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Energy Efficiency trends and policies in Norway

Institute for Energy Technology

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Report title

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Summary

This report represents the national case study of Norway for the IEE-project "Monitoring of EU and national energy efficiency targets: ODYSSEE-MURE" (for more information see http://www.odyssee-mure.eu/). The Norwegian part of the project is co-funded by Enova, which is a Norwegian governmental agency responsible for the promotion of environmentally friendly production and consumption of energy. The report presents the recent energy efficiency trends in Norway on the basis of indicators extracted from the ODYSSEE database. The database contains information on energy use in a detailed level of the industry, transport, household and service sectors and other energy use. It also contains information on energy drivers like heated square meters in the households and services sectors, transported passenger-km and ton-km of gods, value added, production index, production volumes etc. In addition, energy efficiency policies and measures from the MURE database are described.

Final energy use in Norway was 221 TWh in 2013 compared to 215 TWh in 2000. At the same time as the final energy use had an average annual increase of 0.2% during the period from 2000 to 2013, the GDP increased by 1.8% annually and the private consumption increased by 3.9% annually.

In order to assess the actual results of energy efficiency policies and measures, it is necessary to use a bottom-up approach, i.e. to start from the achievements observed for the main energy end-uses and appliances, and to compile them into an aggregate bottom-up energy efficiency index, ODEX, (all end-uses and appliances being weighted according to their weight in the total final consumption). This energy efficiency index aggregates the trends in the detailed bottom-up indicators (by end-use and equipment) in a single indicator. It provides somehow a substitute indicator to energy intensities (industry and transport) or unit consumption (per dwelling for households) to describe the overall trends by sector.

Energy efficiency policies and measures implemented since 2000 have contributed to improve the ODEX (the efficiency) by 17%, or 1.4% per year. This means that if these policies and measures would not have been implemented, the final energy consumption would have been 17% higher in 2013 (approximately 29 TWh).The development has been positive for all sectors, according to the selected indicators.

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EXECUTIVE SUMMARY

This report represents the national case study of Norway for the IEE-project "Monitoring of EU and national energy efficiency targets: ODYSSEE-MURE" (for more information see http://www.odyssee-mure.eu/). The Norwegian part of the project is co-funded by Enova, which is a Norwegian governmental agency responsible for the promotion of environmentally friendly production and consumption of energy. The report presents the recent energy efficiency trends in Norway on the basis of indicators extracted from the ODYSSEE database. The database contains information on energy use in a detailed level of the industry, transport, household and service sectors and other energy use. It also contains information on energy drivers like heated square meters in the households and services sectors, transported passenger-km and ton-km of gods, value added, production index, production volumes etc. In addition, energy efficiency policies and measures from the MURE database are described.

Final energy use in Norway was 221 TWh in 2013 compared to 215 TWh in 2000. At the same time as the final energy use had an average annual increase of 0.2% during the period from 2000 to 2013, the GDP increased by 1.8% annually and the private consumption increased by 3.9% annually. Half of the energy use in 2013 was electricity which was 1% less than in 2000. Oil products represented 35% of total final energy consumption in 2013, an increase of 6% since 2000. The increase was due to increased use in the transport sector while stationary use of oil products has decreased.

The industry sector has decreased its part of final energy use from 39% in 2000 to 32% in 2013. The share used by the household sector was about the same, while the transportation sector has increased from a share of 24% in 2000 to 29% in 2013. The tertiary sector has also increased its share in the period 2000-2013.

In order to assess the actual results of energy efficiency policies and measures, it is necessary to use a bottom-up approach, i.e. to start from the achievements observed for the main energy end-uses and appliances, and to compile them into an aggregate bottom-up energy efficiency index, ODEX, (all end-uses and appliances being weighted according to their weight in the total final consumption). This energy efficiency index aggregates the trends in the detailed bottom-up indicators (by end-use and equipment) in a single indicator. It provides somehow a substitute indicator to energy intensities (industry and transport) or unit consumption (per dwelling for households) to describe the overall trends by sector.

Energy efficiency policies and measures implemented since 2000 have contributed to improve the ODEX (the efficiency) by 17%, or 1.4% per year. This means that if these policies and measures would not have been implemented, the final energy consumption would have been 17% higher in 2013 (approximately 29 TWh).The development has been positive for all sectors, according to the selected indicators. Most of the improvement is registered from 2000 to about 2008 and afterwards the ODEX has flattened out. The energy efficiency index of industry is improved by 16%, an annual improvement of 1.3%, but the ODEX of 2013 is almost the same as in 2008. The household sector has an annual improvement of 1.7% from 2000 to 2012.The transport sector has in overall improved the energy efficiency index of 12% or an annual improvement of 1.0%.

1. ECONOMIC AND ENERGY EFFICIENCY CONTEXT

1.1. ECONOMIC CONTEXT

The annual growth of the Norwegian economy was in average 1.8% from 2000 to 2014, measured as the overall gross domestic product (GDP). The growth was highest until 2008, had a small recession in 2009 and continued to grow after that. In 2013 the GDP growth was 0.7% and in 2014 it was 2.2%.The growth after 2000 was considerably lower than in the period 1990-2000, see Table 1.

Total industry value added decreased in average by 0.16% per year from 2000 to 2014. When looking at the manufacturing industry separately, the picture is different, with an annual increase of 2.5-2.6% in 2000-2008 and 2009-2014 and only a decrease from 2008 to 2009. This growth is considerably higher than in the 1990s. The reason for the decrease in total industry development is decreased activities in the oil and gas drilling after 2005.

Value added of the tertiary sector has increased continuously from 2000 to 2014, with a small decrease from 2008 to 2009. The growth was the highest before 2008 and even higher in the 1990s. The private consumption has also continued to grow, but the growth has slowed down in the last years.

TABLE 1 ANNUAL ECONOMIC GROWTH IN NORWAY, % PER YEAR

	1990-2000	2000-2014	2000-2008	2009-2014
GDP	4.4 %	1.8 %	2.2 %	1.0 %
Private consumption	4.2 %	3.9 %	4.4 %	2.5 %
Value Added industry	5.4 %	-0.2 %	0.2 %	-0.7 %
Value Added mining	9.6 %	-1.5 %	-1.2 %	-2.1 %
Value Added manufacturing	1.2 %	1.9 %	2.5 %	0.8 %
Value Added tertiary	3.8 %	2.8 %	3.1%	1.9 %

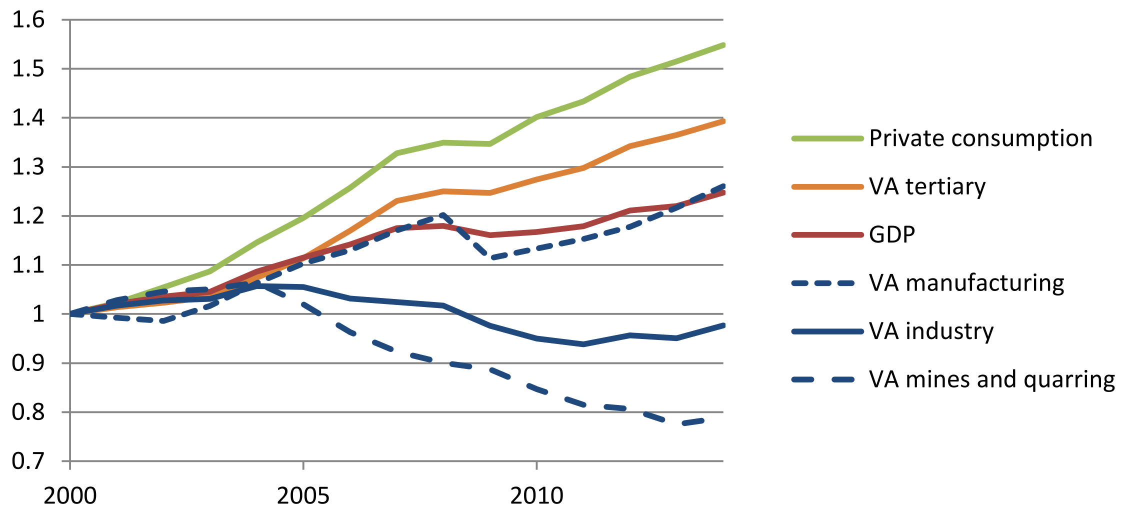

Figure 1 **Macro-economic development in Norway 2000-2014 at constant prices; VA= Value Added (2000=1)**

1.2. TOTAL ENERGY CONSUMPTION AND INTENSITIES

The final energy consumption has been 212-229 TWh per year in the period 2000 to 2013 with a maximum in 2010 and a minimum in 2009, see Figure 2. The energy consumption data is based on the energy balance of Statistics Norway with final data until 2012 and preliminary data from 2013. The principles follow the energy balance with domestic use of energy with energy for transport as one sector (i.e. energy use by private cars is included in the road transportation and not a part of households). Energy used for non-energy purposes is not included and international air traffic is not included. The boundary of the study is direct energy use in mainland Norway and thus energy used for production of exported goods is included but not energy used for production of imported goods.

Half of all energy end use in Norway is electricity. The Norwegian electricity production is almost exclusively based on hydropower, which accounted for 96.1% of total power production in 2013 (Statistics Norway). Historically this has made it possible to have relatively low electricity prices and a large energy intensive industry as well as the use of electricity for heating of buildings. The electricity consumption in 2013 was 109 TWh, 1% less than in 2000. The electricity consumption was at the highest in the cold year of 2010 and at the lowest in 2003, but has overall been rather constant in the period 2000-2013.

The second largest energy carrier is oil products; 78 TWh in 2013, an increase by 6% from 2000. The oil consumption of the stationary sector has decreased but the use of oil products for transportation has increased more.

The gas consumption has grown by 59% but was only 4% of the total final energy use in 2013. The use of coal and coke has decreased by 39% and was 3% of the total use in 2013. District heating had the highest increase, more than three times higher in 2013 than in 2000, and was 5 TWh in 2013. The use of bio energy was 12 TWh in 2013 compared to 11 TWh in 2000.

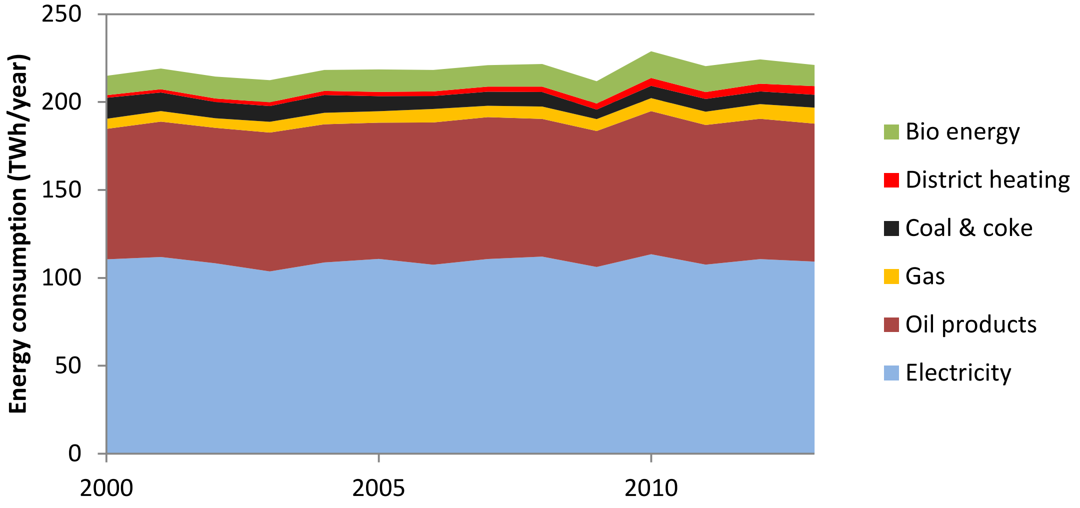

Figure 2 **Final Norwegian energy consumption by energy carrier, 2000-2013 (TWh/year)**

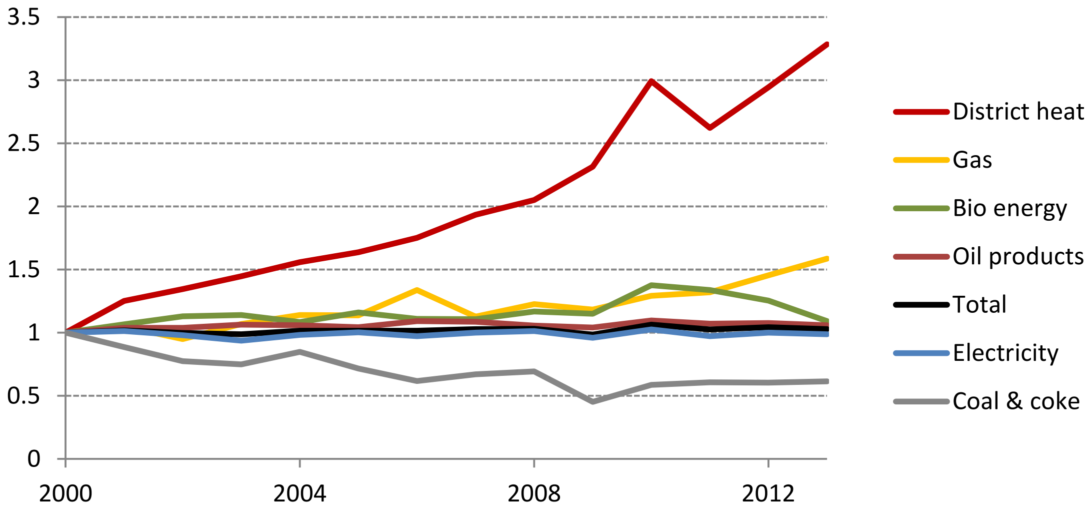

Figure 3 **Trend in final energy use by energy carrier, 2000 = 1**

The sector using most energy both in 2000 and in 2013 was industry, but the share has decreased from 39 % in 2000 to 32 % in 2013, see Figure 4. The transport sector has increased its share most, from 24% in 2000 to 29% in 2013. The share of the household sector has decreased by 1%, while the sector “other” (including tertiary and agriculture) has increased by 3%.

