/dw to 3100 kWh/dw). The different developments in the two unit consumption series are due to a significant decline in electricity used for space heating

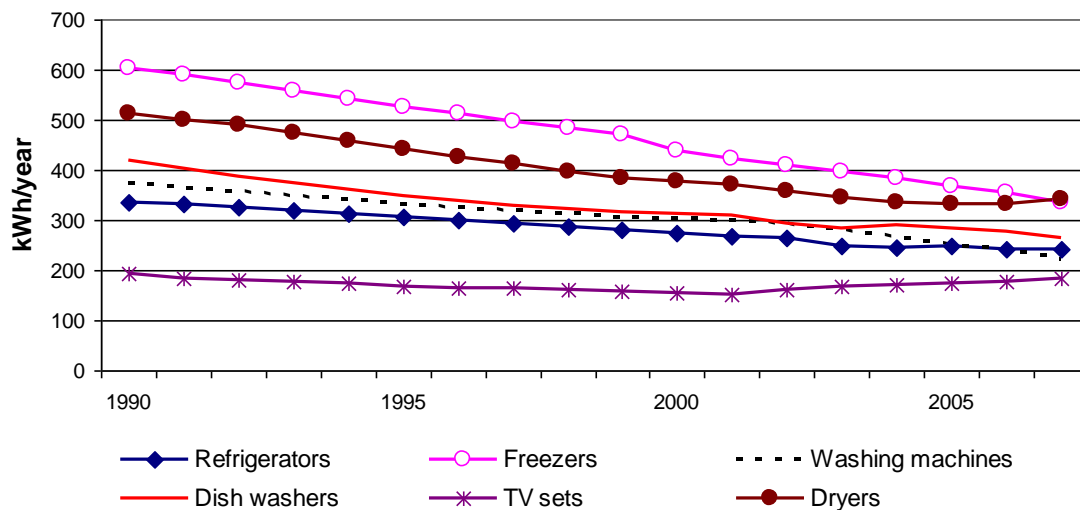


**Figure 3.3.4 Unit electricity consumption per dwelling**

Source: Odyssee

In Denmark – as in all other EU member countries - the number of all kind of electrical appliances has exhibited a significant increase.

Ceteris paribus one should have expected that the outcome of this development has been a significant increase in the electricity consumption. This has not happened and can be explained by a general decline in the specific consumption of all electrical appliances in the same period, cf. figure 3.3.5. Taken as examples from 1990 to 2009, the specific consumption of independent freezers and washing mashines has fallen by 44.3% and 40.2% respectively.



**Figure 3.3.5 Specific consumption of electrical appliances**

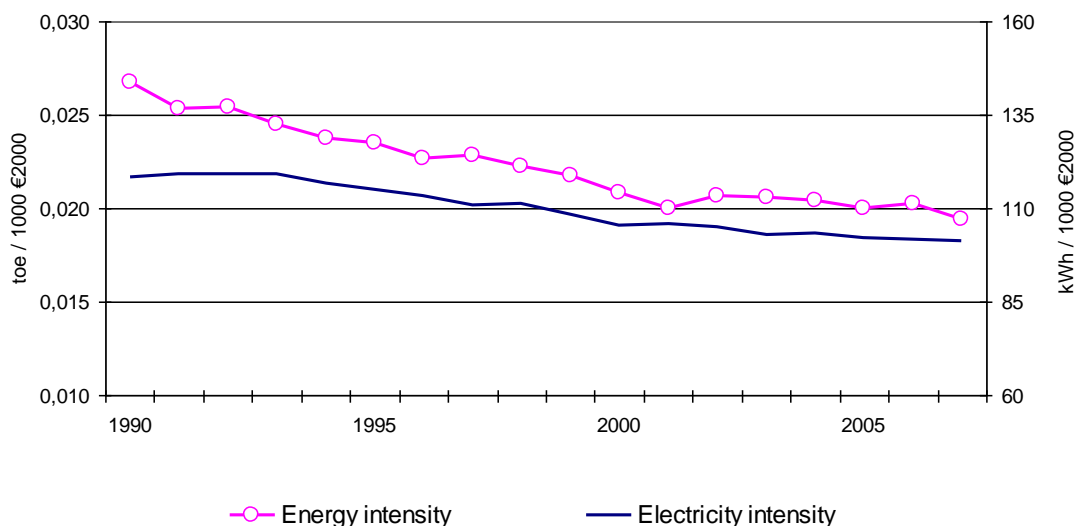
Source: Odyssee

### 3.4 Services

As was the case in Households, the total energy consumption in the service sector (the trade and service sector) is highly dependent on climatic conditions (degree-days), since most of the energy is used for space heating.

In the period 1990 to 2007, the energy intensity in the service sector - after climatic adjustments – has shown a significant fall of 27,3% (from 0.034 toe/1000 €2000 in 1990 to 0.019 toe/1000 €2000 in 2007). Since 2000, the energy intensity has decreased by 6.5%.

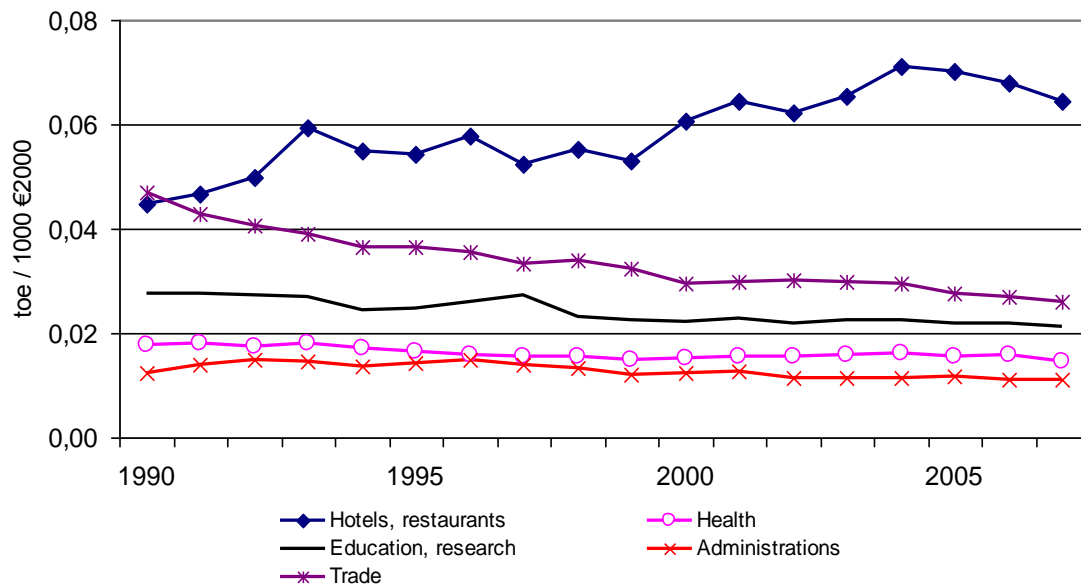
In 2007, the electricity intensity was 101 kWh/1000 €2000, which is 14.6% lower than in 1990. Since 2000, the electricity intensity has declined 4.0%. The lower falls in the electricity intensity compared to total energy is due to a continuous electrification of the service sector (a still higher share of electricity).



**Figure 3.4.1 Energy intensity in the service sector. Climate adjusted**

Source: Odyssee

The energy intensity in the service sector by branch is shown in figure 3.4.2. The energy intensity is highest in *Hotels and restaurants* (0.065 toe/1000 €2000 in 2007) and lowest in *Administrations* (0.011 toe/1000 €2000 in 2007). In the period 1990-2007, the energy intensity has increased in *Hotels and restaurants*. In all other branches the energy intensity has decreased. The most significant decrease is seen in *Trade*, where the energy intensity has decreased by 44.4%.



