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THE EVOLUTION OF NORWEGIAN ENERGY USE FROM 1950 TO 1991

BY
SARITA BARTLETT

STATISTISK SENTRALBYRÅ
CENTRAL BUREAU OF STATISTICS OF NORWAY

Til salgs hos:

Akademika
- avdeling for offentlige publikasjoner
Møllergt. 17
Postboks 8134 Dep
0033 Oslo

Tlf.: 22 11 67 70
Telefax: 22 42 05 51

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Preface

In 1988, the Lawrence Berkeley Laboratory (LBL) was asked by the Royal Ministry of Industry and Energy (formerly the Royal Ministry of Petroleum and Energy) and Oslo Energi (formerly Oslo Lysverker) to analyze the long-term changes in Norwegian energy use and its underlying determinants, and to compare these changes to those that occurred in other industrialized countries. The motivations for this project were to gain a better understanding of past energy-use trends in order to identify the areas in which there exist energy conservation potentials, and to examine the factors that differentiated the evolution of Norwegian energy use from that of other industrialized countries. LBL used a "bottom up", descriptive approach as opposed to formal modelling tools to perform their analysis. Their period of analysis extended from 1950 to 1986. The results of this project are contained in the LBL report entitled *A Long-Term Perspective on Norwegian Energy Use* (Schipper, Horwarth, and Wilson (1990)).

The main findings of the Schipper, *et. al.* (1990) report were that the intensities of energy use in most sectors have increased since OPEC I (between 1973 and 1974) and that energy efficiency in Norway has not improved as much as in other countries since 1973. The authors cite two factors for this finding. First, inexpensive electricity and wood, and increases in the gross domestic product (and disposable income) led to increases in the acquisition of cars and larger homes, and to increases in their utilization. This occurred while consumers in other countries were decreasing their energy use in response to higher real energy prices. Second, Norwegian energy use matured later than in other industrialized countries.

In 1990, under contract from the Norwegian Water Resources and Energy Administration (NVE), the Central Bureau of Statistics began the project "Energibruk i Norge i et langsiktig prespektiv- utvidelse og oppdatering 1985 -1990" (Energy Use in Norway in a Long-Term Perspective- Expansion and Updating from 1985 to 1990). The purpose of this project was threefold.

The first phase of this project was to extend the Schipper, *et. al.* (1990) analysis to include an analysis of the trends in energy use and its underlying determinants that occurred from 1985 to 1990. The author has attempted to follow the methodology used in Schipper, *et. al.* (1990) as much as possible. However, there are several differences between the Schipper, *et. al.* (1990) report and this one. This report does not contain international comparisons, and it is policy benign (i.e., no policy recommendations are presented). In addition, it is important to note that because of data revisions, there are differences in some of the results presented in the two reports.

NVE wanted the unpublished LBL data used in Schipper, *et. al.* (1990) updated through 1990 and organized in a more "user friendly" format. These tasks constituted the second phase of the project. Per NVE's request, these data have been placed in a system of linked Lotus 1-2-3 for windows (version 1.0) worksheets and worksheet files. Unfortunately, in many instances there were inconsistencies between the original and updated data. As a consequence, the author attempted to validate as much of the original data as possible. In some cases, entire original data series were replaced with revised data. The product of this work is a detailed set of sectoral energy use, as well as related economic, and structural, time-series data extending from 1950 to 1990 (or 1991, where there are available data). Following the methodology used by LBL, these data have been constructed using a "bottom up" approach. The data used in this report are presented in Appendix A, and information on the data are summarized in Appendix B. The complete data set, including additional data not contained in the report, is contained on diskettes.

The third phase of this project consisted of an evaluation of types and quality of data needed to improve this type of analysis in the future. The possibilities of extending this analysis to a regional level were also explored.

This work was partially supported by the Norwegian Water Resources and Energy Administration (NVE). The author is grateful to the following individuals for their helpful comments and assistance: Jan Moen (NVE); Knut Alfsen, Torstein Bye, Lisbet Høgset, Kari Anne Lysell, Margaret Simpson, Tone Veiby, and Marit Vågdal (Statistisk sentralbyrå); Oddbjørn Fredriksen, Arne Ljones, and Svein Sandbakken (Energidata); Richard Howarth and Lee Schipper (Lawrence Berkeley Laboratory); and Jon Inge Lian (Transportøkonomisk institutt).

Central Bureau of Statistics, Oslo 30. July 1993

Svein Longva

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Summary

Climate-corrected delivered energy use in the Norwegian residential, service, manufacturing, and transportation sectors increased from around 190 to 620 PJ from 1950 to 1991. The most rapid growth in energy use in each of the sectors occurred between 1960 and 1973. In this period, as in all others, the growth rates differed across sectors. A larger portion of energy use was allocated to consumers (i.e., energy use the residential sector, for personal services, and for passenger transportation).

Growth in real gross domestic product contributed to offset the effects of the large real oil price increases following OPEC I and OPEC II on total energy use. At the same time, this growth also supported increases in comfort and mobility. In addition, many agents (households, firms, and public entities) had the ability to substitute less expensive electricity, and to a lesser extent solid fuels, for oil for space heating and in production processes which further dampened the impact of the price increases. Conversely, this substitution ability also allowed agents to take advantage of lower real oil prices between 1985 and 1986. However, since 1970, the share of electricity used to meet total stationary energy use (i.e., energy use in the residential, service, and manufacturing sectors) has increased almost continuously from 47 to 73 percent, while the share of oil used has declined from 36 to 9 percent.

Sectoral summaries are presented below.

1. Residential Sector

Increases in real disposable income allowed households to purchase larger dwellings, supported increases in appliance ownership, and permitted higher comfort levels in dwellings. Growth in real disposable income also dampened the effects of the large oil price increases following OPEC I and OPEC II. The ability of many households to alter their space heating fuel choice, through the use of supplemental electric heaters and wood stoves, also contributed to reduce the effect of the large relative price changes following OPEC I. This ability, and the increased use of electricity as a main space heating fuel choice, diminished the effects of the second large relative price changes following OPEC II. Conversely, many households took advantage of lower oil prices between 1985 and 1986. Thus, the long-term evolution of energy use in this sector can be characterized by almost continuous growth in energy use which was supported, both directly and indirectly by growth in disposable income, and by space heating fuel switching.

2. Service Sector

From the early 1960s to the mid-1970s, growth in real service sector value added led to an expansion of the floor area, and supported increases in the intensities of energy use for heating and non-heating purposes, which in turn, resulted in large increases in energy use. From the mid-1970s to the mid-1980s, the continued growth in value added and floor area also contributed to increase energy use, but energy use did not grow as rapidly as in the previous period because of slower growth in the average intensity of energy use. Although real sectoral value added levelled off from 1985 to 1990, the continued expansion of the floor area, and increases in the intensity of energy used for non-heating purposes, perpetuated the growth in energy use. Like the residential sector, energy use in the service sector continued to increase in spite of the large real oil price increases following OPEC I and

OPEC II. This occurred because growth in real service sector value added offset the effects of these price increases and also led to increases in comfort. In addition, many firms substituted less expensive electricity for oil for heating purposes.

3. Manufacturing Sector

From the early 1960s to the mid-1970s, strong growth in output, measured as manufacturing sector real value added, led to almost equal growth in energy use. Slight increases in the average intensity of energy use before 1970 also contributed to increase energy use. While sectoral output peaked in 1975, aside from two cyclically-related upturns, it has declined thereafter. However, the modest growth in the output of the energy-intensive industries from the mid-1970s to the early 1980s, and stronger cyclical growth until 1988, led to substantial changes in the composition of the manufacturing sector's output.

In spite of declining output, energy use remained relatively constant (with the exception of a cyclically-related upturn) due to increases in the average intensity of energy use from the mid-1970s to the mid-1980s. From 1988 to 1991, energy use declined. This decline is attributed to decreases in output. The average energy intensity remained fairly constant during this period. While the total manufacturing sector is average intensity of energy use was at its 1970 level in 1990, the energy-intensive industries' average intensity was around 30 percent less. The significant real oil price increases following OPEC I led to short-term reductions in energy use, and more permanent reductions in oil use, as favorable electricity prices promoted the substitution of electricity for oil. The impact of the oil price increases on oil use was reinforced by declining output. Furthermore, regulations governing water deposits and SO_2 emissions also led to reductions in oil use and to increased fuel switching.

4. Transportation Sector

The substantial increases in passenger transportation energy use from the early 1960s to the mid-1980s were sustained by vast increases in automobile ownership and utilization, and by increases in air travel. Increases in automobile ownership, and automobile and air travel were, in turn, bolstered by growth in real disposable income. The substitution of the use of automobiles and airplanes for buses and trains also increased energy use. Since 1987, energy use has remained nearly constant. Growth in disposable income reduced the impacts of the considerable increases in real gasoline prices following OPEC I and OPEC II.

Freight transportation energy use also increased rapidly from the early 1960s to the mid-1980s. From the early 1960s to the mid-1970s, increases in freight ton-kilometers transported supported increases in energy use. The substitution of the use of trucks for ships for freight transport contributed to slightly increase energy use from the mid-1970s to 1979. From 1980 to 1987, the considerable increases in energy use are attributed to increases in freight ton-kilometers transported, and further substitution of the use of trucks for ships. Reductions in the average intensity of freight transportation energy use contributed to decrease energy use from 1987 to 1991. Growth in real gross domestic product dampened the impact of the large increases in real gasoline and diesel prices following OPEC I and OPEC II.

1. Introduction

The purpose of this report is to analyze the evolution of Norwegian energy use from 1950 to 1991. To reveal the causes for this evolution, one must examine the development of the underlying determinants of energy use in each sector. This report describes changes that have shaped the evolution of energy use in the four main sectors of the Norwegian economy. The residential, service, manufacturing, and transportation sectors were chosen because together they have represented more than 90 percent of total delivered energy use, and because it is only for these sectors that sufficient time-series data are available. A forty year time frame makes it possible to analyze the evolution of energy use, and its underlying determinants, in a stable price domain before the large relative price changes following OPEC I (between 1973 and 1974), OPEC II (between 1979 and 1981), and between 1985 and 1986, analyze the short-term impacts of the three large relative price changes, and then evaluate these impacts in a long-term context.

In order to evaluate how energy use will change in the future, it is important to have a clear understanding of the changes that have occurred in the past. In the 1950s, increases in energy use in the manufacturing and transportation sectors sustained the increases in total energy use. The continued increases in these sectors' energy use, as well as strong growth in the other two sectors' energy demand led to large increases in total energy use from 1960 to 1973. The large real oil price increases following OPEC I and OPEC II had little impact on the long-term evolution of energy use, in part, because of the growth in real gross domestic product (and real disposable income). This growth contributed to offset the effects of the price increases in most sectors, and at the same time, it supported increases in comfort and mobility. Many agents (households, firms, and public entities) had the ability to substitute less expensive electricity, and to a lesser extent solid fuels, for oil for space heating and in production processes which further dampened the impact of the price increases. Conversely, this ability also allowed agents to take advantage of lower real oil prices between 1985 and 1986.

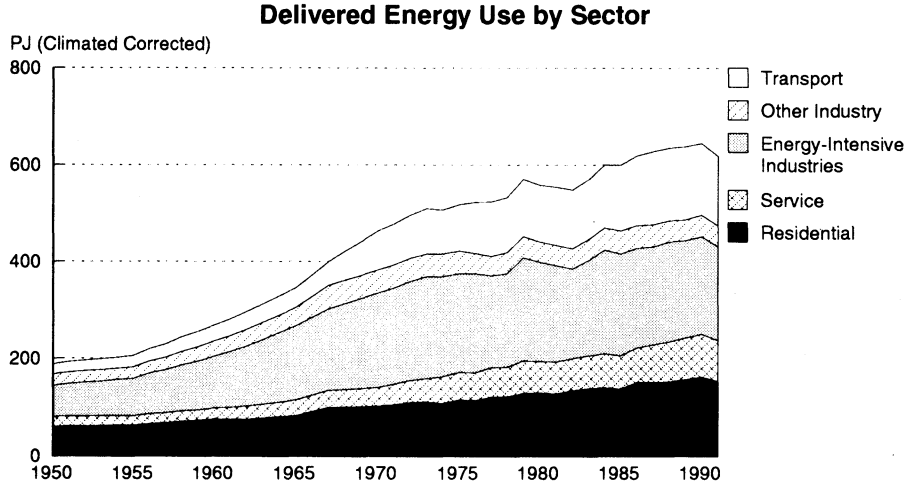
The first section of this report explores the evolution of aggregate energy use. Sectoral analyses are presented in Sections 3 through 6. Appendix A provides tables containing the data used in the graphs presented in this report, and information on these data (i.e, units of measure, assumptions, and sources) are contained in Appendix B.