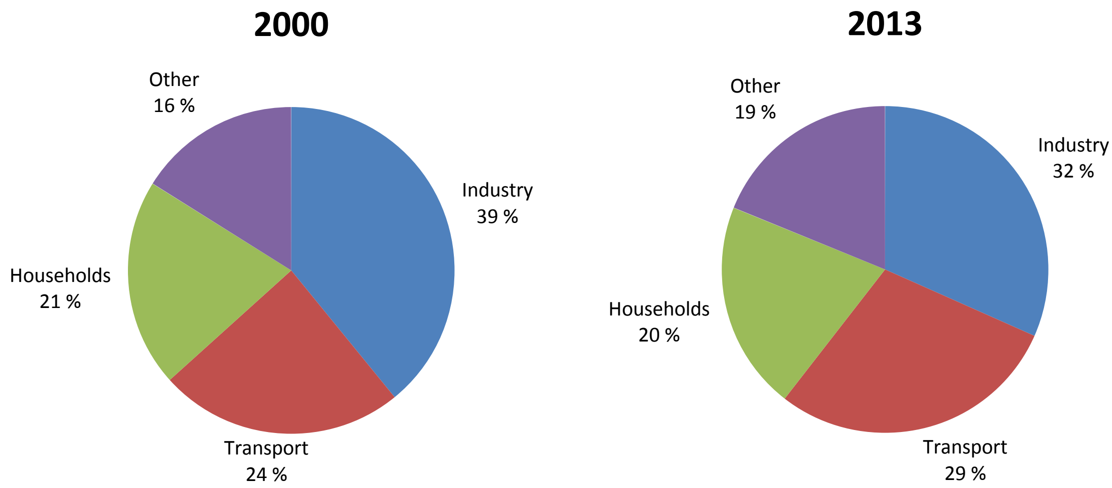

Figure 4 Final energy consumption by sector in Norway in 2000 and 2013

Two general indicators are usually used to characterize the overall energy efficiency trends: the primary energy intensity (i.e. the ratio primary consumption over GDP), and the final energy intensity (ratio final consumption over GDP). The primary intensity provides an assessment of the energy productivity of the whole economy. The final intensity characterizes the energy productivity of final consumers only and so excludes losses in transformation and supply.

Both the primary and final energy intensity decreased from 2000 to 2013, see Figure 5. The decrease until 2008 can be explained by more efficient use of energy, structural changes, increased production and a general growth in the economy. From 2008 the growth in GDP has declined, the most in non-energy intensive sectors. In 2009 the decline in GDP was less than the decline in energy use resulting in decreased energy efficiencies. In 2010 the final energy use of particularly some energy intensive industry increased again, but the overall GDP was almost unchanged, resulting in increased energy intensity. 2010 was also an exceptional cold year, resulting in increased energy use and contributing to the increased intensities. Final energy intensity continues the declining trend after 2010 due to a small increase in energy use and a greater increase in GDP. The primary intensity is rather constant from 2007 to 2013, except for 2010, due to a similar development of energy use and GDP.

A decrease of the ratio final/primary intensity means that more primary energy is needed per unit of final energy consumption. This means that an increasing share of the primary energy consumption is not going to final consumers, but is consumed by the transformation sector. The decreasing ratio final/primary intensity is due to an increasing energy use of oil and gas exploitation. The Norwegian energy transformation sector is dominated by oil and gas exploitation. Most of the electricity production comes from hydro power and there is an increasing production of district heat, but it is still only a small part of the energy use of the transformation sector. In 2009 and 2010 about 4% of electricity production was gas power, an increase from around 0.5 - 1% in the previous years. The increased use of district heating contributed to a higher ratio as well.

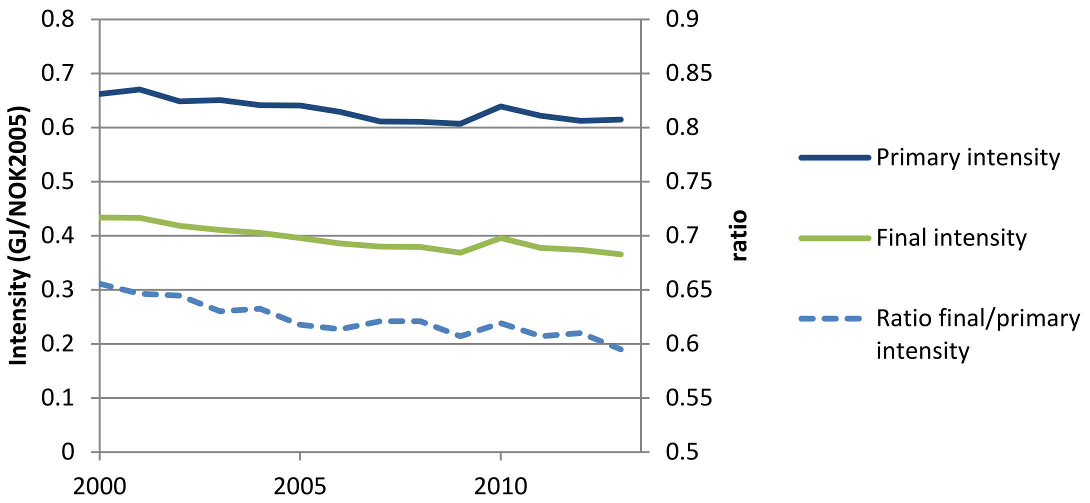

Figure 5 Primary and final energy intensity, 2000-2013 (GJ/NOK2005)

Box 1 The ODYSSEE database

The ODYSSEE database is used for the monitoring and evaluation of annual energy efficiency trends and energy-related CO_2 emissions. The energy indicators are calculated for the years from 1990 onwards (EU-15 countries) or from 1996 onwards (new Member States). The inputs for the indicators are provided by national energy agencies or institutes according to harmonized definitions and guidelines.

ODYSSEE encompasses the following types of indicators:

- Energy/CO_2 intensities which compare the energy used in the economy or a sector to macroeconomic variables (e.g. GDP, value added).
- Unit energy consumption which compares energy consumption to physical indicators (e.g. specific consumption per tonne of cement, steel and paper).
- Energy efficiency indices by sector (ODEX) to evaluate energy efficiency progress (in %).
- Energy savings: amount of energy saved through energy efficiency improvements.
- Adjusted indicators to allow the comparison of indicators across countries (e.g. adjustments for differences in structure i.e. adjusted to the same value added structure).
- Benchmark/target indicators for energy intensive products (steel, cement, paper) to show the potential improvement based on countries with the best performance.
- Diffusion indicators to monitor the market penetration of energy-efficient technologies.

More information at: http://www.odyssee-mure.eu/

1.3. ENERGY EFFICIENCY POLICY BACKGROUND

Enova SF was established in 2001 in order to drive forward the changeover to more environmentally friendly consumption and production of energy in Norway. Enova is a public enterprise owned by the Government of Norway, represented by the Ministry of Petroleum and Energy and its main mission is to strengthen the work in converting energy consumption and generation into becoming more sustainable, while simultaneously improving security of supply. As per January 2015, Enova's goals are summarized as follows:

- More efficient and flexible use of energy.
- Increased use of energy carriers other than electricity, natural gas and fuel oil for heating.
- Increased use of new energy resources, including energy re-utilization and bioenergy.
- Introduction and development of new energy and climate-technologies and solutions in the market.
- Well-functioning markets for efficient and environmentally friendly energy solutions.
- Increased general knowledge in society regarding the possibilities for utilising efficient and environmentally friendly energy solutions.
- Reduced emissions in the transport sector.

The main mechanisms Enova relies on are financial instruments and incentives to stimulate market actors and mechanisms to achieve national energy policy goals, but the agency also provides advice to both households and the private sector on energy saving measures. Enova SF administrates the Energy Fund. The income of the Energy Fund comes from a levy to the distribution tariffs that is mandatory and from allocation from the state budget. In 2014, the total income was NOK 1957 million. With resources from the Energy Fund, Enova has in cooperation with the market triggered annual energy results totalling 18.7 TWh during the period 2001 to 2014[1].

The government agency Transnova was established in 2009 as a trial funding programme with the goal of contributing to halt the trend of the fast increase of greenhouse gas emissions from transport. As per January 1st 2015, Transnova became part of Enova which is now responsible for managing the funding programs directed towards the transport sector.

The Energy Efficiency Directive from 2012 (2012/27/EU) is not implemented yet in Norway and thus no National Energy Efficiency Action Plan (NEEAP) can be presented.

[1] http://viewer.zmags.com/publication/40751ba7#/40751ba7/2

Box 2 The MURE database

The MURE database provides an overview of the most important energy efficiency policy measures in the EU Member States, Norway and the EU itself. The database is structured by final energy consumption sectors (household, tertiary, industry, transport) and also includes a general cross-cutting section. At the level of sectors, the focus is on single policy measures in order to allow a specific analysis of each measure. More general programs comprising several measures are mainly described in the cross-cutting section of MURE. The homogeneity of the measure descriptions over sectors and countries is ensured by detailed guidelines. All measures are classified according to specific keywords, thus allowing queries based on criteria as e.g.:

- their status (completed, on-going or planned)
- their year of introduction and completion
- their type: legislative/normative (e.g. standards for new dwellings), legislative/informative (e.g. obligatory labels for appliances), financial (e.g. subsidies), fiscal (e.g. tax deductions), information/education, cooperative (e.g. voluntary agreements) and taxes (on energy or CO2-emissions)
- the targeted end-uses and the main actors involved by the policy measures
- their semi-quantitative impact: low, medium or high impact, based on quantitative evaluations or expert estimates
- the end-uses involved and the quantitative impact of the policy measure related to a specific end-use (if this information is available).

In order to allow a separate analysis of policy measures from specific sources, two additional categories have been added to the MURE database:

- If a measure is included in the National Energy Efficiency Action Plan under the former EU Energy Efficiency and Service Directive ESD (2006/32/EC) and the Energy Efficiency Directive (2012/27/EU, EED) respectively, it is classified as "NEEAP measure" in the MURE database. A distinction is also made between the 1st, 2nd and 3rd NEEAPs and the reporting on energy efficiency obligation schemes and alternative measures under Article 7 of the EED. This allows an easy identification of policy measures reported in the NEEAPs and under Article 7 EED and a specific analysis of these policies.
- In order to separate of EU-wide measures which are common to all countries (mainly EU Directives) from pure national measures, a set of "EU measures" was defined in the MURE database. In addition, for each policy measure a detailed description is available in the MURE database.

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More information at: http://www.odyssee-mure.eu/

1.3.1. ENERGY EFFICIENCY TARGETS

The long-term frames of the energy policy were studied by a government committee in 2011-2012. Central topics were production, consumption, grid development and import and export of electricity and how it is affecting the Norwegian energy and power balance. An objective was to create a better understanding of the balancing of interests in the energy policy. The work was reported to the Department of Petroleum and Energy on 5 March 2012 (NOU 2012:9). The report describes different paths towards 2030 and 2050 and can be a base for further political decisions. The work with a white paper on energy is ongoing and is expected to be published in 2016.

The key features of the Norwegian energy policy are improved energy efficiency, more flexibility in the energy supply and decreased dependence on direct electricity for heating, and an increased share of renewable energy sources, other than large hydropower, in the energy supply mix. Norway's target is to be carbon neutral in 2050 or in 2030 if international climate agreement.

The directives of energy labels (Directive 2010/31/EC), eco-design (Directive 2009/125/EC) and the energy performance of buildings (Directive 2002/91/EC) are implemented in Norway, while the energy service directive (Directive 2006/32/EC) is still not included in the EEA Agreement2.

Through the regulations for the Energy Fund (Energifondet) and the already established objectives towards an energy alteration, Norway has measures which contribute to efficient use of energy. According to the methodology used by Enova today, investments in new energy production capacity and investments in energy savings are equal.

The EU Renewables Directive (RES) was implemented into the EEA Agreement at the end of 2011 and in 2012 Norway implemented the directive. The Norwegian goal for the share of renewable energy in 2020 is 67.5%, an increase from 60.1% in 2005.

The governments of Sweden and Norway have agreed on a common market for green certificates (GCM) in order to promote new renewable energy projects until 2020. The new market mechanism is expected to annually generate 26.4 TWh of electricity by 2020, where each country is financing 13.2 TWh. The system is neutral regarding renewable technologies, and the two countries share the same level of ambition regarding production increases of the common market.

[2] the European Economic Area (EEA) that unites the 27 EU Member States and Iceland, Liechtenstein and Norway into an Internal Market governed by the same basic rules

2. ENERGY EFFICIENCY IN BUILDINGS

2.1. ENERGY EFFICIENCY TRENDS

The energy consumption in buildings was in total about 78 TWh in 2013. The household sector used 46 TWh and the tertiary sector used 32 TWh in 2013. The energy consumption in households has increased from 42 TWh in 2000 to 46 TWh in 2013 (without climate correction).

The most important energy carrier in buildings is electricity; 81% of residential use and 79% of energy use in tertiary sector in 2013. The electricity consumption was 7% higher in the household sector and 20% higher in the tertiary sector in 2013 compared to 2000.

The household sector has halved its use of oil (1.3 TWh in 2013), while the tertiary sector had about the same consumption of oil in 2013 as in 2000 (2.9 TWh in 2013). Oil products were 3% of the energy use in the household sector and 9% in the tertiary sector in 2013.

The consumption of gas in buildings is very small, but it has increased. In the tertiary sector the consumption was 0.4 TWh in 2013 and in the residential sector it was 0.05 TWh.