**Figure 3.4.2 Energy intensity in the service sector by branch. Climate adjusted**

Source: Odyssee

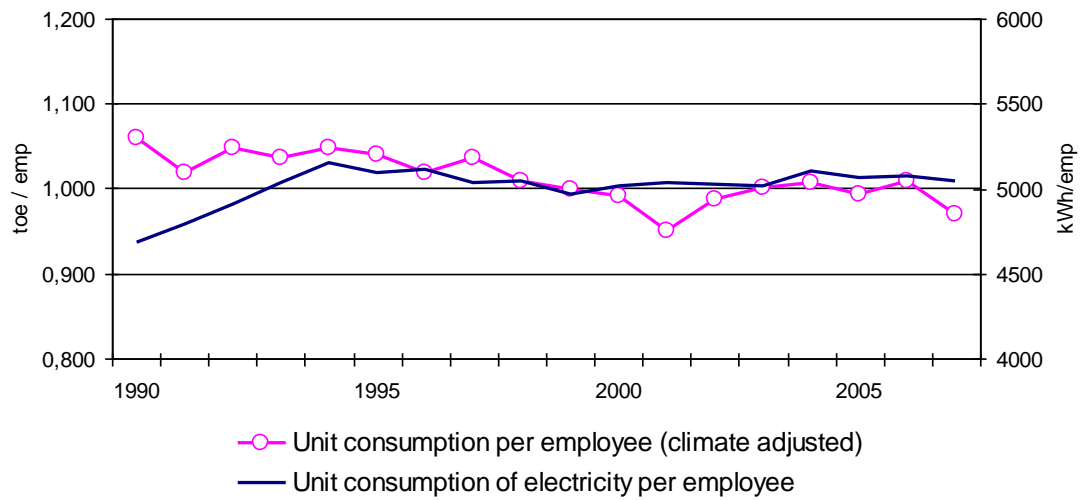
Figure 3.4.3 shows unit consumption in the service sector measured as total energy consumption and electricity consumption per employee. In the period 1990-2007, total unit consumption fell 8.3%. Since 2000, the unit consumption has decreased by 2.0% due to a significant drop in 2007.

From 1990 to 2007, the unit consumption of electricity increased 7.7%. Since 2000, the unit consumption has been almost constant (increased by 0.6%).

The considerable differences in the development in the energy intensity and the unit consumption per employee can be explained by a significant increase in labour productivity (measured as gross value added/total employment) over the period.

The development in the unit consumption measures should be taken as a warning signal. Unless new improvements are initiated, the expected increase in the number of employees will lead to a significant increase in the energy and electricity consumption.

### Energy Efficiency Policies and Measures in Denmark in 2007

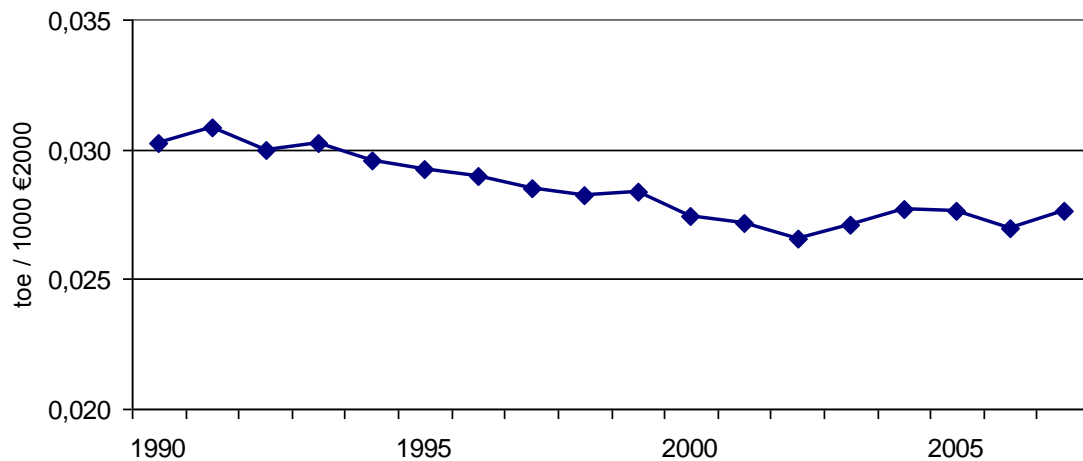


**Figure 3.4.3 Unit consumption per employee in the service sector. Climate adj.**

Source: Odyssee

### 3.5 Transport

A macro economic quick view of the development 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, cf. figure 3.5.1. In the period 1990-2007, the energy intensity in transport has declined 8.7%, which means that the amount of transport needed to produce one unit of GDP has declined 8.7% since 1990. From 2000 to 2007, the intensity has increased modestly by 0.7%

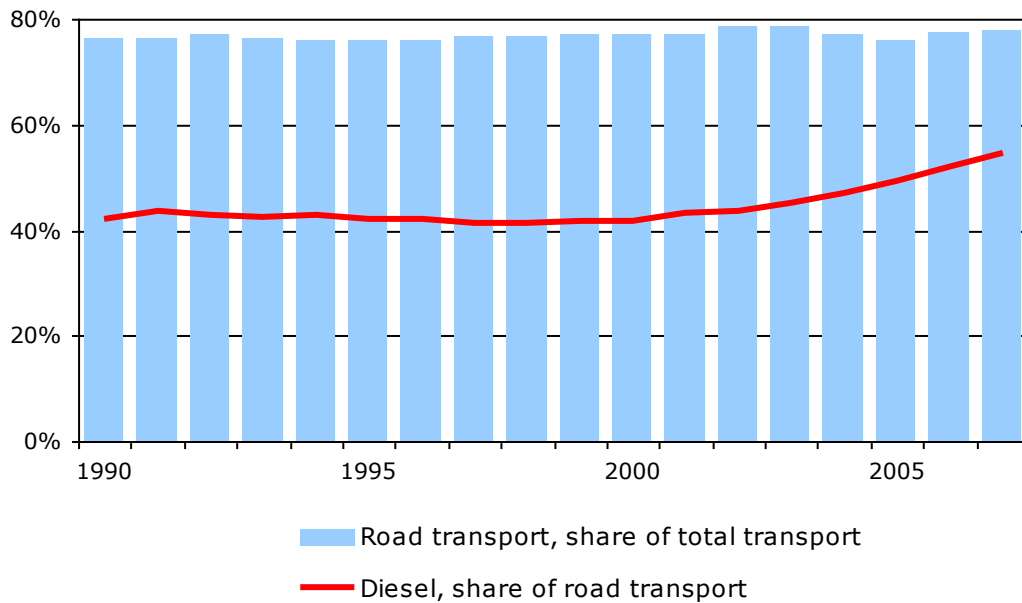


**Figure 3.5.1 Energy intensity of transport**

Source: Odyssee

When energy consumption for transport is divided by modes the picture in Denmark does not differ from the picture in other countries: The consumption for road transport is very dominating, see figure 3.5.2. In 2007, the share of energy for road transport was 77.6% compared to 77.1% in 2000 and 76.3% in 1990.

The share of road transport has only increased very modest over time, but the composition of fuels has changed significantly. The consumption of diesel has increased at the expense of gasoline. In 2007, the share of diesel was 54.7% compared to 41.8% in 2000 and 42.1% in 1990. The higher share of diesel has had a positive influence on the efficiency in road transport.