2. An Overview of Long-Term Energy Use

Climate-corrected delivered energy use in the Norwegian residential, service, manufacturing, and transportation sectors increased from around 190 PJ in 1950 to nearly 620 PJ in 1991. (See Figure 2-1.) In the 1950s, increases in energy demand were supported by growth in energy use in the manufacturing (i.e., energy-intensive and other manufacturing industries) and transportation sectors. From 1960 to 1973, energy use increased at an annual average rate of 5 percent. This increase was bolstered by even stronger growth in energy use in the manufacturing and transportation sectors than in the 1950s, as well as by substantial increases in the other two sectors' energy demand. During the remainder of the 1970s, energy demand continued to increase, albeit at a much slower rate of 2.4 percent per year. While energy use in the residential, transportation, and service sectors continued to grow, energy use in the manufacturing sector declined during this period. After falling slightly from 1979 to 1982, in response to the large energy price increases, energy demand grew until 1990. Energy use in the residential and service sectors increased more rapidly than in the previous period (i.e., from 1973 to 1980), while energy use in the transportation sector increased at a slower rate, primarily because of the decline in the energy used for freight transportation from 1987 to 1990. Aside from a temporary cyclical upturn in energy use in the manufacturing sector in the mid-1980s, demand in this sector continued to fall. From 1990 to 1991, decreases in energy use in each of the sectors led to a nearly 4.2 percent decline in total energy use.

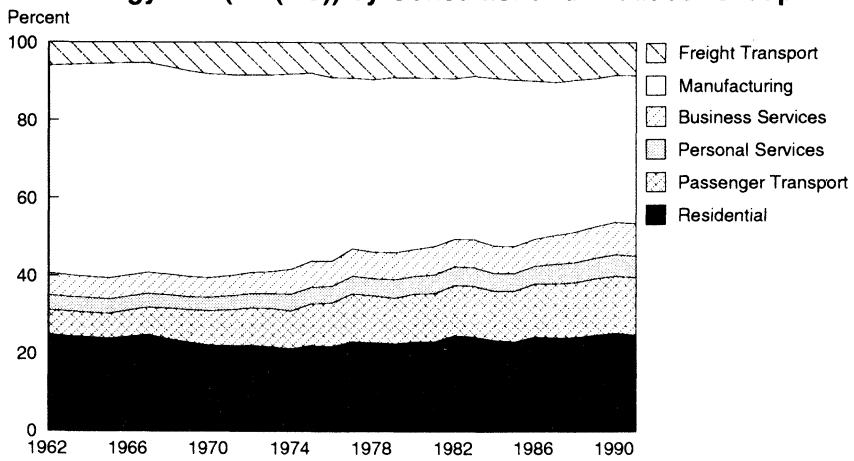
Figure 2-2 illustrates the evolution of the consumer's (i.e., residential, personal services, and passenger transportation) and producer's (i.e., business services, manufacturing,

Figure 2-1
Delivered Energy Use by Sector



The Evolution of Norwegian Energy Use from 1950 to 1991

Figure 2-2
Energy Use (PJ (CC)) by Consumer and Producer Group



freight transportation) shares of delivered energy use from 1962 to 1991. After remaining virtually constant at 35 percent until 1974, the consumer's share of total energy use increased to around 45 percent in 1991. One implication of these increases is that an increasingly larger share of energy-related decisions were being made by a different and larger group of agents.

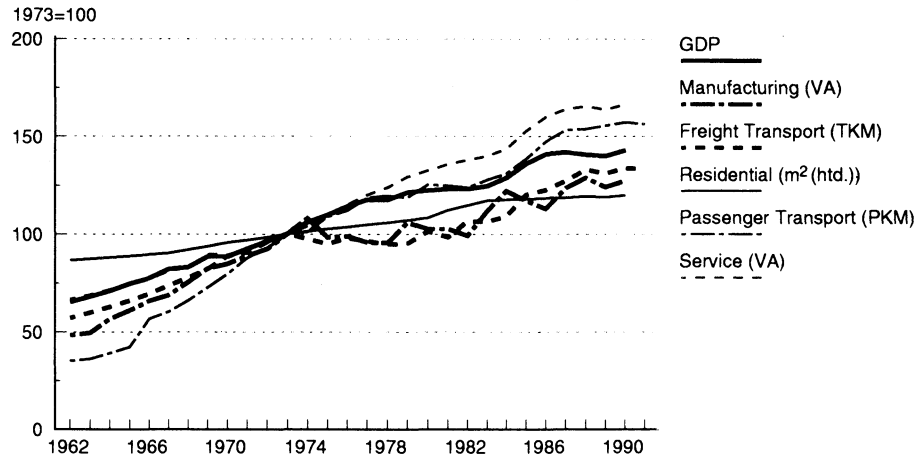
There have also been transformations in the composition of energy use within the consumer and producer groups. In the consumer's group, the share of energy used for passenger transportation increased from 19 to 33 percent from 1962 to 1991, while the share of residential energy use fell from 71 to 55 percent. The share of energy used for personal services increased slightly during this period. In the producer's group, the share of manufacturing energy use fell from 83 percent (65 percent for energy-intensive industries and 18 percent for other industries) to 70 percent (57 percent and 13 percent). The shares of energy used for freight transportation and business services increased from 8 to 15 percent, and 9 to 17 percent, respectively. While most of the growth in freight transportation energy use occurred in the 1960s and 1970s, most of the growth in the energy used for business services transpired in the 1980s.

Figures 2-3 and 2-4 illustrate principal aggregate indicators of activity and energy intensity, indexed to their 1973 values. The heated floor area of the residential dwelling stock grew slower than real gross domestic product (GDP) throughout most of the study period. (See Figure 2-3.) Passenger travel, measured as passenger-kilometers traveled, grew faster than GDP until 1973, followed the growth in GDP until 1985, and then exceeded GDP growth until 1990. Freight activity, measured as freight-ton kilometers traveled, grew faster than GDP until 1973, then slowed until 1981. From the early 1980s to 1990, freight activity tended to follow growth in GDP. Service sector value added followed GDP until 1977, and then tended to exceed GDP growth until 1990. Manufacturing output, measured as real value added, grew more rapidly than GDP until 1975, and then grew slower than GDP until 1978. From 1979 to 1990, the output of this sector was erratic, but it exhibited an upward trend.

As shown in Figure 2-4, the aggregate energy intensity, measured as energy use per unit of real GDP, increased gradually from 1962 to 1967, and then remained fairly stable until it fell by 8 percent between 1973 and 1974. Aside from a slight upturn in 1979, the energy intensity remained relatively constant until 1990. However, as also illustrated in Figure 2-4, the aggregate sectoral intensities have exhibited different trends. The energy intensity of space heating in the residential sector, measured as useful energy per heated m^2, increased from the early 1960s to 1967, and then declined slightly until 1971.[1] From

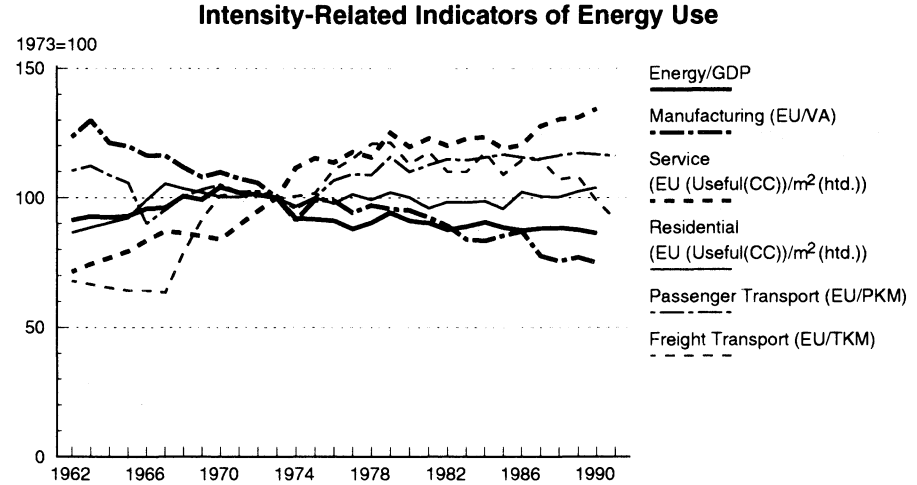
1 Following Schipper, et. al. (1990), it is assumed that heating oil is used at 66 percent system efficiency, solid fuels are used at 55 percent, and electricity and district heat are used at 100 percent.

Figure 2-3
Indicators of Activity



"GDP" refers to gross domestic product, "VA" to real value added, "TKM" to ton-kilometers transported, "m^2 (htd.)" to heated floor area, and "PKM" to passenger-kilometers traveled.

Figure 2-4
Intensity-Related Indicators of Energy Use

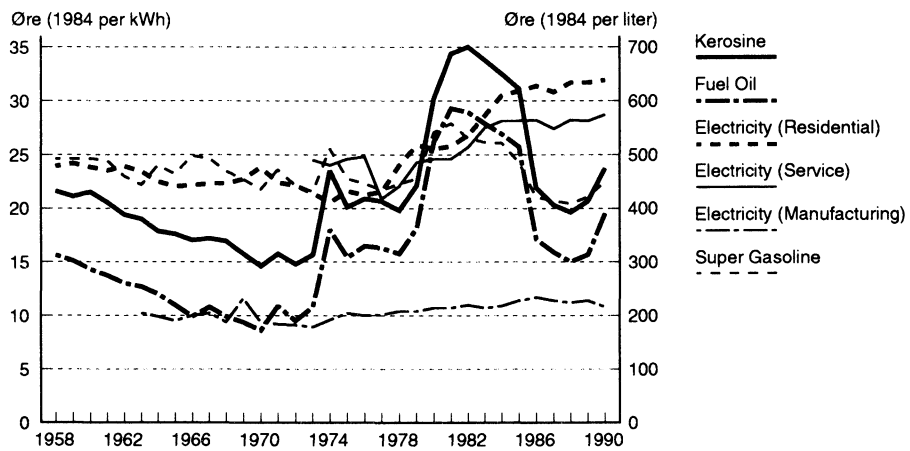


"GDP" refers to gross domestic product, "EU" to energy use, "VA" to real value added, "m^2 (htd.)" to heated floor area, "PKM" to passenger-kilometers traveled, and "TKM" to ton-kilometers transported.

1971 to 1985, the energy intensity of space heating in this sector remained fairly constant, and then increased until 1990. The energy intensity of space heating in the service sector, measured as useful energy per heated m^2, followed the same trend as the residential indicator from 1962 to 1970. However, the intensity of energy use in this sector increased from 1970 to 1990. The most dramatic increase occurred from 1985 to 1990. The energy intensity of passenger transportation, measured as energy use per passenger-kilometer traveled, fell from 1963 to 1966, and then increased until 1970. From 1970 to 1974, this indicator declined, exhibited an upward trend until 1985, and thereafter has remained almost constant. The energy intensity of freight transportation, measured as energy use per ton-kilometer transported, fell slightly from 1962 to 1967, before increasing rapidly until 1970. From 1970 to 1974, this indicator remained fairly constant, and then increased until 1979. From 1979 to 1989, the energy intensity of freight transportation fluctuated, and then fell until 1991. Aside from several small upturns, the intensity of energy use in the manufacturing sector declined from 1963 to 1990.

Figure 2-5 illustrates the changes in selected real energy prices from 1958 to 1990.[2] The large relative price changes following OPEC I, OPEC II, and between 1985 and 1986 did not contribute to any significant, long-term reductions in the sectoral energy intensities, and as a consequence, these relative price changes had only limited, short-term impacts on the growth of both total and sectoral energy use. Therefore, in order to examine the other factors that have had a much more significant effect on the long-term evolution of Norwegian energy use, a sector-by-sector analysis is presented.

Figure 2-5
Selected Real Energy Prices



Real kerosine and fuel oil prices (Øre (1984) per kWh) are for residential customers and include energy and value added taxes (VAT). Real electricity prices (Øre (1984) per kWh) for residential customers and real super gasoline prices (Øre (1984) per liter) include energy taxes and VAT. Real electricity prices (Øre (1984) per kWh) for service and manufacturing sector customers include electricity taxes but exclude VAT.