Use of district heating increases in both sectors and in 2013 2% of the energy use in the residential sector was district heating, compared to 10% in the tertiary sector. In the tertiary sector has district heating increased from 1.0 TWh in 2000 to 3.3 TWh in 2013. The use of district heating in the household sector increased from 0.2 TWh in 2000 to 1.1 TWh in 2013.

Bio energy is mainly used in households as fire wood. In 2013 the bio energy share of households was 13% and of tertiary sector was 1%. The use of bio energy varies significantly with the outdoor temperature and was at the highest in the cold year of 2010 (8.3 TWh in households and 0.2 TWh in the tertiary sector). In the tertiary sector, the use of bio energy has increased three times during the past five years, while the consumption in households is more constant.

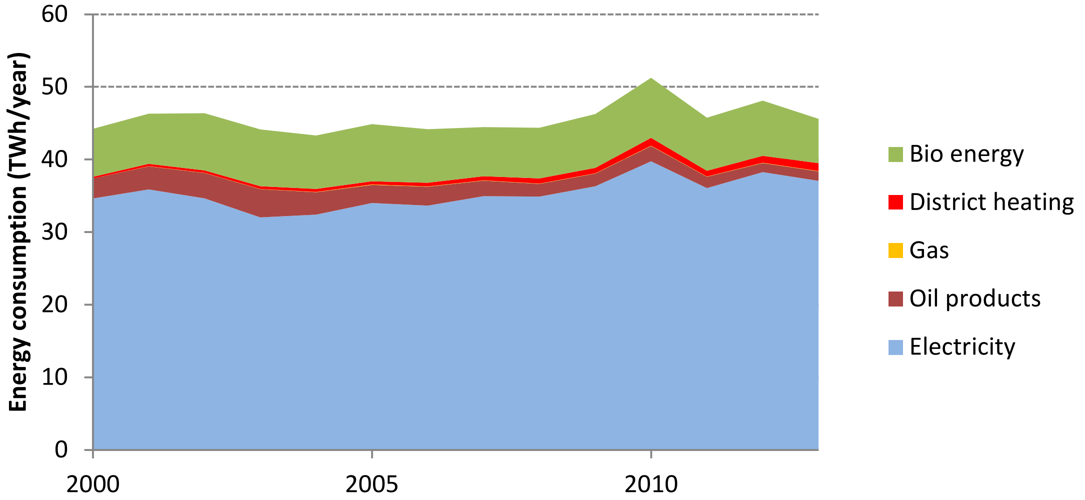

Figure 6 **Final residential energy use by energy carrier (not climate corrected), 2000-2013 (TWh/year)**

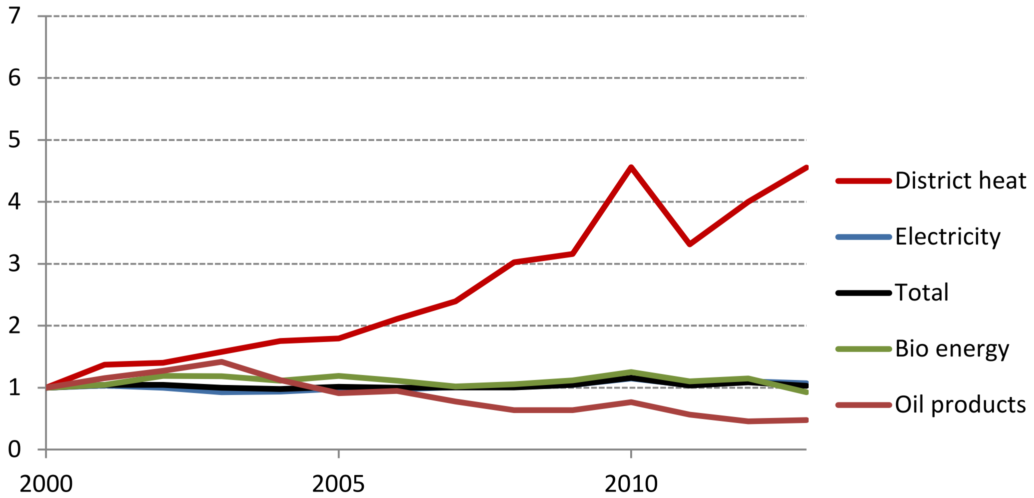

Figure 7 **Trends in energy use in households by energy carrier, 2000 = 1**

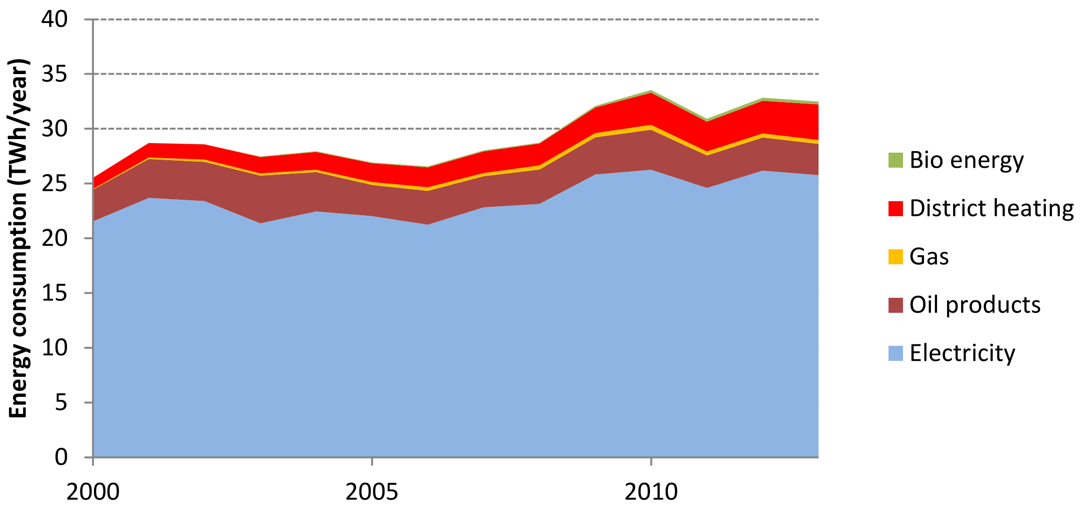

Figure 8 Final energy use by energy carrier in the tertiary sector (not climate corrected), 2000-2013 (TWh/year)

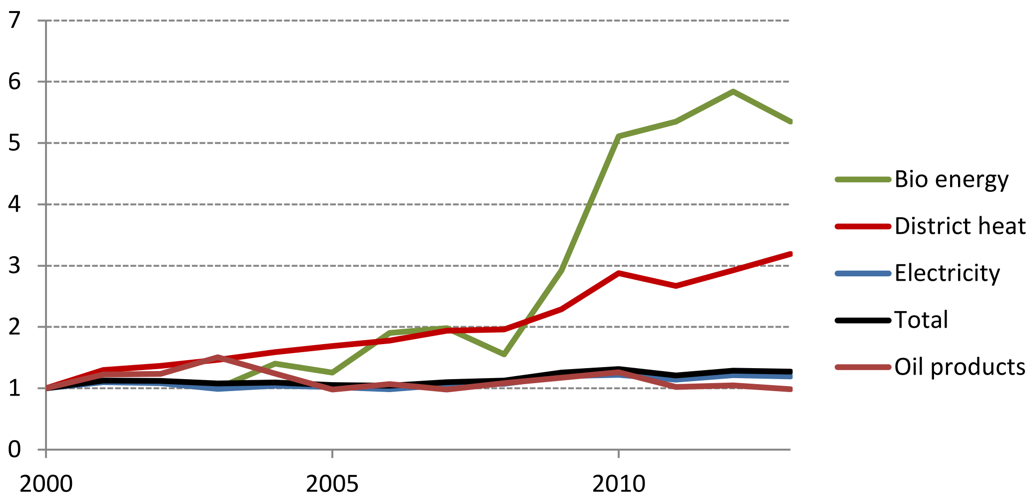

Figure 9 Trends in energy use in the tertiary sector by energy carrier, 2000 = 1 (for bioenergy 2003 = 1)

The climate corrected final energy use [3] of households has been rather constant since about 1995 at approximate 45 TWh, but an increasing trend has been noticed during 2004-2011. From 2011 to 2013 the climate corrected energy use shows a declining trend. It is however difficult to calculate the climate corrected energy use and the uncertainty is too large to be able to identify a significant change in

[3] In ODYSSEE, climate corrections are carried out for all countries using the same methodology, even if climate-corrected national data exist. They are only applied to a certain proportion of the space heating consumption (90%) to account for the fact that some losses are not dependent on the number of degree-days. The correction is done for each country in a linear way on the basis of the ratio between the normal degree-days and the real degree-days.

energy use. The climate corrected energy use increased from 45.6 TWh in 2007 to 48.4 TWh in 2011 and was calculated to be 47.8 TWh in 2012 and 46 TWh in 2013 (preliminary data).

Since no annually updated energy by end-use is available, an assumption of constant energy per household for tap water heating, cooking, lighting and other electricity specific energy use is applied. This methodology is used since the energy and particularly electricity used for space heating is considered as the end-use with largest annual variation.

Driving forces such as private consumption, number of households and population have increased more than the residential energy use, see Figure 10. In 2013 the private consumption was 52% higher than in 2000, the number of households was 16% higher and the population was 13% higher compared to a decrease in climate corrected energy use of 1% from 2000 to 2013 (preliminary data) and an increase in climate corrected energy use of 3% from 2000 to 2012.

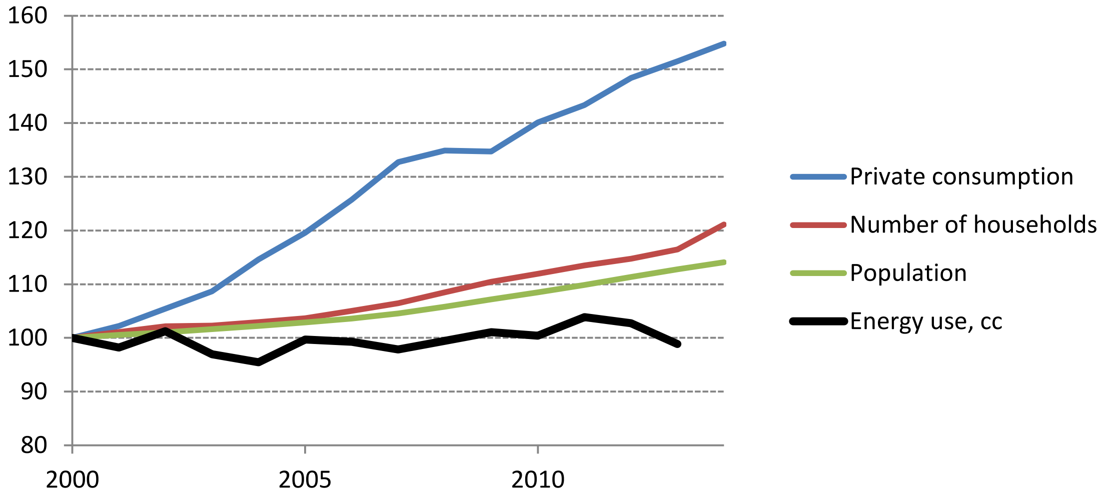

Figure 10 **Trends in climate corrected energy of households, private consumption, number of households and resident population 2000-2014 (2000=100)**

Climate corrected energy use per capita has decreased annually by 1.0 % from 2000 to 2013, see Figure 11. Climate corrected energy use per household has decreased annually by 1.2 %, per area by 1.5 % and per private consumption by 2.7 %. The residential area is however an uncertain value, calculated as the number of households multiplied by the average dwelling area. In addition there is the uncertainty of preliminary energy data of 2013. The annual decreases of the indicators for the period 2000 to 2012 are: 0.6% per capita, 0.9% per household, 1.3% per area and 2.6% per private consumption. The indicators do not include possible increased energy use for production of imported goods, since the boundary of the study is direct energy use in Norway. Climate corrected energy per heated area is used as energy intensity indicator in the residential sector in ODYSSEE, and a decrease of 22 % until 2013 indicates an saving of 10 TWh in 2013 compared to 2000. The decrease until 2012 is calculated to 18%, an energy saving of approximately 8 TWh.

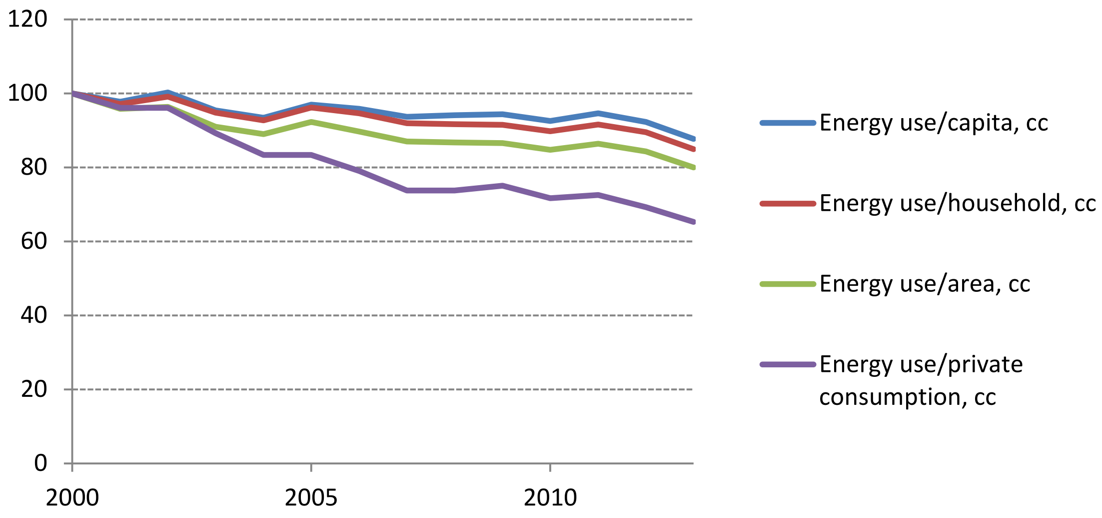

Figure 11 **Trends in energy use per capita, household, area and private consumption, climate corrected; 2000-2014 (2000=100)**

The area per capita has increased by 0.7 % annually from 2000 to 2013. At the same time the number of persons per household has decreased by 0.2 % annually, but since 2009 a stabilization is noticed, see Figure 12. Both these trends have an increasing impact on the energy consumption.

