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Energy efficiency policies and measures in Norway 2006

- Monitoring of energy efficiency in EU15 and Norway (ODYSSEE-MURE)

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Abstract

This report represents the national case study of Norway for the EIE-project “Monitoring of energy efficiency in EU-15 and Norway – ODYSSEE-MURE”. It presents the recent energy efficiency trends in Norway on the basis of indicators extracted from the ODYSSEE database.

Total energy consumption (not including energy as feedstock) has increased from 192 TWh in 1990 to a present maximum of 219 TWh in 1999. From then it has been a slight decrease and in 2005 the final energy consumption was 215 TWh. Energy consumption in manufacturing industry has increased by 11 % from 1990 to 2004, and in the period 1998-2004 it seems to be steadying at approximately 78 TWh. Final energy use in households has increased from 41 TWh in 1990 to a maximum of 46.6 TWh in 1996 and 2002. In 2005 44.1 TWh was used, which is almost the same as the consumption in 1994. It seems to be an interrupt in the increase of energy use in households, despite the growth of all common used drivers in this sector.

Energy efficiency policies and measures implemented since 1990 have contributed to improve the efficiency by 10 %, or 0.7 % per year; this means that if these policies and measures would not have been implemented, the final energy consumption would have been 10 % higher in 2004 (or approximately 19 TWh).

Keywords: Indicators, energy trends, energy savings

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1 Executive Summary

This report represents the national case study of Norway for the EIE-project "Monitoring of energy efficiency in EU-15 and Norway – ODYSSEE-MURE". It 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, 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.

Total energy consumption (not including energy as feedstock) has increased from 179 TWh in 1980 to a present maximum of 219 TWh in 1999. From then it has been a slight decrease and in 2005 the final energy consumption was 215 TWh. The sector using most energy today is the industry, followed by the transport sector. From 1990 to 2004 the growth rate has been highest in the freight sector.

Energy consumption in manufacturing industry has increased by 11 % from 1990 to 2004, and in the period 1998-2004 it seems to be steadying at approximately 78 TWh. There has been an increase of 27 % in the non-ferrous metal production, a decrease of 14 % in the ferroalloy production and an increase of 31 % in the chemical sector.

Final energy use in households has increased from 37 TWh in 1980 to 41.4 TWh in 1990 and a maximum of 46.6 TWh in 1996 and 2002. In 2005 44.1 TWh was used, which is almost the same as the consumption in 1994. It seems to be an interrupt in the increase of energy use in households, despite the growth of all common used drivers in this sector.

Final energy use in the service sector has increased with 63 % from 1980 to 2005. The annual growth was 2.5 % in 1980-2005, but the growth rate has slowed down and was only 1.3 % in 1990 to 2005.

Energy consumption in the passenger transport sector has increased by 8 % from 1990 to 2004 and in freight it has increased by 45 %.

The overall final energy intensity improved annually by 1.9 % from 1990 to 2005 (i.e. final energy over GDP). The improvement was higher during the nineties than during the last five years. General growth in the economy plays an important role in this development, but also structural changes and more efficient use of energy contributes. An increasing share of the primary energy is not going to final energy consumers, mainly due to increased activity in the oil and gas production and non-energy use in chemical industry.

In the ODYSSEE-project an aggregate energy efficiency index, called the ODEX, is developed. The purpose of this index is to assess the actual results of energy efficiency policies and measures. It aggregates the trends in the many detailed indicators in a single indicator.

Energy efficiency policies and measures implemented since 1990 have contributed to improve the efficiency by 10 %, or 0.7 % per year; this means that if these policies and measures would not have been implemented, the final energy consumption would have been 10 % higher in 2004 (or approximately 19 TWh).

The energy efficiency index in industry decreased from 1993 to 1995 but has since then been constant. Within the sub-sectors there are structural changes that not are fully reflected in the production index, leading to higher increase in energy intensity than expected. For the transport sector the index was first constant and then shows improvements in energy efficiency from 1994 to 2004 resulting in savings of approximately 10 TWh. The household sector has a rather constant improvement after 1992 and the total savings are calculated to approximately 8 TWh.

If energy consumption is corrected for changes in activities and structural changes by keeping the activity in 2004 at the same level as in 1990 and the structure of each sector is the same in 1990 and 2004, it is possible to estimate the energy savings of each sector. The savings of industry then becomes approximately 3.5 TWh, the savings in the household sector approximately 4 TWh, the savings of the service sector and other energy use approximately 7 TWh and in the transport of passengers the savings may be calculated to approximately 4 TWh and in the goods transport savings of approximately 5 TWh are obtained. This summarises to 23 TWh compared to 19 TWh with calculation with the ODEX, but here the service sector is not yet included[1]. The annual efficiency improvement is 0.9 %, if the total improvement is 23 TWh, or 0.7 % if the improvement is 19 TWh.

[1] It is difficult for find a good indicator for the service sector, since many countries have less data, or data with a poorer quality, for this sector.

2 The Background to Energy Efficiency

2.1 Overall economic context

The overall gross domestic product (GDP) for the entire Norwegian economy had a growth of 2.3 % in 2005. The growth of on-shore activities was 3.7 % in 2005, and there was a decrease in the off-shore activities as well as in international shipping. The last 15 years there has been an annual increase of 4 % in overall GDP. The growth was highest the first half of this period, due to high activities in oil and gas drilling. See Table 1 and Figure 1.

Table 1 Economic and industrial growth in Norway, % per year

	1990-1997	1997-2002	2002-2005	1990-2005
GDP	4.8	3.2	3.3	4.0
Private consumption	3.5	3.8	5.6	4.0
Manufacturing value added	1.8	-0.4	3.9	1.5

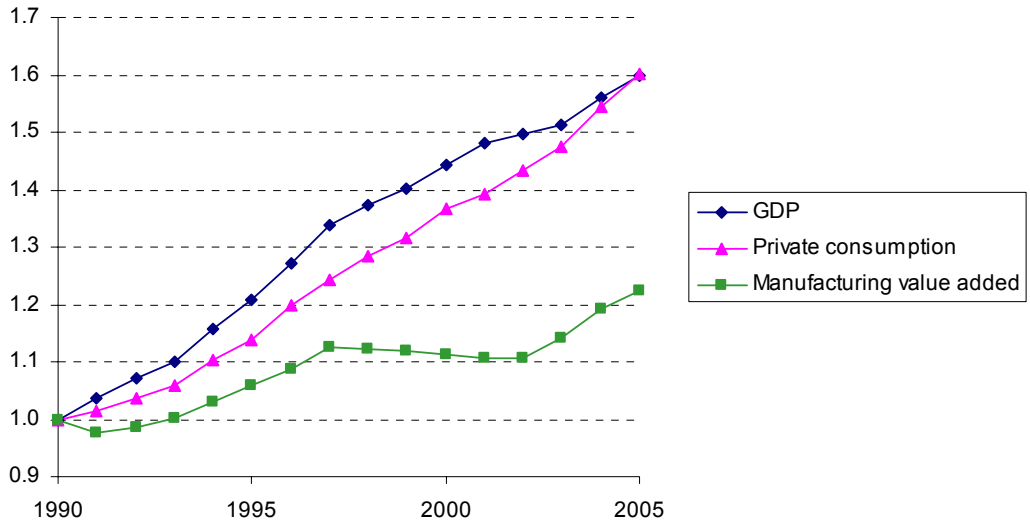

Figure 1 Macro-economic development in Norway 1990-2005 at constant prices.

2.2 Energy consumption trends

Norway is a major producer of oil, gas and hydropower. Most of the electricity production is based on hydropower, and this has historically made it possible to have low electricity prices and a large energy intensive industry as well as use electricity for heating purposes in private homes. Due to large economic growth the last 15 years and almost no new power supply, Norway is now a net importer of power in the joint Nordic electricity market, at least under average climate (precipitation) conditions.

Electricity is found to be a convenient and cheap energy carrier for many purposes and half of all end use energy is electricity. The last 15 years electricity consumption grew by on average 0.9 % per year and from 1980 to 2005 electricity consumption has grown with 53 % (2.1 % per year). The use of biomass has grown on average by 1.1 % per year and gas consumption has an annual average growth of 3.5 % in 1990 to 2005. The share of gas is still quite small, but it is doubled since 1980. Oil consumption has decreased by 16 % from 1980 to 2005. In the period from 1990 to 2005 the oil consumption has in average increased by 0.3 % per year. District heat has an annual average growth of 15 % from 1990 to 2005.

The final energy consumption was 179 TWh in 1980 and 192 TWh in 1990. The highest consumption was in 1999 and since then it has been a small reduction. In 2005 the total energy consumption was 215 TWh, see Figure 2. Coal and coke in e.g. metal production is included, while gas as feed stock is excluded. Energy use in households is corrected for climate variations by the use of degree-days.

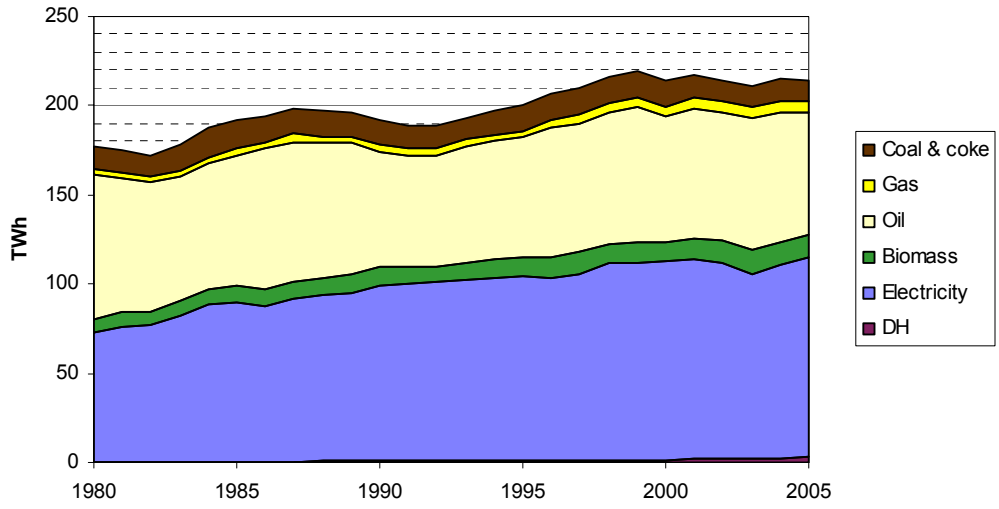

Figure 2 Final energy consumption in Norway 1980-2005 (Source: Energy balances)

The sector using most energy in 2004 was industry (36 %), followed by the transport sector (26 %), the residential sector (21 %) and other uses (17 %). The growth has been highest in the freight sector, increasing from 9 % of final energy use in 1990 to 12% in 2004, see Figure 3.

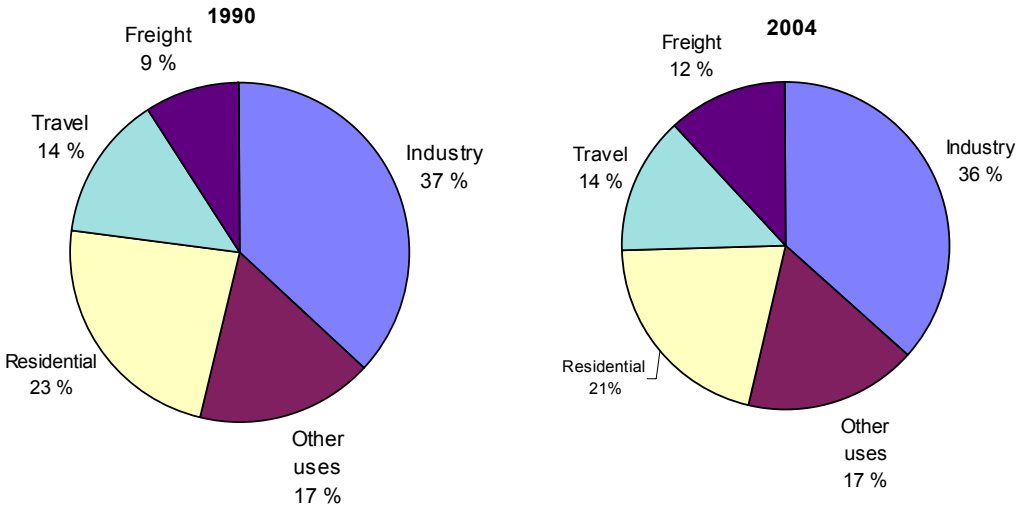

Figure 3 Final energy consumption by sector in Norway in 1990 and 2004

2.3 The policy background to energy efficiency

The alteration to a more environmental friendly energy production and use in Norway is since 2002 managed by Enova SF. Enova is a public enterprise for promoting energy savings, new renewables and environmentally friendly natural gas solutions. Enova is owned by the Government of Norway, represented by the Ministry of Petroleum and Energy. Enova's main mission is to contribute to environmentally sound and rational use and production of energy, relying on financial instruments and incentives to stimulate market actors and mechanisms to achieve national energy policy goals.

A trading system for greenhouse gas emissions entered into force 1 January 2005 and the concept is in line with the EU emission trading system.

ENOVA SF administrates the Energy Fund. The income of the energy fund comes from a levy of 1 øre/kWh (0.008 €/kWh) to the distribution tariffs that is mandatory. The electricity trade concessionaire adds a levy to the tariff of 1 øre/kWh of all tapping from the distribution grid to the end user, in connection with invoicing. The electricity trade con-

cessionaire pays the energy fund 1 øre/kWh multiplied with the energy quantity consumed by the end users of the distribution grid.

ENOVA chooses the measures and administrate the fund in order to achieve the national goals in the best way. ENOVA are not an executive/operative company, but engages external actors to carry out definite tasks on behalf of ENOVA.

The energy fund is used to project related measures as purchasing services, payment of grants and other financing of measures in the field of consumption, environmentally friendly heat, wind and natural gas. The fund supports projects in industry, the tertiary sector, the household sector as well as production of new, renewable energy.

ENOVA organizes the activities in different programmes:

- Reduced energy use – industry
- Energy management – companies in network
- Grants for energy savings in homes, buildings and outdoor equipment areas
- Energy plans in municipalities
- Grants to heat plants using bio energy, heat pumps, waste fuels or waste heat
- Processing of bio fuel
- New technology
- Wind power
- Information and communication
- Education and training

New renewable electricity production

A new scheme for support of electricity production from new renewable energy sources was launched in October 2006. Wind power will be supported by 8 øre/kWh (10 €/MWh) electricity produced, immature technologies and electricity production based on bio fuels will get 10 øre/kWh (12.5 €/MWh) and hydro power will get 4 øre/kWh (5 €/MWh) for production representing the first 3 MW of the installed capacity in the plant. The support will be paid in 15 years, and the first year of the scheme will be 2008.

Public budget dedicated to energy efficiency

Most of the public budget dedicated to energy efficiency is collected in the Energy Fund. As from 2005 there has been no grant over the state budget to the Energy fund. The levy on the distribution tariff was 1.0 øre/kWh (1.25 €/MWh) in 2006. In 2006 the energy fund had in total 687 MNOK (approximately 86 M€), see Table 1.

Table 2 Energy Fund [million NOK] (1 € ≈ 8 NOK)

	2002	2003	2004	2005	2006
Distribution tariff; transferred to the Energy Fund	200	192	470	665	665
Transfer to the Energy fund from the state budget	349	259	60	0	0
Income from interests previous year		20	13	14	22
Total	**549**	**472**	**543**	**679**	**687**

In order to strengthen the priority area of the Fund, the government proposes a new fund called "statutory fund of energy conservation and renewable energy". In the state budget of 2007, the government suggests to grant 10 000 MNOK (approximately 1200 M€) and suggests to grant another 10 000 MNOK (approximately 1200 M€) in 2009. The annual yield is expected to approximately 880 MNOK from 2009 and will be canalized through Enova. With this increase, Enova will administer approximately 1160 MNOK (approximately 145 M€) in 2007 and 1600 MNOK (approximately 200 M€) from 2010.

Energy taxes

The electricity tax in Norway has been low in a European perspective. The Energy Commission report (NOU 1998:11, The energy and power balance to 2020), showed a need for a tax increase in order to stabilise electricity use. Following the report the tax has increased from approx 5.75 øre/kWh in 1998 to 10.05 øre/kWh in 2006. Industrial production has a reduced electricity tax; in 2006 the tax was 0.45 øre/kWh, which is the minimum value from the *Council Directive Restructuring the Community Framework for the Taxation of Energy Products and Electricity*.

Some energy intensive industries are exempted from the tax, such as metal industry, cement industry and part of chemical industry. Pulp and paper industry can based on a voluntary agreement on energy management be exempted from the tax. There are other exemptions from the electricity tax, such as greenhouses and households in Northern-Troms and Finnmark counties.

The CO_2-tax is an important instrument to reduce emissions of greenhouse gases. About 64 % of the total emissions of CO_2 are covered by this tax. The CO_2-tax was 53 øre/litre in 2006 for mineral oil. However, the main oil-consuming industrial sectors fish meal and pulp and paper pay only 50% of the CO_2- tax.

Sulphur-tax on mineral oil is 7 øre/litre per 0.25% weight units of sulphur (S). There is no sulphur-tax on mineral oil with less than 0.05% weight units of sulphur.

Mobile energy use is heavily taxed, and the fuel tax in 2006 is 410 øre/litre unleaded gasoline, in addition to the CO_2 tax on 79 øre/litre.

Fuels where bio energy is the main component, such as E85 (85 volume-% ethanol and 15 volume-% gasoline) has no fuel tax or CO_2 tax from 2007.

The general VAT rate, which applies to electricity and other energy sources, was 25% in 2006.

Energy prices

Figure 4 shows useful heat prices, produced by electricity or light fuel oil, in the household sector in constant 1998-prices. The price of heat produced from electricity was rather constant from about 1985 to 2000, but then there was a strong increase with a top in 2003. The price of heat produced by fuel oil was below the electricity heat price until 1999, if the boiler efficiency is gradually increased from 58 % in 1978 to 80 % in 2002 (source: Statistics Norway). The price of gasoline has increased with 3 % from 1980 to 2004 in constant market prices, see Figure 40.