2 A more detailed presentation of energy prices is presented in the sectoral sections.

3. Residential Sector

3.1 Introduction

Energy use in the residential sector depends on physical and behavioral determinants. Physical determinants include the size and characteristics of the dwelling stock and the energy-using equipment. The characteristics of the dwelling stock that influence energy use consist of the composition (e.g., the percentage of single- and multi-family dwellings), the vintage, and the thermal integrity of the dwellings. The characteristics of the energy-using equipment (i.e., space and water heating equipment, appliances, and lighting) that affect energy use include the types of fuels used for space and water heating, and the efficiencies of the equipment. The behavioral determinants encompass the households' selection and utilization of the physical determinants. The physical and behavioral determinants, in turn, are shaped by the socio-demographic characteristics of households, household income, prices, climate, and the institutional setting. In this section, we examine the changes in these determinants, and how these changes have shaped the evolution of energy use in this sector.

3.2 Physical Determinants

The number of private residential dwellings increased steadily from an estimated 0.92 to 1.76 million from 1950 to 1991. Increases in household disposable income led to increases in the size of homes in spite of decreases in the average family size. The average area per dwelling increased steadily from 75 to 110 m^2 from 1950 to 1990, while the average family size decreased from 3.5 to 2.4 persons.[1] These changes led to a substantial increase in the average area per capita. (See Figure 3-1.)

The increases in the average dwelling size can be partially attributed to changes in the composition of the dwelling stock. Growth in household disposable income allowed households to purchase single-family dwellings which tend to be larger than multi-family dwellings. From 1960 to 1990, the share of detached single-family dwellings increased from one-quarter to one-half of the dwelling stock. The share of farm dwellings decreased from 20 to 9 percent, and the share of attached and semi-attached single-family dwellings declined from 32 to 22 percent. The share of multi-family and combined dwellings remained fairly constant at around 20 percent of the dwelling stock. (See Figure 3-2.) Increases in the share of single-family dwellings supported, in part, increases in energy use per dwelling, not only because these dwellings tend to be larger than multi-family dwellings, but also because they have larger exposed surface areas.

1 See Appendix B, Section 2.A.1.

Figure 3-1
Area per Dwelling and per Capita, Household Size and Real Disposable Income per Household (kr. 1984)

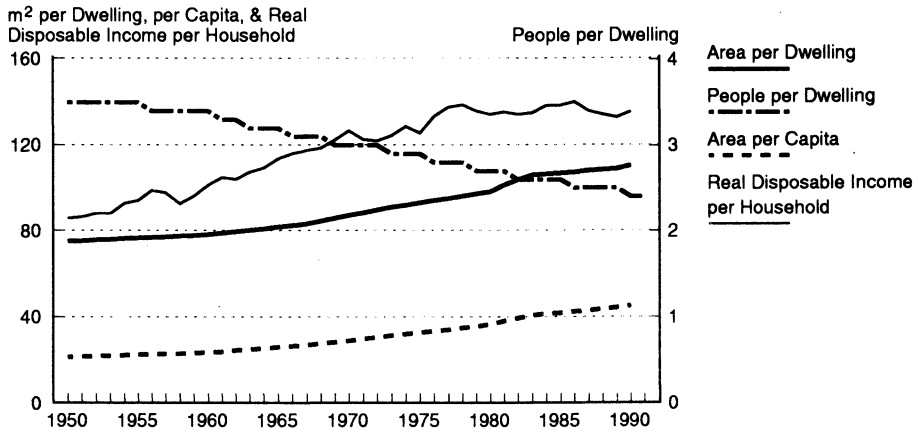
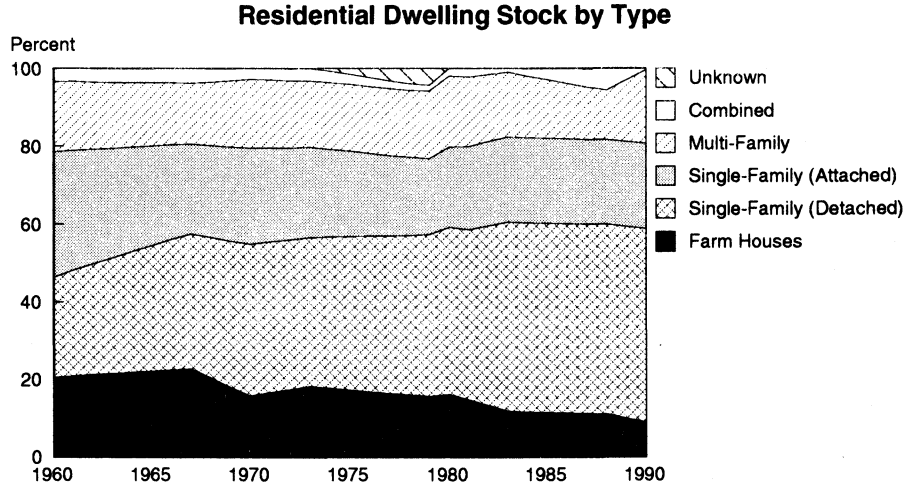


Figure 3-2
Residential Dwelling Stock by Type



3.2.1 The Vintage of the Dwelling Stock

Because of the rapid expansion of the dwelling stock, 76 percent of the dwellings were less than 45 years old, and 38 percent were less than 20 years old in 1990. However, since the early 1970s, the rate at which new dwellings have entered the dwelling stock has declined. The composition of these new dwellings has also changed. From 1986 to 1991, the share of new single-family dwellings entering the dwelling stock in each year declined from 63 to 33 percent, while the shares of semi-attached and attached single-family, and multi-family dwellings increased from 25 to 41 percent, and from 7 to 19 percent, respectively.

3.2.2 Other Characteristics of the Dwelling Stock

In spite of the significant share of "newer" dwellings, only 54 percent of the households surveyed in the Statistisk sentralbyrå's (SSB) residential energy use survey in 1990 reported that their dwellings were fully insulated, 32 percent reported that their dwellings were partially insulated, and 14 percent stated that they had no insulation. (See Figure 3-3.) While nearly all of these households (93 percent) reported that their dwellings had

Figure 3-3
Insulation Levels (1990)

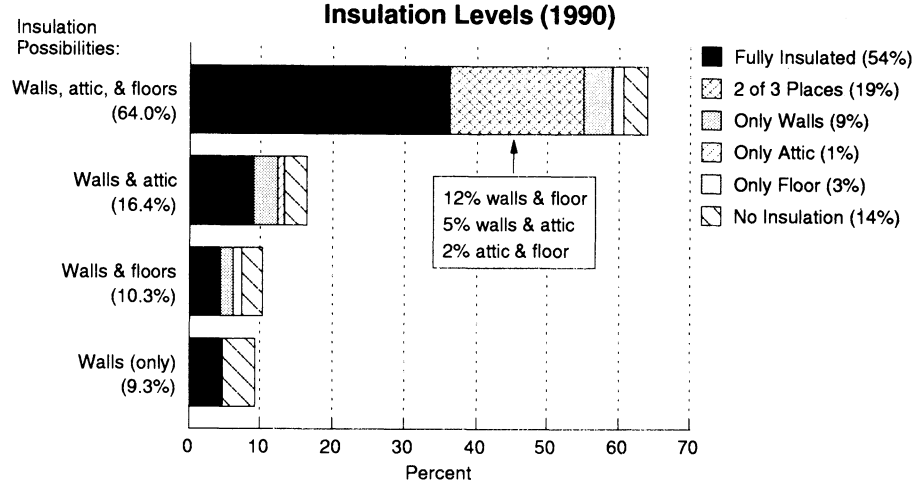
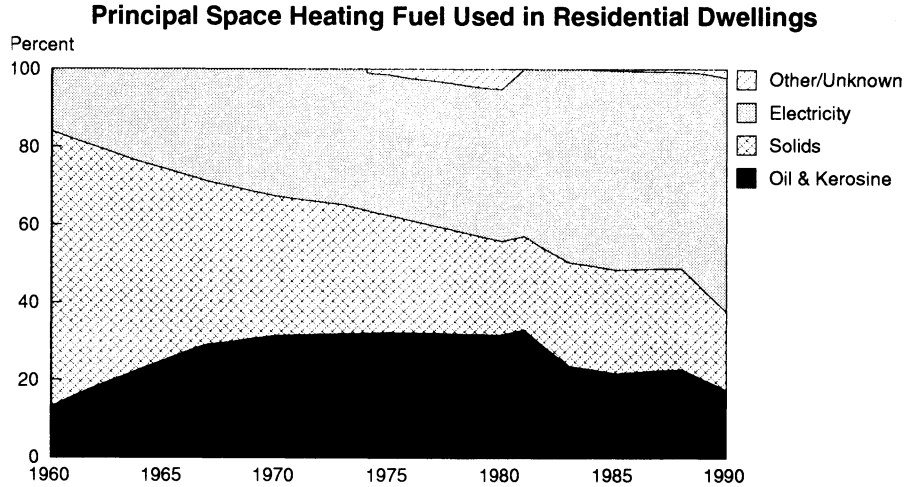


Figure 3-4
Principal Space Heating Fuel Used in Residential Dwellings



double- or triple-pane windows, only around 15 percent of the households had installed weather-stripping in their homes since 1980.

3.2.3 Space Heating Systems

The distribution of principal space heating systems found in dwellings changed significantly from 1960 to 1991.[2] (See Figure 3-4.) From 1960 to the mid-1970s, the share of households using solid fuel-based space heating systems as a principal space heating source declined as households replaced these systems with more convenient oil-based systems and non-central electric space heaters, and as the latter were installed in new dwellings.

From the mid-1970s to 1991, the share of households using electric space heaters increased rapidly due to their lower purchase, installation, and operating costs. In 1990, sixty percent of households surveyed in the SSB's residential energy use survey reported

2 The share of dwellings with a centrally-based space heating system fluctuated between 10 and 12 percent from 1960 to 1991.

using electricity as their principal space heating source, while 20 percent reported using solid fuels, 17 percent reported using oil or kerosine, and approximately 1 percent reported using district heat.[3]

Most households can use a combination of space heating equipment. From 1983 to 1990, the share of households who reported using more than one type of space heating equipment increased from 68 to 80 percent. Around 30 percent of the households surveyed in the SSB's residential energy use surveys (in 1983 and 1990) reported using electricity as supplemental or secondary space heating. In addition, a significant number of households have used wood for this purpose.[4]

3.2.3.1 Thermostats and Night Setback Controls

From 1983 to 1990, the number of households who reported owning a thermostat increased slightly from 47 to 53 percent, but only 7 percent of the households surveyed in 1990 reported owning night setback controls on their thermostats.

3.2.4 Water-Heating Systems and Cooking Equipment

While electric water heaters were installed in 91 percent of the dwellings in 1970, this share had increased to 96 percent by 1990. The share of oil water heaters installed in dwellings declined from 8 percent in 1970 to 3 percent in 1990. It is assumed that 1 percent of the households used district heat to heat hot water.[5]

It is estimated that all households use electricity for cooking purposes. However, according to Schipper, *et. al.* (1990), between 5 to 10 percent of the households may have used wood until 1970, and approximately 1 percent of the households used city gas in the 1960s and early 1970s.

3.2.5 Appliance Ownership

Growth in household disposable income also supported increases in appliance ownership. Appliance ownership, measured as the share of households owning a particular appliance, and as the number of appliances owned by an individual household, increased rapidly from the 1960s to 1991. Table 3-1 illustrates the changes in the ownership of refrigerators, freezers, and refrigerator/freezers ("kombiskap") from 1975 to 1991. While the share of households who owned a separate refrigerator and freezer remained almost constant during this period, the share of households who owned a refrigerator/freezer and an additional freezer increased from 4 to 18 percent, and the share of households owning all three appliances increased from 1 to 6 percent. These increases are significant because refrigerators and freezers account for the largest share of appliance electricity use.