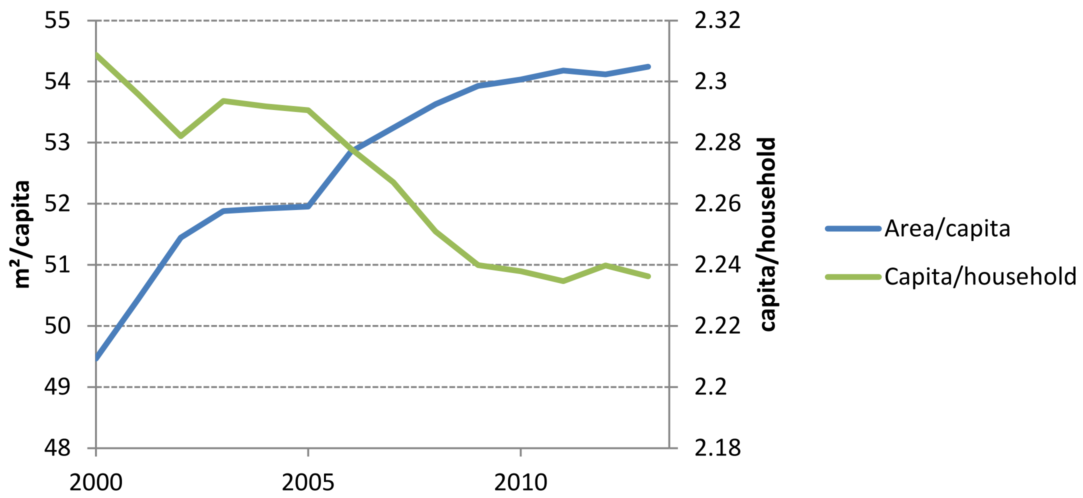

Figure 12 **Area per capita and persons per household 2000-2013**

The share of multi-family houses is increasing, see Figure 13. In 2001, 34 % of new dwellings were flats, while the share has increased to 44 % in 2011 and 52 % in 2014. In 2001, 78 % of all dwellings were single-family houses and in 2014 this share was about 73 %. An increasing share of flats will contribute to a decrease of energy consumption, since the energy intensity is less for flats compared to single-family houses.

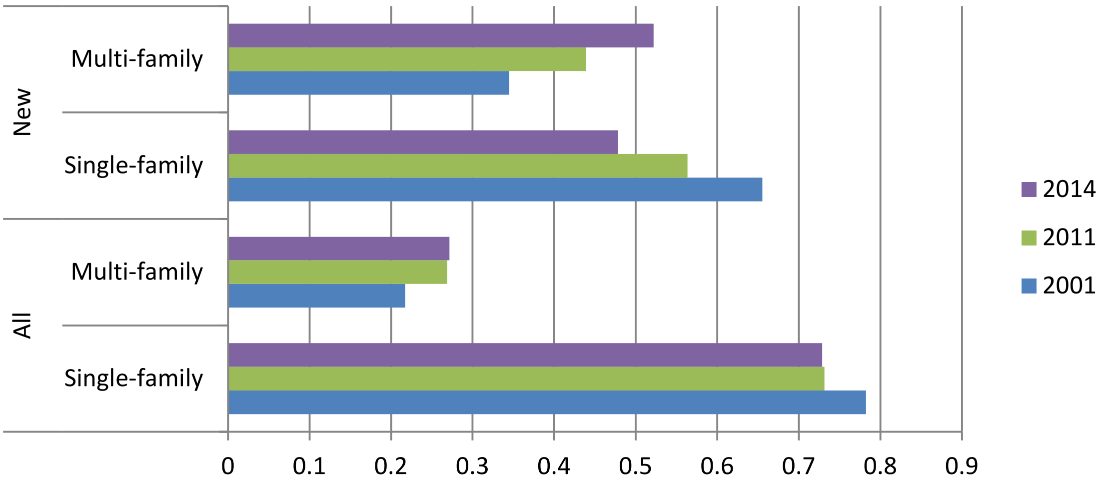

Figure 13 **Share of flats and single family houses of total dwellings and of new dwellings 2001, 2011 and 2014**

Energy use in the tertiary sector is compared with the trends in value added, number of employees and the building area in Figure 14 and the corresponding indicators are presented in Figure 15. The statistics were changed from 2008 due to a new standard of classification and it is therefore complicated to evaluate the development before and after 2008. Value added is available with the new classification back to 2000, but not energy use and the number of employees.

The building area is the most interesting driver, but it is uncertain due to lack of statistics. The trend is probably better since the statistics of new constructions is available. The energy use per area increased from 2000 to 2008 by 4% or 0.5% per year. From 2009 to 2013 there was a decrease of 5% or 1.2% per year. The energy use is not climate corrected and a high energy use is observed in the cold year of 2010.

Value added of the tertiary sector was 1.4 times higher in 2013 than in 2000, and at the same time the energy use has increased by 27% (without climate correction) with a change in classification after 2008. The energy intensity calculated as energy use per value added decreased by 7% from 2009 to 2013 or by 0.8% per year. The decrease from 2000 to 2008 was 13% or 1.7% per year.

The energy use per number of employees decreased by 12% from 2000 to 2008, or by 1.6% annually. From 2009 to 2013 there was an annual decrease of 0.8%.

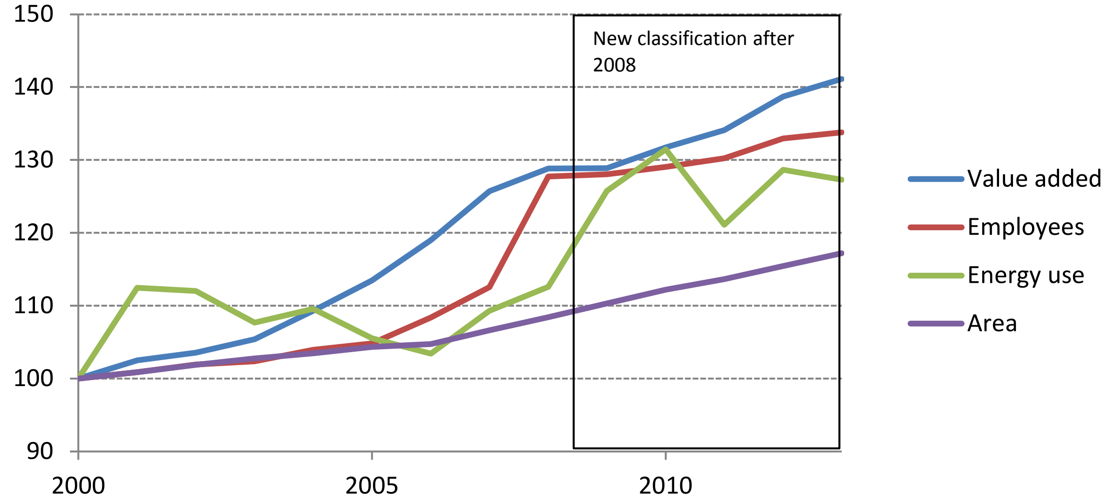

Figure 14 Trends in final energy use, value added, area and number of employees in the tertiary sector, 2000-2013

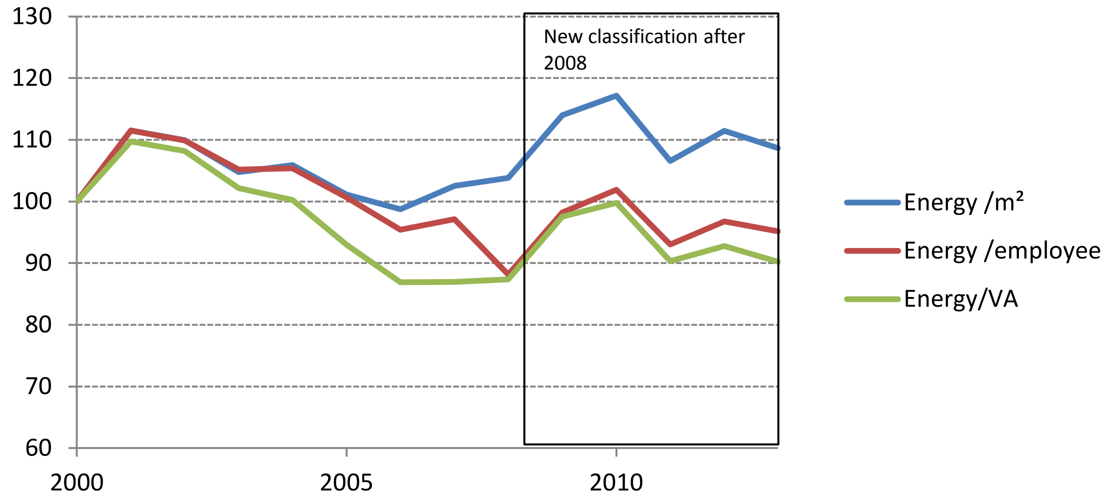

Figure 15 Trends in energy use per area, employee and value added in the service sector, 2000-2013

Figure 16 shows energy use of tertiary sub-sectors. The sub-sector “other” has become the one using most energy, 8.0 TWh in 2013. From 2009 to 2013 the annual increase of “other” is 2.1%. The sub-sector “other” includes e.g. recreation, arts, entertainment, repair of consumer goods, hairdressers, dry cleaning and membership organizations. Education shows the best development during this short time; an annual decrease of 2.8%.

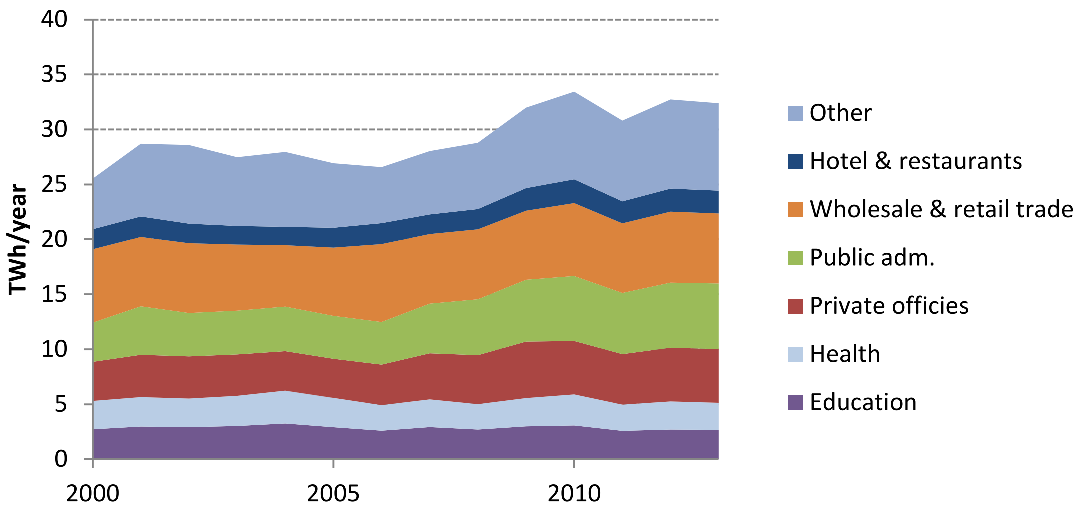

Figure 16 **Energy consumption in sub-sectors in the tertiary sector, 2000-2013**

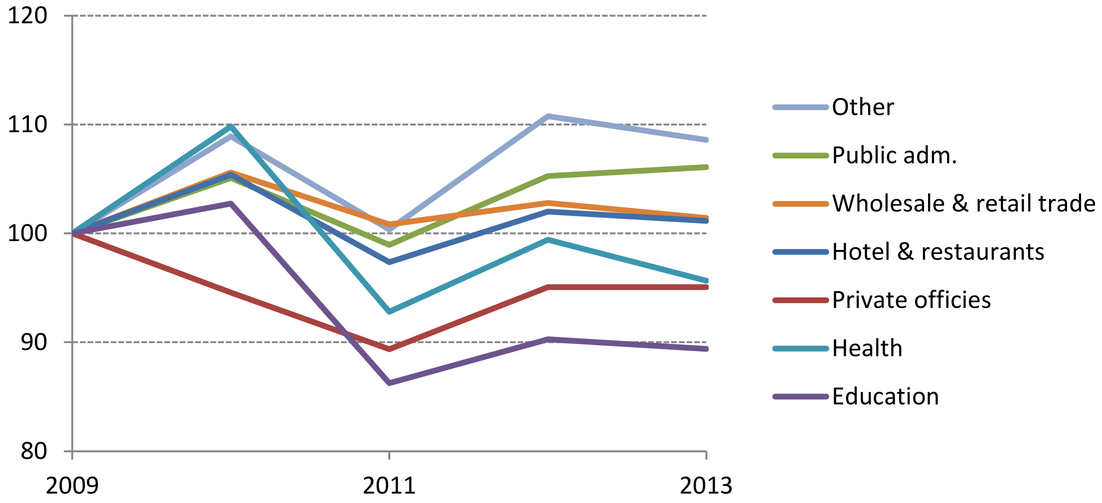

Figure 17 **Trends in energy use in tertiary sub-sectors, 2009-2013**

2.2. ENERGY EFFICIENCY POLICIES

Building regulations

The objective of the plan and building regulations is that planning in accordance to the law will arrange coordination of national, regional and local activities and be a foundation for decisions on use and protection of resources, development and secure aesthetic considerations. The current law entered into force for the first time 1 July 1986 and was amended in 1997, 2007, 2008 and 2010. In February 2008 the regulation was changed to partly implement the EU directive 2002/91/EC concerning energy efficiency and energy use in buildings. The building regulation 2010 is valid for the whole country without differences between regions. The scope and extent of the regulation is all types of constructions and products for constructions. Construction works with installations shall be carried out in such manner as to promote a low demand for energy and power. The building has to be as energy efficient as the requirements described in the law or fulfil the requirements of a total net energy demand (frame demand) as specified in the regulations.