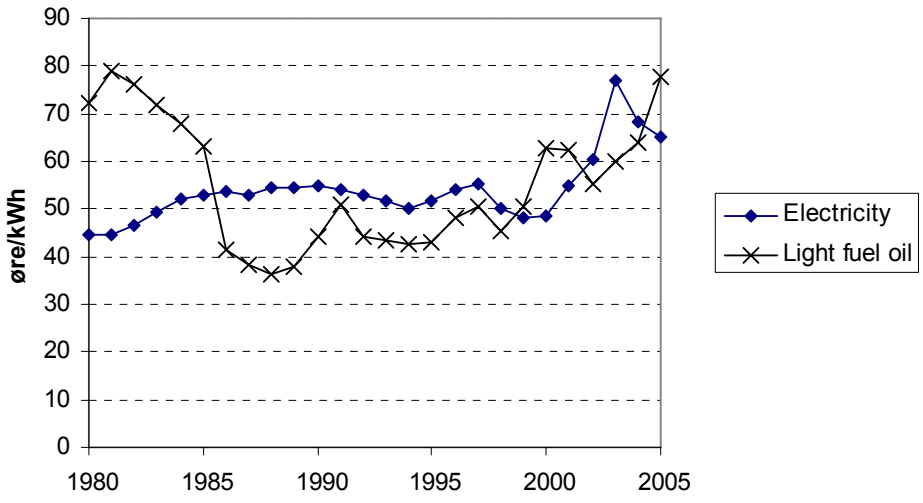

Figure 4 Energy prices in the household sector in constant 1998-prices. Norwegian øre /kWh (100 øre = 1 NOK = 0.125 €). The boiler efficiency for fuel oil is gradually increased from 58 % in 1978 to 80 % in 2002 and electricity efficiency is 100 % (source: Statistics Norway)

3 Overall Assessment of Energy Efficiency Trends

3.1 Energy intensity trends

Two general indicators are usually used to characterise 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.

Since 1990 both the final and the primary intensity has decreased, with only small increases in 1993 and 1998, see Figure 5. The decrease was in average higher during the 1990s, than during the past 5 years, Table 3.

The final intensity has decreased from 0.69 MJ/NOK2000 in 1990 to 0.50 MJ/NOK2000 in 2005 (-28 %). The primary energy intensity has decreased less, only 18 % from 1990 to 2005. The reasons for these decreases are complex and will be further analysed later in this report. A part of it is due to more efficient use of energy, but also structural changes, increased production and a general growth in the economy plays an important role.

The ratio final/primary intensity has decreased from 0.79 in 1990 to 0.70 in 2005. A decrease in this ratio 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, mainly due to increased activity in the oil and gas production and non-energy uses in chemical industry.

Table 3 Variations in primary and final energy intensities in Norway (% per year)

	1990-2005	1990-2000	2000-2005
Final intensity	-1.9	-2.2	-1.5
Primary intensity	-1.2	-1.4	-1.0
Ratio final/primary	-0.8	-0.9	-0.6

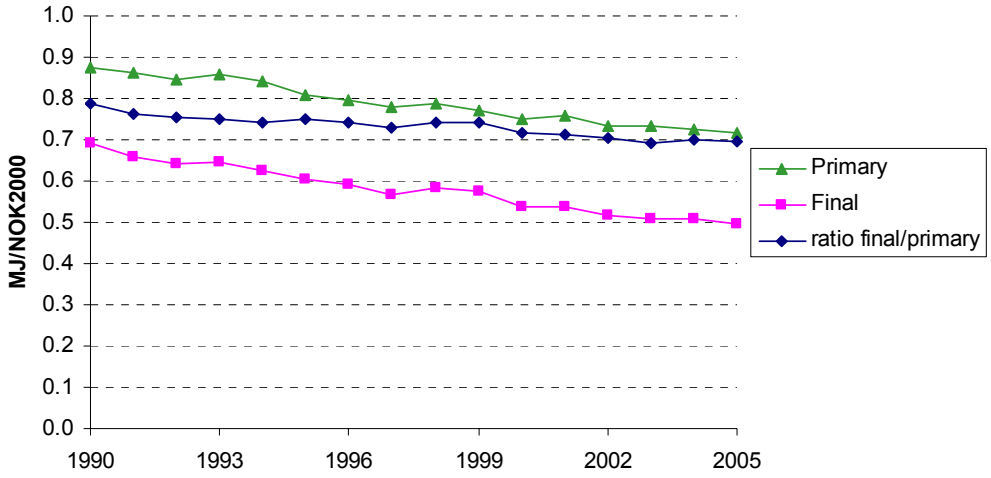

Figure 5 Primary and final energy intensity, 1990-2005

3.2 Energy efficiency

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.

ODEX

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. E.g. the chemical industry uses 20 % of the energy in the industry sector, thus the chemical index has a weight value of 20 % of the industry index.
- 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. 1990), so as to avoid to have results influenced by the situation of the base year.

Energy efficiency policies and measures implemented since 1990 have contributed to improve the efficiency by 10 %, or 0.7 % per year (Figure 6): this means that if these policies and measures would not have been implemented, the final energy consumption would have been 10 % higher in 2004 (or approximately 19 TWh).

The energy efficiency index in industry decreased from 1993 to 1995 but has since then been constant. The transport sector was first rather constant and then shows improvements in energy efficiency from 1994 to 2004. The household sector has a rather constant improvement after 1992. 1990 was a very warm year and the climate correction might be overcorrecting for the effect of a higher average temperature.

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.

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. This leads to a high increase in energy intensity of the chemical sector and a quite small overall reduction in the manufacturing industry. For more details, see chapter 4.

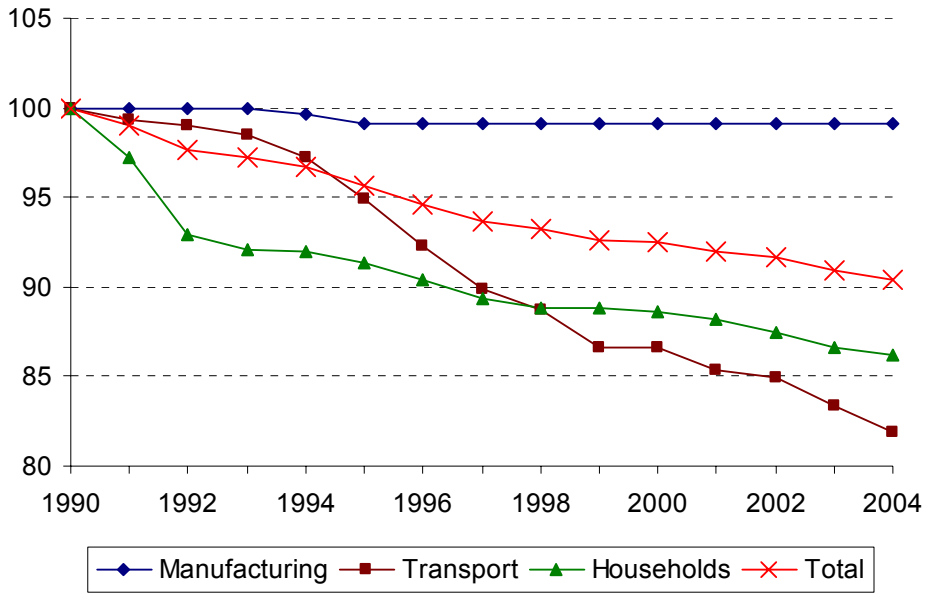

Figure 6 Energy efficiency progress (at normal climate)

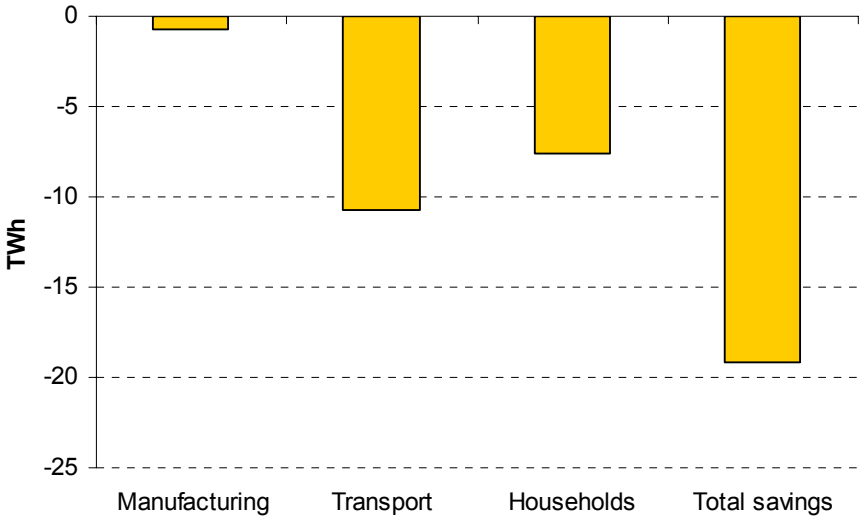

Figure 7 Cumulative energy savings in 2004 compared to 1990 (based on the ODEX)

3.3 CO2-emissions and energy efficiency

In Norway total emissions of greenhouse gases have increased by 10 % from 1990 to 2005. The Kyoto process imposes Norway not to exceed its total GHG emissions in 1990 by more than 1 %, so Norway should cut back its emission by 9 % until 2010 or acquire an equal amount of emission permits. The growth in greenhouse gases is slightly less than the growth in final energy consumption, which was 14 % in the same period. The main reason for the growth in greenhouse gases is the strong growth in the energy sector (exploitation of oil and gas).

In order to examine the reasons for the growth in greenhouse gas emissions we will decompose it into products of different ratios:

$GHG = (GHG/CO_2) * (CO_2/FF) * (FF/TPE) * (TPE/GDP) * GDP$

where

- *GDP*: Gross Domestic Product
- *TPE*: Total Primary Energy
- *FF*: Fossil fuels
- CO_2: CO_2 emission from use of fossil fuels as energy
- *GHG*: CO_2 equivalents of all greenhouse gas emissions including non-energy CO_2 emissions

The ratio TPE/GDP is the energy intensity of the national economy. Figure 8 shows that this ratio has been reduced by 20 % since 1990. Without this reduction, energy related CO_2 emissions would have been 20 % higher (keeping everything else constant).

The FF/TPE ratio shows the fossil fuel fraction of energy use. This has increased by 5% since 1990. We observe the effect of the dry year 1996, where reduction in renewable electricity use was replaced by increased use of fossil fuels (oil). The effect of increased coal power production in Denmark, which is backup producer for Norway, is not included in the graph. In that case, the 1996-peak would have been even more pronounced.

The CO_2/FF ratio expresses the average carbon content of fossil fuel use. There is a reduced intensity, indicating that gas use is growing faster than use of oil and coal.

The GHG/CO_2 ratio expresses the relation between all greenhouse gas emissions counted in CO_2 equivalents and CO_2 emissions from the energy system. For Norway this ratio has decreased 13 % since 1990. This means that the abatement of "other" greenhouse gases has been more effective than for CO_2 emissions, which actually *increased* by 24 % between 1990 and 2005. The main reason for the reduction in the overall emissions was the drastic reduction of SF6 in aluminium manufacturing in 1991/92.

To conclude reduced energy intensity (TPE/GDP) and reductions in "other" GHG emissions have been the most positive factors for controlling overall GHG emissions. The renewable share of total primary energy use has been almost constant the last decade. Increased activity (GDP) is the main reason for boosting emissions of GHGs.

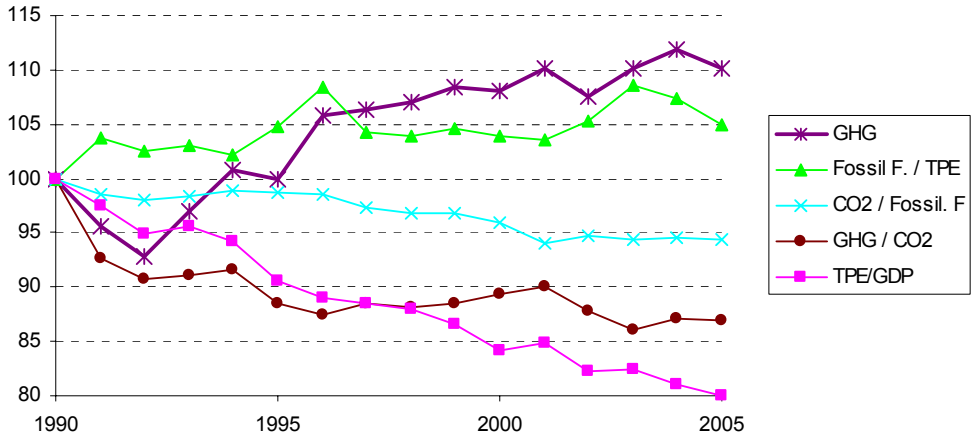

Figure 8 Decomposition of emissions of greenhouse gases

4 In-depth View on the Industrial Sector

4.1 Overall context

Value added in manufacturing industry has grown with 22 % from 1990 to 2005, while there has been a big increase in oil and gas exploitation and therefore almost a doubling of value added in mining (95 % increase from 1990 to 2005).

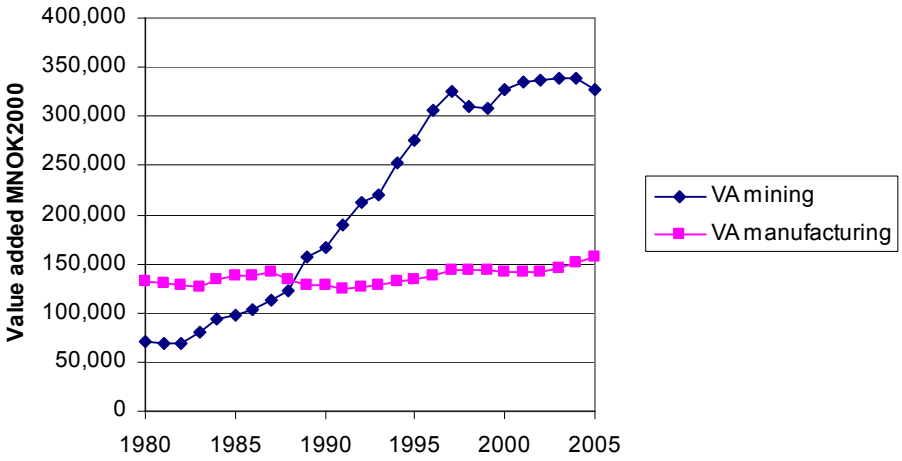

Figure 9 Value added in manufacturing industry and mining (including oil and gas exploitation), 1980-2005, mill. NOK in constant 2000-prices

The increase in value added is lower than the average manufacturing increase for important sectors like the primary metals and paper and printing. The increase in production of primary metals was only 5 % from 1990 to 2005. Paper and printing industry increased with 11 % from 1990 to 2005, while the paper and pulp had a stronger growth, 37 % from 1990 to 2005. The sub-sectors increasing most were the food and drink sector with 39 % and the machinery sector with 31 %.

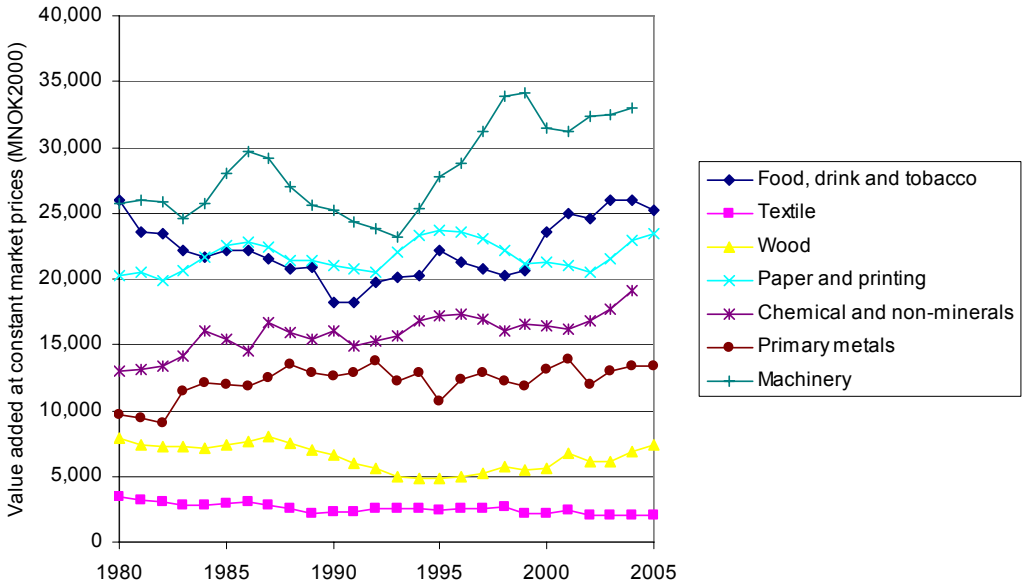

Figure 10 Value added at constant market prices for different industry sub-sectors in 1980-2005 (MNOK2000)

4.2 Energy consumption trend

Industry is the major energy-consuming sector in Norway, using approximately 36 % of final energy use. Energy intensive branches as metals manufacturing, basic chemicals and paper & pulp production dominate the sector's energy use, using 83 % of total energy in manufacturing industry in 2004, see Figure 11.

The energy consumption in manufacturing industry has increased from 69 TWh in 1990 to 77 TWh in 2004, or by 11.5 %. The production of non ferrous metals uses 1/3 of the energy in manufacturing industry, and today this is mainly production of aluminium. The energy use in this sector has increased with 27 % since 1990. However, the production of ferrous metals has decreased by 14 %. Together, the production of primary metals uses 9 % more energy than in 1990, which is more than the increase in value added of 5 %. The chemical industry has an increase in energy use by 31 % from 1990 to 2004.