Table 3-1
Refrigerator, Freezer, and Refrigerator/Freezer Ownership
(% of Households)

	1975	1980	1985	1991
Refrigerator (Only)	24	19	18	6
Freezer (Only)	5	5	2	1
Refrigerator/Freezer (Only)	7	10	13	13
Refrigerator & Freezer	54	52	47	52
Refrigerator & Refrigerator/Freezer	1	1	1	1
Freezer & Refrigerator/Freezer	4	7	12	18
Refrigerator, Freezer & Refrigerator/Freezer	1	2	3	6

3 See Appendix B, Section 2.A.5.a.(1).
4 See Appendix B, Section 2.A.5.b.
5 See Appendix B, Section 2.B.

Figure 3-5
Household Appliance Ownership

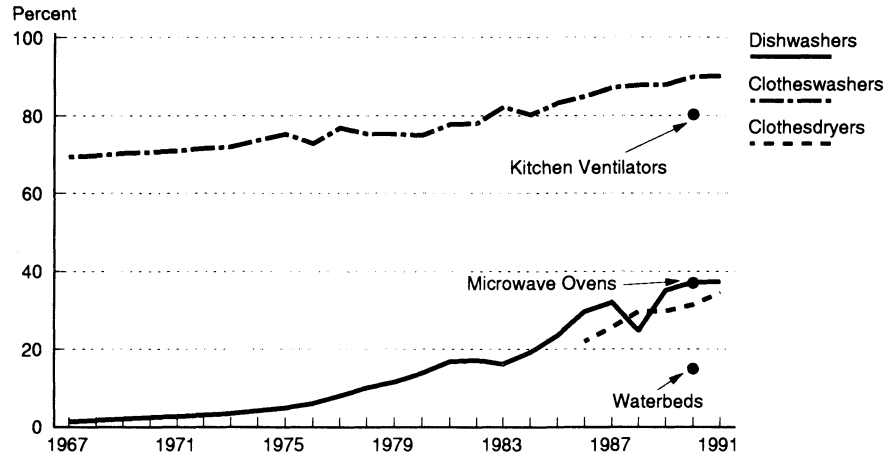
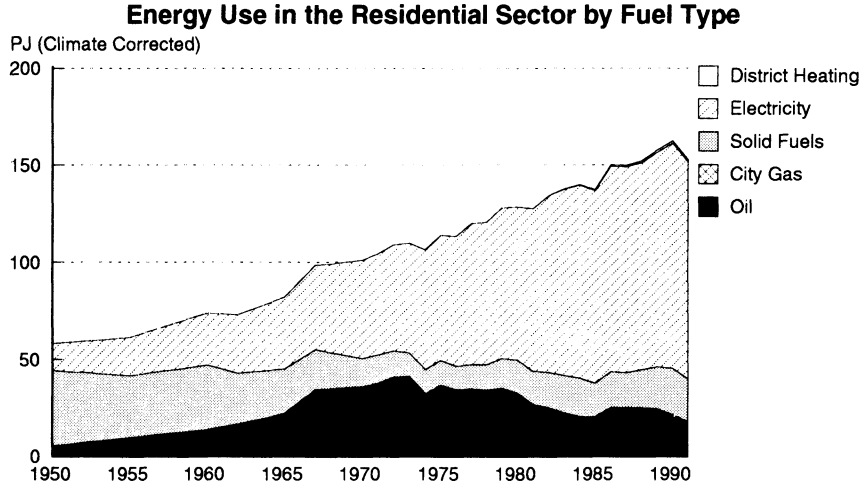


Figure 3-6
Energy Use in the Residential Sector by Fuel Type



The share of households who owned a dishwasher increased from 2 to 37 percent from 1969 to 1991, and the share of households who owned a clothesdryer or drying closet increased from 22 to 34 percent during the same period. (See Figure 3-5.) In 1991, many households owned specialized kitchen equipment such as microwave ovens (increasing from 22 to 39 percent from 1989 to 1991), kitchen ventilators (80 percent), and mix-masters (87 percent). The share of households who owned at least one television increased from 83 percent in 1975 to nearly 100 percent in 1991, and from 1984 to 1991, the share of households who owned video-cassette recorders increased from 8 to 42 percent. In 1990, fifteen percent of the households reported owning a waterbed.

3.3 Energy Use

Residential energy use increased almost continuously from 58 PJ (climate-corrected) in 1950 to 162 PJ in 1990, before decreasing to 153 PJ in 1991. (See Figure 3-6.) From 1950 to 1973, oil and electricity were substituted for solid fuels for space heating purposes. After the large oil price increases in 1973, the share of oil used to meet energy demand declined from 37 to 15 percent in 1985. After 1973, the share of electricity used increased from 52 to 72 percent,

as households substituted away from the use of oil towards the use of electricity for space and water heating purposes, and as more households acquired more electrical appliances.

From 1985 to 1986, oil use increased by 25 percent, however in subsequent years, its use again declined. In 1991, oil use was 18 PJ (or 12 percent of the total demand in this sector). From 1985 to 1991, solid fuels use (99 percent of which was wood use) increased at an annual average rate of almost 5 percent, and surpassed the use of oil in 1990. In 1991, the use of solid fuels was 22 PJ (or 14 percent of total demand). Nearly all of the recent growth in the use of solid fuels (wood use) can be attributed to increases in its use as a supplemental space heating source. The use of electricity increased from 99 PJ in 1985 to 116 PJ in 1990, before declining to 112 PJ in 1991 (or 73 percent of energy use in this sector). Finally, district heat, which was introduced in the early 1980s, increased from 0.2 to 1.2 PJ from 1983 to 1991.

3.3.1 Energy Use by End Use

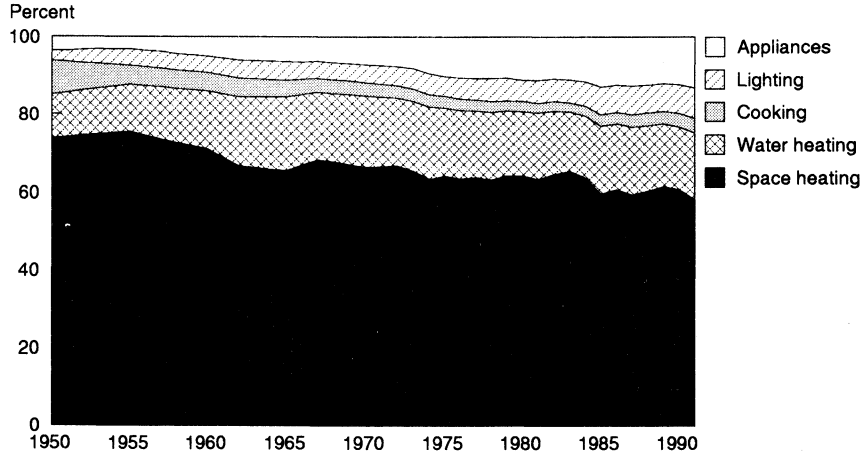
Figure 3-7 illustrates the evolution of the shares of energy use by end use. The share of energy used for space heating purposes declined almost continuously from 74 percent in 1950 to 58 percent in 1991. Similarly, the share of energy used for cooking, decreased from 9 percent in 1950 to 4 percent in 1991. From 1950 to 1970, the decreases in the space heating and cooking shares can be attributed to more rapid growth in the energy used for water heating, lighting, and appliances. However, from 1970 to 1991, the continued decline in the share of energy used for space heating can be attributed to the stronger growth in the energy used for appliances and lighting.

3.4 Intensity of Energy Use

Growth in real disposable income has supported higher levels of comfort in Norwegian dwellings. The intensity of space heating energy use (measured as climate-corrected useful energy per household per m^2) increased by nearly 16 percent from 1950 to 1990. (See Figure 3-8.) Even though increases in the intensity of energy used for space heating were somewhat offset by improvements in the thermal characteristics of the dwelling stock, there is evidence that a significant portion of potential energy savings has been exchanged for greater comfort levels. (Also see section 3.6).

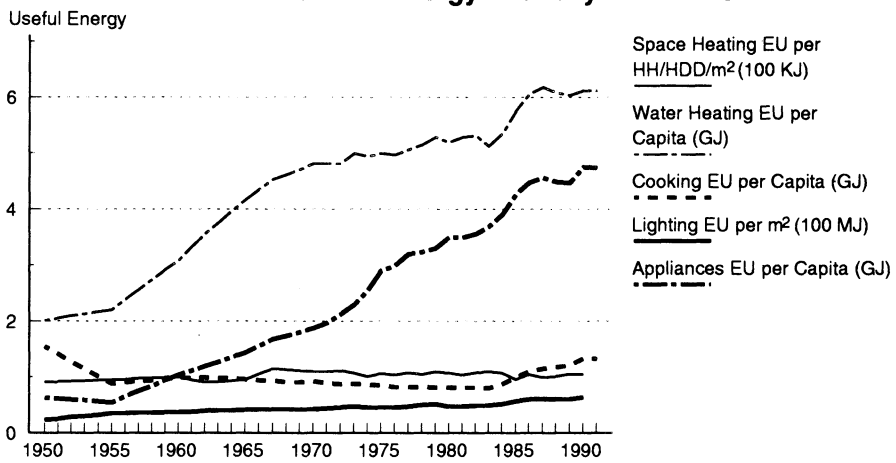
The intensities of energy use for water heating and appliances (measured as useful energy per capita), and lighting (measured as electricity per m^2) increased by 228 percent, 654 percent, and 178 percent, respectively. While the intensity of the energy used for cooking

Figure 3-7
Energy Use (PJ (CC)) in the Residential Sector by End Use



The Evolution of Norwegian Energy Use from 1950 to 1991

Figure 3-8
Residential Sector Energy Intensity Indicators



"EU" refers to energy use, "HH" to household, and "HDD" to heating-degree day.

(measured as useful energy per capita) declined by 48 percent from 1950 to 1983, it increased by 65 percent from 1983 to 1990.

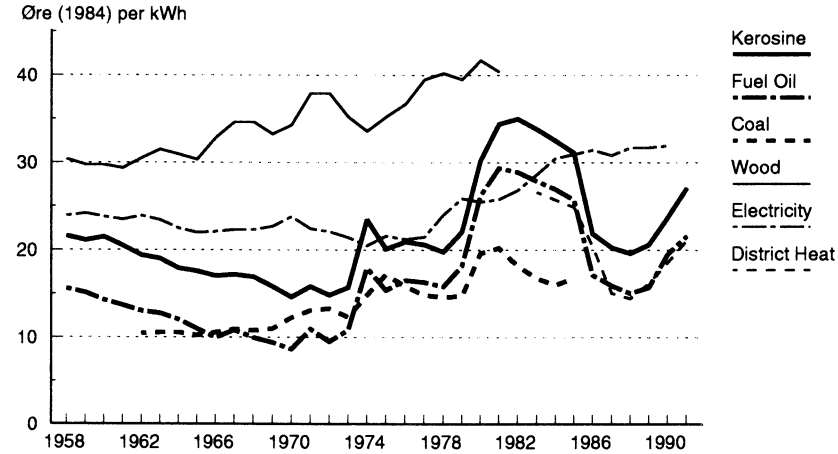
3.5 Energy Prices

Figure 3-9 illustrates changes in real energy prices (in 1984 Øre per kWh) and Figure 3-10 shows changes in relative useful energy prices for residential customers. Between 1973 and 1974, the real price of kerosine increased by 50 percent and the real price of fuel oil increased by 67 percent, while the real price of electricity fell by 4 percent. The large shift in relative prices contributed to a 22 percent reduction in oil use and a 9 percent increase in the use of electricity. Total energy use declined by 3 percent. Increases in real disposable income per household dampened the effect of the large increases in oil prices, and at same time, the increases in disposable income supported increases in appliances ownership and their use. Appliance electricity use increased by 12 percent during this period. Furthermore, many households had the ability to substitute electricity for oil for space heating purposes through the use of supplemental space heaters. While the oil used for space heating purposes decreased by 23 percent, the electricity used for this purpose increased by 17 percent.

From 1978 to 1982, the real price of kerosine increased by 77 percent, and the real price of fuel oil increased by 83 percent. These increases contributed to a 27 percent reduction in oil use. In spite of a 12 percent increase in the real electricity price, its use increased by 23 percent. Total climate-corrected energy use increased by nearly 11 percent. Again, these changes can be attributed to increases in appliance electricity use, and the households' ability to use electricity and wood for supplemental space heating. In addition, many households installed new electric space heating systems. The share of households who reported using these systems as a main space heating system increased from 38 to 46 percent during this period.