It is not allowed to install burners of fossil fuels for baseload. Buildings until 500 m² utility floor space shall be projected and constructed so that a minimum of 40% of useful heating demand can be covered with other energy supply than direct electrical heating or fossil fuel based heating at the end user, unless the heating demand is less than 15 000 kWh per year. Buildings above 500 m² utility floor space shall be projected and constructed so that a minimum of 60% of useful heating demand can be covered with other energy supply than direct electrical heating or fossil fuel based heating at the end user.

It is decided that the energy requirements in the building regulations from 2010 shall be strengthen to passive house level by 2015 and near zero energy level by 2020. The requirement on energy is proposed to become 26% and 38% higher respectively for dwellings and office buildings in the building regulations of 2015. The requirements concern mainly new buildings and main constructions, which comprise about 1 to 2% of the yearly building mass. By 2020, when the new requirements reach full effect for new buildings and main constructions, it is expected that this will correspond to an energy efficiency result of between 1 to 1.2 TWh per year. The requirement for energy supply is expected to be modified and simplified: the regulation concerning the use of fossil energy is expected to become stricter while the regulation for use of electricity is expected to become less strict. A new requirement for energy supply will imply that buildings above 1000 m^2 utility floor space shall have flexible heat solutions, while small houses must be built with a chimney.

Enova Recommends

This is a scheme which shall make it easier to choose products and solutions with good energy performance. The scheme targets mainly the supply side, but another goal is to influence the purchase decisions made in households towards choosing the best products in terms of energy. Low-energy windows were the first product under Enova Recommends. In the start of this program, there were only one or two producers in Norway which delivered windows of "Enova Recommends" quality. Nowadays, most producers deliver windows of this quality, so the scheme has had a good effect in terms of developments in the supply side. The second product field under this program was insulation/tightness. Here, both the performance and the insulation/tightness products are important. The effects on the market for insulation are more difficult to access.

Today the "Enova Recommends" scheme includes 3-layers low-energy windows, insulation and tightness up to the methods in building regulations specified in TEK10. There are currently three insulation producers who are Enova's partners in this program. Enova specially recommends solutions which have a higher performance than required by building regulations and standards.

Enova support schemes - households

Enova has a diversity of programs supporting energy efficiency measures in households. The current support programs directed to households includes installation grants or support for:

- Energy advice (energy labelling and energy savings measure plan)

- Air-water heat pump
- Liquid water heat pump
- Exhaust air heat pump
- Oil burner or oil tank phase-out
- Oil stove phase-out
- Bio-oven with water jacket
- Bio-boiler
- Installation of solar collector
- Central heating management system
- Greywater heat recovery
- Production of electricity
- Holistic upgrading of dwelling
- Energy efficient new buildings
- Balanced ventilation
- Central heating system

Enova support schemes – tertiary

The programme for the use of energy in the built environment is a joint programme for a large and complex market. The target group for the programme is people who take decisions and make investments in projects with energy targets. Advisers, architects, contractors, manufacturers and suppliers of goods serve as driving forces for the development and implementation of these projects.

As per 2015 the programme is divided in the following schemes:

- Support for assessment of energy measures in buildings
- Support to existing buildings
- Support to energy efficient new buildings
- Support to central heating
- Support to new technology for future buildings
- Support for energy measures in infrastructure

Projects that can be supported are investments in a minimum of 10 % savings of energy in buildings, portfolio of buildings, outdoor equipment like road lighting, railways, sports grounds, water works, sewage treatment plant and waste management. The grant has to be a triggering factor. Enova intend to support the project up to a level where it is yield a normal return of the investment.

Energy Statistics of the Norwegian Building Network

All building owners that are supported by any of Enova's programmes for energy efficiency or conversion have to yearly report their energy use and other relevant information that may be of interest when analysing the energy use in buildings. This information is, e.g., general building data, technical installations, operational hours, etc. As from 2003 the reporting is to a web-based system. Enova publishes an annual report with energy statistics from the building network. The energy statistics offers a tool for building owners, consultants, authorities and others. Benchmarking figures may be used for comparison of buildings in different building groups as, e.g., schools, hospitals, offices etc.

3. ENERGY EFFIENCY IN TRANSPORT

3.1. ENERGY EFFICIENCY TRENDS

The total energy consumption in the transport sector has increased from 52 TWh in 2000 to 64 TWh in 2013, corresponding to a total increase of 23% and an annual increase of 1.6%. The use of diesel oil has increased by 3.5% per year, while gasoline consumption is reduced by 4.0% per year. The total use of oil products has increased by 1.2% in average per year. Use of biofuels has increased considerably, but the share is low; 1.7 TWh in 2013 or 2.6% of all energy use for transportation.

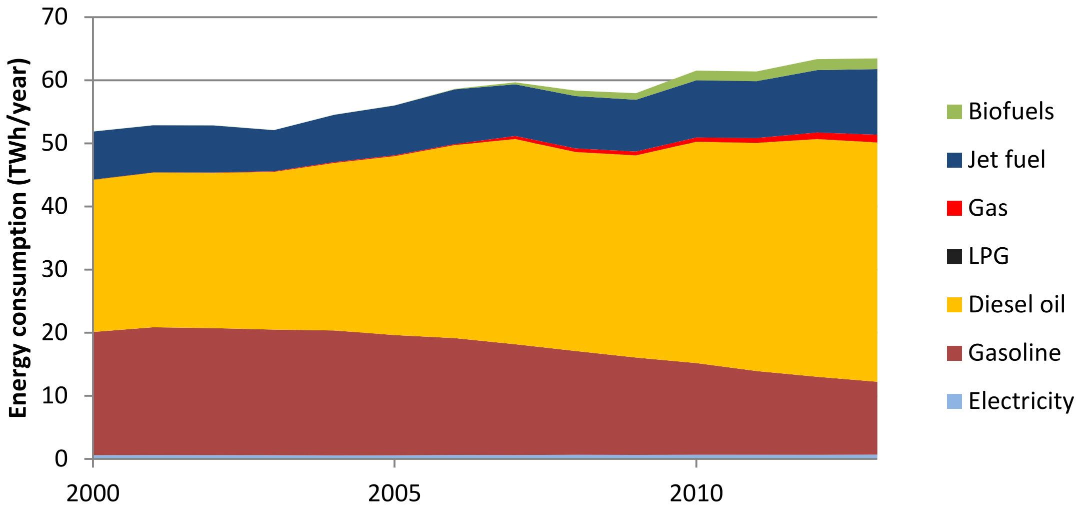

Figure 18 Energy use by fuel type in the transport sector, 2000-2013 (TWh/year)

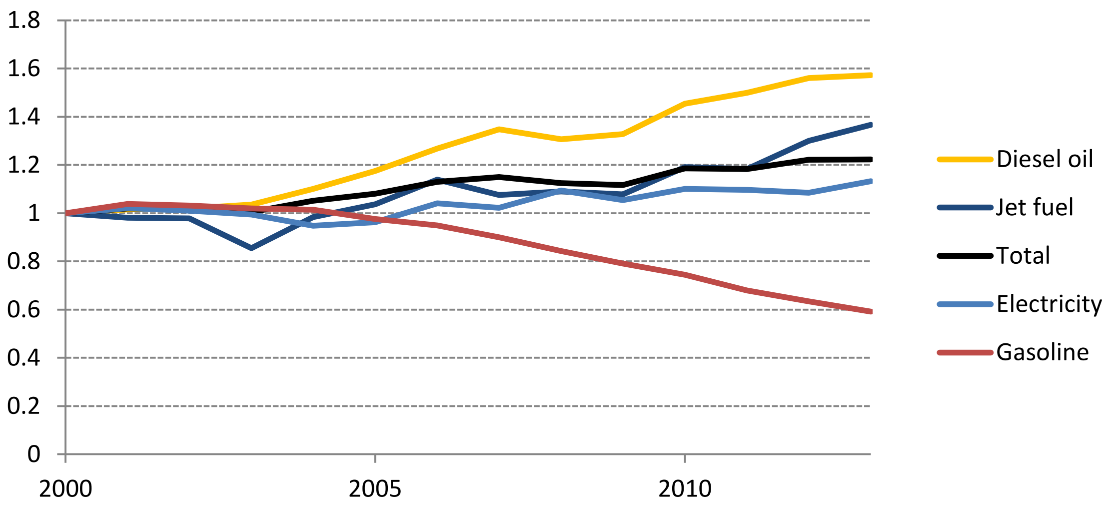

Figure 19 Trends in energy use in transport by energy carrier, 2000 = 1

Road transport has increased its share of total transport from 65% in 2000 to 68% in 2013 and sea transport has reduced its share, see Figure 20. The increasing number of battery electric vehicles contributes to an increased electricity use, but it is only a minor part of total electricity use in transportation.

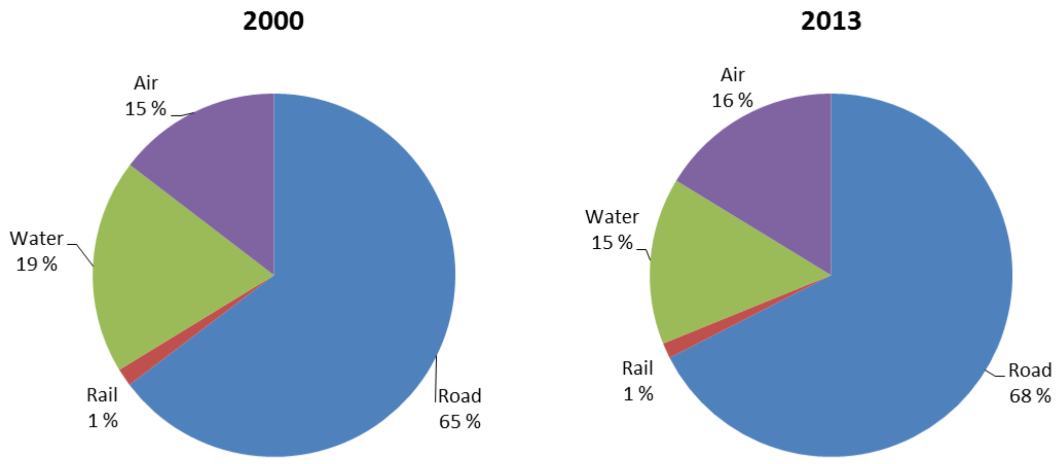

Figure 20 Share of different transport modes in 2000 and 2013

Cars are dominating in personal transport with a share of 81% in 2013 and an annual increase of 1.4%. Total passenger transport has in average increased by 1.3% per year since 2000. Passenger travel by bus has decreased annually by 0.8%, while travel by air, car, motorcycle, train and metro has increased. The highest domestic increase is travel by metro/tram with an annual increase of 3% followed by motorcycles with an increase of 2.7% per year, but both these modes represent only a small part of total transportation.

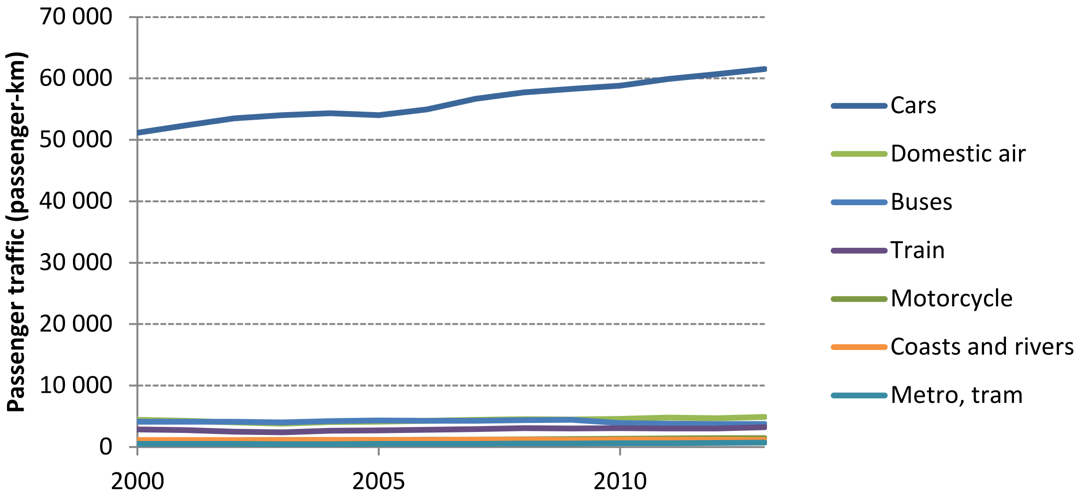

Figure 21 Travel by mode, passenger kilometers, 2000-2013

The stock of diesel cars has increased from 5% in 2000 to 46% in 2013, see Figure 22. The share of other cars than gasoline and diesel (i.e. battery electric, hydrogen and gas cars) was 1.6% in 2014. The annual sale of new cars has increased by 2.8% per year in average since 2000 and was 144 202 cars in 2014. Figure 23 presents the share of new cars by type. In 2014 13% was battery electric cars and 9% was hybrid cars.