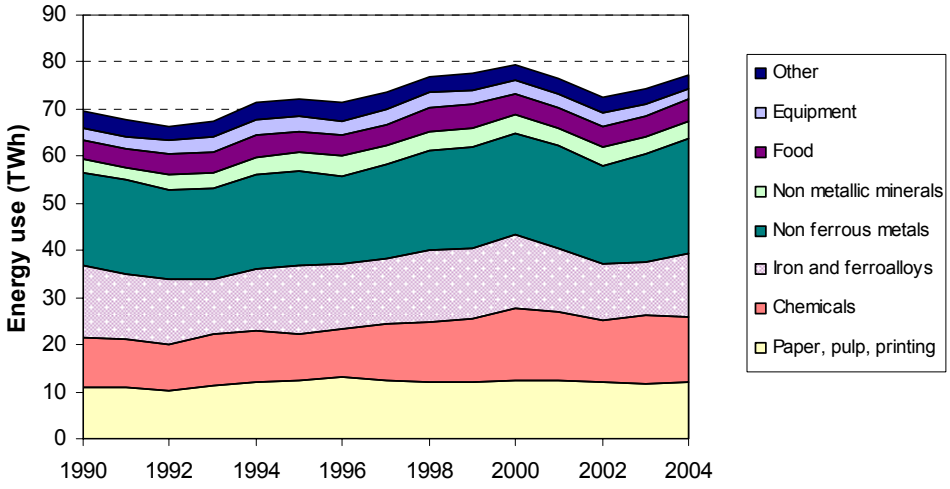

Figure 11 Trends in energy use per sector in manufacturing 1990-2004 (TWh)

The share of electricity was 64 % in both 1990 and 2004, but only 50 % in 1980. The share of fuel oil was reduced from 26 % in 1980, to 9 % in both 1990 and 2004, see Figure 12.

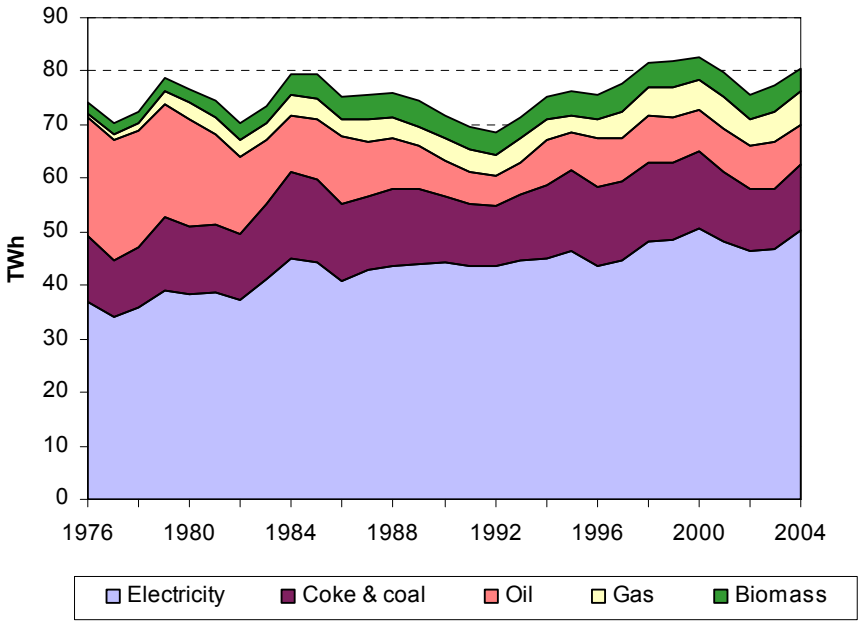

Figure 12 Final energy consumption by energy in manufacturing 1976-2004 (TWh)

4.3 Recent energy efficiency measures

Enova is working to increase the competitiveness of Norwegian industry through environmental friendly and efficient energy use. All companies that have projects with total potential energy results of more than 0.5 GWh can apply for investment support.

Pulp and paper companies are offered the possibility to participate in a five-year programme, which requires that certain energy efficiency obligations are fulfilled and in exchange the companies are exempted from the electricity tax.

A trading system for greenhouse gas emissions entered into force 1 January 2005, which stimulates the industry, which is not covered by the present CO_2-tax, to reduce their climate gas emissions.

4.4 Energy intensity trends

The sector iron and ferroalloys includes production of steel, iron and ferroalloys were the last is dominating the sector in Norway. In 1993 the production of metallic silicon was moved from production of ferroalloys to production of chemicals. As this is a very energy intensive production, the intensity of iron and ferroalloys went down in 1993 and the intensity of chemicals went up. The production of ferroalloys has been more and more energy intensive, as alloys with a higher degree of silicon has grown much more than other metals. Since plants with a main production of silicon metals are included in the chemical sector after 1993, the picture of the development is quite complicated, but the increase in the ferroalloy intensity from 1996 and forward can probably be explained by a production of alloys with a higher content of silicon. From 1990 to 2000 the production of ferrosilicon with 90 % silicon and pure silicon metal increased by 85%, while other ferroalloys only increased by 14 %.

The chemical industry includes very different production plants and many of them are energy intensive, e.g. production of carbides, silicon metal, fertilizers and methanol. The high increase in the chemical sector in 1997 is due to the start of a new plant producing methanol. The production increased the following years and was in 2001 more than twice as high as in 1997 and 28 % higher than in 1998. The production of carbides has been considerable reduced after 2002, both due to close-down of one plant and due to lower production in the other three plants. Due to higher growth rates in energy intensive chemical industry than in other chemical industry, the value added and production index has increased less than the energy consumption of the sector.

Non-ferrous metals includes production of aluminium, magnesium, nickel etc, and in Norway it is the production of aluminium that dominates the energy consumption of this

sector. The production of aluminium with the Søderberg-technology was rather constant until 2001, when two plants were closed down. There has been an increase with the more modern and energy efficient pre-baked technology, with a new plant starting up gradually from 2002 and forward. The total production volume was rather constant until 1997, and has since then increased by approximately 50 %. In 1995 the statistics show an increase in use of coke without any increase in either other energy carriers or ton produced aluminium. Together with a decrease in production index, this gives an increase in the energy intensity. In 2002 the only Norwegian magnesium plant was closed down.

The energy intensity of paper, pulp and printing has increased by 2 % from 1990 to 2004. The production of mechanical pulp is electricity intensive and has increase by approx 34 % from 1990 to 2004. On the other hand, the chemical pulp production has decreased in the same period by 14 %. The production of chemical pulp uses most energy per ton of product, followed by mechanical pulp, while paper production is less energy intensive. But in this sector also printing is included, which has a very low energy intensity compared to both pulp and paper production. A new, big paper machine was started up in 1993 at the same time as the production of mechanical pulp increased considerable. A chemical pulp plant was closed down in 1997. In 1996 the electricity price was high and more oil with lower boiler efficiency was used, causing an increase in intensity.

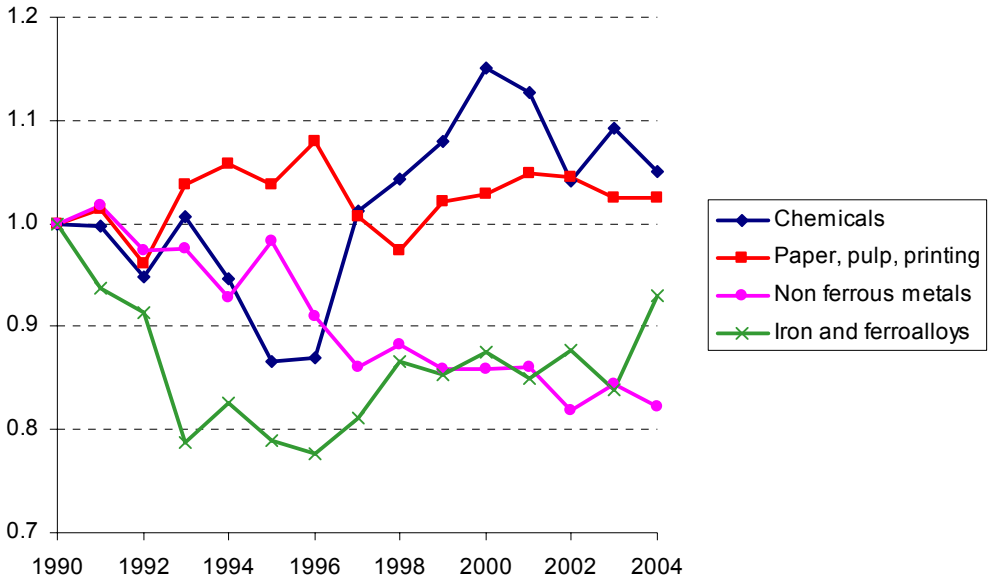

Figure 13 Relative energy intensities in heavy industries 1990-2004

Production of non-metallic minerals had a high increase in energy intensity in the beginnings of the nineties, see Figure 14. The largest energy consumers in this sector are two cement plants and one of them changed process from wet to dry in 1990-1992 and was then partly out of operation. Since the middle of the nineties, the energy consumption has been rather constant while the production index has increased, causing a decreased energy intensity. This trend changed in 2003, when the energy use was constant but the production index decreased, despite a constant production of cement. This indicates that other products with higher influence on the production index and less influence on energy use decreased. The use of non-conventional fuels, like tyres, has increased the last years and the energy efficiency of these fuels is lower than for conventional fuels, but since they are cheaper it is profitable for the plant to use them.

The energy consumption of the wood industry is more difficult to measure than other branches, due to the high use of internal fuels as bark and chips. The quality of the statistics is less accurate than for other energy carriers, and some of the ragged profile of the energy intensity of the wood industry may be explained by this (e.g. 1999). The trend from 1992 to 2004 is an increasing energy intensity and this could be because of more of the products are artificially dried and to a lower content of moisture, which increases the energy use. The products are processed more than earlier, thus increasing the intensity further.

The food industry has increased the energy intensity by 16 % from 1990 to 2004. One of the most energy intensive products in the food industry is the production of fish meal. In 1998 this production increased considerable, without any increase in the production index, thus causing a great increase in the energy intensity of food industry. Generally the degree of processing the products in the food industry has increased.

The equipment industry had first an increase in energy intensity followed by a decrease from 1993 to 2004. The energy consumption was the highest in 1995 and has then decreased by 25 % to 2004. During the same time the production index first increased and then slightly decreased again. As a total the energy intensity of the equipment industry decreased by 21 % from 1990 to 2004.

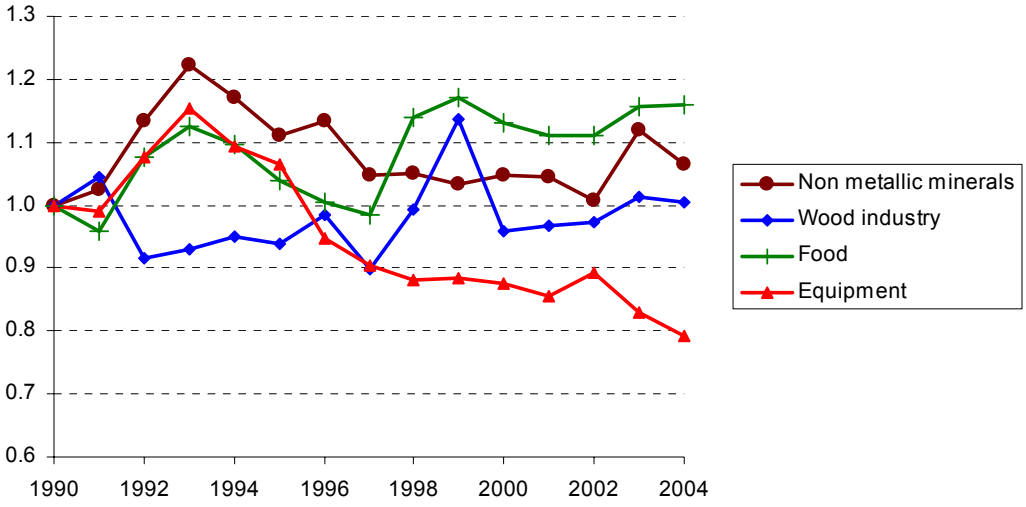

Figure 14 Relative energy intensities in light industries. Final energy use/production index: 1990-2004

Energy intensity can be calculated in different ways. In Figure 15 three different energy intensities for production of non-ferrous metals are presented. Energy consumption divided by value added in constant market prices[2] for non-ferrous metals has increased by 60 % from 1990 to 2004. In the same period, energy consumption divided by the production index has decreased by 14 %. If the value added based intensity is used, the energy savings can be calculated to approximately – 16 TWh (negative saving), while the production index gives an energy saving of approximately 4.7 TWh.

A third way of calculating the energy efficiency development is to divide the energy consumption with the production in tons of aluminium. This gives an decrease of 8 % or 1.9 TWh from 1990 to 2004. Since this only includes the production of aluminium and not other non-ferrous metals, it is not exactly the same. Aluminium used approximately 89 % of the energy in non-ferrous, and thus has a dominating role on the development of the sector of non-ferrous metals.

[2] Value added (VA) is the value of the production minus the product input. VA in constant market prices is calculated based on the volume in the base year (2000 in this case) and by linking calculated changes in volume from this base year. This means that the product price is assumed to be the same as in the base year, and also the salary, and in principal will changes over time illustrate changes in volume, while the effect of changing prices is removed. But if the product input increases more than the production value, the VA will increase less than the production and vice versa.

This shows that the indicator used could have great importance on the analyse of the energy efficiency development. Figure 16 shows the changes in value added, production index and ton produced aluminium together with the energy use.

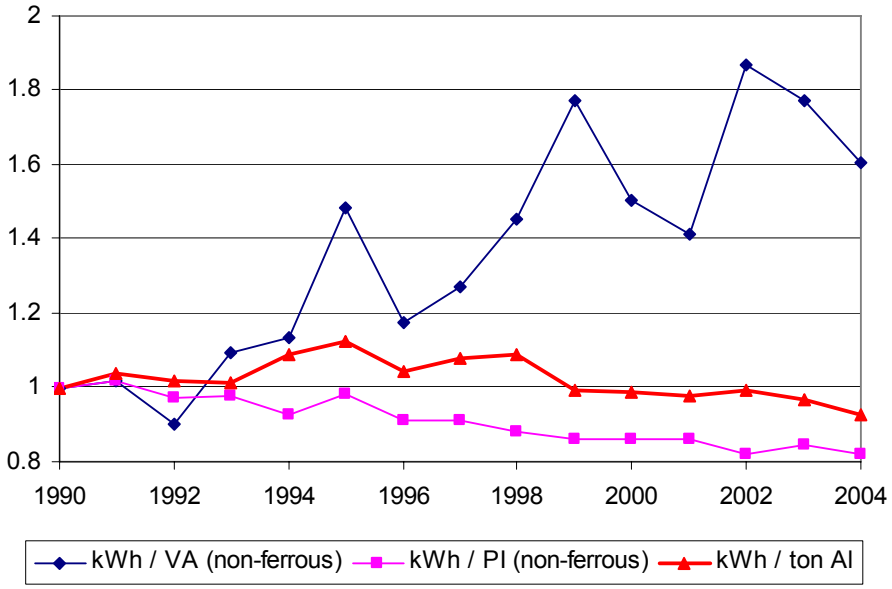

Figure 15 Relative change in energy intensity calculated as energy / value added, energy /production index and energy / ton produced aluminium. 1990=1

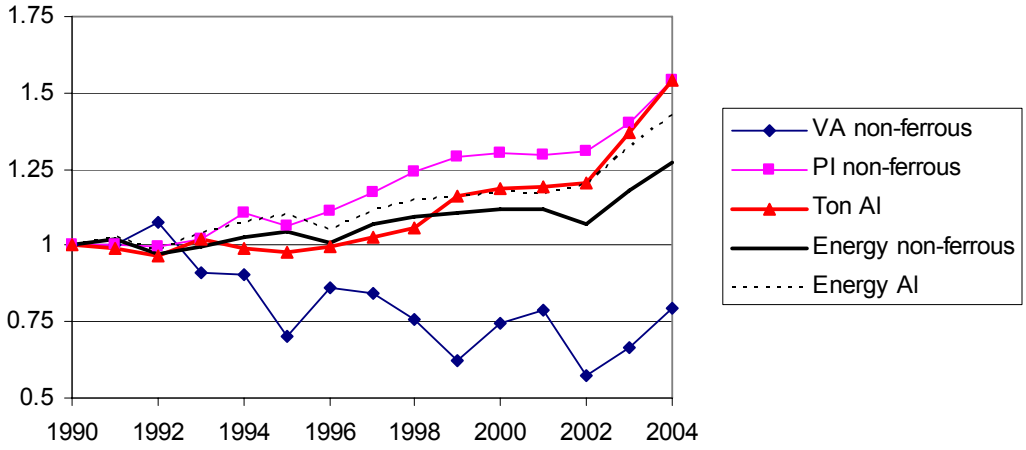

Figure 16 Relative change in value added (VA) in constant market prices, production index (PI), ton produced aluminium, energy use in production of non-ferrous metals and energy use in aluminium production

4.5 Energy efficiency

The actual energy use of industry increased by 11 % from 1990 to 2004, see Figure 17. If the intensity and structure are kept at the same level as in 1990, the changes in activity would have increased the energy use by 10 %. The activity increased until 1998 but has then decreased again.

If the activity and intensity is kept at the same level as in 1990, the structural changes would have increased the energy consumption by 8 %. Until 1998, structural changes would have caused a reduction in energy use, but after that the structural changes have increased the demand of energy.

If both the activity and structure are kept at the 1990-level, the reduction in energy intensity can be calculated to 5 %. This means that if the intensity had been the same as in 1990, the energy use in 2004 would have been 3.5 TWh higher.