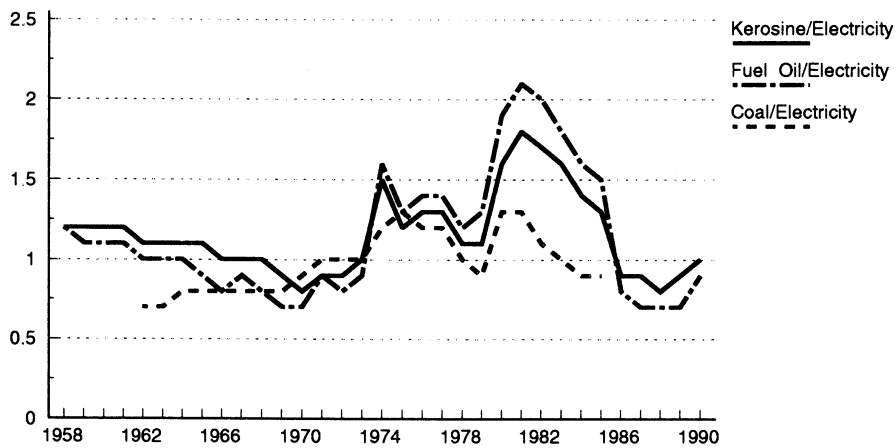
By 1988, real oil prices had returned to their 1978 levels. While oil consumption increased by 25 percent from 1985 to 1986, and then remained constant until 1988, oil consumption was 27 percent lower than in 1978. From 1988 to 1991, real oil prices increased substantially (real kerosine prices rose by 38 percent, and real fuel oil prices increased by 44 percent), while real electricity prices remained fairly constant. During this period oil consumption fell by 40 percent.

Figure 3-9
Real Energy Prices for Residential Customers



Energy prices include energy and value added taxes (VAT).

Figure 3-10
Relative Useful Energy Prices for Residential Customers



3.6 Household Behavior and Energy Conservation

A recent Energidata report states that energy demand in the residential sector could be reduced by nearly 25 percent if all cost-effective structural and technical improvements were undertaken (Energidata (1991)). However, it also states that only 60 to 70 percent of these reductions would be permanent because households "take back" as much as 40 percent of the energy savings by increasing their comfort levels. In 1979 and 1983, households surveyed in the SSB's residential energy use surveys stated, on average, that their desired indoor temperature was 21.5^0 C, although it wasn't ascertained whether this desired temperature was realized. In 1990, households, reported, on average, that the temperature in the living area of their dwelling was 21.5^0 C.

Bartlett (1992) found that households who had undertaken structural energy conservation measures (or lived in dwellings that had been fully insulated, and had double- or triple-pane windows installed) tended to perform behavioral measures (i.e., lowering room temperatures, using less hot water, and turning off lamps) less frequently than the average household. Conversely, households who lived in poorly insulated dwellings tended to perform these behavior measures more frequently. One of the conclusions of this analysis was that traditional barriers to energy conservation (i.e., lack of access to capital and

information, and split-incentive type barriers) may not be able to fully explain many households' reluctance to undertake economically-viable conservation measures, and this reluctance may be attributable to more complex barriers. For example, Wilhite and Ling (1990) reported that households' energy-using behavior is strongly associated with their perceptions of what constitutes a good home environment (i.e, a warm house).

3.7 Changes Relative to 1973

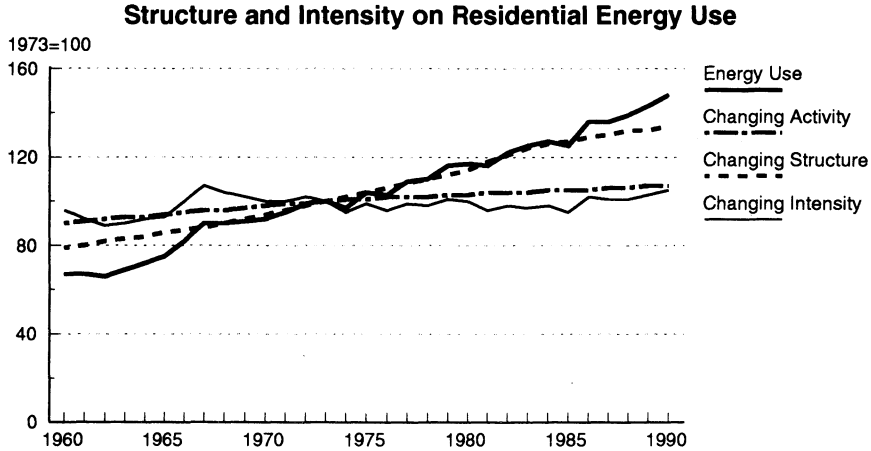
Using a methodology similar to that used in Schipper, *et. al.* (1992), it is possible to isolate the effects of changes in activity, structure, and intensity on residential energy use. First, energy use is decomposed by end use (i.e., space heating, water heating, cooking, lighting, and appliances). Then identities are used to isolate the effects of these changes on energy use in the five end-use groups.[6] Each identity has the following form:

$$\text{Energy Use}_i = (\text{Intensity}_i)\,(\text{Activity}_i)\,(\text{Structure}_i),$$

where i is the i^{th} end use. Intensity is measured as: space heating energy use per heated m^2, the energy used for lighting per m^2; and the energy used for water heating, cooking, and appliances per household. Population is the measure of activity for each end use. Structure is measured as: heated floor area per capita (space heating); floor area per capita (lighting), and the inverse of the number of persons per dwelling (water heating, cooking, and appliances).[7] Total sectoral energy use is the sum of the end-use identities.

Figure 3-11 illustrates the effects of isolating changes in activity, structure, and intensity on energy use relative to 1973. From 1973 to 1990, structural changes (e.g., changes in area per capita, persons per dwelling, and appliances per capita) were the dominate factor contributing to the increases in energy use. From 1973 to 1990, these changes led to a 34 percent increase in energy use. Changes in activity (population growth) increased energy use by 7 percent. Changes in energy intensity, relative to 1973, tended to slightly dampen the effects of the other factors until 1986. (All else being equal, changes in energy intensity would have led to energy use remaining at, or below, its 1973 level until 1986.) However, from 1986 to 1990, increases in the energy intensity (in the non-heating end uses) also contributed to increase energy use.

Figure 3-11
Relative Impacts of Changing Activity, Structure and Intensity on Residential Energy Use



6 The methodology used in this report differs from that used in Schipper, *et.al.* (1992). Schipper, *et.al.* (1992) combined the water heating and cooking end uses, and included lighting with the appliance end use. In addition, the structural component of the appliance end use identity was disaggregated by appliance type (i.e., refrigerators, freezers, refrigerator/freezers, clotheswashers, clothesdryers, diswashers, and lighting).

7 For example, the identity used for space heating is
$\text{Energy Use}_{SH} = (\text{Energy Use}_{SH} / \text{htd. m}^2)\,(\text{Population})\,(\text{htd. m}^2 / \text{Population})$.

3.8 Conclusion

Growth in real household disposable income, especially from the 1950s to the late 1970s, supported increases in the average dwelling area. Demographic changes and increases in disposable income led to a decline in the average number of persons per dwelling from 1950 to 1991. These factors translated into large increases in the average area per capita which contributed to increase energy use. Changes in the composition of the dwelling stock also contributed to increase energy use because, all else being equal, energy use per m^2 is greater in single-family dwellings than in multi-family dwellings. Although the thermal performance of the dwelling stock has improved, much of the improvement has been used to increase comfort levels instead of reducing energy use.

Due to their lower lifecycle costs (i.e., the purchase, operating, and maintenance costs over the lifetime of the equipment), the share of households using electricity as a main (and supplemental) space heating fuel source increased dramatically as electric heaters were installed in both new and existing dwellings. As a consequence, nearly all households also use electricity to heat water, and for cooking. Increases in real disposable income supported increases in appliance ownership, measured both as the share of households owning a particular appliance, and as the number of appliances owned by an individual household. Increases in real disposable income per household also contributed to increases in the intensity of energy use, especially in the intensity of energy used for water heating, lighting, and appliances.

The shifts in relative prices following OPEC I and OPEC II, and between 1985 and 1986 had virtually no impact on the growth total energy use in this sector. Increases in real disposable income per household offset, in part, the effects of the first two large price increases. The effects of these shifts were also offset by the ability of many households to alter their space heating fuel choice through the use of supplemental electric space heaters and wood stoves, and through the choice of electricity as a main space heating fuel source. Conversely, this flexibility also allowed many households to take advantage of lower oil prices in mid-1980s.

4. Service Sector

4.1 Introduction

The service sector is comprised of private and public entities that produce heterogenous goods and services. Energy use in this sector is determined by total activity (measured as service sector value added), the size and physical characteristics of the building stock (e.g., the heated floor area, vintage, and thermal integrity of the buildings), the composition of the sector (i.e., the relative shares of service sector value added or floor area by entity type), the types of energy-using equipment installed in buildings, the building owner's and occupant's selection of equipment, and the occupant's utilization of the installed equipment. Energy use is also determined by the climate, prices, and the institutional setting.[1] In this section, we will examine how some of these factors have shaped the long-term evolution of energy use in this sector.[2]

4.2 Service Sector Value Added[3]

Service sector value added is an economic indicator of sectoral activity. Real value added increased at an average annual rate of 3.3 percent from nearly 94 to almost 235 billion 1984 kroner from 1962 to 1990. From the early 1960s to 1974, real service sector value added grew at the same pace as real gross domestic product (GDP) and the sector's share of GDP remained fairly constant at around 50 percent. By 1990, this share had increased to 58 percent.

Figure 4-1 illustrates the shares of real service sector value added by building group. Most shares remained fairly constant from 1962 to 1990, with the exceptions of the hotel and restaurant group's share, which decreased from 6 to 2 percent, and the health and social services group's share, which increased from 7 to 14 percent.

4.3 Service Sector Floor Area

Growth in this sector's value added led to an expansion of floor area. From 1950 to 1991, the estimated total heated floor area increased at an average annual growth rate of 2.4 percent from approximately 24.9 to nearly 66.4 million m^2.[4] From 1985 to 1991, the heated floor area grew at a larger average annual rate of around 2.8 percent. In 1991, there was

1 Many studies have also used the number of employees per m^2 as an indicator of energy use in this sector. This indicator is not examined in this study.
2 Data limitations preclude an analysis of the thermal integrity of the building stock, the types of energy-using equipment found in the building stock (aside from space-heating equipment), the building owner's and/or occupant's selection of energy-using equipment, and the institutional setting.
3 See Appendix B, Section 3.B.1.
4 See Appendix B, Section 3.C.

Figure 4-1
Real Service Sector Value Added (kr. 1984) by Building Group

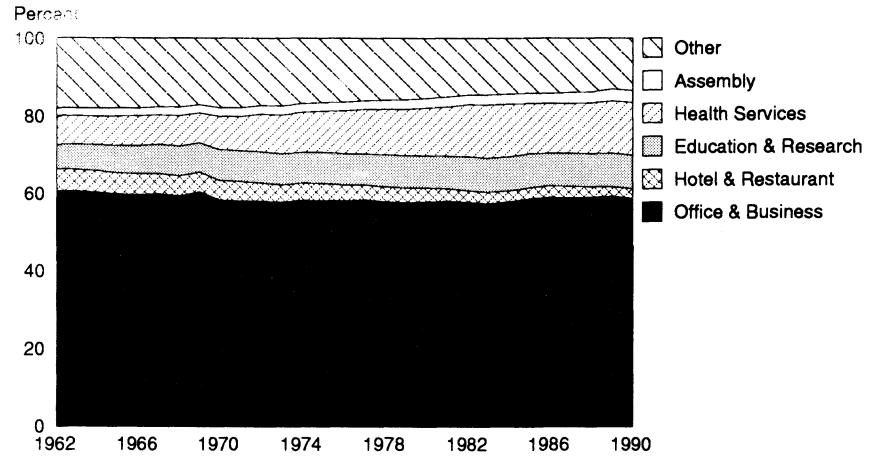
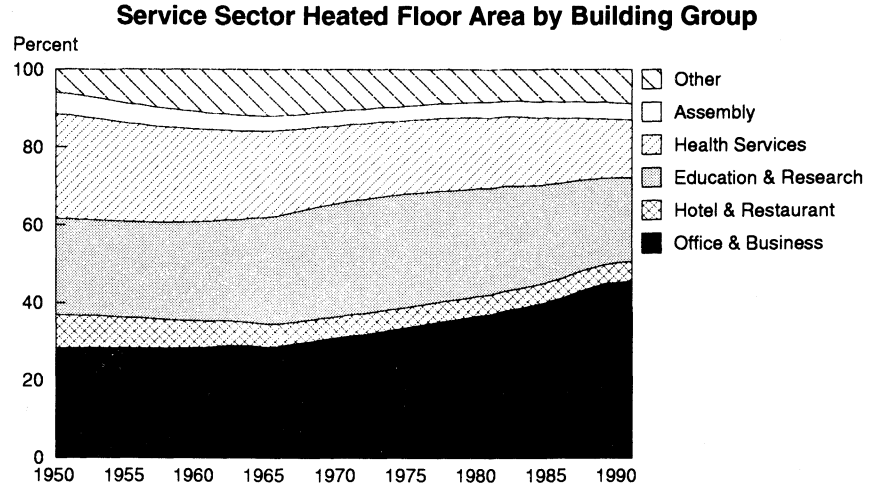


Figure 4-2
Service Sector Heated Floor Area by Building Group



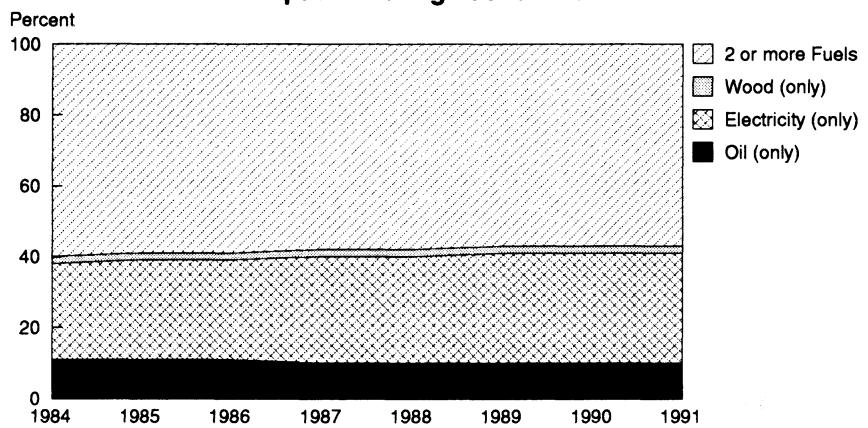
roughly 15.6 heated m^2 per capita (or 18.9 m^2 of total service sector utility floor area per capita).