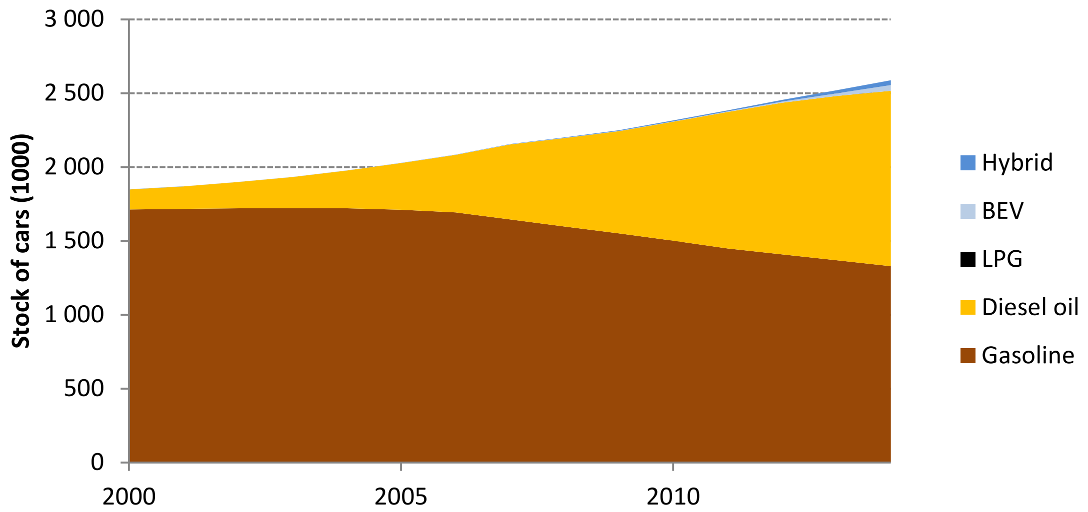

Figure 22 Stock of cars, 2000-2014 (1000 cars)

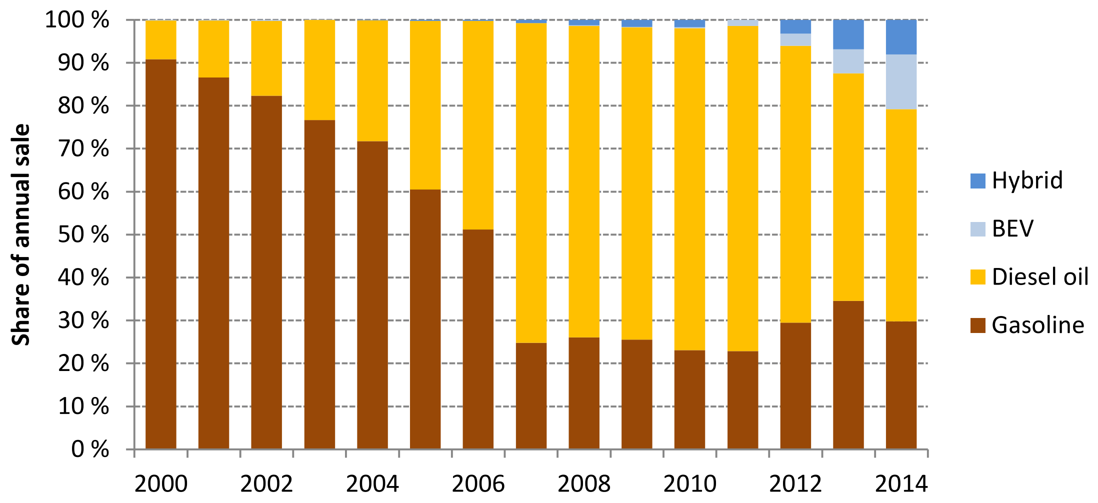

Figure 23 Share of annual sale of new cars by type, 2000-2014

The number of cars has increased annually with 2.4% from 2000 to 2013, number of cars per capita has increased with 1.8% per year and the average distance travelled by car has remained rather constant. At the same time, the energy consumption is calculated to have increased by 1.1% per year and the specific energy consumption is calculated to have decreased in average by 1.3% annually from 2000 to 2013. The energy use by cars is calculated based on the emission inventory and it follows the number of cars quite well from 2000 to about 2007. After that, the number of cars continues to increase at the same time as the energy consumption by cars shows a flattening, see Figure 24.

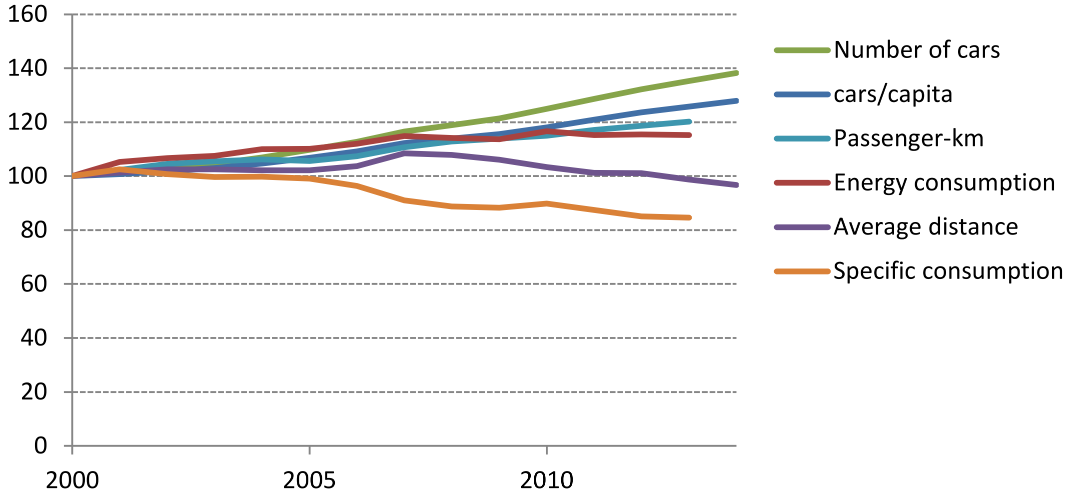

Figure 24 **Trend of car transport drivers and indicators, 2000-2013/2014 (2000=100)**

The specific energy consumption of the average stock of cars and new gasoline and diesel cars is presented in Figure 25. Specific consumption of average car stock is calculated as the energy consumption divided by the number of cars multiplied with the average distance travelled. It has decreased from about 8.0 litres/100 km in 2000 to about 6.7 litres/100 km in 2013. The specific consumption of new cars is calculated based on the average emissions presented by OFV[4]. The major part of the decrease of new gasoline cars is observed after 2006, see Figure 25. The increased share of diesel cars of the total stock contributes to the decreased specific consumption of the average stock, since the specific consumption of diesel cars in average is below that of gasoline cars. The specific consumption is an average of all cars with large impact of the motor size. Average emissions of new cars are based on test cycles and how well they represent the actual driving are under discussion.

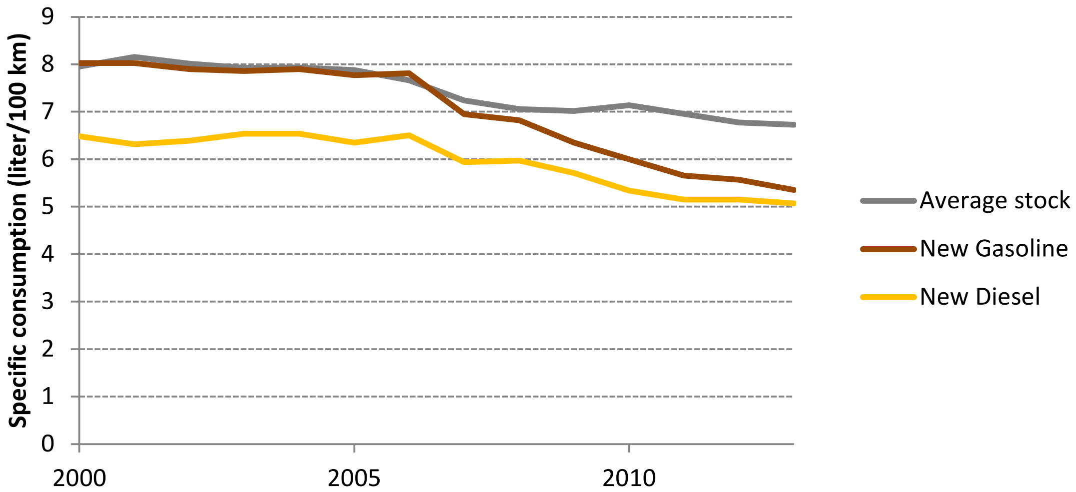

Figure 25 **Specific energy consumption of average car stock, new gasoline cars and new diesel cars, 2000-2013 (liter/100 km)**

[4] Opplysningsrådet for Veitrafikken http://www.ofv.no/

3.2. ENERGY EFFICIENCY POLICIES

Many measures in the transport sector in Norway are local measures like road pricing, reduced speed limits in specific areas due to environmental reasons, tax for use of studded tyres in city centre etc. The duties on petrol and diesel, as well as the registration tax on vehicles, are high. The purchase tax is correlated to CO_2-emissions.

Transnova was established against the backdrop of the Norwegian Report on Climate and based on the political consensus on climate in 2008. The mandate pointed to the fact that greenhouse gas emissions from transport increase faster than emissions from other sources. The national goal was to halt this trend, in order to reduce emissions. The second political consensus on climate from 2012 stated that Transnova no longer was a trial program but a permanent governmental body. Since 1st January 2015, Enova has taken over the responsibility of managing the programs directed towards transport, which previously were under the responsibility of Transnova. Enova's main contribution for transport projects consists of investment support. Enova's currently available programs for transport consist of the following funding schemes: support to energy management, support to energy measures in ships, support to energy measures in land transport, support to new energy and climate technology in transport, support to biogas and biofuels and support to electric charging infrastructure for vehicles.

Introduction of battery electric vehicles

Battery electric vehicles (BEV) have been introduced faster in Norway than in most other countries. This has been driven by several policies, introduced since 2001, such as the exemption from nonrecurring tax for vehicles, free parking and charging on public parking places, free drive in lanes for public transport and exemption from road toll. In addition there have been a research and development scheme on battery technology administered by the Norwegian Research Council, and a demonstration scheme administered by Transnova/Enova. In April 2015 the number of battery electric vehicles in Norway was more than 50 000, 18 090 of them were new cars registered in 2014. In addition 3063 zero emission cars were imported in 2014. 13% of the new registration of cars was zero emission cars. The share of zero emission cars is highest in urban areas, where availability to bus lanes as well as high cost of toll roads, ferries etc. have major impacts.

Purchasing power of the road authorities

Battery hybridization and full electric propulsion has recently been demonstrated to give very large energy efficiency gains in the maritime sector. While not many ships have been retrofitted yet, this can be expected to happen over the coming years. New ships are expected to have some level of hybridization, at least for crane operations, in many cases for load leveling of the main engine. The road authorities (Statens Vegvesen) have used their purchasing power to trigger the first fully battery electric ferry, Ampére, which started operations in 2015. Initial documentation shows that this ferry has a significantly reduced energy consumption compared to traditional ferries, both through effective propulsion, but also because significant design changes were introduced to reduce the need for battery and battery charging. The first fully electric fishing vessel was also introduced in 2015. Both of these trends, hybridization and full electrification, will over time give significant reductions in fuel consumption in the maritime sector.

4. ENERGY EFFICIENCY IN INDUSTRY

4.1. ENERGY EFFICIENCY TRENDS

Energy use of industry has decreased from 84 TWh in 2000 to 70 TWh in 2013, in average an annual decrease of 1.4%. Electricity is the main energy carrier; 62% of total energy use in 2013. Use of gas and district heating has increased in this period, and the use of coal and coke for energy shows the highest decrease, followed by use of oil. Until 2008 the annual decrease was small, but in 2009 the reduction in energy use was considerable due to the recession, and from 2010 the energy use has stabilized on a level about 10 TWh below that before the recession.

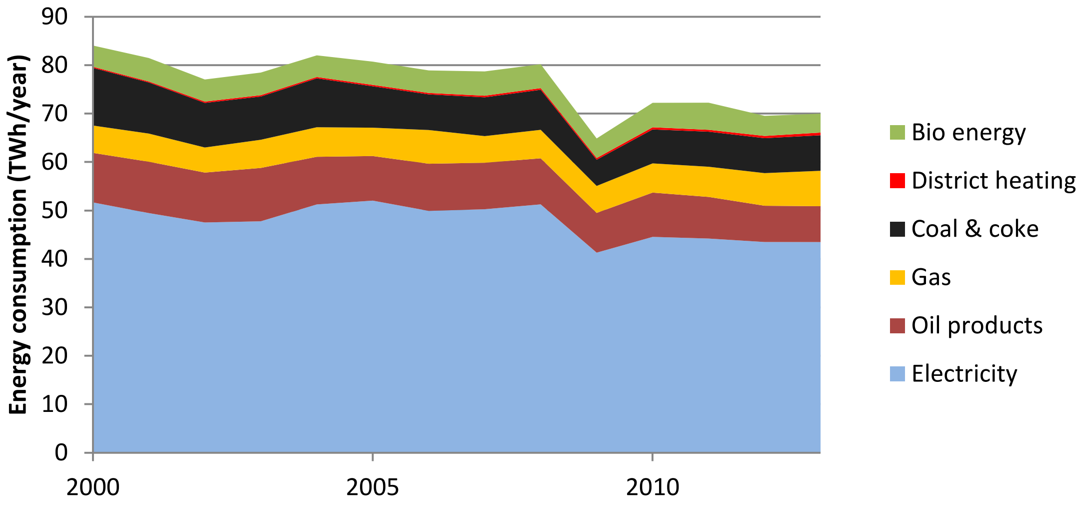

Figure 26 Final energy consumption by energy carrier in industry, 2000-2013 (TWh/year)

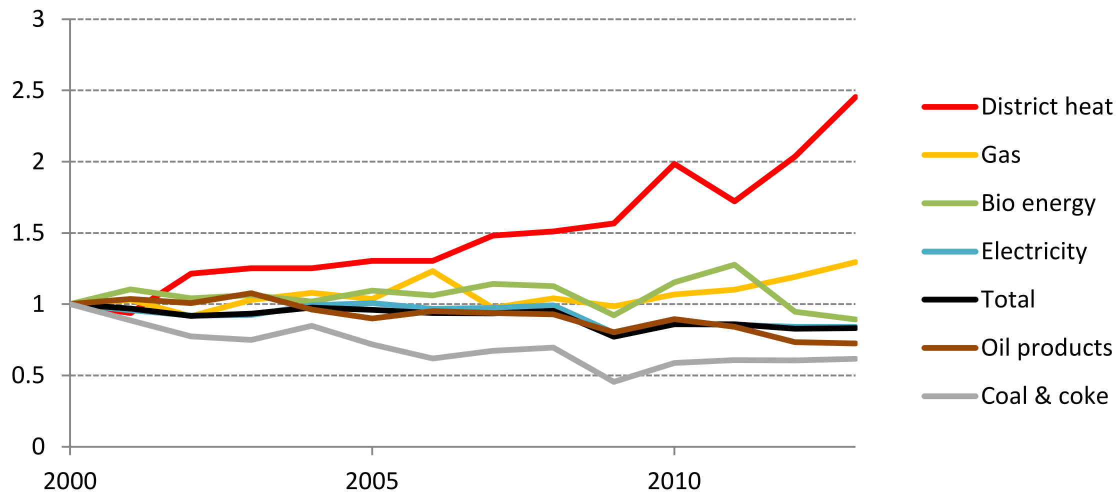

Figure 27 Trend in energy use in industry by energy carrier, 2000 = 1

Energy intensive branches such as metals manufacturing, basic chemicals and pulp & paper production dominates the sector's energy use, using 79 % of total energy use in manufacturing industry in 2013. The sub-sector with the highest share is the production of non-ferrous metals (mainly aluminium) that used 31 % of final energy in 2013. The chemical industry had the second highest share (24 % in 2013) followed by the production of iron, steel and ferro-alloys and the pulp & paper industry with a share of respectively 14 % and 9 % in 2013.