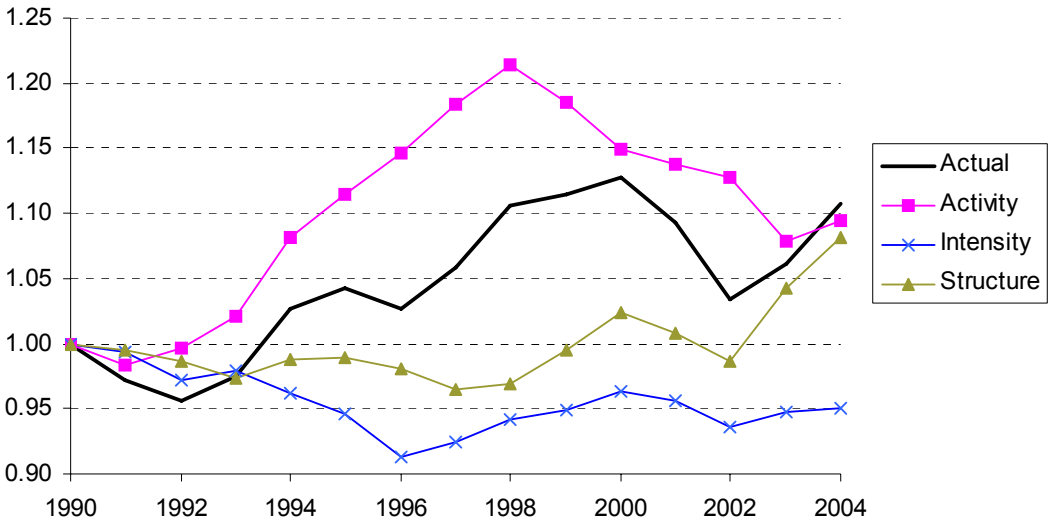

Figure 17 Effect of activity in manufacturing (keeping structure and intensity constant at 1990-level), structure (keeping activity and intensity at 1990-level) and intensity: 1990-2004.

5 Energy efficiency measures

5.1 Recent Energy Efficiency Measures

Residential Sector

Grants for electricity savings in households. The autumn 2006 the parliament introduced a new grant scheme with the objective to reduce the electricity consumption in households. The target group of the grant scheme is private households. They can apply for grants for investments in heat pumps (not air-to-air heat pumps), pellets boilers, fireplaces using pellets and electric heating control devices. The grant is restricted to 20 % of the investment costs or a maximum grant of 4000 NOK (approximately 500 €) for boilers or fireplaces using pellets or for heating control devices and a maximum of 10 000 NOK (approximately 1250 €) for heat pumps (not air-to-air heat pumps). A similar grant scheme was in use in the spring 2003.

Energy information helpline Information and advice are provided free of charge through a national energy information helpline. The information helpline covers all the country and may be contacted by telephone, e-mail or Internet. The helpline is operated from 8 a.m. to 4 p.m. and during campaigns the operating time is enlarged. Private people may free of charge get energy advices, publications or other information material. Questions sent by e-mail are guaranteed an answer within 24 hours.

Transport Sector

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.

Reward scheme for better public transportation and reduced use of cars in cities The objective of the scheme is to stimulate to a more trafficable area, better environment and health in the large city areas, by suppressing the growth in need for transportations and increase the number of public transportations and at the same time reduce transportation by private cars. The larger cities get the opportunity to apply for support to transportation measures in order to solve the transportation challenges in the different city areas. The applicants have to present specific plans (the first years of the scheme) and gradually results, with the aim to solve local challenges in association with transportation and environment. A local transportation policy that contributes to

limitation of the use of private cars and increases the use of public transportation is a central factor in the assignment of funds from the reward scheme.

Measures to be supported could mainly be divided in three areas:

1. Measures to reduce the use of private cars
2. Measures for planning of land use and transportation that is more in favour of public transportations
3. Measures to make the public transportation more attractive

Industrial Sector

Reduced energy use - industry. Enova is working to boost the competitiveness of Norwegian industry through environmentally friendly and efficient energy use. In the course of 2005 Enova has extended its main programme oriented towards Norwegian onshore industry. Via the programme "Reduced energy use – industry", all companies that have projects with total potential energy results of more than 0.5 GWh can apply for investment support.

Projects that can be supported are energy-efficient solutions or processes, measures for energy recovery or use of waste heat and conversion to renewable energy sources. The maximum grant level is 20 % of approved project costs.

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 once a year report 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 (see http://www.enova.no/industrinettverk/).

Energy management – companies in networks. The energy management program aims at small and medium sized companies with an annual energy consumption of at least 0.5 GWh. Companies or concerns working in project networks can apply for support to energy audits and energy management systems. The grant is individually evaluated and will not exceed 50 % of total approved project costs. The projects have to result in an energy saving of at least 10 % of the total energy consumption or conversion to new renewable energy sources. The companies have to sign a contract with a quantified energy saving/conversion. As described above, the companies have to report energy consumption and production figures to Enova at least five years after the project is finished.

Energy efficiency in energy intensive industry. Pulp and paper companies are offered the possibility to participate in a five-year programme, which requires that certain energy efficiency obligations are fulfilled, and stipulates penalty arrangements in case the obligations are not fulfilled. These commitments are considered to replace the steering effect of the electricity tax, and the companies are therefore granted a full exemption from the electricity tax on electricity used in the industrial production process during the programme period.

The objective of the tax exemption is to achieve a more efficient use of energy. The motivation for the programme is to establish a system for improving energy efficiency in companies characterised by high energy consumption and where the potential for savings is therefore significant, if the companies were given an incentive to take energy saving measures during a five-year period because they would receive a tax relief.

Emission trading. A trading system for greenhouse gas emissions entered into force 1 January 2005 and the concept is in line with the EU emission trading system. The emission trading system stimulates the industry, which is not covered by the present CO_2-tax, to reduce their climate gas emissions. Companies not covered by the CO_2-tax, are assigned emission quotas based on historical emissions in 1998-2001. Industries included in the emission trading system are oil refineries, iron and steel, cement and lime industry, glass industry as well as several energy production plants. The trading system includes only a small part of all climate gas emissions (approximately 10%).

Tertiary Sector

Grants for energy savings in homes, buildings and outdoor equipment areas. In order to achieve better communication with the market actors in the homes, buildings and outdoor equipment areas, Enova changed the programme structure in these areas from several sub-programmes to a single overall programme in 2005. The idea was to make it simpler for the actors, by having everyone wanting to apply for support for their projects deal only with a single programme. By means of this change Enova hopes to achieve greater flexibility as regards use of resources in the market area. 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.

Projects that can be supported are investments with 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. Grants are also given to prototype projects covering the extra cost of the project to achieve the

energy goal. These projects could be rehabilitation or new buildings (both dwellings and non-residential buildings). The energy goal has to be at least 50 % below normal standard. The grant has to be a triggering factor. Enova intends to support the project up to a level were it is yield a normal return of the investment. The level of grant is normally 0.2-0.5 NOK/kWh (0.025-0.06 €/kWh).

Energy plans in municipalities. The municipalities are in a unique position to influence the development of energy use in the community, being the actor with most government and overview of development schemes in their region. The local governments are the owners of 25 % of all non-residential buildings in Norway and use 1/3 of all energy in Norwegian non-residential buildings. This gives a large potential for energy conservation and conversion of energy use that is less dependent on a single energy source.

All local governments have a local energy plan. Since 2005 Enova supports the local governments to pursue ideas from these plans further. The program supports preparation of municipal energy and environmental plans, studies of possible district heat or energy plant projects and possible energy conservation and/or conversion projects in municipal buildings or installations. It is desired that the supported projects is used as decision basis to move on to Enova's program for investment grants. Enova supports maximum 50 % of the project costs, limited to NOK 100 000.

Cross-cutting measures

Energy fund ENOVA SF administrates the Energy Fund (Energifondet). The income of the energy fund comes from a levy of 1 øre/kWh (0.008 Euro/kWh) to the distribution tariffs that is mandatory and from allocation from the state budget. In order to strengthen the priority area of the Fund, the government proposes a new fund called "statutory fund of energy conservation and renewable energy". In the state budget of 2007, the government suggests to grant 10 000 MNOK (approximately 1200 M€) and suggests to grant another 10 000 MNOK (approximately 1200 M€) in 2009. The annual yield is expected to approximately 880 MNOK from 2009 and will be canalized through Enova. With this increase, Enova will administer approximately 1160 MNOK (approximately 145 M€) in 2007 and 1600 MNOK (approximately 200 M€) from 2010.

ENOVA chooses the measures and administrate the fund in order to achieve the national goals in the best way. The energy fund is used to project related measures as purchasing services, payment of grants and other financing of measures in the field of consumption, environmentally friendly heat, wind and natural gas. The fund supports projects in industry, the tertiary sector, the household sector as well as production of new, renewable energy.

5.2 Patterns and Dynamics of Energy Efficiency Measures

In this section, diagrams are shown in the form of a spider's web with the measure types on the spokes of the web. The greater the preference for a certain measure type, the more the pattern will resemble the hands of a watch indicating the preferences. The broader the policy in the sector, the more equally spread the measures on the different axes so that the pattern resembles a pentagon or other polygons depending on the number of categories. The diagrams show all ongoing measures in the end of 2006 included in the MURE database. Completed measures and proposed measures like the energy performance of buildings are not included. Each measure has the same value in the diagrams, not considering the importance or spread of the measure.

Residential Sector

The spider's web of the Norwegian measures in the residential sector is shown in Figure 18.

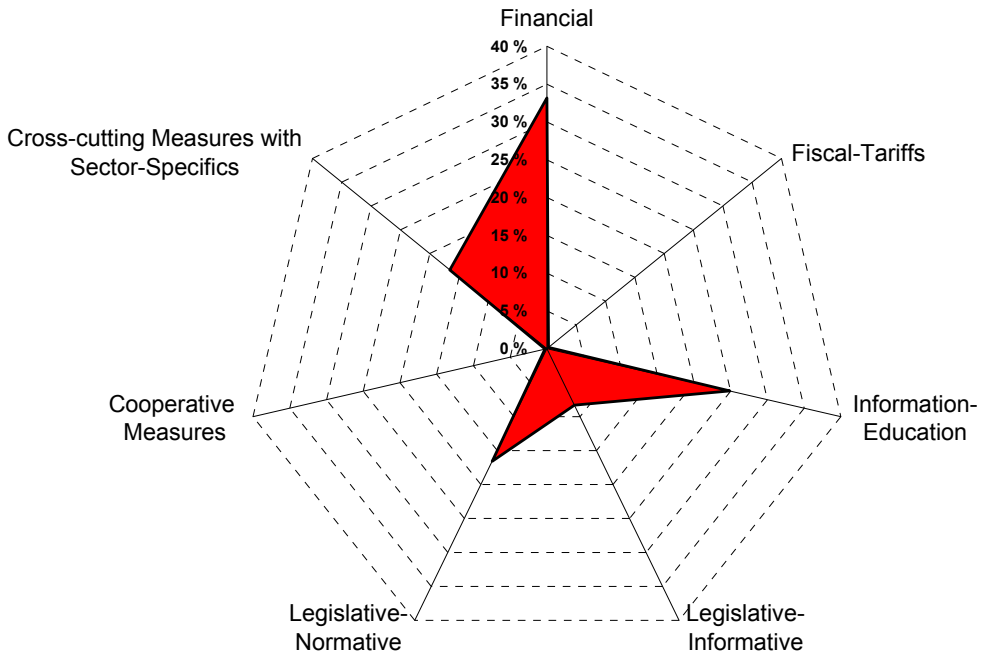

Figure 18 Spider graph of ongoing measures in residential sector

The measures are to one third financial measures (grants for electricity savings, BAA - new dwellings, energy saving loans, Oslo energy efficiency fund). Measures with an informative-educational character are the second largest group, with measures like the energy information helpline (Enova's svarstjeneste), energy act on informative billing

and simple energy audits. The different energy efficiency label schemes are here presented as one measure, even though the date of implementation differs (legislative-informative). The building regulations and the energy efficiency requirements on refrigerators, freezers and their combinations are the measures of the legislative-normative type. Energy and environmental taxes are cross-cutting measures with sector-specifics, since the level of the tax differs in different sectors. Compared to the average of all the partners in this ODYSSEE-MURE project, there are more Norwegian financial and information-education measures and less legislative and cooperative measures.

Transport Sector

The number of measures in the transport sector is low and each measure has therefore a large share in Figure 19. The mostly used measures are the financial measures represented by the taxes on gasoline and diesel oil and the reward scheme for better public transportation and reduced use of cars in cities and the legislative-normative measures represented by the speed limits and the semi-annual technical inspection of vehicles. The fiscal measure in the transport sector is the purchase tax on vehicles and the legislative-informative measures is the energy labelling of new cars. Compared to the other project partners, there is a higher share of legislative measures and a lower share of information, social planning and cooperative measures.

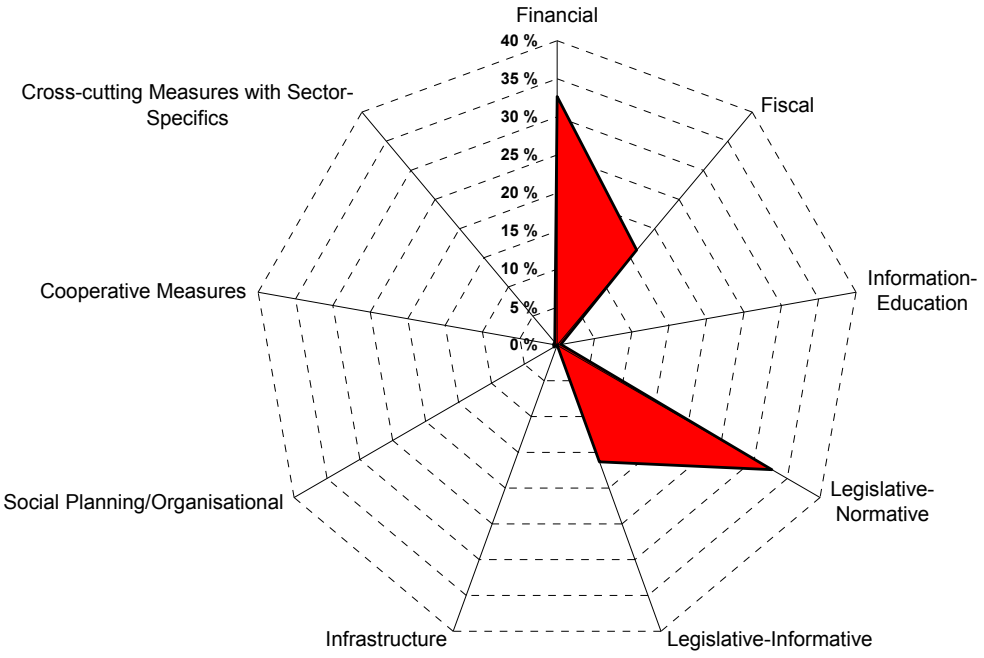

Figure 19 Spider graph of ongoing measures in the transport sector

Industrial Sector

Financial measures are the most used measure type in the industry sector, i.e. grants to energy efficiency measures, see Figure 20. Energy and environmental taxes are defined as cross-cutting measures with sector-specifics due to different tax levels in different sectors. Emission trading is an example of the market-based instruments. In EU-15 there is a higher share of cooperative, information-education-training and legislative measures and a lower share of financial measures than the ongoing measures in Norway.

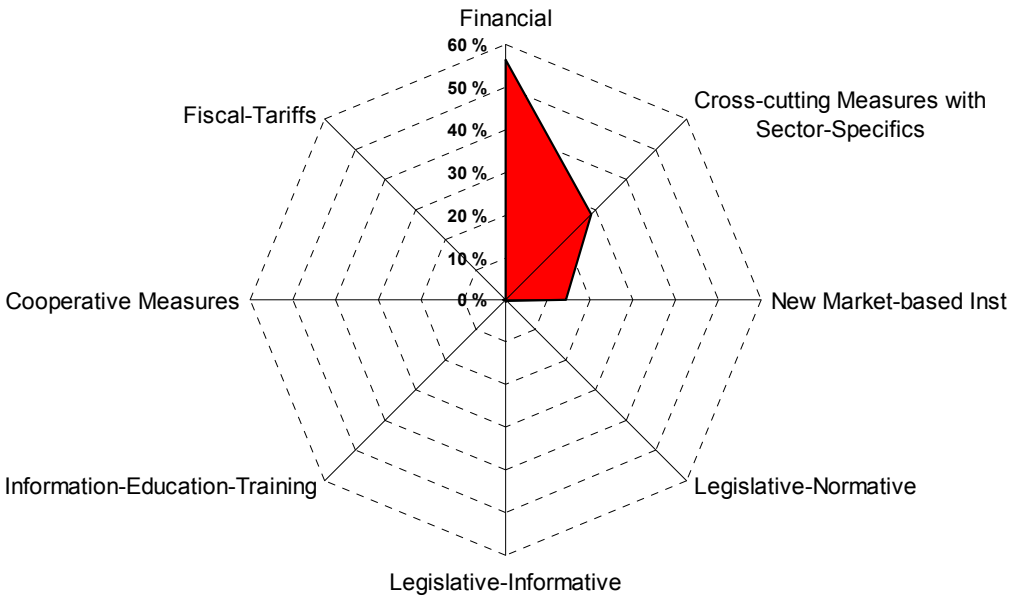

Figure 20 Spider graph of ongoing measures in the industry sector

Tertiary Sector

Also in the tertiary sector there is a high share of financial measures (e.g. grants for energy efficiency measures and financial support for municipal energy plans), see Figure 21. The legislative-normative measure is the buildings regulations, the cross-cutting measure is the energy and environmental taxes and the education-information-training measure is the Norwegian building energy network. The EU-15 has a higher share of legislative and cooperative measures and a lower share of financial measures.