The composition of the heated floor area is an important indicator of energy use because energy use per m^2 can vary significantly among buildings used for different purposes. From 1950 to 1991, the share of heated floor space of the office and business building group increased from 28 to 46 percent of the total service sector heated floor. (See Figure 4-2.) Nearly all of this growth occurred after 1970. The shares of the total heated floor area of the other groups declined (health and social services, and educational and research building groups) or remained almost constant (hotel and restaurant, and assembly building groups).

4.3.3 The Vintage of the Building Stock

The vintage of the building stock is an indicator of energy use because it is generally assumed that the energy used per m^2 in new buildings is less than in old ones. The majority of the heated floor area, around 57 percent, was completed after 1950, and nearly 20 percent of the area was completed after 1984.

Figure 4-3
Service Sector Heated Floor Area by Installed Space Heating Fuel Source



4.4 Space Heating Systems

The choice of a heating system or systems (including fuel choice) is an important indicator of energy use, especially in Norway, given the significance of the space-heating load. While the choice of more than one system generally requires larger investment costs than a single system using only one fuel, multi-fuelled systems permit the user to alter their space heating fuel mix (generally within a limited range), and thus reduce operating costs in the presence of shifting relative prices. In 1991, nearly 60 percent of the heated floor area could be heated by more than one energy source. (See Figure 4-3.) The share of area that could be heated by only electricity increased from around 27 to 31 percent from 1984 to 1991. This finding can be mainly attributed to the introduction of new buildings installed with systems using only electricity. From 1984 to 1991, 46 percent of the heated floor area in new buildings (i.e., those built after 1984) was only electrically heated, while just 5 percent was heated with oil alone.

4.5 Energy Use

Climate-corrected delivered energy use in the service sector grew at an annual rate of 3.5 percent from 1950 to 1991. (See Figure 4-4.) Energy use remained fairly constant in the 1950s at around 20 PJ, and then increased rapidly in the 1960s and 1970s, before levelling off in the early 1980s. From 1985 to 1991, energy use grew at an annual rate of 3.7 percent, and reached 85 PJ in 1991.

As illustrated in Figure 4-5, the shares of energy use by building type remained fairly constant from 1976 to 1991.

4.5.1 Energy Use by Fuel Type

The types of fuels used to meet energy demand in the service sector have changed dramatically since 1950. While solid fuels represented nearly 50 percent of energy use in 1950, their use was curtailed by the mid-1970s. Oil use, which peaked in 1970 at 22 PJ (or 57 percent of climate-corrected delivered energy use), declined almost continuously until 1991. In 1991, oil use represented only 13 percent of energy use in this sector. The use of electricity increased continuously from 5 PJ (or 22 percent of climate-corrected delivered energy use) in 1950 to 73 PJ (or 86 percent of climate-corrected delivered energy use) in 1990, and then declined slightly in 1991. District heating, which was introduced into the service sector in the early 1980s, increased from less than 1 PJ in 1983 to 1.6 PJ in 1991.

Figure 4-4
Energy Use in the Service Sector by Fuel Type

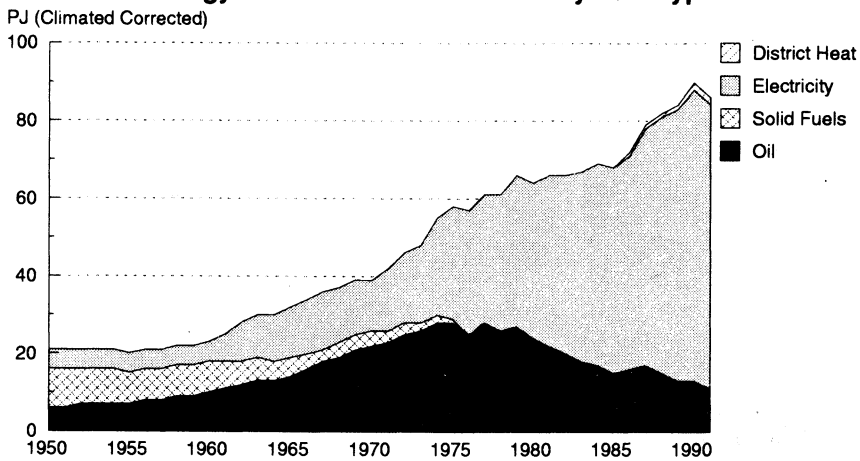
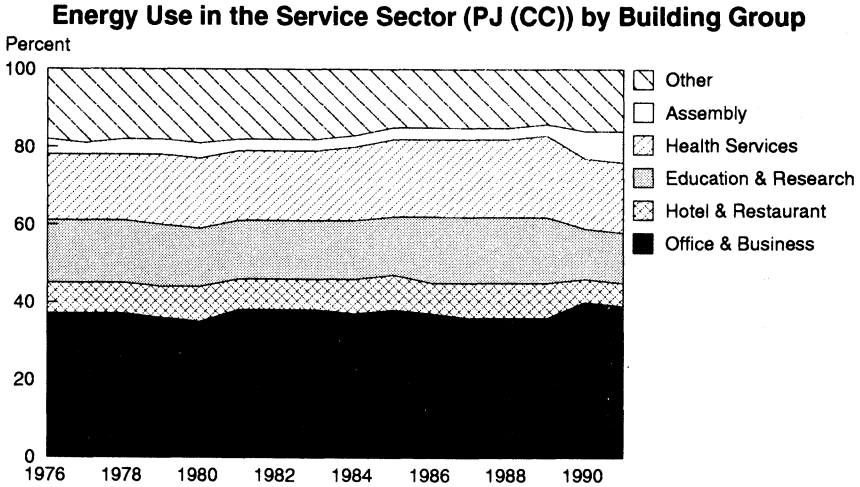


Figure 4-5
Energy Use in the Service Sector (PJ (CC)) by Building Group



Excludes district heating.

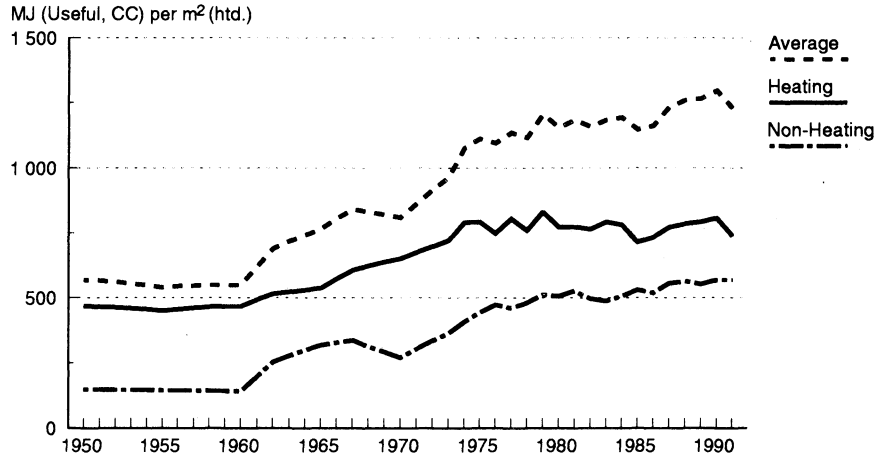
4.5.2 Energy Use by End Use

There is little information on energy consumption by end use in this sector. If one accepts the assumptions made about the end-use shares in Schipper, *et. al.* (1990), and further assume these assumptions are appropriate over time, then in 1991, the energy used for space heating represented around 49 percent of total energy use in this sector, water heating represented 6 percent, and miscellaneous uses of electricity (cooking, lighting, ventilation systems, and office equipment) accounted for 45 percent. However, Selskapet for Lyskultur reported that the electricity used for lighting in this sector was approximately 10 TWh (36 PJ) or 42 percent of total energy use in 1989 (Selskapet for Lyskultur 1992). Therefore, the share of energy used for miscellaneous uses of electricity should, in all likelihood, be somewhat higher, while the share of energy used for space heating should be smaller.

4.5.3 The Intensity of Energy Use

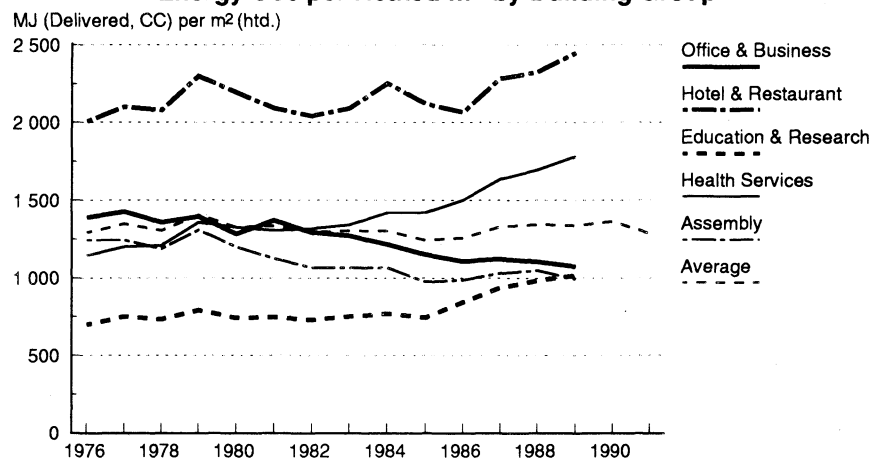
Figure 4-6 illustrates changes in the intensity of energy use (measured in useful energy per heated m^2) from 1950 to 1991. After remaining fairly constant from 1950 to 1960, the

Figure 4-6
Service Sector Energy Intensities



Heating includes water heating.

Figure 4-7
Energy Use per Heated m² by Building Group



District heating is included in the average intensity, but excluded from the building group intensities.

intensity increased rapidly through the mid-1970s. This growth occurred because of increases in the intensity of energy used for space heating and non-heating purposes, both of which were supported by growth in service sector value added. After gradual growth in the late 1970s and early 1980s, increases primarily in the intensity of energy used for non-heating purposes, led to a 12 percent increase in the average energy intensity from 1982 to 1990. While increases in the acquisition and utilization of energy-using equipment led to increases in the average intensity of energy used for non-heating purposes, increases in the utilization of equipment also generated waste heat. The increases in waste heat, and the introduction of new buildings with higher thermal performance standards, led to a levelling of the average intensity of energy used for heating purposes. As a consequence of these changes, in 1990, the difference between the intensity of energy used for heating and non-heating purposes was 25 percent less than in 1950.