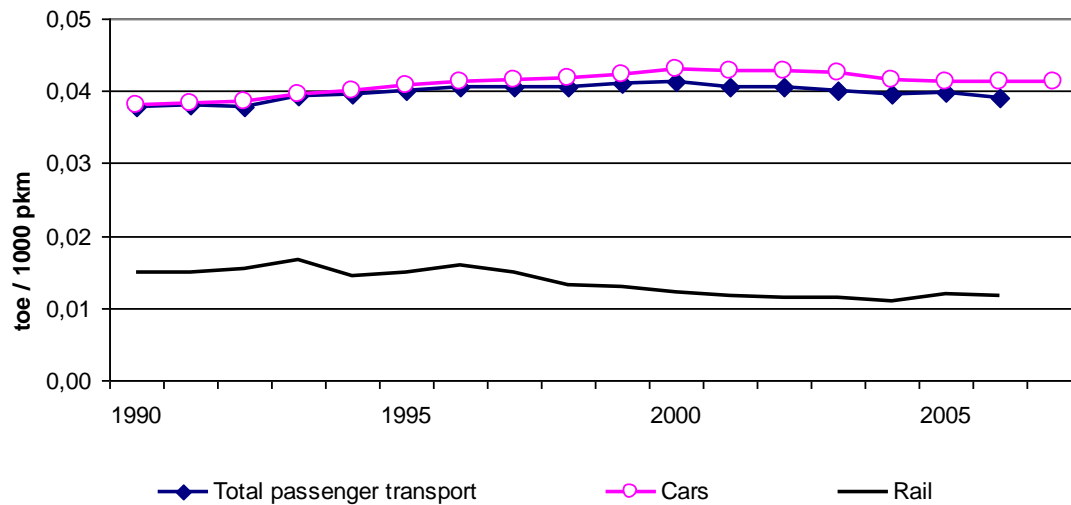
**Figure 3.5.2 Shares of road transport and diesel for road transport**

Source: Odyssee

The overall energy consumption for passenger transport – measured as toe per 1000 passenger-kilometre – has increased from 0.038 in 1990 to 0.039 in 2006 equivalent to an increase of 3,5%. From 2000 to 2006, the overall unit consumption fell 5.3%. This means that an average kilometre of passenger transport since 2000 is carried out with 5.3% less energy and there has been an improvement in the overall energy efficiency.

In the period 1990-2000, the unit consumption per passenger-km for cars has increased by 8.4%. In 2000, the unit consumption was at its highest level - 0,043 toe per 1000 passenger-kilometre. From 2000 to 2007, the situation has improved by a decrease in the unit consumption of 4.1%.

For rails, the unit consumption per passenger-km fell 22.1% in the period 1990-2006 and 5.4% in the period 2000-2006.



**Figure 3.5.3 Unit consumption in passenger transport**

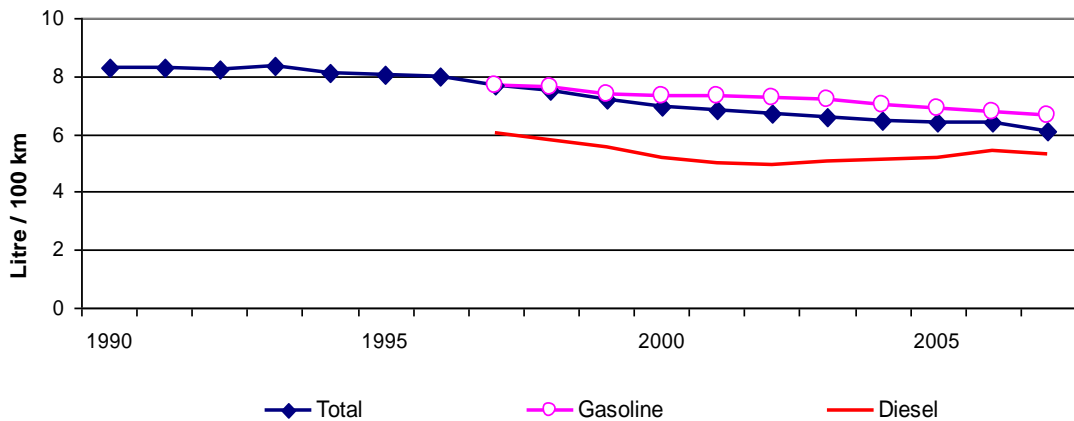
Source: Odyssee

New cars become more and more efficient. Figure 3.5.4 shows the average specific consumption of new cars (total), new gasoline cars and new diesel cars measured as litre of fuel per 100 km. From 1990 to 2007, the average specific consumption for cars (total) fell 26.6% corresponding to an average annual reduction of 1.8%. From 2000 to 2007, the average specific consumption fell 12.8% corresponding to an average annual reduction of 1.9%.

The average specific consumption of new cars (total) depends on more factors. The most important ones are technical standards, size of the cars and fuel mix. In the whole observed period 1997 to 2007, there has been a significant change in the composition of the car fleet toward diesel cars. Since diesel cars are more efficient than gasoline cars, this has contributed to the reduction in the average specific consumption for cars (total).

Another driver for the reduction in the average specific consumption for cars (total) is the more and more efficient gasoline and diesel cars, cf. figure 3.5.4. From 1997 to 2007, the average specific consumption for gasoline cars and diesel cars fell 13.7% and 11.9% respectively.

### Energy Efficiency Policies and Measures in Denmark in 2007

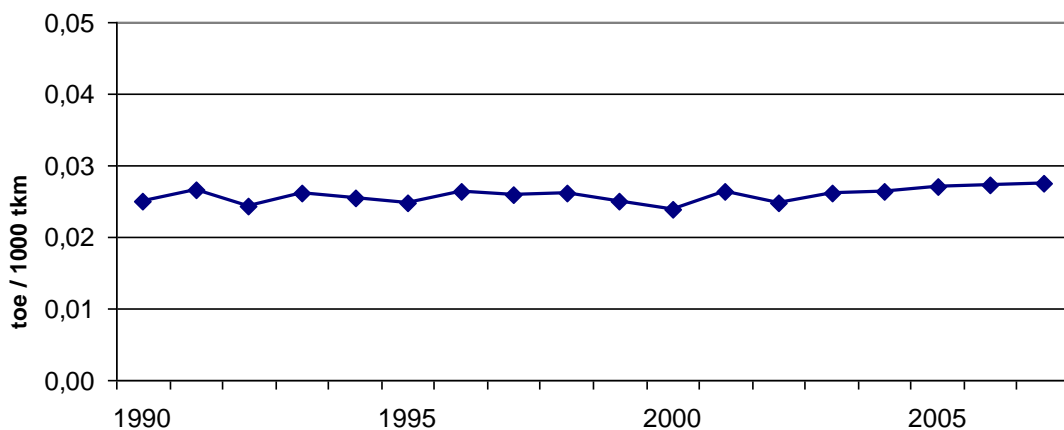


**Figure 3.5.4 Specific consumption of new cars**

Source: Odyssee

In the period 1990-2007, the unit consumption of road transport of goods by trucks – measured as toe per 1000 ton kilometre -has increased by 10.4%, cf. figure 5.4.5. The development has been very different in the two sub-periods 1990-2000 and 2000-2007. In the former period, the unit consumption fell 4.5%, while in the latter period the unit consumption went up by 15.6%.

It has to be stressed that the indicator used does not give a correct picture of the development from 2000 to 2007. This is due to a – for Denmark - problematic definition of the denominator (number of ton kilometre) resulting in a underestimation of the number of ton kilometre in the years after 2000.



**Figure 3.5.5 Unit consumption of road transport by trucks**

Source: Odyssee

### **3.6 Assessment of energy efficiency/savings through ODEX: Total and by sector**

An alternative method to illustrate the development in energy efficiency for final energy consumers by consumption sectors is to use the “energy efficiency index” also called ODEX. This is done in figure 3.6.1, which shows the ODEX-indices (2000=100).