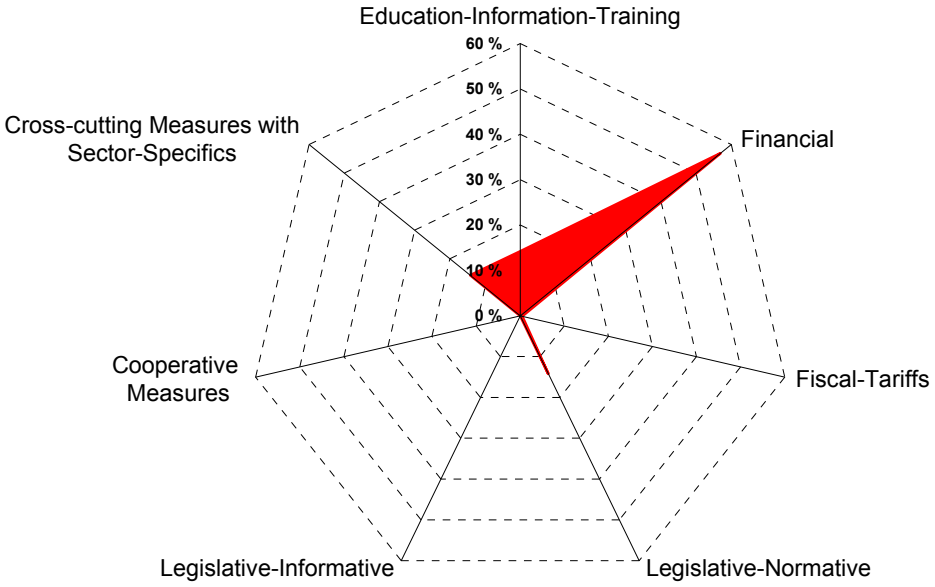

Figure 21 Spider graph of ongoing measures in tertiary sector

5.3 Innovative Energy Efficiency Measures

As a part of the Enova programs for industry, the companies have to report annual energy consumption and production figures to Enova at least five years after the project is finished. Enova gathers energy consumption and production figures in a database. The companies have to once a year report their figures on a web-based reporting scheme. The benchmarking scheme is open for all industry plants, not only those participating in one of the industry programs.

Enova calculates specific energy consumption for different industry sectors and presents the anonymous data on web. Benchmarking is based on comparing the specific energy consumption, SEC, (e.g. kWh/kg) of the companies. SEC is calculated according to total energy use and total production of the site. To date, 43 different benchmark groups have been established among the 800 participating companies that once a year report their figures for energy and volume of production into the web-application. Because one factory usually produces different products with different energy intensities, weighting factors are used to normalise these differences in some of the groups. More information can be found at http://www.enova.no/industrinettverk/ .

Earlier, this reporting was part of the Norwegian Energy Efficiency Network and the annual reporting was based on paper forms. The reporting started in 1990 with three industrial branches and has been enlarged year by year.

In the EIE-project BESS, a web-based tool for international benchmarking of key indicators for selected sectors within the European food and drink industry is developed. The tool which is currently tested by pilot companies from the dairy, bakery and meat industries within the BESS project builds upon the Norwegian benchmarking system. The primary objective of the BESS project is to promote widespread use of best practice energy management and benchmarking tools and to improve energy efficiency in industrial small and medium-sized enterprises (SMEs), with particular focus on the food and drinks industry. For more information, see http://www.bess-project.info. Figure 22 shows an example of comparison of plant specific SECs.

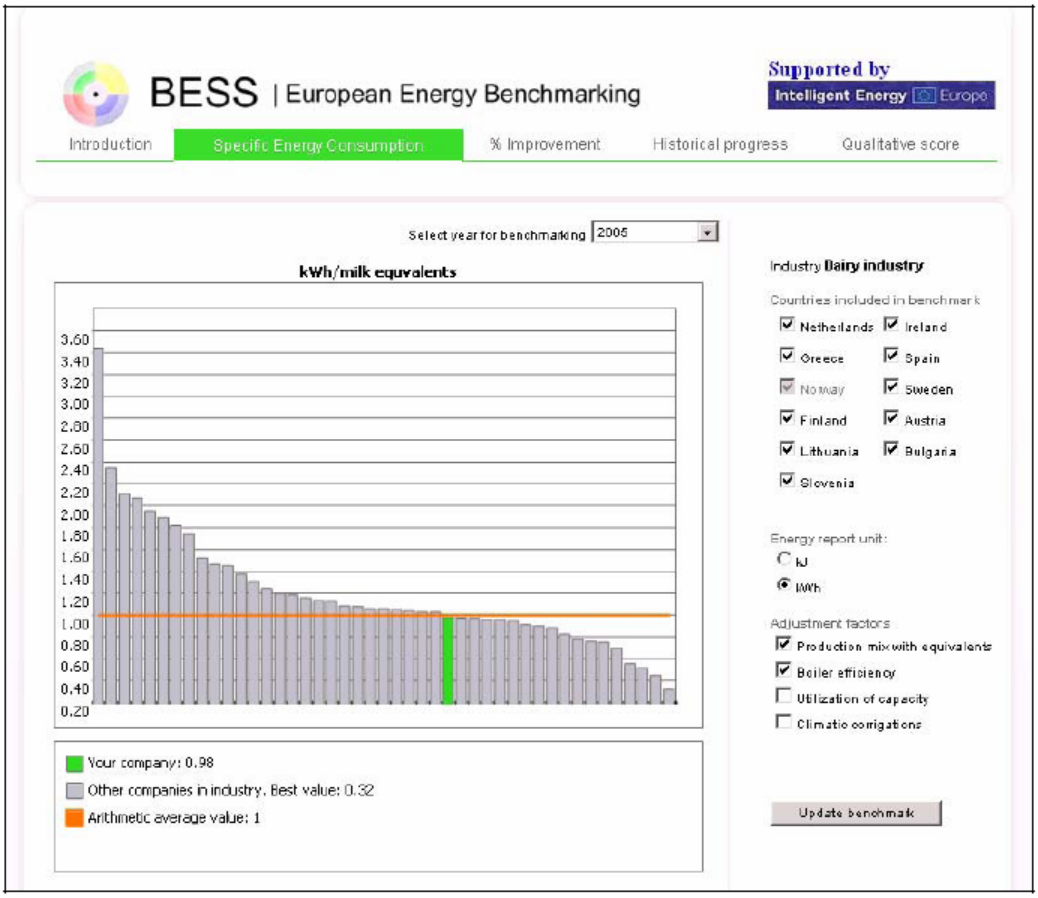

Figure 22 Example of specific energy consumption graph of the BESS system

Enova also has a benchmarking system for the building sectors, as a part of the Norwegian Building Network. The network is based on support to building owners that co-operate in networks based on energy efficiency agreements with the authorities. Through network processes based on energy efficiency agreements, building owners and users will increase their knowledge in energy efficiency to make the right decisions. The main target groups are private and public owners of non-residential buildings and housing associations. Energy statistics are an integrated part of the activities in the Building Network. The objective is to give the players a tool in the work of planning and managing buildings.

5.4 Lessons from Quantitative Energy Efficiency Measure Evaluations

Evaluation of the audit scheme of the Norwegian Industrial Energy Efficiency Network

The Norwegian Industrial Energy Efficiency Network organized an energy audit scheme in the period 1996 – 2002. The audit scheme was evaluated in 2005 by an independent foundation[3].

Description of the energy audit scheme

The audit scheme was organized as a part of a larger programme, called Industrial Energy Efficiency Network (IEEN). This IEEN also provided information on energy efficiency measures, contributed to exchange of knowledge and experience in workshops, supported demonstration projects and benchmarking of energy efficiency. The audits scheme consisted of three elements; phase 1 with establishment of energy management, phase 2 with a more detailed energy audit and finally economic support for implementing an energy monitoring system. The main goal of the audit scheme was to increase the knowledge and expertise in the industry on efficient and environmental friendly energy use. The last period of the scheme, energy savings was included as an important goal.

In the period 1996 - 2002 the audit scheme supported 627 phase 1 projects, 172 phase 2 projects and 161 energy monitoring systems. In total, the support was 6.5 mill. €.

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3 Stiftelsen Østlandsforskning, Evaluering av Bransjenettverket for industriens analyseordning 1996-2002, Anne Rønning og Ingunn Saur Modahl, Dec. 2005, www.st.no

Evaluation methodology

The evaluation included four main topics:

i) General description of the audit scheme

ii) Evaluation of the organisation of the audit scheme

iii) Evaluation of the impact (increased knowledge and realised energy savings)

iv) Assessment of the share of "free riders"

The evaluation was carried out with the following basis:

- Interviews with energy auditors and industrial companies
- Questionnaire – sent to energy auditors and industrial companies
- Meeting and interview with the facilitator of the audit scheme (IFE)

The evaluation was based on questionnaires and interviews, thus it was important to prepare questions which were neutral and easy to understand. The questionnaire was answered anonymously.

The methodology to calculate the energy savings as a result of the audit scheme was based on a direct data collection. This implies that the companies themselves calculated the actual savings and reported it to the evaluating company. Data collection concerning energy savings is solely based on the questionnaires.

In total, the questionnaire was sent to 873 companies; of which 110 were returned, due to change of address, close-down etc. The total number of answers was 245, which gives an answering rate of 32 %.

The total energy consumption in the companies responding was 18 TWh/year, while the total energy consumption in the IEEN was 50 TWh/year. The respondents amount to 36 % of the total energy consumption.

Results

The evaluation concludes that the energy audit scheme has been useful for the industry, and the organisation of the scheme has been well administered.

The main motivation to participate in the audit scheme was potential economic savings, and lack of time and resources was the main reason not to participate. The participating companies increased their knowledge on energy use, and increased knowledge was considered the triggering factor for implementation of energy efficiency measures.

In general, the energy efficiency measures carried out after the energy audits did not receive other public financial support.

The audit scheme had auditors with good knowledge in technological challenges, energy management and energy efficiency. Active auditors were considered important to obtain progress in the projects.

The 245 companies answering the questionnaire reported energy efficiency measures with corresponding savings of 809 GWh/year. This represents 6 % of these companies annual energy consumption.

The support from the audit scheme was in average 0.07 NOK/kWh (0.85 € cent/kWh/year). The share of free riders is not clear. However, in the range 10 – 50 % of the energy efficiency measures could have been carried out without the audit scheme.

Evaluation of grants to electricity savings in households 2003

Enova administrated a grant scheme for electricity savings in households in the spring 2003. Grants were given to investments in heat pumps, fireplaces using pellets and electric heating control devices. The grant scheme was evaluated in 2004/2005 by an independent organisation.[4]

The objective of the evaluation was to analyse

i) the administration of the scheme,

ii) the impact on the households

iii) the impacts on the energy market and the society.

Methodology

The evaluation is based on analyses of relevant documents, interviews with different actors (decision-makers and staff members at Enova, suppliers, trade organisations etc.) and analyses of data.

Enova established a database for the scheme, and this was used as the basis of the analysis. In addition a questionnaire was sent to 1821 households, divided in four groups; households that had received support for respectively heat pumps, pellets

4 Nord-Trøndelagsforskning, Evaluering av tilskuddsordningen til varmepumper, pelletskaminer og styringssystemer, Even Bjørnstad m.fl. , NTF-rapport 2005:2, ISBN 82-7732-136-8, March 2005

stoves and control devices, and households that did not use their promised support. 61 % of the questionnaires were returned. This was then supplemented with additional information from the Population and Housing Census 2001 from Statistics Norway. In addition to energy figures, information of demography, geography, building types and other relevant information was gathered. Most of the electricity figures were collected directly from the distribution companies. Electricity use the first half of 2002 was compared with electricity use the first half of 2004. The Norwegian Meteorological Institute contributed with degree-day figures on a community level, making it possible to normalize the electricity use in the two periods.

Sales figures were collected by interviews with 20 different actors in the energy market (e.g. producers of clean burning fire places, deliverers of oil products, producers of control devices and wood pellets, trade organisations, distributors of heat pumps, installation contractor etc.).

Results

The evaluation concludes that Enova has administered the scheme well compared with the approved criteria and commission. The administration costs were 10.4 % (excl. VAT) of the granted amount. The scheme didn't contribute in a great extent to make the households less dependent of electricity, but considering the short period of the scheme, this is an unreasonable demand according to the evaluating report.

The scheme was mostly oriented to larger dwellings, with an annual electricity use of more than 15 000 – 20 000 kWh. Households in all counties have applied for support and a majority of households with couples has used the scheme. More than 85 % of the households are satisfied with their investments.

The average electricity savings are calculated to 20 % or 5 800 kWh per year and household. This represents 33 % of electricity used for heating. Investments in heat pumps and electric heating control devices were profitability for 70-75 % of the households. Fireplaces using wood pellets were only profitability for 20 % of the households, mainly due to relatively low difference between the price of electricity and wood pellets.

Many of the households state that they would have made the investments even if they didn't get any support. It is probably many circumstances that contribute to the investments. The massive information during this winter with shortage of electricity and many advises about electricity saving measures played an important role, in addition to the support.

The market for heat pumps is now established and better heat pumps can be bought at a lower price than before the scheme. Interviews and sales figures imply that the sup-

port scheme contributed to a large content to this. The market for fireplaces for wood pellets is still small, probably due to uncertainties regarding supply and price of pellets in relation to the rather high investment cost. Also the market for electric heating control devices is still small and the deliverers didn't notice an increased sale as a consequence of the support scheme.

The support scheme probably resulted in investments in 21 000 households (5.5 % more than the number of supported households), which is 1 % of all Norwegian households. The total annual savings in electricity is calculated to 110 GWh and total energy savings are calculated to 129 GWh/year, which is 0.3 % of total energy consumption in households.

The scheme was marginally socio-economic profitable, if the saved electricity is valued to 0.44-0.46 NOK/kWh.

6 Outlook: Future National Developments under the EU Energy Efficiency Directive

The Energy Efficiency Directive is not yet part of the agreement on the European Economic Area (EEA). The Norwegian Ministry of Petroleum and Energy are discussing future national developments and measures under the EU Energy Efficiency Directive and the Energy Efficiency Action Plan. New measures to be taken under the Action Plan will not be reported until the Directive is implemented. The Energy Efficiency Directive has been submitted to relevant institutions and organizations in Norway, and the statements are in general positive.

The Norwegian government is collaborating with the other Nordic countries in order to assess the Directive and possible applications in the Nordic region. The implementation of the Directive in Norway is to be decided upon.

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 to day, investments in new energy production capacity and investments in energy savings are equal. New regulations as a consequence of the Energy Efficiency Directive must be considered. The Directive might have administrative, economic and legal consequences, and the Ministry of Petroleum and Energy are assessing the impact.

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. To achieve this, Enova's objectives are 12 TWh energy in 2010, either in new energy production capacity or as reduced energy consumption. Included in the objectives are:

- to limit energy use considerably more than if developments were allowed to continue unchecked
- to increase annual use of water-based central heating based on new renewable energy sources, heat pumps and waste heat of 4 TWh by the year 2010;
- to install wind power capacity of 3 TWh by the year 2010
- and increase environmentally friendly land-based use of natural gas

The Storting, (the Norwegian Parliament) approved in 2004 to implement the Directive 2002/19/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings in Norway. In October 2004 the Norwegian Water

Resources and Energy Directorate (NVE) got responsible to implement the directive in Norway and the work with the new law started.

An extensive work with the formulation of the legal framework and the practical accomplishment are in progress. The tentative plan is to send the new law and regulations out for public hearing from the Royal Ministry of Petroleum and Energy in 2007. If the new regulations in association to the law are adopted in 2007, the new law may be in force in 2008. Full implementation will then be possible in 2009.

The Energy Efficiency Action Plan (EEAP) will include both the Energy Efficiency Directive and the Building Directive.

Annex 1

Selected Graphs on Energy Efficiency Trends

Households

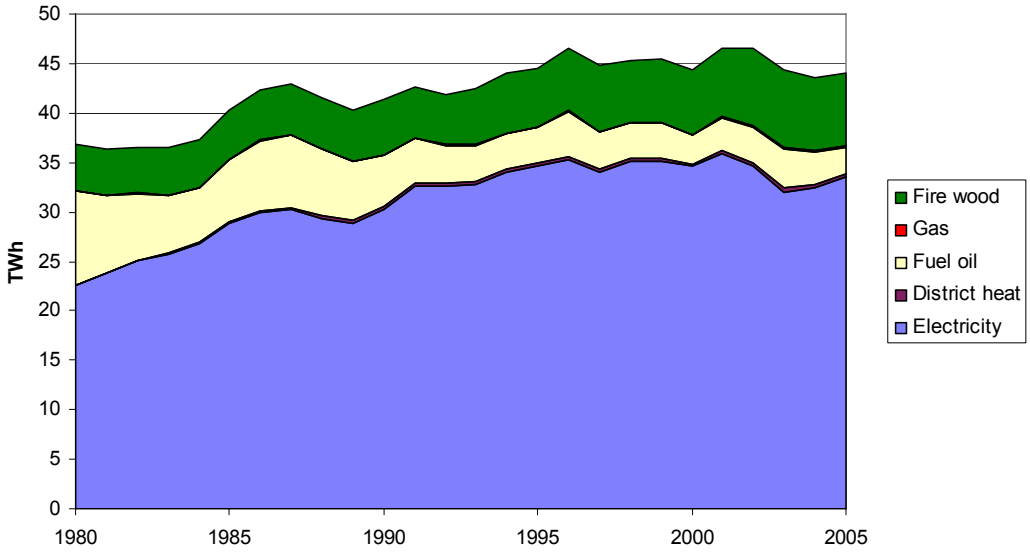

Figure 23 Final residential energy use by fuel (not climate corrected): 1980-2004 (TWh)

Final energy use in households has increased from 37 TWh in 1980 to 41.4 TWh in 1990 and a maximum of 46.6 TWh in 1996 and 2002. In 2005 44.1 TWh was used, which almost the same as the consumption in 1994 (44.0 TWh). The electricity share was 61 % in 1980, increased to 73 % in 1990 and was 76 % in 2005. At the most, 78 % of energy used was electricity (in 1992, 1995 and 2000). The use of fuel oil has decreased from 9.6 TWh in 1980 to 5.1 TWh in1990 and 2.6 TWh in 2005. The use of fire wood has increased from 4.7 TWh in 1980 to 5.7 TWh in 1990 and 7.4 TWh in 2005. The consumption of district heat was 0.4 TWh in 2005 and the gas consumption was 0.2 TWh in 2005.