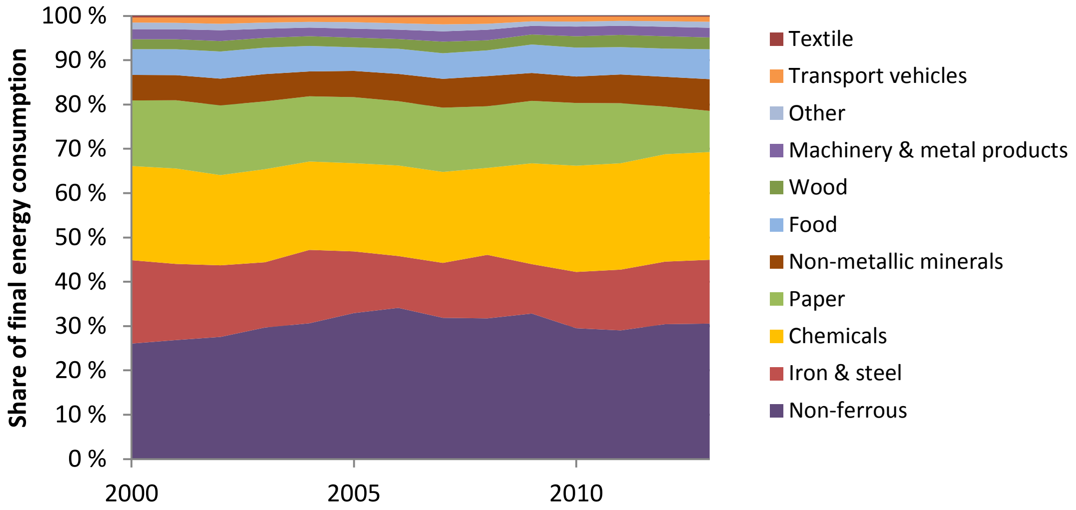

Figure 28 Share of final energy consumption by industry sub-sector, 2000-2013

The energy statistics was based on the old standard of classification until 2008 and the statistics of 2009-2013 follows the new standard of classification. The consequence of the change of classification is that graphic production, recycling and some industry service is moved from manufacturing industry to the service sector. In overall, the energy use of companies that have changed classification is less than 1 % of the energy used in the industry sector. The macro economic data are based on the new standard of classification back to 1990.

The energy use development in the six sub-sectors using most of the energy is presented in Figure 29. Production of non-ferrous metals had a maximum of energy use in 2008 of 24 TWh and was in 2013 20 TWh, or 8% lower than in 2000. Energy use of chemicals is reduced by 10% from 2000 to 2013. Pulp & paper industry has more than halved its energy use since 2000 and production of iron & steel has decreased by 40%.

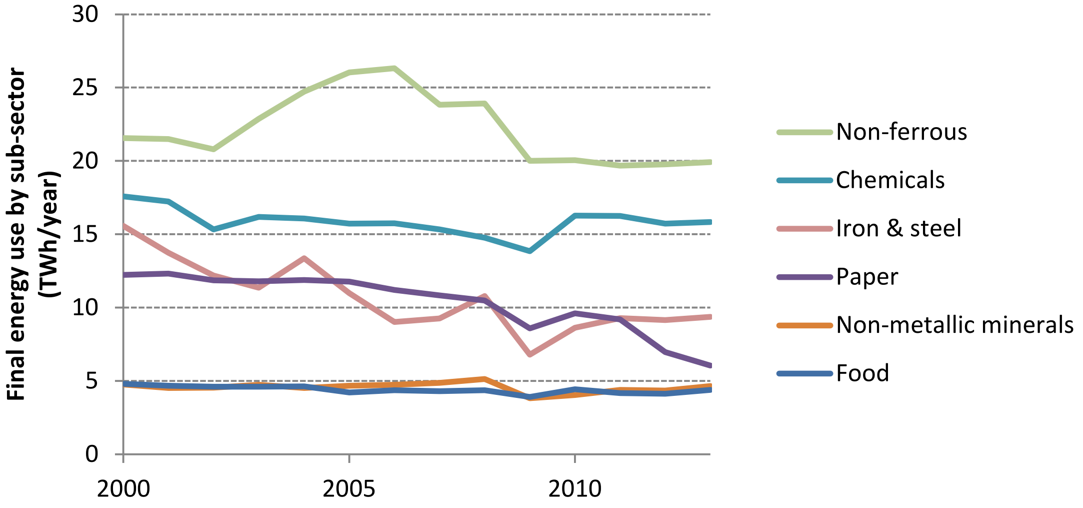

Figure 29 Final energy use by sub-sector 2000-2013 (TWh/year)

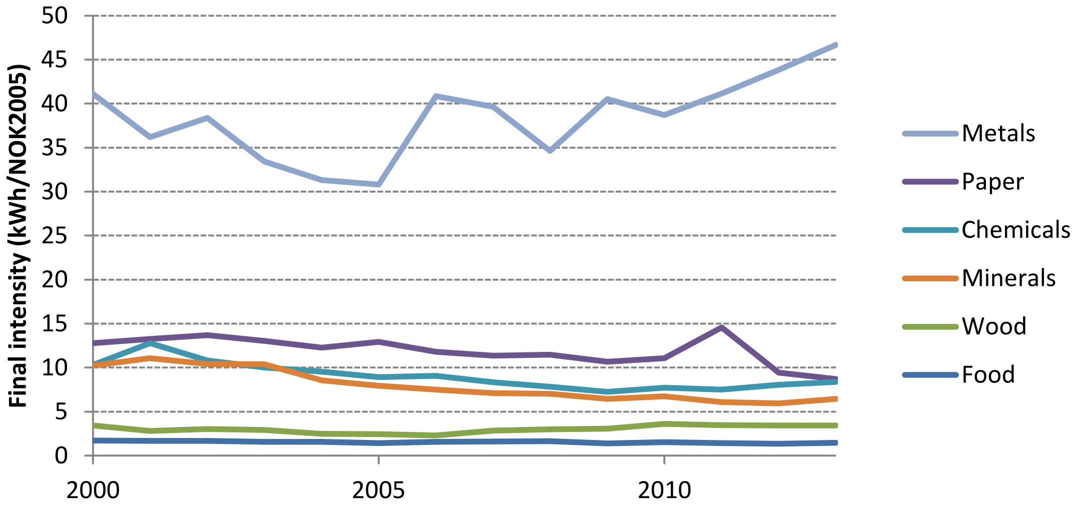

Figure 30 Energy intensity in major sub-sectors 2000-2013 (kWh/VA NOK2005)

Non-ferrous metals is the industry sub-sector with the highest energy consumption. It includes production of aluminium, magnesium, nickel etc., and in Norway it is the production of aluminium that dominates the energy consumption of this sector. Aluminium is produced at seven Norwegian locations. In 2002 the only Norwegian magnesium plant was closed down. The electricity consumption was 21 TWh in 2008, down to 17 TWh in 2010-2011 and up to 18 TWh in 2013. Primary aluminium is produced both by the older Søderberg technology and the newer more energy efficient pre-baked technology. Two Søderberg plants were closed down in 2001 and three more plants in 2006-2009. There has been an increase with the more modern and energy efficient pre-baked technology, with two new big plants starting up gradually from 2002 and forward. The newest plant was opened in 2004 and the annual production of primary aluminium was slightly below 1.4 mill tons until the recession in 2009. Then the production volume decreased by 18 % and it has only slightly increased up to 2013. The energy intensity calculated as energy used per ton aluminium produced has been reduced with 15% from 2000 to 2013, see Figure 31. But if the intensity is calculated as energy use for production of non-ferrous metals divided by the production index of non-ferrous metals it has increased by 21%. Data for value added of non-ferrous metals is not available, but for primary metals (i.e. also including ferro alloys). The energy indicators for primary metals calculated both with value added and with the production index are included in Figure 31 for comparison. This illustrates the importance of the definition of indicator and the difficulties to calculate energy performance.

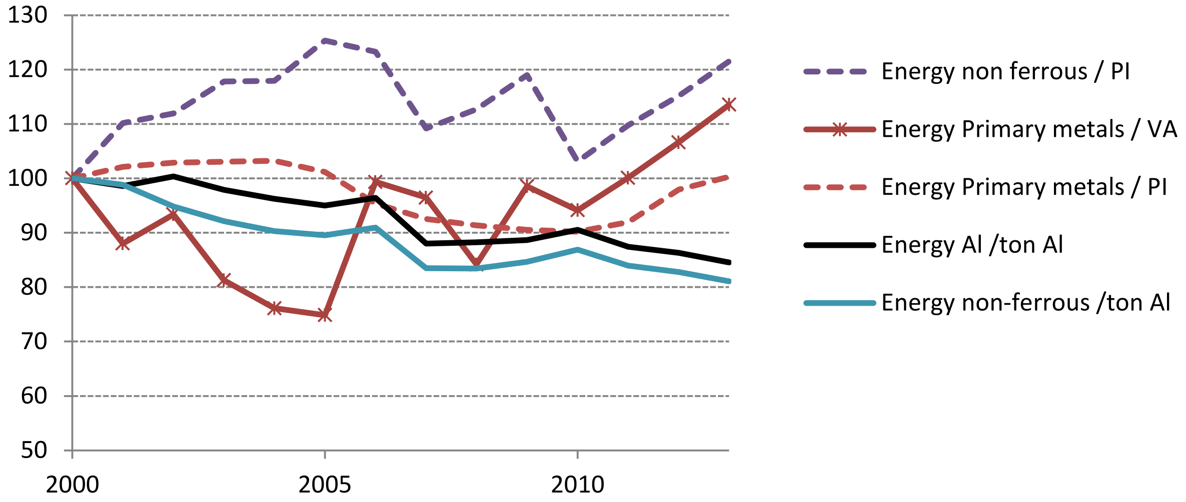

Figure 31 Indicators for production of primary metals, non ferrous metals and aluminium 2000-2013

Primary metals include steel and ferroalloys in addition to aluminium and other non-ferrous metals. The Norwegian steel and ferroalloy sub-sector is dominated by production of ferroalloys. The production of ferroalloys has become more and more energy intensive, as alloys with a higher degree of silicon has grown much more than other metals. The indicator energy use per production index for primary metals decreased from 2000 to about 2010 by 10% but has then increased to the same level as in 2000. Since the calculation of the energy indicator has high impact on the resulting development of energy efficiency and the specific energy consumption per ton produced is not available for all primary metals it is difficult to report the development of this subsector.

The chemical industry includes very different production plants and many of them are energy intensive, such as production of carbides, silicon metal, fertilizers and methanol. The production of carbides has been considerably reduced in this period, both due to the close-down of plants and lower production in the other plants. The production index of all chemical industry has increased more than the production index of basic chemicals since 2000, and since basic chemicals are more energy intensive than other chemical industry this results in a decrease in energy intensity for the chemical industry (caused by structural changes within the sub-sector). The energy use and production index of chemicals slightly decreased in 2009, but peaked in 2010-2011 followed by a decrease to slightly above the level before the recession in 2012-2013. The indicator energy use per production index of chemical industry has decreased by 19% from 2000 to 2013.

The energy intensity of paper, pulp and printing decreased from 2000 to 2005 but has then increased and was 6% higher in 2013 compared to 2000, when energy intensity is calculated as energy use per ton paper produced. The production of mechanical pulp is electricity intensive and increased until 2004, but has since then decreased and was in 2013 60% less than the production in 2000. The chemical pulp production has decreased by 45% from 2000 to 2013. The paper production in 2013 was about half of that in 2000. The production of chemical pulp uses most energy per ton of product, followed by mechanical pulp, while paper production is less energy intensive. The pulp and paper industry has had problems with low earnings and production volumes have been reduced and plants have been shut down.

The energy consumed per unit of production tends to decrease less (or even increase) in a period of recession for two reasons. First of all, process energy does not decrease proportionally to the activity as the efficiency of equipment drops if they are not used at full capacity. Secondly, part of the energy consumed is independent of the production level; if production declines, only the former part of consumption decreases, but not proportionally.