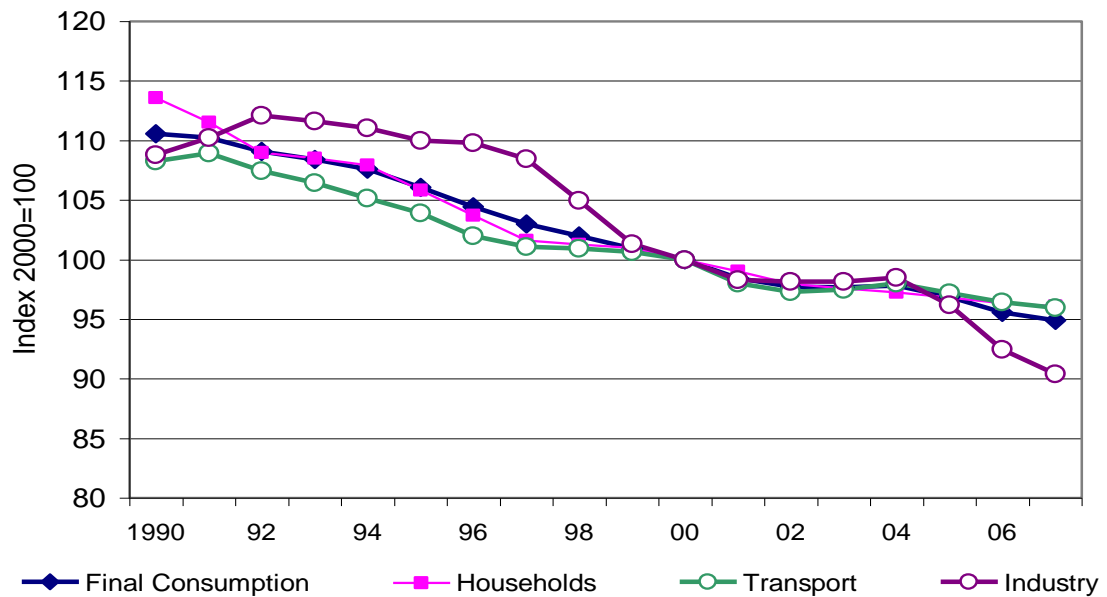
In the period 1990-2007, for total final energy consumption there has been an improvement in energy efficiency of 14.2%, cf. that the ODEX index fell from 110.5 in 1990 to 94.5 in 2007. This corresponds to an average annual improvement of 0.9%. Since 2000, the improvement - as in other EU countries - has been a little slower with an average annual improvement of 0.7%.

All sectors have contributed to this development. From 1990 to 2007, the improvement in energy efficiency in transports was 11.4% corresponding to an average annual improvement of 0.7%. In industry the improvement was 16.9% corresponding to an average annual improvement of 1.1%. In households the improvement was 15.4%, which corresponds to an average annual improvement of 1.0%.

From 2000 to 2007, the improvement has been more modest in transport and households. In both sectors the average annual improvement slowed down to 0.6%. In industry the average annual improvement was 1.4%, which is more the in the years before 2000.

Further information about the ODEX-indicator can be found in Annex 2.

## Energy Efficiency Policies and Measures in Denmark in 2007



**Figure 3.6.1 Energy efficiency indices for final consumption (ODEX)**

Source: Odyssee

ODEX “aggregates” the trends in the unit consumption by sub-sector or by end-use into one index on the basis of the weight of each sub-sector/end-use of total energy consumption. Unit consumption by sub-sector is expressed in different physical units in order to be as close as possible to energy efficiency evaluation, e.g. toe/m<sup>2</sup>, kWh/appliance, toe/ton, litre/100km). The overall ODEX for final consumers is calculated on the basis of about 30 sub-sectors (7 modes in transport, 9 end-uses for households and 11 branches in industry). ODEX is calculated as a 3-year moving average to remove the effect of short-term fluctuations due to business cycles and imperfect climate adjustments.

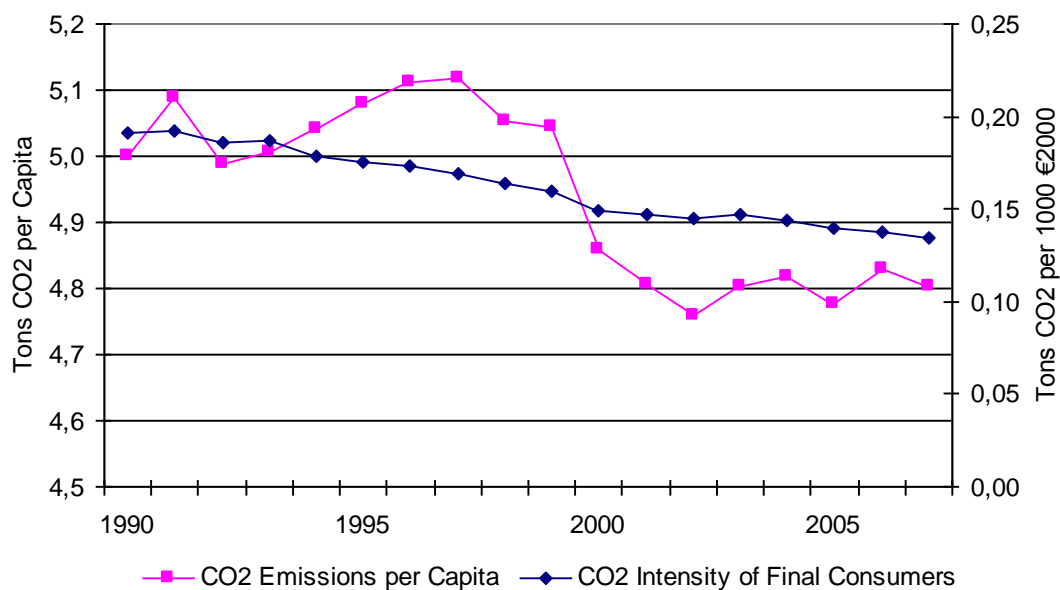
ODEX provides an aggregate indicator to summarise the energy efficiency improvement in a sector. An index of 80 means a 20% improvement of the energy efficiency. In the ODYSSEE database, energy efficiency index of a given sector is an evaluation of aggregate energy savings of all energy-consuming modules.

### 3.7 CO<sub>2</sub>-emissions trends

Figure 3.7.1 shows CO<sub>2</sub> emissions per capita and final consumption of fossil fuels per gross value added unit, when emissions from electricity consumption are excluded.

Measured per capita, the CO<sub>2</sub> emissions have decreased by 3.9% from 1990 to 2007. Since 2000, the CO<sub>2</sub> emissions per capita have decreased 1.2%.

Measured per gross value added unit, the CO<sub>2</sub> emissions have decreased by 29.5%, from 1990 to 2007, which should be compared to the previously mentioned decline in the energy intensity of final consumption of 14.2%. The difference can mainly be explained by the significant changes in fuel composition, from coal and oil to natural gas, renewable energy and district heating. Since 2000, the CO<sub>2</sub> emissions per gross value added unit have decreased 9.7%.



**Figure 3.7.1 CO<sub>2</sub> Emissions from final consumption (excl. electricity)**

Climate adjusted

Source: Odyssee

## **4 Energy efficiency measures**

### **4.1 Recent energy efficiency measures**

#### **Residential Sector**

##### **Energy requirements for new and existing buildings**

Nearly 40% of energy consumption is in buildings; the annual energy bill for heating totals more than DKK 30 billion. As part of meeting the long-term challenges, it is therefore important to reduce energy consumption for heating. This is technically feasible.

The energy requirements for new buildings have been intensified quite considerably over the last 25 years. And there must be ongoing intensification of the energy requirements for new buildings in accordance with technical and economic possibilities. This includes a need for a long-term plan that allows for time to carry out the necessary research and development and for the industry, the consultants and the business sector to be able to market more efficient components and buildings. Under the EU's Buildings Directive, the energy provisions must be reassessed every five years.

As part of the development of buildings with lower energy consumption than that required by the new energy provisions of the Building Regulations (low-energy buildings), there must be focus on research and development and demonstration. There must also be incentives to establish buildings that are better than those required by the currently applicable requirements.

Future strengthening of requirements for energy consumption will be based on both technological developments and profitability.

Requirement in the Building Regulation regarding maximum heat loss:

- BR 82: a new building may use 10 litres oil/m<sup>2</sup>.
- BR 95: a new building may use 7.5 litres oil/m<sup>2</sup>.

The future requirements cannot be directly compared with current requirements, but can be converted to

- New energy requirement 2006: a new building may use 5.5 litres oil/m<sup>2</sup>.
- New energy requirement 2010: a new building may use 4.2 litres oil/m<sup>2</sup> (milestone).