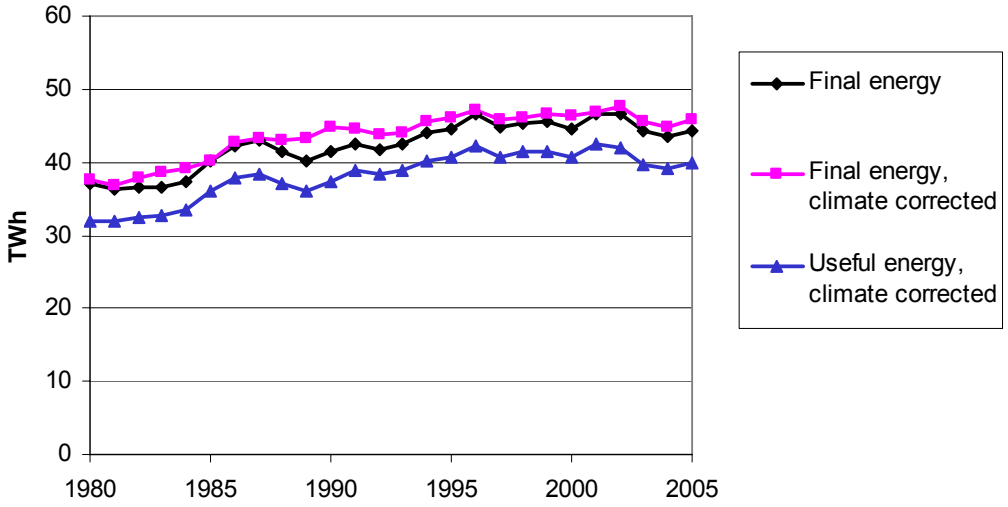

Figure 24 Energy consumption in households 1980-2005, effects of climate and „heating“ efficiency.

Climate variations explain to a large extent short-term variation in energy use. The climate corrected final energy use is rather constant at approximately 46 TWh (165 PJ) after 1994.

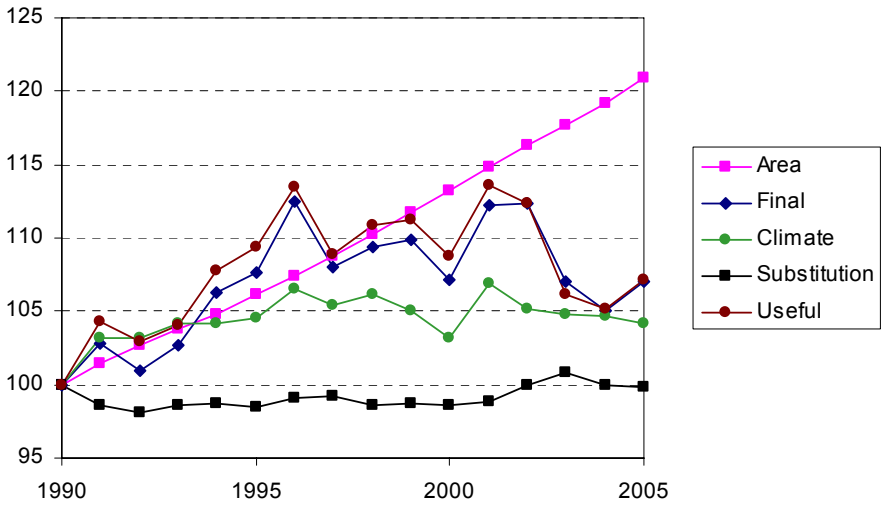

Figure 25 Effect of climate variations, fuel substitution and heated area on final energy use: 1990-2005

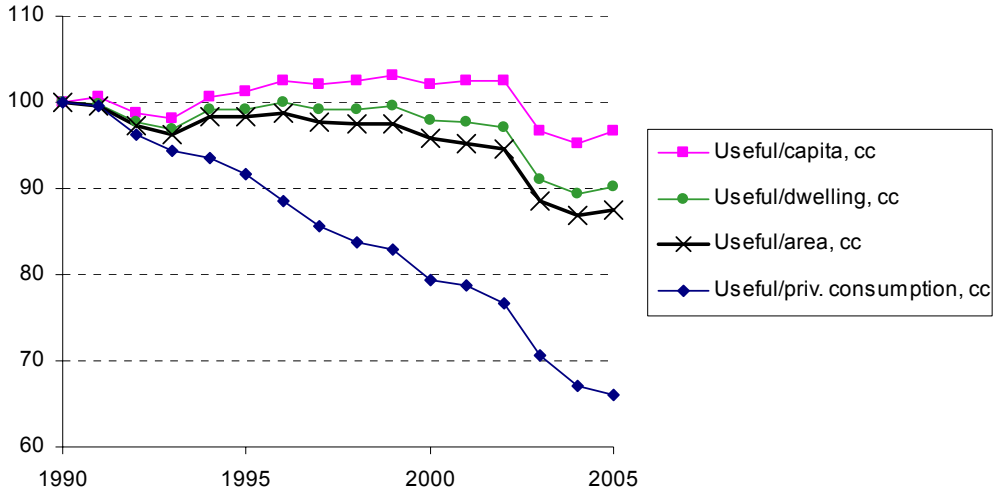

Figure 26 Fuel intensities in residential sector (climate corrected): 1990-2005

Useful energy per capita has been rather constant from 1990 to 2002, but after that it decreased by approximately 6 %. Useful energy per dwelling and per heated area has decreased since 1996, and was in 2005 10 % and 12 % less than in 1990. Climate corrected energy per heated area is used as energy intensity indicator in the residential sector in ODYSSEE, and a decrease of 12 % indicates an annual saving of 3.8 TWh. Useful energy per private consumption has decreased by 34 % from 1990 to 2005.

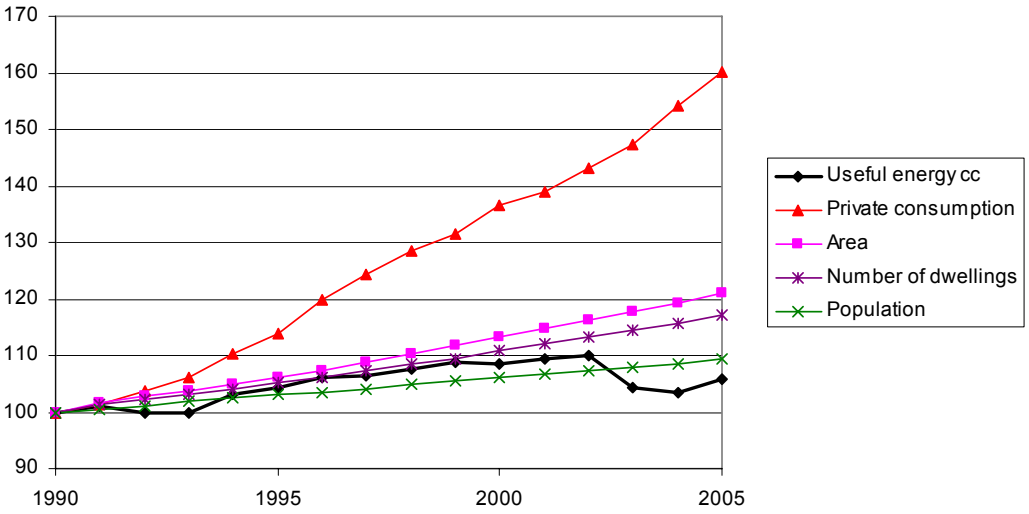

Figure 27 Trends in useful energy, private consumption, area, number of dwellings and resident population 1990-2005

Despite large increase in driving forces like private consumption, area and number of dwellings, the climate corrected useful energy has remain at the same level the last 10 years.

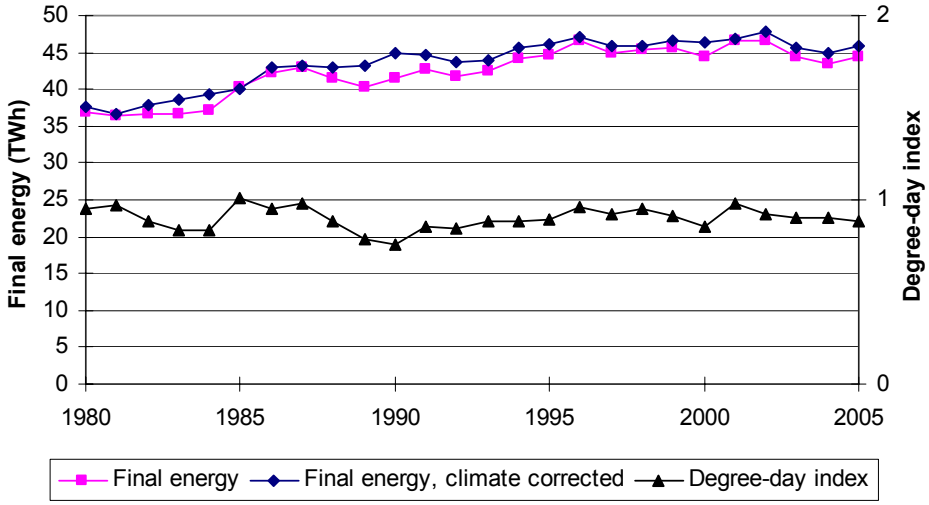

Figure 28 Degree-day index and final energy use 1980-2005

The degree-day index is calculated as the degree-days of the year divided by the normal degree-days. This index has been below 1 in all years between 1980 and 2005, i.e. all years have been warmer than the average (except in 1985 when it was 1.01).

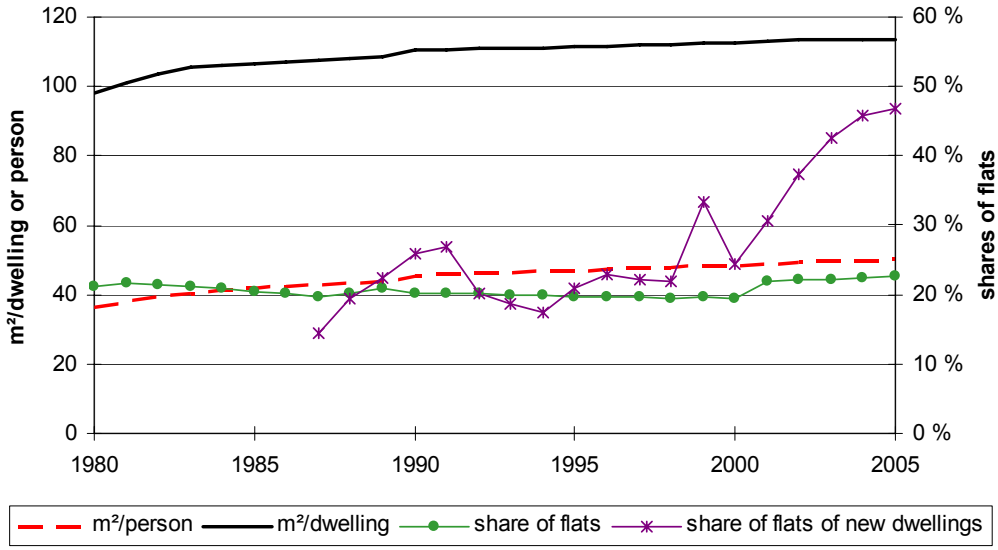

Figure 29 Area per capita and per dwelling and number of flats of total stock (share of new dwellings and share of total stock)

The area per capita was 36 m²/person in 1980 and has increased to 50 m²/person in 2005. Since 1990 the total increase has been 11 % or 0.7 % per year. The average area per dwelling was 98 m² in 1980 and 114 m² in 2005. Since 1990 the increase has been 3 % or 0.2 % per year. The share of flats of the total stock of permanent dwelling was 21.2 % in 1980, 20.0 % in 1990 and 22.5 % in 2005. Of the new dwellings, 47 % was flats in 2005 compared to 26 % in 1990. The figures of number of flats and dwellings in 2001 are based on the Population and Housing Census 2001 and 1991, while the other figures are calculated with an estimated annual demolishing rate of 0.5 % and the number of new flats/dwellings.

Service

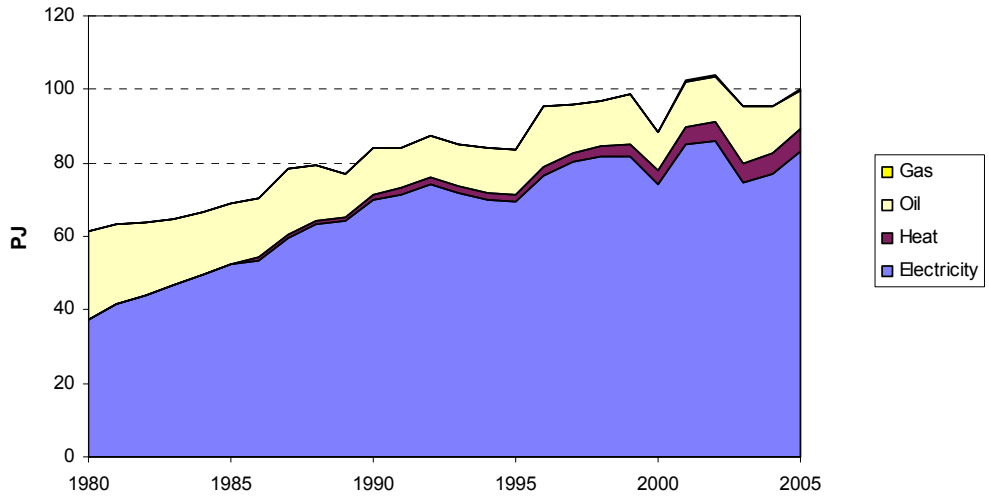

Figure 30 Finale energy use by fuel in service sector (not climate corrected): 1980-2005

Final energy use in the service sector has increased from 61 PJ in 1980 to 100 PJ in 2005 (+63 %). In 1980 electricity use was 61 % of total energy use and in 2005 it has increased to 83 %. The use of fuel oil has been more than halved, from 24 PJ in 1980 to 11 PJ in 2005. 6 PJ of district heating was used in 2005. The annual growth was 2.5% in 1980-2005 and 1.3 % per year from 1990 to 2005. Energy use in 2000 is considerable reduced according to the energy balance of Statistics Norway, but no reason for this has been identified.

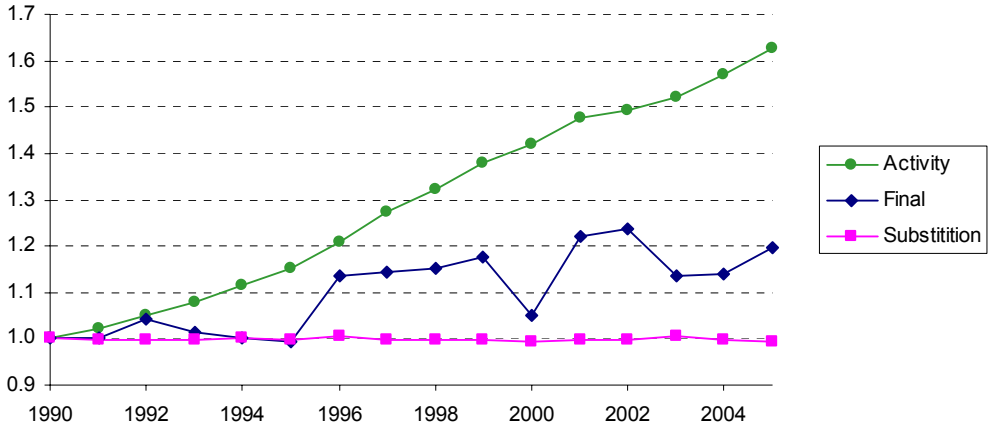

Figure 31 Effect of increased activity (value added in real terms) and substitution (oil to electricity) on final energy use in service sector: 1990-2005

The final energy use in the service sector has increased by 19 % while the activity has increased by 63 % from 1990 to 2005. The effect of substitution in this period is almost neglectable.

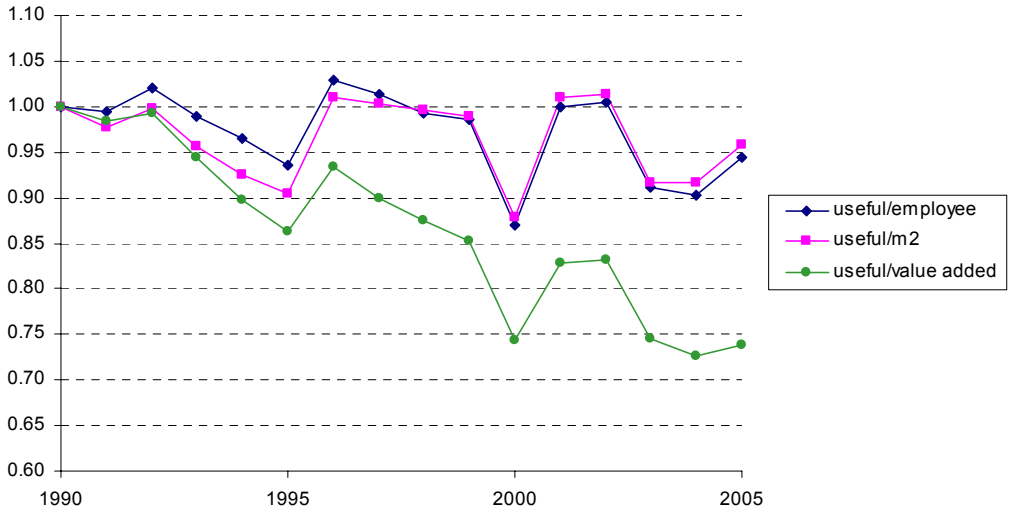

Figure 32 Energy efficiency indicators for the service sector: 1990-2005

Useful energy per employee and per surface (m²) shows a similar development, and has decreased by 5 % and 4 % since 1990. Useful energy per value added in the service sector has decreased by 26 % from 1990 to 2005.