The intensity of energy use is heavily dependent on building type because of the variations in the tasks performed in these buildings. (See Figure 4-7.) For example, the average energy intensity in the hotel and restaurant group was between 2.4 and 2.8 times greater than that of the education and research group. From 1976 to 1982, the average

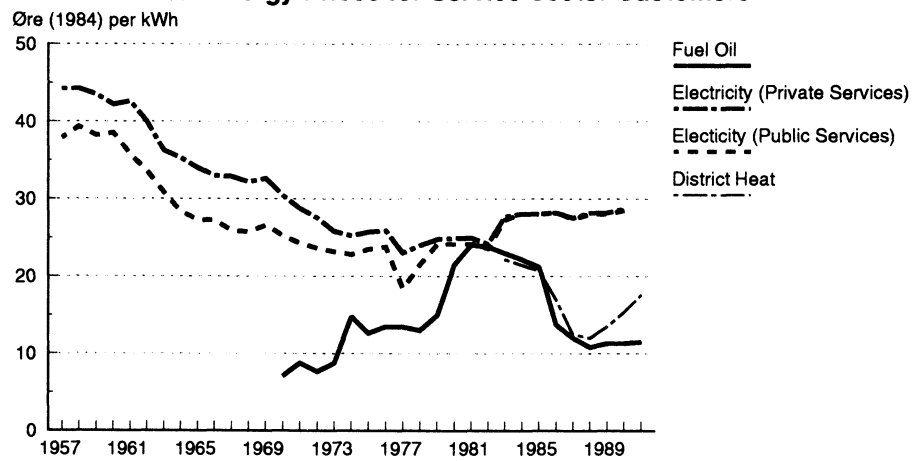
intensities in each of the building groups followed the same trend. However, after 1982, the increases in the average intensities in the education and research, health services, and hotel and restaurant building groups were large enough to offset the improvements in the average energy intensity of the office and business building group (even as this group's share of total service sector floor area was increasing).

4.6 Energy Prices

The 68 percent increase in the real fuel oil price between 1973 and 1974 did not lead to a reduction in oil use because the effect of the price increase was offset by the growth in service sector value added. (See Figures 4-8 and 4-9.) This growth supported a nearly 10 percent increase in the intensity of energy used for heating purposes between these years.

Between 1979 and 1981, oil prices increased by 60 percent. This contributed to a 19 percent reduction in oil use. However, because of the continued growth in service sector value added, a lack of corresponding increases in electricity prices, and because many firms had the ability to substitute electricity for oil, total energy use remained constant. During

Figure 4-8
Real Energy Prices for Service Sector Customers



Energy prices include energy taxes, but exclude value added taxes (VAT).

Figure 4-9
Relative Useful Energy Prices for Service Sector Customers

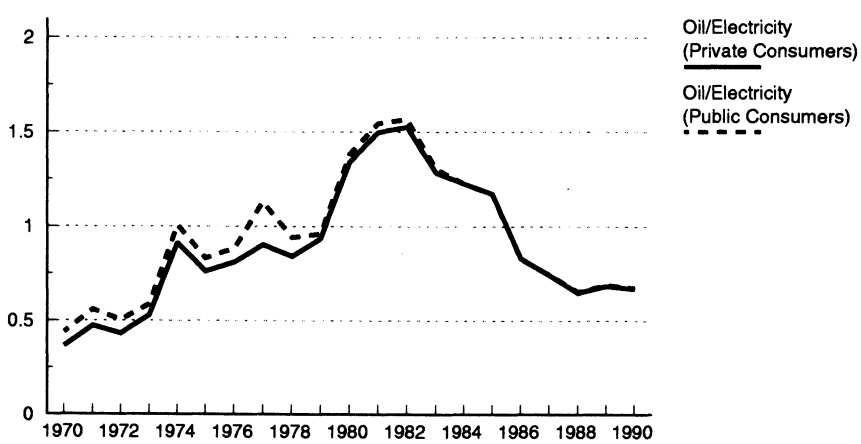
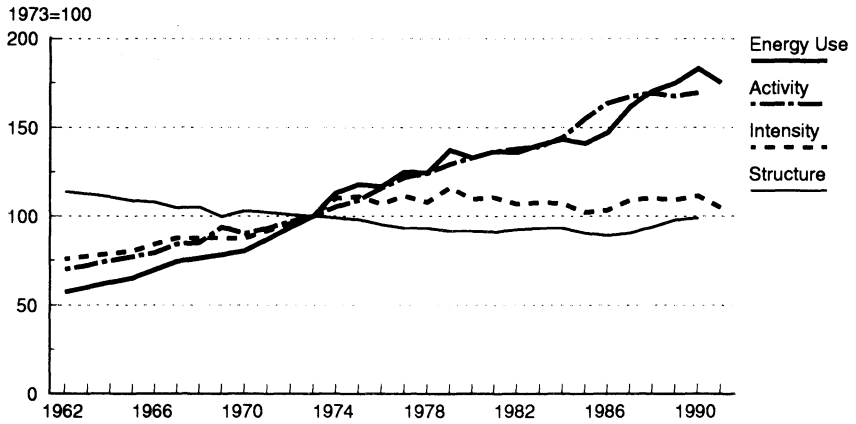


Figure 4-10
Relative Impacts of Changing Activity, Intensity, and Structure on Service Sector Energy Use



this period there were only slight reductions in the intensity of energy used for heating purposes. Although real oil prices declined by 55 percent from 1981 to 1988, with the exception of a small upturn in oil use between 1986 and 1987, its use has not increased.

4.7 Changes Relative to 1973

Using the methodology described in Schipper, *et. al.* (1992), it is possible to isolate the effects of changes in activity, intensity, and structure on energy use in the service sector. To isolate these changes, the following identity is used:

$$E = (E/Q)\ (Q/V)\ (V),$$

where E is total energy use in the service sector, Q is the floor area, and V is service sector value added. The first term is the measure of intensity, the second is structure, and the third is activity.

Figure 4-10 shows the effects of isolating changes in activity, intensity, and structure on energy use relative to 1973. Changes in sectoral activity (value added) led to a 70 percent increase in energy use from 1973 to 1990. Changes in energy intensity also contributed to an 11 percent increase in energy use over this period. Structural changes, that is changes in the floor area per kroner of value added, has tended to slightly dampen the increases in the two other factors because value added has grown more rapidly than floor area. However, from 1987 to 1990, floor area grew more rapidly than value added, and as a consequence, structure changes accounted for a 1 percent decrease in energy use from 1973 to 1990.

4.8 Conclusion

After remaining relatively constant from 1950 to 1960, energy use grew rapidly from 1960 to 1975. This evolution was supported by the growth in real value added, which in turn, led to an expansion of the floor area. The growth in real value added also led to increases in the intensities of energy use for heating and non-heating purposes which also boosted energy use.

While service sector value added and floor area continued to increase from the mid-1970s to the mid-1980s, the average intensity of energy use in this sector did not rise as rapidly as in the previous period. As a consequence, energy use increased at a slower rate. Although real service sector value added levelled off from 1985 to 1990, the continued expansion of the floor area and increases in the intensity of energy used for non-heating purposes led to a 37 percent increase in energy use.

The large real oil price increases between 1973 and 1974, and between 1979 and 1981, had little impact on total energy use in this sector because of the growth in real value added, and because many firms had the ability to substitute electricity for oil for heating purposes. Increases in the share of the electrically heated floor area and the use of electricity for non-heating purposes have supported the growth in electricity demand. In spite of favorable fuel oil prices since 1982, there has been an almost continuous decline in the use of this fuel.

5. Manufacturing Sector

5.1 Introduction

Energy use in the manufacturing sector is dependent on the level of output produced (measured as valued added, gross output, or physical production), and the intensity of energy used to produce this output. This sector is comprised of a collection of industries engaged in the production of diverse commodities, and as a consequence, there can be large differences in the energy intensities among industries. Over time, the level of energy demand may change because of transformations in the composition or structure of this sector. In this section, we describe the changes in, and the relationships among, these determinants.

5.2 Output

5.2.1 Manufacturing Value Added

From 1962 to 1975, manufacturing output, measured as real value added, grew rapidly at an annual average rate of nearly 4.7 percent. At its peak in 1975, output was 80.8 billion 1984 kroner, and represented 26 percent of Norway's gross domestic product (GDP). Aside from two cyclical upturns, in 1979 and between 1985 and 1987, real manufacturing value added declined to 64.3 billion 1984 kroner, and this sector's share of total GDP reached a low of 16 percent in 1990.

The growth of energy-intensive industries' output exceeded sectoral growth throughout the study period. (See Figure 5-1.) In 1962, the output of energy-intensive industries represented 16 percent of manufacturing value added. (Non-ferrous metals represented 4 percent, followed by stone, clay, and glass (4 percent), paper and pulp (4 percent), iron, steel, and ferro-alloys (3 percent), and industrial chemicals (1 percent).) Between 1962 and 1974, the output of the energy-intensive industries increased at an annual average rate of 7 percent, from almost 7.1 to 15.9 billion 1984 kroner. During this period, output grew rapidly in the non-ferrous metals (with annual growth of 9.5 percent) and industrial chemicals (8.2 percent) industry groups.

With the exception of a large cyclical upturn in 1979, there was only a small increase in the output of the energy-intensive industries from 1975 to 1982. This modest growth was due to continued growth in the industrial chemicals and non-ferrous metals industry groups.

Between 1983 and 1990, the output of these industries increased (albeit cyclically) by nearly 14 percent to 18.7 billion 1984 kroner. This growth was supported by further increases in the output of the industrial chemicals, paper and pulp, and to a lesser extent, non-ferrous metal industries. Due to the continued growth in the output of the energy-intensive industries, especially in the 1980s, this output represented 29 percent of manufac-

Figure 5-1
Output of Energy-Intensive Industries
(% of Manufacturing Sector Real Value Added (kr. 1984))

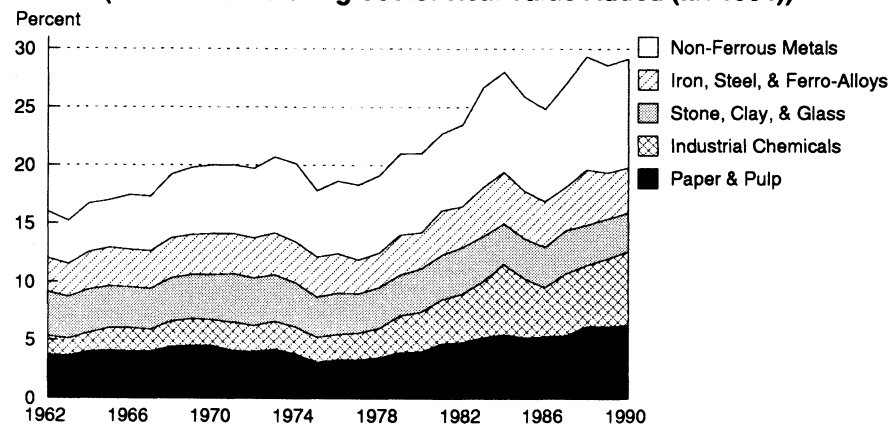
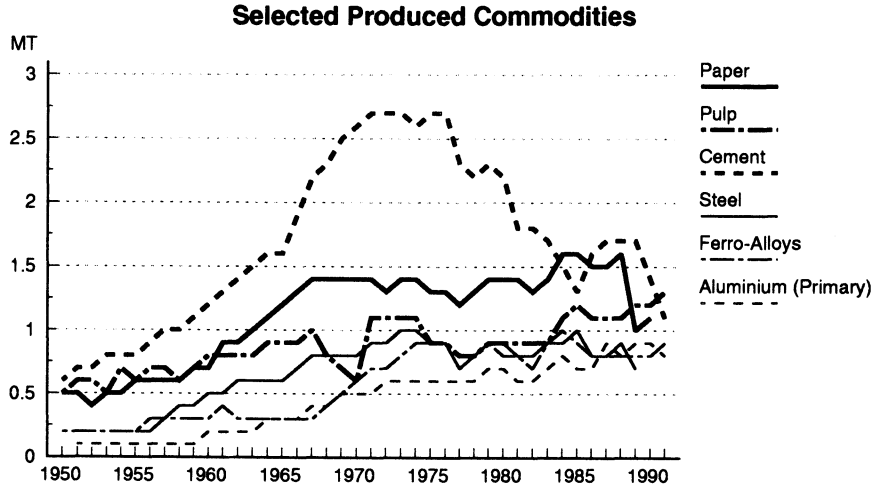


Figure 5-2
Selected Produced Commodities



turing value added in 1990.[1] (Non-ferrous metals accounted for around 9.5 percent, followed by paper and pulp (6.5 percent), industrial chemicals (6 percent), iron, steel, and ferro-alloys (4 percent), and stone, clay, and glass (3 percent).)