- New energy requirement 2015: a new building may use 3 litres oil/m<sup>2</sup> (milestone).
- Average net heat consumption in existing buildings today: 14 litres oil/m<sup>2</sup>.

The Government considers it to be essential that the requirements in the Building Regulations are complied with. It is therefore necessary to have effective controls in connection with handling cases involving buildings. In this regard, the energy labelling of new buildings make a significant contribution.

With a view to promoting conservation in the new buildings, the government will:

- Tighten the energy requirements in the Building Regulations for new buildings by 25-30% as of 2006.
- Aim to further tighten the energy requirements by approximately 25% in 2010 and strengthen them still further in 2015.
- As of 2006, define two classes of low-energy buildings in the new Building Regulations. The building classes will consume 25% and 50% less energy respectively than according to requirements in force as of 2006.
- For low-energy buildings, abolish both the obligation to connect to district-heating and natural-gas systems and the ban on the use of electric heating.
- Intensify inspections to ensure compliance with the Building Regulations.

With a view to promoting heat savings in existing building, the Government will:

- Introduce a requirement specifying that all existing buildings that are to have major renovations done must implement the energy improvements identified by the energy labelling.
- Introduce specific requirements in the Building Regulations relating to replacement of roofs, windows in a facade and oil and gas boilers, and to change of heat supply. Through legislation, implement more efficient and user-friendly energy labelling of buildings sold or rented.
- Set the validity of energy labels for small buildings at a maximum of 5 years.
- Set the frequency of regular energy labelling of buildings over 1000 m<sup>2</sup> at a maximum of 5 years.
- Introduce regular energy labelling of all public buildings regardless of size.
- After 3 years, assess whether, on the basis of the experience gained, regular labelling of all buildings should be introduced.
- Introduce inspection schemes for oil- and gas boilers and ventilation systems.
- Work to integrate energy-labelling and status reports.
- Investigate the possibilities for reducing fixed rates for district-heating and electricity supply.
- Strengthen stakeholders' efforts to promote energy savings, including market influencing, campaigns, etc.

With respect to the political agreement of 10 June 2005, network- and distribution companies must prioritise heat savings. In this context, they must, for example, enter into agreements with the construction sector on package- and standard solutions. Citizens must have access to advice on achieving energy savings, including on financing.

## **Transport Sector**

### **Introduction of bio fuels for transport**

It is important to bend to the upward-sloping curve of fossil fuel consumption in transport. Thus the aim of the Danish Government is to increase the share of bio fuels and other renewables in transport to 5.75% in 2012 and 10% in 2020. This is in line with the EU target.

The Danish Government expects to see its draft bill on sustainable bio fuels adopted by Parliament before the summer break 2009. The law on sustainable bio fuels will implement the Government's aim of introducing at least 5.75 pct. Bio fuels and other renewables in transport by 2012. It is an absolute condition that all bio fuels must meet the sustainability criteria adopted by the EU in order to be counted towards the 5.75 pct. target. For this reason the draft bill has awaited the adoption of the EU sustainability criteria for bio fuels which took place December 2008.

The Government decided with effect from 1 January 2005 to exempt bio fuels from the CO<sub>2</sub>-levy which is imposed on fossil fuels for transport purposes. The Commission has approved the Danish CO<sub>2</sub>-exception in case number NN 59/2005. Since May 2006 one oil company, Statoil, has distributed and sold bio95 at its gas-stations. Bio95 is a 5 pct. volume blend of bio ethanol in 95 octane petrol. Currently the total annual sale of bio fuels amounts to approximately 0.2 pct. of the total energy consumption in transport.

The Government has launched a new national Danish programme for the development of cost-effective second-generation technology for the production of bio ethanol of 200 million DKK for 2007-2010 with focus on large-scale demonstration plants. The programme has taken the form of R&D grants to pre-commercial investments in and operation of pilot- and demonstration-plants.

Moreover, the Government has launched a limited biodiesel programme for 2007-2009 of 60 million DKK. The programme's aim is to demonstrate the use in practise of biodiesel in selected and limited fleets of vehicles – for instance public busses. The main part of the programme budget has been used to compensate the higher prices on biodiesel compared to mineral diesel during the first part of project period.

## **Industrial Sector**

### **Voluntary Agreements in Industry on Energy Efficiency**

Since 1996, Denmark has used voluntary agreements (VAs) on energy efficiency as an important instrument to improve the energy efficiency in industry. The voluntary

agreement scheme is closely integrated with the Green Tax Package as companies. Who enter an agreement; receive a rebate on the green taxes. The agreement system has two main objectives. One is to encourage energy-intensive companies to improve their energy efficiency. The other is to ensure that the international competitiveness of energy-intensive companies is retained. The agreement system contains three essential elements:

- Implementation of a certified energy management system in accordance with the Danish energy management standard DS 2403.
- Special investigations focusing on improving energy efficiency of the primary production.
- Process investments in projects improving the energy efficiency.

By 2004, approximately 280 Danish companies have entered into an agreement. Representing more than 50% of the total energy consumption in the industry. By 2005, approximately 60 of these companies are part of the Danish allocation plan for a CO<sub>2</sub> emissions allowance trading scheme and will therefore drop out of the voluntary agreement concerning the energy use which is under the CO<sub>2</sub> emissions' allowance trading scheme. It is still possible for these companies to conclude a voluntary agreement concerning the electric energy.

The DEA evaluations show that the VA scheme has reduced the energy use in the participating companies. However, there are no truly reliable estimates of the net impact. An often cited estimate is a CO<sub>2</sub> emission reduction of 6% in participating companies for 1996-2005. resulting in a decrease of the CO<sub>2</sub> emissions by 400.000 tonnes before 2005. 60% of the CO<sub>2</sub> emissions reduction are assumed to result from the implementation and maintenance of an Energy Management System (EMS) in the participating companies. The EMS was cautiously estimated to improve the energy efficiency by 0.44% per year in the evaluation in 1998 and by 0.4% in the evaluation in 2000. Assuming the EMS accounts for 60% of the energy efficiency improvements. the VAs generally have improved energy efficiency by about 0.7% per year.

**Table 1: Estimation of CO2 reductions in 2005 from the two first rounds of agreements(1996-97) and the first five rounds (1996-2000).**

CO2 reductions in 2005		
Agreement entered	1996-1997	1996-2000
Estimated impact in	1999	2005
Concrete projects	1.2%	1.5%
Special investigations	0.8%	1.0%
Energy management	0.8%	3.8%
Total impact	2.7%	6.3%

It is predicted that the total reduction of CO2 emissions will accumulate to 2.7% for the two first rounds of agreements. The three sources (concrete projects, special investigation and energy management) each contribute approximately one third of this reduction.

Table 1 also contains an estimate of the total impact of the first five rounds of agreements in 2005. When compared to the first rounds, the main difference is larger savings due to energy management. The effects of concrete investment projects are adjusted downwards in the long term, since a similar energy audit, carried out after only three years, would identify fewer projects. The same is true for special investigations unless new criteria are applied. It is estimated that a continuation of the agreement system by 2005, relative to a situation without agreements, can lead to a decrease in CO2 emissions corresponding to 6% of total emissions in trade, industry and services. However, the positive effects of energy management are based on the assumption that companies will continue to work on improving their systems.

Furthermore, the evaluation of the energy tax system shows that the administrative costs of entering into an agreement are between 10 and 20 percent of the tax subsidy. These costs are mainly due to energy audits and verification. Although there are costs

connected with the implementation of the energy management system, most companies view it as a positive element.