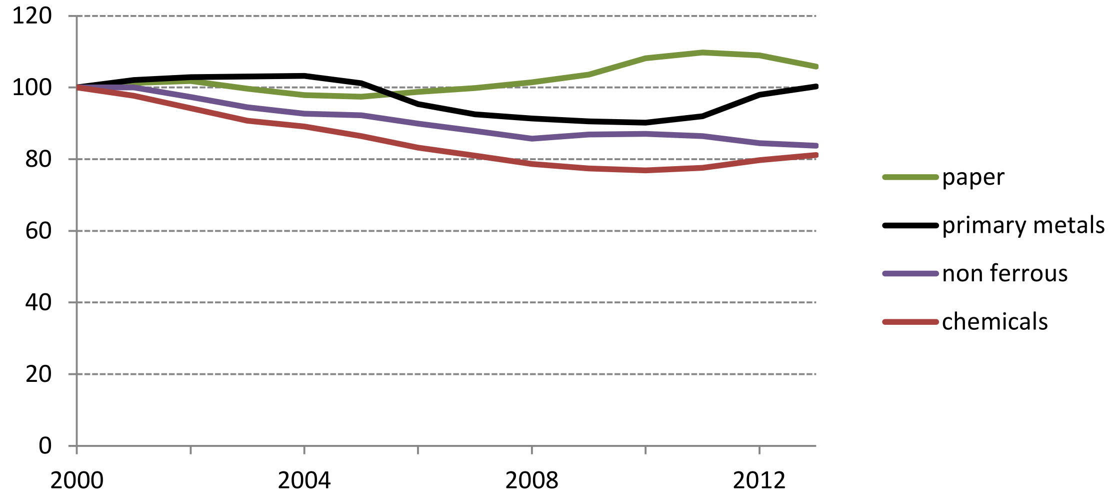

Figure 32 **Relative energy intensities in heavy industries. Final energy use/production index for primary metals and chemicals, final energy use/ton production for paper and non-ferrous metals; 2000-2013**

The largest energy consumers in production of non-metallic minerals are two cement plants. The production of clinker has decreased by 17% since 2000 but there has also been an opening of a new plant producing lime in this sector. The production index includes both non-metallic minerals and plastic and was the same in 2008 as in 2000 but has since decreased by 18%. The energy consumption of non-metallic minerals has been rather constant from 2000 to 2013, as has the less energy intensive subsector of rubber and plastics. This results in an increase of the energy indicator the last years, although the most energy intensive production of clinker has decreased.

The food industry had the same energy intensity in 2013 as in 2000 with minor fluctuations in between. Production of fish products used 25% of the energy of this subsector in 2013, followed by production of fodder, dairy products and meat products. Both the energy consumption and the production index have decreased by 9% from 2000 to 2013.

The energy intensity of the wood industry was rather constant from 2000 to 2009, but shows a poor development after that. The production index was 23% less in 2013 than in 2000 and the energy consumption was 6% less, resulting in increased energy intensity. If only purchased energy is included, the development of the energy indicator will be more positive, since the electricity use also has decreased by 24% while the use of by-products as bark and wood chips is at the same level as in 2000.

The subsectors machinery, transport equipment and fabricated metals all have lower energy intensity in 2013 compared to 2000. Most of the decrease occurred before 2009. The energy use has decreased at the same time as the production index has increased.

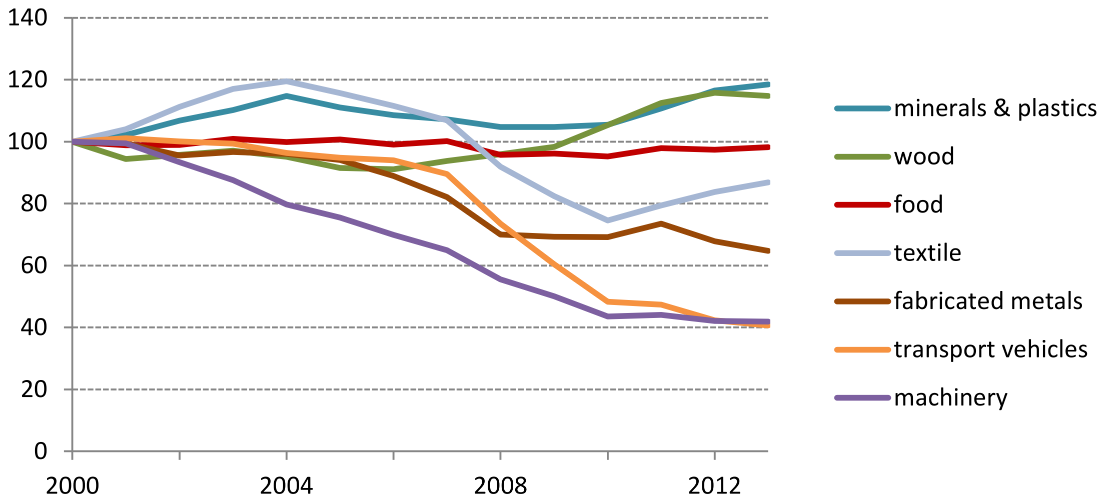

Figure 33 **Relative energy intensities in light industries. Final energy use/production index: 2000-2013**

4.2. ENERGY EFFICIENCY POLICIES

Support to energy measures on industry

Enova is working to boost the competitiveness of Norwegian industry through environmentally friendly and efficient energy use. Enova's programs are now directed both towards the onshore and offshore Norwegian industry. As per 2015, the following schemes are available: support to the introduction of energy management in industry and infrastructure, support to pre-project for energy measures in industry, support for energy measures in industry, support to central heating systems, support to pre-project new energy and climate technology in industry, support to new energy and climate technology in industry, support to the introduction of new technology, support to energy measures in infrastructure.

Studies and experience from completed projects show that there is a large potential for energy efficient production in industry and for conversion from fossil to renewable sources. The target group of this program are industry companies localized within the Norwegian territory and/or within the Norwegian economic zone. The project must be related to one or several of these areas:

- Energy efficiency: contribution to reduced energy use per produced unit
- Utilization of surplus energy: recycling of heat or cold to own use or third party use, or eventually for electricity production
- Conversion from fossil sources or electricity to renewable sources

The technology must be commercially available. The project must have a potential of energy results equivalent to 100 000 kWh or more. The grant has to be a triggering factor for investments in measures which otherwise would not have been implemented due to lack of profitability. Applications are prioritized based on these criteria:

- Ambitious energy goal relative to the company's total energy use
- Long lifetime for the energy result
- High energy results relative to kWh/NOK
- Documented feasibility (i.e., projects for which the technology, the business model and the marked can be verified, projects with realistic plans for organisation, financing and project accomplishment, project with a good documented managerial plan).

The companies have to report energy consumption and production figures to Enova at least five years after the project is finished. As a part of the program, Enova gathers energy consumption and production figures in a database. The companies have to report yearly their figures on a web-based reporting scheme. Enova calculates specific energy consumption for different industry sectors and presents the anonymous data on web. These benchmarking figures may be used to compare the company with other similar companies or with their own historical figures.

Support for new energy and climate technology in industry

The goal of this programme is to increase the introduction of new energy and climate technology related to production processes. The target groups are production companies in Norway with innovative demonstration projects which introduce new energy and climate technology. The technology must contribute to effective use of energy, energy recovery, conversion from electricity and fossil sources to renewable energy sources, increase in energy production from renewables or reduction in emissions of greenhouse gases from production processes.

The programme aims at supporting investments in physical installations for demonstration. The projects shall have a defined goal for innovation, for example, in form of reduced costs, increased efficiency, use of new energy sources, reduced specific energy use (energy use per produced unit), reduced emissions of greenhouse gases, etc. The innovation goal shall be documented and must include a real improvement in relation to the established standard. The project must have a defined budget and a clear plan for implementation and financing. The project may involve suppliers and cooperation between several partners.

Funding can be provided to the demonstration of technology that has not been introduced before in commercial scale in relation to production processes in Norway, including technology which previously has only been demonstrated in small-scale. In addition, the projects shall have a defined innovation goal, as well as a defined energy and/or climate goal related to the installation applying. The installation shall be placed in a production company in Norway and have a lifetime of minimum 2 years. Required concessions and emissions allowances must be available before funding is attributed.

An example of a project supported by Enova is the Karmøy technology pilot, a plant for production of the most energy and climate efficient primary aluminium metal. The decision to build a new pilot plant is taken and it is planned to be in operation in 2017 with an annual production of 75 kt and a specific energy consumption of 12.3 kWh/kg aluminium well under the world average.

5. ASSESSMENT OF ENERGY EFFICIENCY/SAVINGS THROUGH ODEX

In order to assess the actual results of energy efficiency policies and measures, it is necessary to use a bottom-up approach, i.e. to start from the achievements observed for the main energy end-uses and appliances, and to compile them into an aggregate bottom-up energy efficiency index, ODEX, (all end-uses and appliances being weighted according to their weight in the total final consumption). This energy efficiency index aggregates the trends in the detailed bottom-up indicators (by end-use and equipment) in a single indicator, see Box 3. It provides somehow a substitute indicator to energy intensities (industry and transport) or unit consumption (per dwelling for households) to describe the overall trends by sector.

Energy efficiency policies and measures implemented since 2000 have contributed to improve the efficiency by 17 % until 2013, or 1.4% per year, see Figure 34. This means that if these policies and measures would not have been implemented, the final energy consumption would have been 17% higher in 2013 (approximately 29 TWh). For the period with final energy data, i.e. 2000 to 2012, the increase in energy efficiency is calculated to 15% corresponding to approximately 27 TWh.

The development has been positive for all sectors, according to the selected indicators. Most of the improvement is registered from 2000 to about 2008 and afterwards the ODEX has flattened out. The energy efficiency index of industry has decreased by 16%, an annual improvement of 1.3%, but the ODEX of 2013 is almost the same as in 2008. The transport sector has in overall improved the energy efficiency index by 12% corresponding to an annual improvement of 1.0%. The household sector had an annual improvement of 1.9 % from 2000 to 2013 with a considerable improvement after 2011. But one should be aware that the data of 2013 are preliminary. The improvement until 2012 is 18% compared to 22% until 2013.

In order to calculate the ODEX of the household sector, the energy consumption should be known for end-use sectors as space heating, hot water, cooking and large appliances. Since this data is not available in Norway, the calculations are simplified and based on estimates. The household ODEX is therefore to be regarded as an estimate of the development in the sector. Two main factors contribute to increase the household energy consumption; first the increasing number of dwellings due to population growth and the growing number of one person households and secondly the higher comfort (more household appliances and larger homes). On the other hand, energy savings, resulting from energy efficiency improvements in the various end-uses, contribute to decrease the household consumption.

The ODEX of the industry sector is weighted with the shares of energy consumption of the sub-sectors. Important sectors in Norwegian industry then become the chemical, primary metals and paper industry. In the chemical industry there have been major structural changes, which not are fully reflected in the production index.

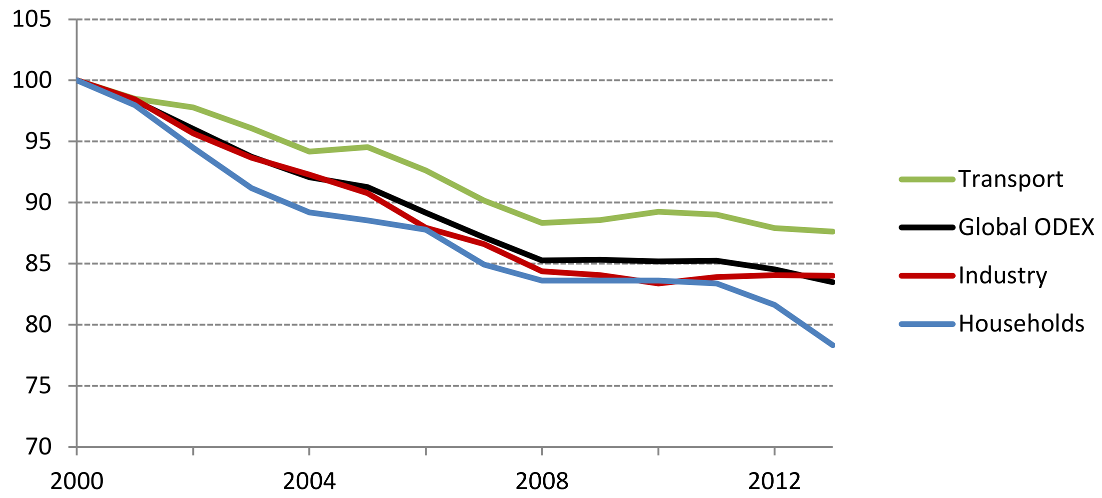

Figure 34 Energy efficiency progress (at normal climate), ODEX total, industry, transport and households, 2000-2013

Box 3 ODEX

ODEX is the index used in the ODYSSEE-MURE project to measure the energy efficiency progress by main sector (industry, transport, households) and for the whole economy (all final consumers). ODEX stands for "ODYSSEE energy efficiency index".

ODEX by sector is calculated from unit consumption trends by sub-sector:

- By aggregation of unit consumption indices by sub-sector in one index for the sector on the basis of the current weight of each sub-sector in the sectors energy consumption
- Unit consumption by sub-sector is expressed in different physical units so as to be as close as possible to energy efficiency evaluation; toe/m², kWh/appliance, toe/ton, litre/100 km...)
- Energy efficiency gains are measured in relation to the previous year („sliding ODEX") and not to a base year (e.g. 2000), so as to avoid to have results influenced by the situation of the base year.

A value of ODEX equal to 90 means a 10% energy efficiency gain.

ODEX indicators represent a better proxy for assessing energy efficiency trends at an aggregate level (e.g. overall economy, industry, households, transport, services) than the traditional energy intensities, as they are corrected for structural changes and for other factors not related to energy efficiency (more appliances, more cars…).

More information: http://www.odyssee-mure.eu/publications/other/odex-indicators-database-definition.html

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