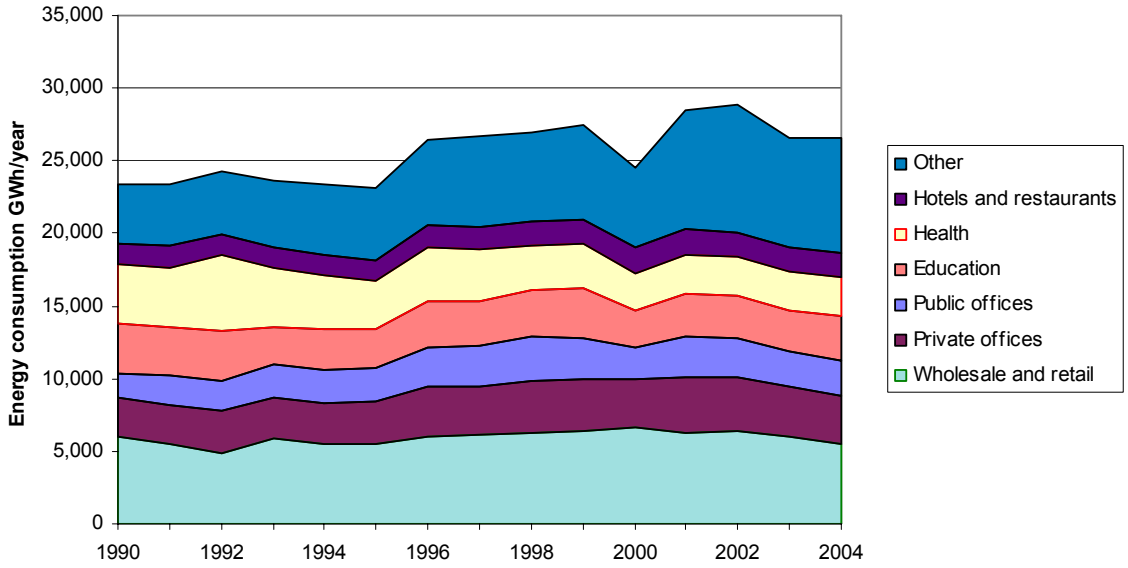

Figure 33 Energy consumption in sub-sectors in the service sector: 1990-2004

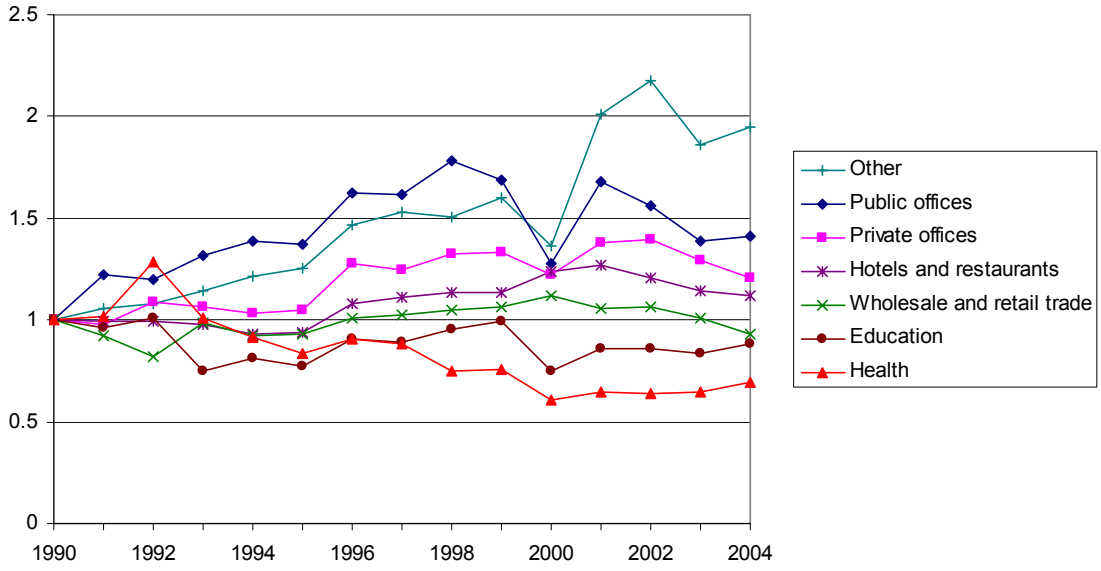

Figure 34 Trends in energy use in service sub-sectors: 1990-2004

Energy consumption has decreased in the health, education and Wholesale and retail trade sectors with 31 %, 11 % and 7 % since 1990. In all other sectors the energy consumption has increased; most in the “other” sector, 95 %, followed by the public offices, 41 %, the private offices, 20 % and hotels and restaurants 12 %.

Transport

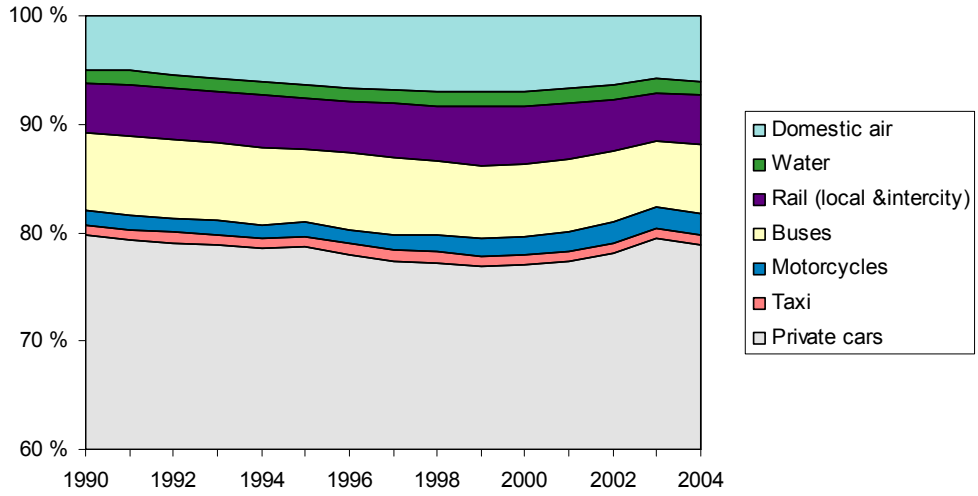

Figure 35 Travel by mode, % of person kilometres: 1990-2004

Private cars are still the dominating mode, 79 % in 2004, which is 1 % less than in 1990. Domestic air transport has increased most and is 1.2 % higher in 2004 than in 1990. Buses have decreased by 1 % from 1990 to 2004. Transport by water, rail and taxi is rather constant in 1990 and 2004.

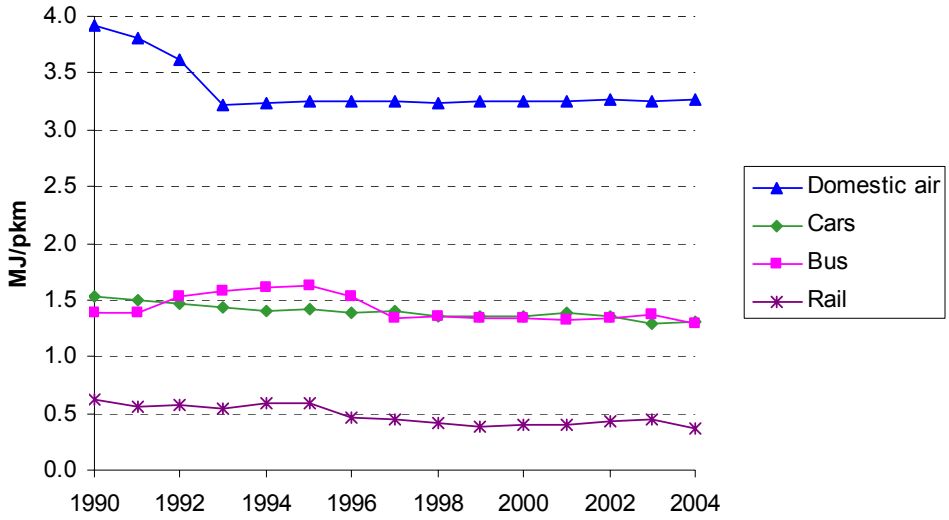

Figure 36 Unit consumption (MJ/passenger km) by mode: 1990-2004

Air transport uses most energy per passenger-km, while cars and buses use less than half of the air transport. Transport by railway is the most energy efficient, only 28 % of the unit consumption of cars.

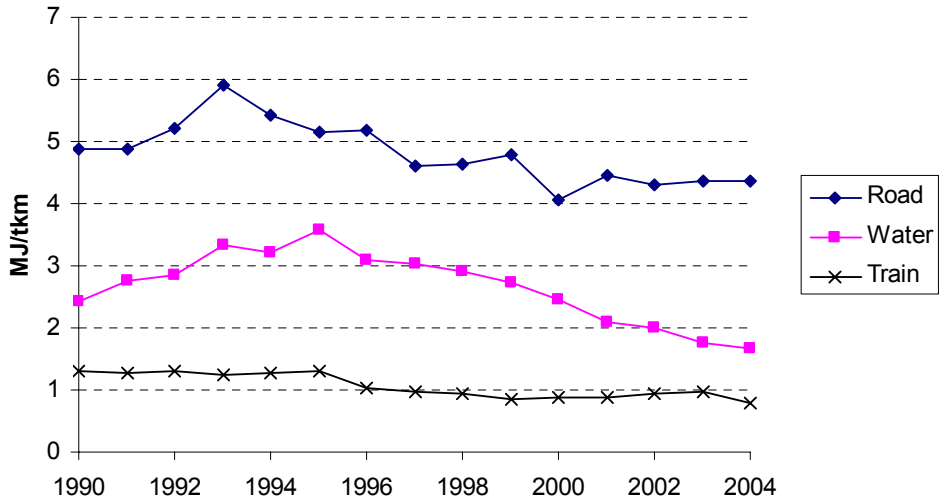

Figure 37 Unit consumption for freight modes (MJ/tkm): 1990-2004

The unit consumption for transport of goods on both roads and water has been more efficient since the mid-1990s. Road transport of goods uses most energy per ton of km transported, while transport by rail is most efficient.

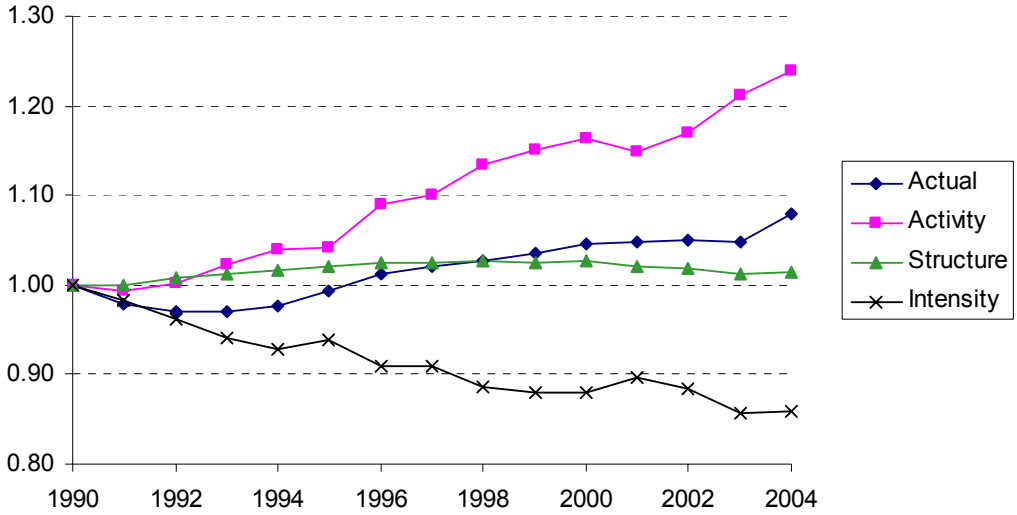

Figure 38 Effect of activity in travel (keeping Structure (traffic mode) and Intensity level at 1990-level), Structure (keeping Activity and Intensity at 1990-level) and Intensity: 1990-2004

The energy consumption in travel has increased by 8 % from 1990 to 2004. If the intensity and structure is kept at 1990-level the energy consumption for travel would have been 24 % higher. The structure effect in travel is quite low, and only increases the energy use with 1.5 % from 1990 to 2004. The intensity has decreased by 14 % from 1990 to 2004, indicating energy savings of 4.1 TWh in 2004.

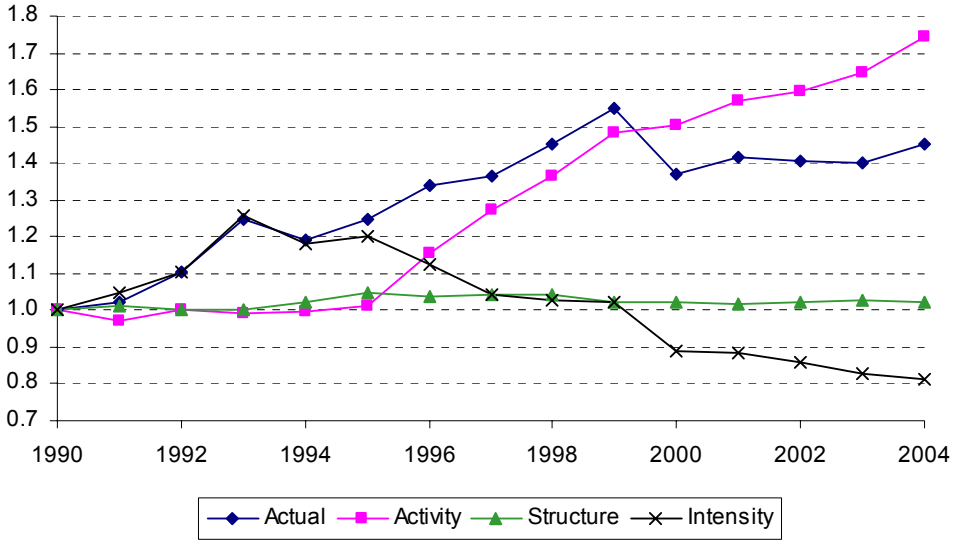

Figure 39 Effect of activity in freight (keeping Structure (traffic mode) and Intensity level at 1990-level)**, Structure** (keeping Activity and Intensity at 1990-level) **and Intensity: 1990-2004**

The energy consumption for freight has increased by 45 % from 1990 to 2004. If the intensity and structure is kept at 1990-level the energy consumption for freight would have been 75 % higher. The structure effect in freight is quite low, and only increases the energy use with 2.2 % from 1990 to 2004. The intensity first increased during the early 1990s and has then decreased (19 % from 1990 to 2004), indicating energy savings of 4.9 TWh in 2004.

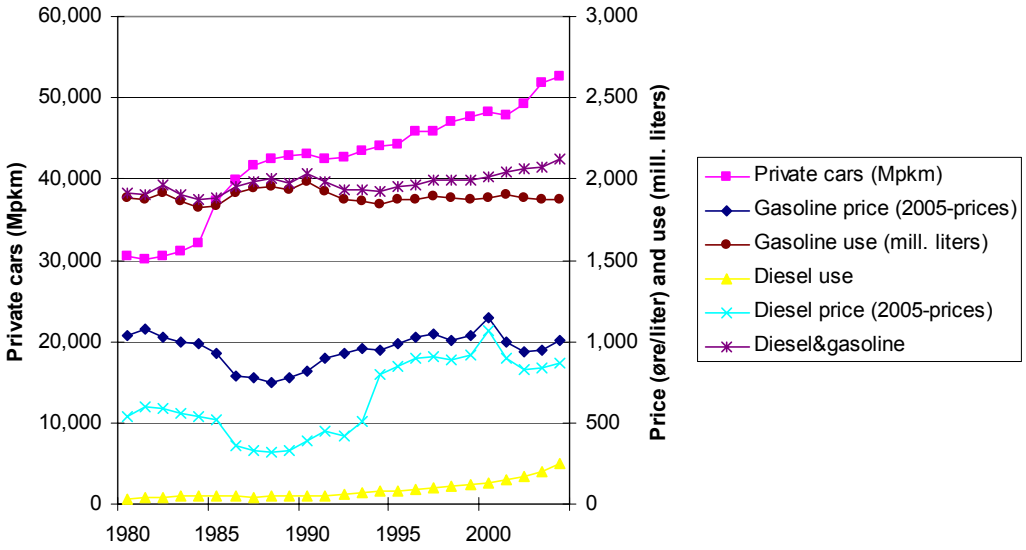

Figure 40 Use of gasoline and diesel as a function of prices and activity

The activity in travel by cars has increased with 73 % from 1980 to 2004. At the same time the use of gasoline and diesel (in mill. litres) has increased by 11 %. There has been a switch towards more use of diesel (increased 8 times). The price of gasoline in constant 2005-prices has decreased by 3 % in the period. There was an increase in gasoline price from 1988 to 2000, but this shows no effect on the use of gasoline or in the activity of travelling by car. The jump in diesel price in 1994 is due to a change in diesel taxes from a km-tax to a fuel tax.

Annex 2

Energy Efficiency Measure Summary by Country

Definition of the (semi-quantitative) impact level

In general: definition of the impact in terms of final energy. All electricity savings should be linked only to electricity, all other savings (except for those involving fuel substitution and CHP) to the overall final energy consumption.

Fuel substitution and CHP savings: the savings should be linked to the primary energy, calculated with a fixed factor of 2.5.

The categories (low, medium, high) should be linked to the aggregate electricity or energy consumption of the respective sector (households, transport, industry or tertiary), and not to a particular end-use, because the aggregation of the impacts is easier.