## **Tertiary Sector**

### **Reverse-the-trend agreements**

The Electricity Saving Trust's "reverse-the-trend agreements" are an offer to municipalities, regions, the state and large office enterprises under which fixed targets are set for their electricity savings. The Electricity Saving Trust offers public-sector agreement partners the following:

- Coaching with a fixed contact person and a number of specialists
- Help in introducing an energy-efficient procurement policy
- Materials for behaviour campaigns
- A free "electricity-savings toolbox"
- Presentations at thematic meetings
- Use of self-check tools
- PR and profiling in the media

The Electricity Saving Trust requires from the public-sector agreement partners:

- Establishment of targets for electricity savings. E.g. to save two per cent each year from 2008 to 2010 compared with 2007
- Registration on "Se Elforbrug", making it possible to monitor electricity consumption
- Openness on how savings are implemented so that others can benefit from experience
- A written agreement with the Electricity Saving Trust

*The Electricity Saving Trust's vision: Stop growth in electricity consumption by 2009.* The background for the agreements is that electricity consumption by the public sector is growing by one per cent per year. The Electricity Saving Trust's vision is that this growth is curbed by no later than 2009.

## **Cross-cutting measures**

### **Action Plan for Renewed Energy Conservation**

Published in June 2005, the Energy Saving Action Plan establishes a framework for efficient energy conservation until 2013. As outlined in the plan, the Danish government aims for verifiable energy savings corresponding to an average of 7.5 PJ per year over the period 2006-2013. The plan requires energy savings in all sectors except transport.

It is envisaged that grid and distribution companies for electricity, natural gas, district heating and oil will likely achieve much of the government's reduction goal. Other measures concerned the implementation of more rigorous rules on energy in building regulations, new and better energy labelling, better inspection of boilers and ventilation equipment, special efforts within the public sector, and the reorganisation of energy companies' energy saving efforts. The plan established a Coordination Committee to ensure that savings initiatives are cost-effective. The committee seeks to ensure better joint prioritising and increased co-operation and co-ordination among all players. It focuses on heat savings, specifically those from a well-designed, effective energy labelling for buildings. The labels also include financing proposals. In order to promote the realisation of heat savings, the government, in connection with the implementation of L 136 on energy savings in buildings: - sets the frequency of regular labelling of large buildings at a maximum of 5 years; - set the validity of energy labels for small buildings at a maximum of 5 years; - committed to ensuring the regular labelling of all public buildings regardless of size; and - to consider, after 3 years, whether, on the basis of the experience gained, all buildings should be regularly labelled. The plan further provides that grid and distribution companies shall prioritise heat savings. As a part of these initiatives, they shall enter into agreements with the building sector on package and standard solutions. Arrangements shall be made so that citizens have a place to contact for advice on realisation, including also advice on financing. Under the plan, the Minister of Transport and Energy has initiated negotiations with municipalities and regions with a view for to them complying with the same requirements for energy-effective purchase and energy savings, with up to 5 years' payback time, as state institutions.

## 4.2 Innovative energy efficiency measures

### Research, development and demonstration

Following a decline in public funding for energy research in 2002, the Danish Government has increased the public budgets for energy research, development and research. From 2005-2010 the Government has doubled the public budgets to approximately 1 billion DKK in 2010.

**Table 4.2 Public budgets for Energy research, development and demonstration in 2001-2007**

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
EUDP: Energy research programme for development and demonstration							236	219	300	410
EFP Energy Research Programme	251	44	45	77	75	76				
Other public research programmes on energy research and technology development	27	31	41	50	128	178	202	208	274	497
Research funding and Public Service Obligations from utilities	100	110	125	125	155	155	155	155	155	155
<b>Total public funding for research, development and demonstration in 2001-2010, Mill. DKK</b>	<b>378</b>	<b>185</b>	<b>211</b>	<b>252</b>	<b>358</b>	<b>399</b>	<b>593</b>	<b>582</b>	<b>729</b>	<b>1062</b>

The importance of research, development and demonstration in new energy technologies and the implementation on the market is today highly prioritised in the energy policy. The development and marketing of better and more efficient energy technologies will contribute to the security of supply, the environmental targets as well as the growth of the industry and society.

A new public programme (EUDP) starting in 2008 is focussed on the demonstration link in the process from research to marketing. The administration of this programme is led by an independent board of members from the public and private sectors.

## **5 National developments under the EU Energy Efficiency Directive and the 20% energy efficiency target of the EU**

### **Outlook: Future National Developments**

The Government's vision is a Danish society independent of fossil fuels.

Denmark has committed to meeting an ambitious and binding target for reducing greenhouse gases by 2020. This target is the most ambitious in the EU: By 2020, Denmark must have reduced the greenhouse gas emissions from Danish non-ETS sectors by 20% relative to 2005.

Denmark's international commitment to a significant reduction in the greenhouse gas emissions not covered by the ETS in the period 2013-2020 poses a special challenge. Therefore, the government has launched a comprehensive analysis work in order to discover how Denmark can live up to its commitment most appropriately. The work will be published in fall 2009.

The high level of ambition underpins the need for a Danish policy that will give Denmark the highest return on climate and energy investments. A good example of such a climate and energy policy is investing in wind turbines and biomass for combined heat and power production.

Another good example is the electric car. The current investments in expanding the infrastructure to accommodate electric cars are a relatively cheap way to reduce CO<sub>2</sub> emissions from the transport sector. The electric car solves three problems in one, since it also provides energy savings and opportunities for increasing the share of renewable energy in our energy system.

Energy savings and energy efficiency are important components of Danish energy policy and contribute to limiting energy consumption. We need significant and cost-effective energy savings within all areas. We need to spend less energy in our homes; enterprises need to be made more energy-efficient; and we need to aim special efforts at public institutions.

The energy policy agreement from 2008 sets out ambitious goals for energy-saving initiatives. Total annual energy savings must be raised to 1.5% of the final energy consumption for 2006 (10.3 PJ per year), which corresponds to the combined energy consumption of about 110,000 homes. Furthermore, we must reduce gross energy consumption by 4% by 2020 relative to 2006. At the same time, it has been decided that the energy-savings requirements of energy companies will be increased by about 85% from 2010, and that the requirements for the energy performance of buildings will be tightened by at least 25% in 2010, 2015 and in 2020. There will also be set requirements for energy renovation of existing buildings including requirements for several buildings components (windows, roofs, boilers, pumps, etc.)

Along with security of supply, energy savings and green growth, expanding the use of renewable energy in Denmark is at the core of the Danish energy policy. As a step towards the long-term goal for a green-growth economy which is independent of fossil fuels, the government is taking pains to deliver the ambitious goal of a share of 20% renewables in gross energy consumption by 2011 and at least 30% in final energy consumption by 2020, as stipulated in the EU climate and energy package. In addition, there is a binding target of 10% renewable energy in the transport sector by 2020.

The energy agreement from February 2008 improved framework conditions and enhanced support for wind, biomass, biogas, waste and other renewable energy technologies such as photovoltaic solar modules, wave power and gasification.

The recipe for long-term security of supply is to reduce energy consumption through energy savings, increased use of renewables, and closer collaboration in Europe. In the short and medium terms, coal will still however be a necessary source of fuel if Danish security of supply is to be maintained. In 2009, the Government will present a strategy for security of supply. This strategy will be a catalogue of possible, new energy-policy initiatives in the period up to 2025. The initiatives will be discussed along with the recommendations of the Government's Climate Commission to be released in 2010.

## **Annex 1**

### **Energy Efficiency Measure Summary by Country**

MURE (Mesures d'Utilisation Rationnelle de l'Energie) is a database on measures for energy efficiency. The database provides information on energy conservation measures which have been carried out in the 15 Member States of the European Union, and enables the simulation and comparison at a national level of the potential impact of such measures. Danish measures have been updated in 2003 and the results can be seen in the four tables below.

**MURE II Household – Updating of Measures Table 1**

Measure Code	Title	Changes	New status
<u>DK2</u>	Grant for energy saving measures for pensioners' dwellings	Updated. new description uploaded	Completed
<u>DK3 (ex B2DK3)</u>	Energy management for larger buildings	Updated. new description uploaded	Ongoing
<u>DK4 (ex B2DK1)</u>	Heat Consulting	Updated. new description uploaded	Completed
<u>DK6 (ex B3DK1)</u>	EU energy labelling of electric appliances	Updated. new description uploaded	Ongoing
<u>DK8 (ex B1DK4)</u>	Revision of thermal building code (2005/2006)	Updated. new description uploaded	Ongoing
<u>DK9</u>	Agreement on efficient windows	Updated. new description uploaded	Completed
<u>DK10</u>	Grid Supplied Heat Planning	Updated. new description uploaded	Ongoing
<u>DK11</u>	Energy Certificate	Updated. new description uploaded	Ongoing
<u>DK12</u>	Grants for connection of houses built before 1950 to district CHP systems	Updated. new description uploaded	Completed
<u>DK14</u>	1995 Regulations for New Building	Updated. new description uploaded	Completed
<u>DK15</u>	Energy labelling of smaller buildings	Updated. new description uploaded	Completed
<u>DK16</u>	Grants for Energy Savings Products for Household	Updated. new description uploaded	Ongoing

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<u>DK17</u>	Electricity Saving Trust	Updated. new description uploaded	Completed
DK18	Heat inspection of small oil heat furnaces	Updated. new description uploaded	Ongoing
<u>DK21</u>	Energy requirements for new and existing buildings (substitute by DK8)	Updated. new description uploaded	Completed
<u>DK22</u>	Carbon Dioxid tax	Updated. new description uploaded	Ongoing
<u>DK23</u>	A-pumps	Updated. new description uploaded	Completed
<u>DK24</u>	Guide for lower electricity consumption	Updated. new description uploaded	Completed
<u>DK25</u>	Cheapest-most expensive campaign focusing on electricity savings	Updated. new description uploaded	Completed
<u>DK26</u>	My house – the intelligent home	Updated. new description uploaded	Ongoing
<u>DK27</u>	Club1000 - 1000 kWh campaign	Updated. new description uploaded	Ongoing
<u>DK28</u>	The electricity savings label (Elsparømærket)	Updated. new description uploaded	Ongoing
<u>DK29</u>	Electricity-saving sockets	Updated. new description uploaded	Ongoing

**MURE II Industry – Updating of Measures Table 2**

<b>Measure Code</b>	<b>Title</b>	<b>Changes</b>	<b>New status</b>
DK 2	Agreement on energy saving measures	Updated. new description uploaded	Ongoing
DK 1	Green taxes on energy use in industry	New measure. description uploaded	Ongoing
DK 4	Emissions Trading Registry	New measure. description uploaded	Ongoing

**MURE II Tertiary – Updating of Measures Table 3**

<b>Measure Code</b>	<b>Title</b>	<b>Changes</b>	<b>New status</b>
DK3	Heat inspection of small oil heat furnaces	Updated. no new description uploaded	Ongoing
DK4	1995 Regulations for new Building	Updated. no new description uploaded	Completed
DK5	Monitoring and Labelling of Larger Buildings	Updated. no new description uploaded	Completed
DK6	Monitoring and Labelling of Smaller Buildings	Updated. no new description uploaded	Completed
DK7	Grid Supplied Heating Planning	Updated. no new description uploaded	Ongoing
DK8	Tax on energy expenses in government financed institutions	Updated. no new description uploaded	Ongoing
DK9	Promoting energy conservation in the public sector	Updated. no new description uploaded	Ongoing
DK10	Reverse-the-trendagreements	Updated. no new description uploaded	Ongoing

## Energy Efficiency Policies and Measures in Denmark in 2007

## **Annex 2**

### **Country Profile**



# Energy Efficiency Profile: Denmark

February 2009

## Energy Efficiency Trends

### Overview

In Denmark, the energy efficiency of final consumers (measured as a three-year moving average) improved by 14.1% from 1990 to 2007. The bottom-up index, referred to as ODEX, experienced a decrease from 100 in 1990 to 85.9 in 2007. All sectors have contributed to this significant improvement in energy efficiency. In the period 2000-2007, the energy efficiency has increased by 5.1%. Again, all sectors have contributed to the improvement.

### Industry

The efficiency of the industrial sector (measured at the level of 14 branches - in terms of energy used per production index or per tonne - and aggregated for the whole sector) improved by 16.9% from 1990 to 2007. The increase in efficiency in the chemical industry contributed significantly to the Danish result by an improvement of 54.3%. In the food and tobacco industry the energy efficiency increased by 17.7%, while the energy efficiency in the non-metallic industry decreased by 15.4%. From 2000 to 2007, the energy efficiency for the industry sector as a whole increased by 9.6%.

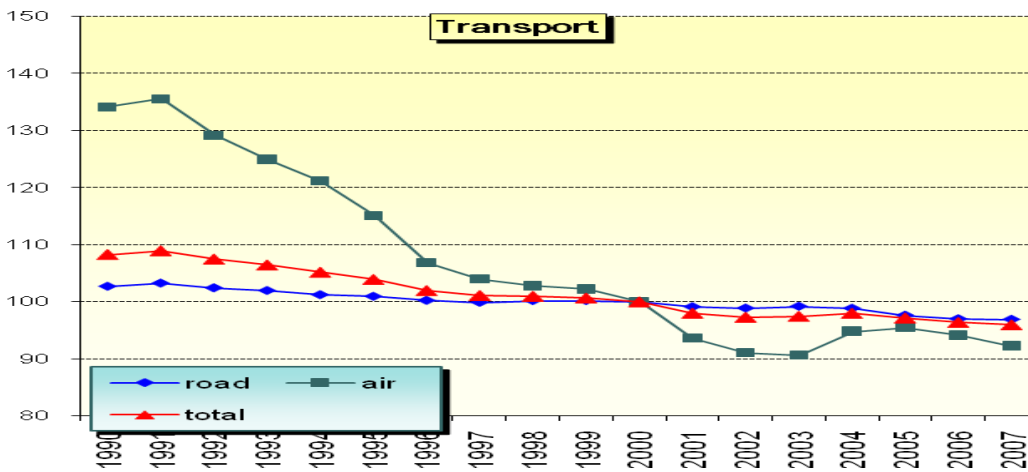
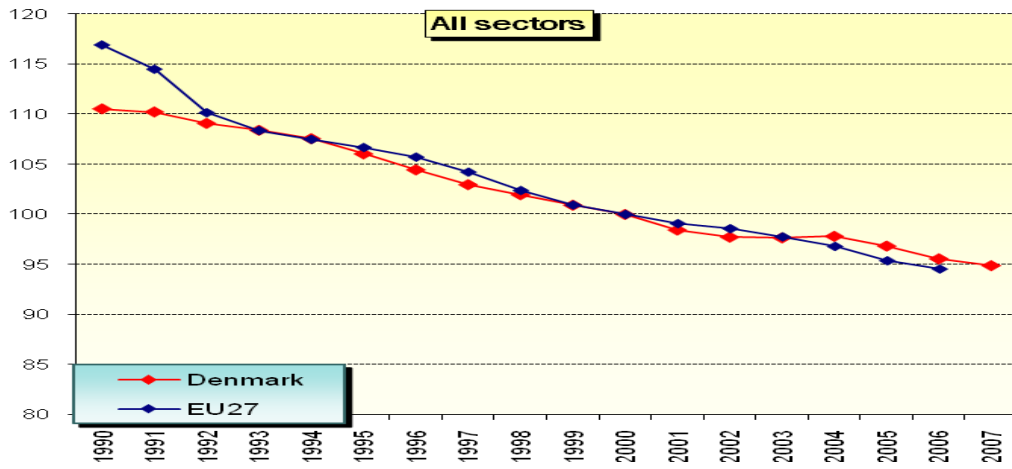
### Households

Between 1990 and 2007, the total energy efficiency of households improved by 15.4%. For space heating, the improvement in efficiency was 14.3%. Substitution of old oil burners with new natural gas burners and district heating has contributed significantly to the improvement. In the same period, large electrical appliances exhibited an improvement in energy efficiency of 29.7%. This development, and a decrease in the use of electricity for heating, has contributed in stabilizing the total electricity consumption by the Danish household sector. From 2000 to 2007, the total in energy efficiency for households has increased by 3.9%. The energy efficiency in space heating improved by 3.2%, while large electric appliances improved by 13.7%.