The following limits (in each case in % of the overall final energy or electricity consumption of the sector; in case of fuel substitution and CHP: of primary energy consumption) are defined for the three impact levels:

- **low impact: <0.1 %**

- medium impact: 0.1-<0.5 %

- high impact: ≥0.5 %

Table 4 All Norwegian measures in the household sector of MURE

Measure Code	Measure Title	Status	Measure Type	Subsector	Target Audience	Starting Year	Ending Year	Semi-quantitative Impact
NOR1	Energy efficiency label scheme for domestic washing machines and tumble driers	Ongoing	Legislative/Informative	Appliances	manufacturers, retailers	1996		Medium
NOR2	Local energy efficiency fund in Oslo (Enøkfondet i Oslo)	Ongoing	Financial	Appliances, Hot water, Heating	owner-occupiers, housing associations, landlords	1981		Medium
NOR3	Environmental taxes	Ongoing	Cross-cutting with sector-specific characteristics	Appliances, Hot water, Heating	owner-occupiers, general public, tenants	1991		Medium
NOR4	Building regulations 1987 (Byggeforeskrift 1987)	Completed	Legislative/Normative	Heating	general public	1987	1997	Medium
NOR5	Energy efficient low energy houses (Energibruk i boliger)	Completed	Financial	Hot Water, Heating	owner-occupiers, housing associations, building professions, landlords, tenants, manufacturers, retailers	2003	2004	Low
NOR6	Energy information helpline (Enovas svartjeneste)	Ongoing	Information/Education	Appliances, Hot water, Heating	general public	2003		Low

Measure Code	Measure Title	Status	Measure Type	Subsector	Target Audience	Starting Year	Ending Year	Semi-quantitative Impact
NOR8	Information and education financed by NVE (Opplæring og informasjon)	Completed	Information/Education	Appliances, Hot water, Heating	owner-occupiers, housing associations, building professions, general public, landlords, tenants, manufacturers, retailers	1990	2001	Low
NOR9	Energy efficiency label scheme for domestic dishwashing machines	Ongoing	Legislative/Informative	Appliances	manufacturers, retailers	1999		Low
NOR10	Energy taxes	Ongoing	Cross-cutting with sector-specific characteristics	Appliances, Hot water, Heating	owner-occupiers, general public, tenants	1975		Medium
NOR11	Mandatory Energy Efficiency Activities through Regional Energy Efficiency Centres (Lovpålagt enøk - Regionale enøksentra)	Completed	Information/Education	Appliances, Hot water, Heating	owner-occupiers, housing associations, general public, landlords, tenants, retailers	1994	2001	Low
NOR12	Energy saving loans (Husbanken)	Ongoing	Financial	Heating	owner-occupiers, housing associations, general public	1996		Low
NOR13	Energy efficiency label scheme for refrigerators, freezers and their combinations	Ongoing	Legislative/Informative	Appliances	manufacturers, retailers	1996		Medium

Measure Code	Measure Title	Status	Measure Type	Subsector	Target Audience	Starting Year	Ending Year	Semi-quantitative Impact
NOR14	Grants to electricity savings in households (Elsparetiltak i husholdningene)	Completed	Financial	Heating	general public	2003	2003	Low
NOR15	Energy efficiency label scheme for residential lighting	Ongoing	Legislative/Informative	Appliances	manufacturers, retailers	1999		Low
NOR16	Building Regulations 1997 (Byggeforskrift 1997)	Ongoing	Legislative/Normative	Heating	building professions, general public	1997		Medium
NOR17	Energy Act on informative billing (Energiloven)	Ongoing	Information/Education	Appliances, Hot water, Heating	general public	1999		High
NOR18	Simple Energy Audit (Enøk-sjekken)	Ongoing	Information/Education	Appliances, Hot water, Heating	general public	1997		Low
NOR19	Energy performance of buildings (Bygningsenergidirektivet)	Proposed (advanced)	Legislative/Informative	Heating	owner-occupiers, housing associations, building professions, general public, landlords, manufacturers	2009		High
NOR20	Energy efficiency requirements on refrigerators, freezers and their combinations	Ongoing	Legislative/Normative	Appliances	manufacturers, retailers	1999		Medium
NOR21	EcoBuild support scheme (ØkoByggprogrammet)	Completed	Financial	Heating	housing associations, building professions, manufacturers	1998	2002	Medium

Measure Code	Measure Title	Status	Measure Type	Subsector	Target Audience	Starting Year	Ending Year	Semi-quantitative Impact
NOR22	Grants for electricity savings in households 2006 (Til-skuddsordningen 2006)	Ongoing	Financial	Heating	general public	2006		Low
NOR23	Grants for energy savings in homes, buildings and outdoor equipment areas (Bygg, bolig og anlegg)	Ongoing	Financial	Appliances, Hot water, Heating	building professions	2005		Medium
NOR24	Energy efficiency label scheme for air condi-tioners (Energimerking av klimaanlegg)	Ongoing	Legislative/Informative	Appliances, Heating	general public	2004		Low

Table 5 All Norwegian measures in the transport sector of MURE

Measure Code	Measure Title	Status	Measure Type	Subsector	Target Audience	Starting Year	Ending Year	Semi-quantitative Impact
NOR1	Purchase tax on vehicles (Engangsavgift på motorvogner)	Ongoing	Fiscal	Passengers, Goods	New vehicles	1959		Medium
NOR2	Energy labelling of new cars	Ongoing	Information, Legislation	Passengers	New vehicles	2001		Low
NOR3	Taxes on gasoline and auto diesel oil	Ongoing	Financial	Passengers, Goods	General public, Existing vehicles, New vehicles, Transport companies, Fleet owners	1986		Medium
NOR4	Speed limits	Ongoing	Legislation	Passengers, Goods	General Public	1965		Medium
NOR5	Semiannual technical inspection of vehicles	Ongoing	Legislation	Passengers, Goods	General Public	1998		Medium
NOR6	Reward scheme for better public transportation and reduced use of cars in cities (Belønningsordningen)	Ongoing	Financial	Passengers	Individual passengers, Collective passengers, General public	2004		Low
NOR7	Public transport packages	Completed	Information, Infrastructure	Passengers	Individual passengers, Collective passengers, General public	1996	2000	Low

Table 6 All Norwegian measures in the industry sector of MURE

Measure Code	Measure Title	Status	Measure Type	Subsector	Target Audience	Starting Year	Ending Year	Semi-quantitative Impact
NOR1	Energy taxes	Ongoing	Fiscal	All Sectors	Large enterprises, SMEs	1975		Low
NOR2	Market introduction of energy efficient technologies	Completed	Financial	All Sectors	Large Enterprises, SMEs, Energy suppliers, Building profess.	1994	2002	Medium
NOR3	Pilot and demonstration projects in industry (PEI)	Completed	Financial	All Sectors	Large enterprises, SMEs	1990	1993	Low
NOR4	Investment grants for energy-saving measures (Tilskuddsordningen)	Completed	Financial	All Sectors	Large enterprises, SMEs, Building profess.	1990	1993	High
NOR5	Audits: Cleaner technology and energy efficiency in industry (RENOK)	Completed	Financial, Education/Information/Training	All Sectors	Large enterprises, SMEs, Energy Managers / Account.	1991	1994	Low
NOR6	Demonstration programme: Energy in industry (EII)	Completed	Financial	All Sectors	SMEs	1986	1989	Low
NOR7	Environmental taxes	Ongoing	Fiscal	All Sectors	Large enterprises, SMEs	1991		Medium
NOR8	Energy efficiency in industry (Program for energieffektivisering i energiintensiv industri)	Ongoing	Financial, Voluntary agreement	Paper and board	Large Enterprises	2005	2014	Medium

Measure Code	Measure Title	Status	Measure Type	Subsector	Target Audience	Starting Year	Ending Year	Semi-quantitative Impact
NOR10	Research programme: Energy efficient technologies in industry (EEI)	Completed	Financial	All Sectors	Large Enterprises, SMEs	1992	1994	Low
NOR11	Norwegian industrial energy efficiency network	Completed	Financial, Education/Information/Training	All Sectors	Large enterprises, SMEs	1989	2002	High
NOR12	Grants to heating plants	Ongoing	Financial	All Sectors	Large enterprises, SMEs, Energy suppliers, Building Profess.	1997		Medium
NOR13	Emission trading	Ongoing	Other market-based instruments	Iron and steel, Non metallic minerals	Energy managers/Account., energy suppliers, Large enterprises	2005		Low
NOR14	Energy management – Companies in network	Ongoing	Financial	All sectors	SMEs	2003		High
NOR15	Reduced energy use – industry	Ongoing	Financial	All sectors	Large enterprises, SMEs	2003	2007	High

Table 7 All Norwegian measures in the tertiary sector of MURE

Measure Code	Measure Title	Status	Measure Type	Subsector	Target Audience	Starting Year	Ending Year	Semi-quantitative Impact
NOR1	Norwegian Building Network	Ongoing	Education/ Information/ Training Voluntary agreement	All sectors	Building profess., Public estates	1996		High
NOR2	Information and education financed by NVE	Completed	Education/ Information/ Training	Total Sector	Building profess., energy managers/Account., Energy suppliers, General public, Large enterprises, Local authorities, Prof. associations, Public estates, SMEs	1990	2001	Low
NOR3	Building regulations 1987 (Byggeforeskrift 1987)	Completed	Legislation	Total Sector	Building profess., General public, Public estates	1987	1997	Medium
NOR4	Energy taxes	Ongoing	Fiscal	Total Sector	Building profess., Energy managers/Account., Energy suppliers, General public, Large enterprises, Public estates, SMEs	1975		Medium
NOR5	Building Regulations 1997 (Byggeforskrift 1997)	Ongoing	Legislation	All sectors	Building profess., General public	1997		Medium
NOR6	Energy performance of buildings (Bygningsenergidirektivet)	Proposed (advanced)	Legislation	Total Sector	Building profess., General public, Public estates	2009		High

Measure Code	Measure Title	Status	Measure Type	Subsector	Target Audience	Starting Year	Ending Year	Semi-quantitative Impact
NOR7	Market introduction of energy efficient technologies	Completed	Financial	Total Sector	Building profess., Energy suppliers, Large enterprises, SMEs	1994	2002	Low
NOR8	Investment grants for energy-saving measures (Tilskuddsordningen)	Completed	Financial	Total Sector	Building profess., Large enterprises, SMEs	1990	1993	High
NOR9	Environmental taxes	Ongoing	Fiscal	Total Sector	Building profess., Energy suppliers, eneral public, Large enterprises, Public estates, SMEs	1991		Medium
NOR10	Mandatory Energy Efficiency Activities through Regional Energy Efficiency Centres (Lovpålagt enøk - Regionale enøksentra)	Completed	Education/ Information/ Training	Total Sector	Building profess., Energy managers/Account., General public, Public estates, SMEs	1991	2001	Low
NOR12	Grants to heating plants	Ongoing	Financial	Total Sector	Building profess., Energy suppliers, Large enterprises, SMEs	1997		Medium
NOR13	Energy plans in municipalities	Ongoing	Financial	Public buildings	Local authorities, Public estates	2005		Low
NOR14	Grants for energy savings in homes, buildings and outdoor equipment areas	Ongoing	Financial	Total sector	Building profess., Large enterprises, Public estates	2005		High
NOR15	Local energy efficiency fund in Oslo	Ongoing	Financial	Total sector	Building profess	1981		Low

Table 8 All Norwegian measures in the cross-cutting sector of MURE

Measure Code	Measure Title	Status	Measure Type	Starting Year	Ending Year	Semi-quantitative Impact
NOR1	Energy Fund	Ongoing	Financial Measures	2002		High
NOR2	Local energy studies (Lokale energiutredninger)	Ongoing	Legislative/Normative Measures	2003		Low
NOR4	Energy policy	Ongoing	General Energy Efficiency / Climate Change / Renewable Programmes	2000		Unknown

Annex 3

Data Situation and Data Quality

This report deals mainly with the evolution of energy efficiency in Norway in the period from 1990 to 2004. 2004 is the last year for which final detailed energy statistics exists. Preliminary energy statistics for 2005 are also available and are used were it is considered as appropriate.

The project has elaborated common methods and indicators for presenting national energy efficiency improvements based on national statistics. Generally, care should be taken not to address any apparent result as a consequence of physical/real change in energy use. Statistics might not be consistent from year to year and some data are estimated very coarsely.

Statistics Norway has prepared most of the data. Energy use in service sector (and "other "consumers) is calculated as a residue, by Statistics Norway, subtracting energy in industry, households and transport from the total final consumption, and this data should be regarded as more approximately than other data. In 2005 Statistics Norway updated the energy statistics for 1990-2002 and this has been included in the ODYSSEE-database

The data in the ODYSSEE-database are qualified as follows:

•To qualify the indicators, such as ODEX, we qualify first the data composing the ODEX
•We use 2 types of grades:
•one to qualify the data source A, B and C
•One to qualify the data quality 1,2 and 3

•The grades would be made by the national teams using "objective" criteria for the source and semi-objective criteria for the quality

Quality of source
- A: Official statistics

•Official statistics/surveys (national statistical office, Eurostat/AIE, Ministries statistics
•Model estimations used as official statistics
•Data "stamped" by Ministries
- B: Surveys/ modelling estimates (consulting, research centres, universities, industrial associations)
- C: Estimations made by national teams (for the project)

Quality of data
- 1 Good
- 2 Medium
- 3 Poor

➔For official sources :subjective appreciation made by national teams in collaboration with the source of data: 1 or 2

➔For surveys: quality grade depends on the size of the sample :large sample=1….
➔For estimates by national team : quality grade depends on the method: formal modelling higher quality (1 or 2) than expert estimate (2 to 3)

Sector	Unit	Source	quality	Grade
Transport				
road	Mtoe	Statistics Norway	A	1
cars	Mtoe	own calculations	C	3
goods transport	Mtoe	own calculations	C	3
buses	Mtoe	own calculations	C	3
motorcycles	Mtoe	own calculations	C	3
rail transport	Mtoe	Statistics Norway	A	1
water transport	Mtoe	Statistics Norway	A	1
air (total)	Mtoe	Statistics Norway	A	1
total	Mtoe	Statistics Norway	A	1
specific cons of cars	l/100km	own calculations	C	3
traffic of road	Gtkm	Statistics Norway	A	1
num of bus	k	Bil og veistatistikk	A	1
number of motorcycles	M	Bil og veistatistikk	A	1
traffic of water	Gtkm	Statistics Norway	A	1
number of air transport passengers	Mpas	Statistics Norway	A	1
rail traffic	Gtkb			
rail traffic of goods	Gtkm	Statistics Norway	A	1
rail traffic of passengers	Gpkm	Statistics Norway	A	1
Trains' technical coefficients for goods transport(gross ton-tkm hauled per tkm)		own calculations	C	3
Trains' technical coefficients for passenger trans-port(gross ton-tkm hauled per pkm)		own calculations	C	3
Households				
Heating (actual)	Mtoe	Statistics Norway +own calculations	C	3
Heating (with climatic corrections)	Mtoe	Statistics Norway +own calculations	C	3
Water heating	Mtoe	Statistics Norway +own calculations	C	3
Cooking	Mtoe	Statistics Norway +own calculations	C	3
Elec. appliances & lighting	Mtoe	Statistics Norway +own calculations	C	3
Large appliances	Mtoe			
Sum of end-uses	Mtoe	Statistics Norway	A	1
consumption of households	Mtoe	Statistics Norway	A	1
electricity cons of households	Mtoe	Statistics Norway	A	1
fuel cons of households	Mtoe	Statistics Norway	A	1
fuel cons of households with cc	Mtoe	Statistics Norway	A	1
degree days	1	Statistics Norway	A	1
degree days of reference	1	Statistics Norway	A	1
share of space heating	1	Statistics Norway +own calculations	C	3
percent of dwelling with central heating	1	Statistics Norway	A	1
floor area	m2	Statistics Norway	A	1
Stock of permanently occupied dwellings	k	Statistics Norway	A	1
Annual new dwellings	k	Statistics Norway	A	1
Cumulated new dwellings		Statistics Norway	A	1
number of new houses	k	Statistics Norway	A	1
share of new houses		Statistics Norway	A	1
Theoretical unit consumption of new multi family dwellings	toe/dw	own calculations	C	3
Theoretical unit consumption of new single	toe/dw	own calculations	C	3

family dwellings				
specific consumption of new dwellings	toe/dw	own calculations	C	3
Stock of refrigerator	k			
Stock of independent freezers	k			
Stock of washing machines	k			
Stock of dishwashers	k			
Stock of TV sets	k			
Specific consumption of refrigerator (permanently occupied dwellings)	kWh/xx			
Specific consumption of independent freezers (permanently occupied dwellings)	kWh/xx			
Specific consumption of washing machines (permanently occupied dwellings)	kWh/xx			
Specific consumption of dishwashers (permanently occupied dwellings)	kWh/xx			
Specific consumption of TV sets (permanently occupied dwellings)	kWh/xx			
average specific consumption of electrical appliances per households	kWh/dw			
Industry				
chemicals, rubber & plastics	Mtoe	Statistics Norway	A	1
chemicals	Mtoe	Statistics Norway	A	1
rubber & plastics	Mtoe	Statistics Norway	A	1
primary metals	Mtoe	Statistics Norway	A	1
steel	Mtoe	Statistics Norway	A	1
other	Mtoe	Statistics Norway	A	1
non mineral metallic	Mtoe	Statistics Norway	A	1
cement	Mtoe	Statistics Norway	A	1
other	Mtoe	Statistics Norway	A	1
paper	Mtoe	Statistics Norway	A	1
food	Mtoe	Statistics Norway	A	1
textiles	Mtoe	Statistics Norway	A	1
equipment	Mtoe	Statistics Norway	A	1
machinery	Mtoe	Statistics Norway	A	1
transport vehicles	Mtoe	Statistics Norway	A	1
fabricated metals	Mtoe	Statistics Norway	A	1
mac+veh+fab	Mtoe	Statistics Norway	A	1
ipiccpxx	index	Statistics Norway +own calculations	C	2
ipichixx	index	Statistics Norway	A	1
ipicmpxx	index	Statistics Norway	A	1
ipimprxx	index	Statistics Norway	A	1
ipisidxx	index	Statistics Norway +own calculations	C	2
ipimnfxx	index	Statistics Norway	A	1
ipimnmxx	index	Statistics Norway	A	1
ipipppxx	index	Statistics Norway +own calculations	C	2
ipiiaaxx	index	Statistics Norway	A	1
ipitexxx	index	Statistics Norway	A	1
ipieqpxx	index	Statistics Norway +own calculations	C	2
production of steel	kt	SFT	B	1
production of paper	kt	www.fao.org	A	1
production of cement	kt	company reports	B	1