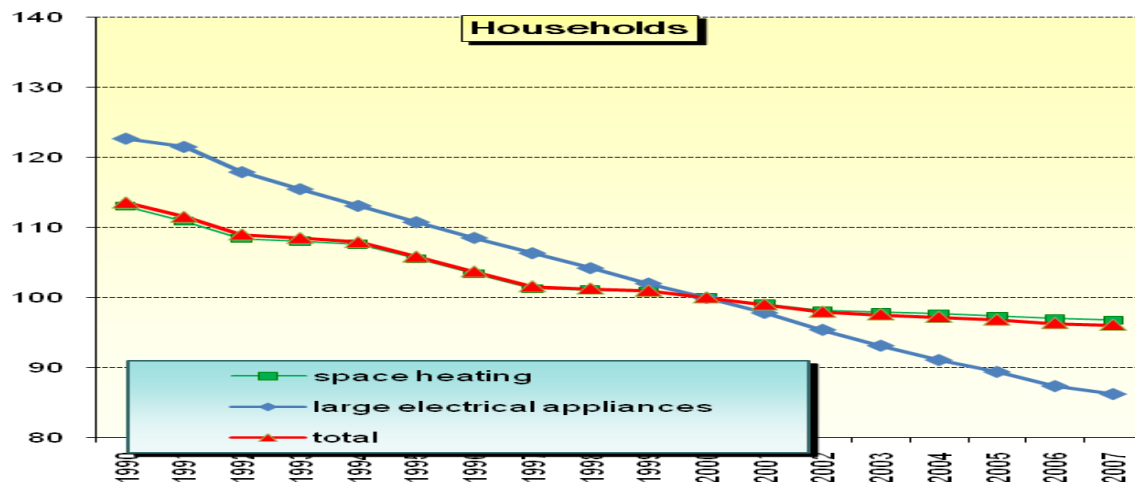
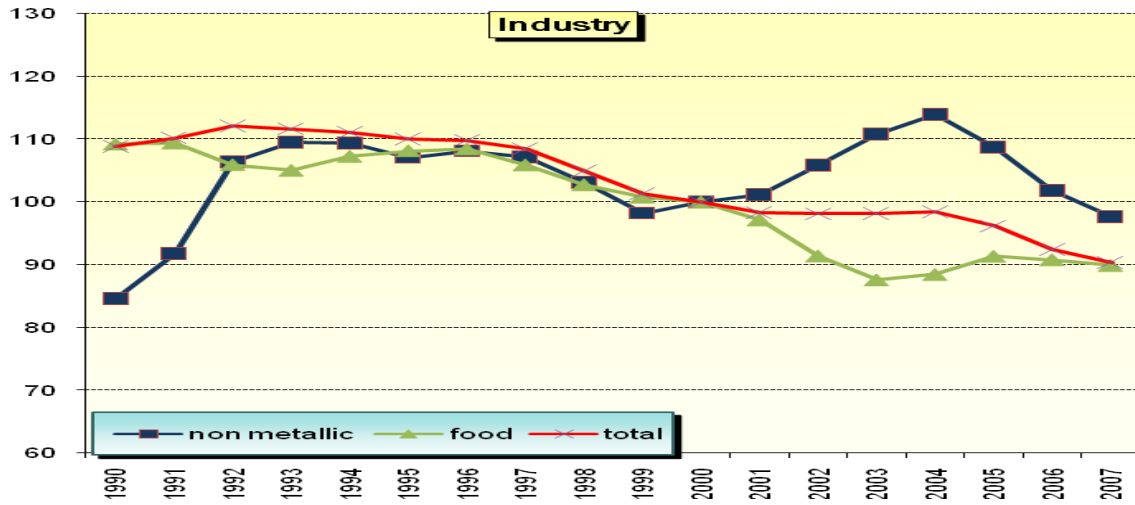
### Transport

The transport sector has experienced an improvement in energy efficiency of 11.2% between 1990 and 2007. This improvement is mainly due to air transport (improved by 31.2%). For road transport, the energy efficiency increased by 5.7%. Between 2000 and 2007, the energy efficiency of the transport sector has increased by 3.9%.

### Energy efficiency index



## Energy Efficiency Policies and Measures in Denmark 2006



## Energy Efficiency Policy Measures

### Institutions and programmes

The mandate of the Danish Energy Agency is to advise the Minister for Climate and Energy, to assist other authorities, to administer Danish Energy legislation and to conduct analyses and assessments of developments in the energy sector. The government has launched an energy efficiency policy emphasizing cost-effective and market-based solutions.

The following documents lay down the general guidelines for Danish energy policy and energy efficiency activities:

- Energy Agreement, February 21st. 2008.
- An Action Plan for Renewed Energy Conservation, September 2005
- Report on Climate Change Strategy, February 2003

In the agreement of Feb. 21st. 2008 it is stated that the annual savings from 2010 shall be increased to 1.5% of the final energy consumption in 2006.

### **Industry**

Together with general energy and CO<sub>2</sub> taxation measures, the following initiatives have been implemented to enhance energy savings and improve energy efficiency in the industrial sector:

- A voluntary agreement scheme closely integrated with the Green Tax Package, which provides rebates on green taxes for companies participating in the scheme.
- Emissions trading with CO<sub>2</sub> cap for bigger industries.

### **Households, Services**

The intensified energy conservation efforts are in particular focused on energy consumption in buildings and in electrical applications and products. The main initiatives include more stringent energy requirements included in the Building Regulations, an improved energy labelling scheme, enhanced inspection of boilers and ventilation systems and increased efforts in the public sector.

The Building Regulation was tightened in 2006 and in the 2008 agreement it was decided to tighten it further in 2010 and 2015 reducing the energy by 25% in both cases. In 2008 it has been decided to assign the state institutions a saving target, demanding that the energy consumption in 2011 should be 10% lower than in 2006.

In addition to general energy and CO<sub>2</sub> taxation, 4 programmes have been initiated to improve energy savings and efficiency in the household and the tertiary sectors:

- Energy labelling of electrical appliances.
- Establishment of the Electricity Saving Trust, which promotes electricity savings in the public sector and in households.
- Energy efficiency strategy for buildings, and Centre of knowledge for energy efficiency for buildings 2008.

### **Transport**

The government considers cost efficiency as essential in regulating the environmental impact of transport. A strategy for sustainable transportation and improved infrastructure has been launched in December 2008.

### **Energy Sector**

An agreement from 2006 committed the electricity, natural gas and oil networks and distributing companies to achieve specific energy saving targets, to contribute to an easy access to information on energy efficiency and to carry out energy efficiency campaigns with the purpose of influencing the consumer behaviour. In the energy agreement of Feb. 21st 2008, the specific energy saving target is increased by app. 85% from 2010.

Energy prices and taxes

Energy prices and taxes are among the most important determinants of energy consumption and have been successfully used to promote energy savings in Denmark. From 1990 to 2007, revenues from "green" taxes increased from DKK 13.9 billion to DKK 36.4 billion or by 161%.

## Selected Energy Efficiency Measures

Sectors	Title of measures	Since
Cross-cutting measures	Project energy town	2008
Cross-cutting measures	Increased energy companies obligation to reduction of energy consumption	2008
Cross-cutting measures	Campaigns to promote energy saving in buildings	2008
Households	Tertiary Building codes 1)	1995, revision in 2005-2008
Households	Energy labelling of larger buildings	1997
Households	Energy labelling of electrical appliances	1993
Transport	Green owner's fee for passenger cars	1999
Industry	Agreement on energy saving measures	1996
Industry	Green taxes on energy use in industry	1996
Industry	Emissions trading	2005

Source: MURE data base

[www.mure2.com](http://www.mure2.com)