5.2.2 Physical Production

Changes in the output of the energy-intensive industries reflect changes in physical production, as illustrated in Figure 5-2. Production grew rapidly from the 1950s to the mid-1970s, remained fairly constant during the remainder of the 1970s (with the exception of the production of cement), and then increased slightly in the early 1980s. From 1987 to 1991, the production of these commodities declined or remained constant, except for a small increase in the production of pulp. In 1991, the production of these commodities (with the exceptions of pulp and aluminum) were below their 1974 levels.

1 While the output of the energy-intensive industries increased throughout the study period, the number of firms decreased. From 1970 to 1990, the number of firms declined by 1.2 percent annually. The most noticeable declines were in the number firms producing paper and pulp (3.4 percent per year), and metals (2.5 percent per year).

5.3 Energy Use

Energy use and output in the manufacturing sector have followed a similar trend, that is, most of the growth occurred before 1973. (See Figure 5-3.) From 1950 to 1973, energy use increased at an annual average rate of 4.7 percent (almost the same rate as manufacturing value added), increasing from approximately 89 to 257 PJ (excluding feedstocks). From 1973 to 1983, energy use fluctuated between 230 PJ (1977) and 257 PJ (1979). After its peak in 1984 at 259 PJ, energy use decreased to 236 PJ in 1991. In 1991, energy use in this sector was 8 percent lower than it was in 1973.

Energy use in energy-intensive industries has followed approximately the same trend as aggregate energy use in the manufacturing sector. From 1950 to 1960, energy use in energy-intensive industries grew faster than sectoral energy use, increasing from 65 to 107 PJ. The energy-intensive industries' share of total manufacturing energy use increased from 73 to 78 percent. Energy use increased rapidly in each of the energy-intensive industry groups. The annual average growth rates during this period ranged from 4.4 percent in paper and pulp, and iron, steel, and ferro-alloys industries to 7.3 percent in non-ferrous metal industries.

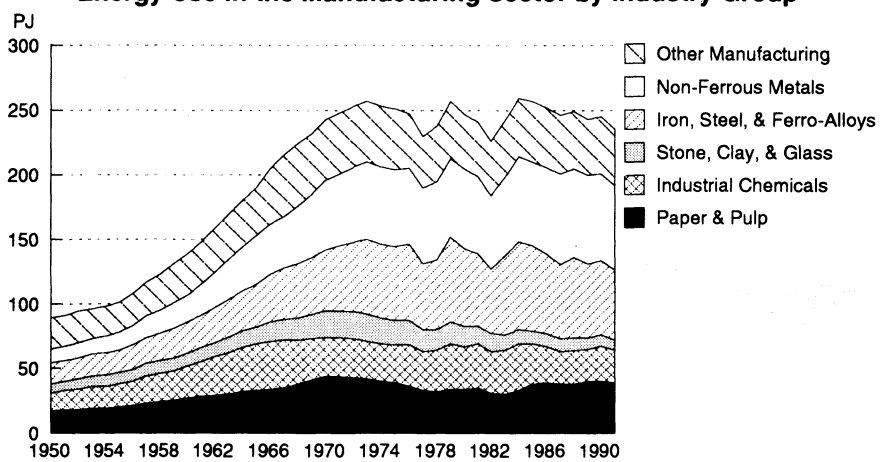
From 1960 to 1973, energy use in energy-intensive industries grew slightly faster than energy use in manufacturing sector. Energy use in non-ferrous metal industries continued to increase at an annual rate of 8.4 percent. Energy use in the iron, steel, and ferro-alloys, stone, clay, and glass, and paper and pulp industry groups also increased fairly rapidly (at growth rates of 5.4, 5.4, and 3.5 percent per year, respectively). After strong growth from 1950 to 1960, energy use in industrial chemical industries grew at a slower annual rate of 1.4 percent. By 1973, energy-intensive industries' share of manufacturing energy use had increased to 82 percent.

With the exceptions of an almost 8 percent cyclically-related drop in energy use in energy-intensive industries from 1976 to 1977, and a 10 percent increase from 1979 to 1980, energy use remained relatively stable from 1973 to 1980. During this period, slower growth in energy use in the metal and industrial chemical industry groups was offset by declining use in the other energy-intensive industry groups.

Energy use in energy-intensive industries also peaked in 1984 at 214 PJ, and then declined to 193 PJ in 1991. The paper and pulp and non-ferrous metals industry groups were the only groups that experienced any growth in energy use from 1985 to 1991 (0.7 and 0.3 percent per year). In 1991, energy use in energy-intensive industries was also around 9 percent lower than in 1973, and it represented 82 percent of manufacturing energy use.

As a consequence of the differing energy-use growth patterns, the composition of the energy-intensive industries, in terms of energy use, has shifted over the study period. In

Figure 5-3
Energy Use in the Manufacturing Sector by Industry Group



Excludes district heating and feedstocks.

1950, the energy-intensive industry groups ranked by energy use were: Paper and pulp (17 PJ or 27 percent of the energy-intensive-industries group's energy use), iron, steel, and ferro-alloys (16 PJ or 24 percent), industrial chemicals (14 PJ or 23 percent), non-ferrous metals (11 PJ or 16 percent), and stone, clay, and glass (7 PJ or 10 percent). By 1991, the groups were ranked as: Non-ferrous metals (66 PJ or 34 percent), iron, steel, and ferro-alloys (54 PJ or 28 percent), paper and pulp (39 PJ or 21 percent), industrial chemicals (25 PJ or 13 percent), and stone, clay, and glass (8 PJ or 4 percent). Nearly all of these shifts occurred fairly evenly over the study period.

5.3.2 Energy Use by Fuel Type

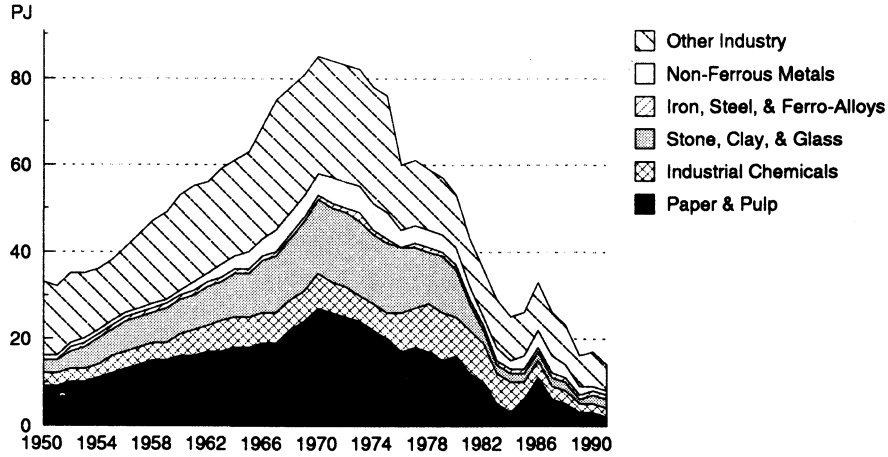
The types of energy used in the manufacturing sector have changed significantly over the study period, as shown in Figures 5-4 through 5-6. These figures also illustrate the industry groups' abilities to alter their fuel mixes in response to changing energy prices.

5.3.2.1 Oil Use

Oil use increased rapidly from 32 PJ in 1950 to its peak of 85 PJ in 1970. (See Figure 5-4.) However, the share of total energy demand met by oil use remained almost constant at around 35 percent. In 1950, slightly more than one-half of the oil used was in non-energy-intensive industries, but by 1970 this share had dropped to 32 percent. During the same period, the share of oil used in the paper and pulp, and stone, clay, and glass industry groups increased from 28 to 32 percent, and 8 to 20 percent, respectively.

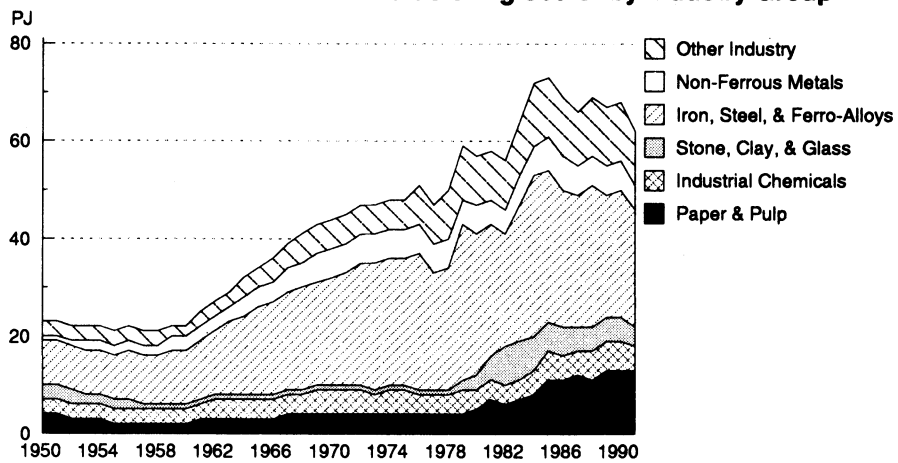
From 1970 to 1991, oil use decreased sharply, although there was a small upturn in its use between 1984 and 1986. Oil continued to be used predominately in paper and pulp industries and non-energy-intensive industries; however, the share of energy demand met by oil in these industries decreased significantly. (In 1975, oil represented 53 and 57 percent of paper and pulp, and non-energy-intensive industries respective total energy demands, but by 1991, these shares had fallen to 6 and 15 percent.[2]) The stone, clay, and glass industry group was the only group that continued to meet more than half of its energy demand with the use of oil throughout the 1970s, but by 1991, this share had fallen to 21 percent. In 1991,

Figure 5-4
Oil Use in the Manufacturing Sector by Industry Group



2 A large portion of the reduction in oil use in the paper and pulp industry group is due to a regulation enacted in the mid-1970s on water deposits. Under this regulation, wood and related wastes, and water are separated, and then the wastes are reintroduced as an energy input in the production process(es). As a consequence, the use of oil is reduced.

Figure 5-5
Solid Fuels Use in the Manufacturing Sector by Industry Group



oil use was 56 percent less than in 1950 and represented only 6 percent of the energy used in this sector.

5.3.2.2 Solid Fuels Use

After a slight decline in the use of solid fuels in this sector from 1950 to 1960, its use increased rapidly at an annual rate of 6.8 percent from 1960 to 1970. (See Figure 5-5.) Nearly all of this growth can be attributed to their increased use in the iron, steel, and ferro-alloy industry group. The use of these fuels continued to increase throughout the 1970s.[3] Again, most of its use was in the iron, steel, and ferro-alloy industry group, and to a lesser extent in the non-ferrous metal and other non-energy-intensive industry groups. After a slight downturn between 1980 and 1982, the use of solid fuels began to increase again, and in 1984, their use peaked at 72 PJ (or nearly 28 percent of demand). From 1985 to 1991, the use of solid fuels declined at an annual rate of 3.1 percent. This can be mainly attributed to decreases in their use in the iron, steel, and ferro-alloy industry group. However, the use of solid fuels in the paper and pulp industries increased by 3 percent annually during this period. In 1991, solids fuels represented 27 percent of total energy demand in this sector. Nearly 38 percent of the solid fuels were used in iron, steel, and ferro-alloy industries, 21 percent in paper and pulp industries, and 17 percent in other non-energy-intensive industries.

5.3.2.3 Electricity Use

From 1950 to 1976, electricity use in the manufacturing sector increased rapidly from 33 to 134 PJ, and the share of total energy demand met by electricity use increased from 37 to 54 percent. (See Figure 5-6.) This growth can mainly be attributed to the increases in the electricity used in the metal industry groups. From 1977 to 1984, electricity use increased by 33 percent. Electricity use in this sector peaked in 1984 at 162 PJ (or 62 percent of sectoral demand).

After a 7 percent decline between 1984 and 1986, electricity use remained relatively constant until 1991.[4] In 1991, electricity use accounted for more than half of each of the

3 The composition of the solid fuels used in this sector changed from 1976 to 1991. The use of coke, which represented 68 percent of solid fuels use in 1976, declined to 43 percent in 1991. During the same period, the use of coal and wood increased from 18 percent to 29 percent, and 14 percent to 28 percent, respectively.

4 This sector's use of occasional electric power ("tilfeldig kraft") increased steadily from 4 PJ in 1986 to 14 PJ in 1991, and in 1991, its use represented 9 percent of this sector's total electricity use.

Figure 5-6
Electricity Use in the Manufacturing Sector by Industry Group

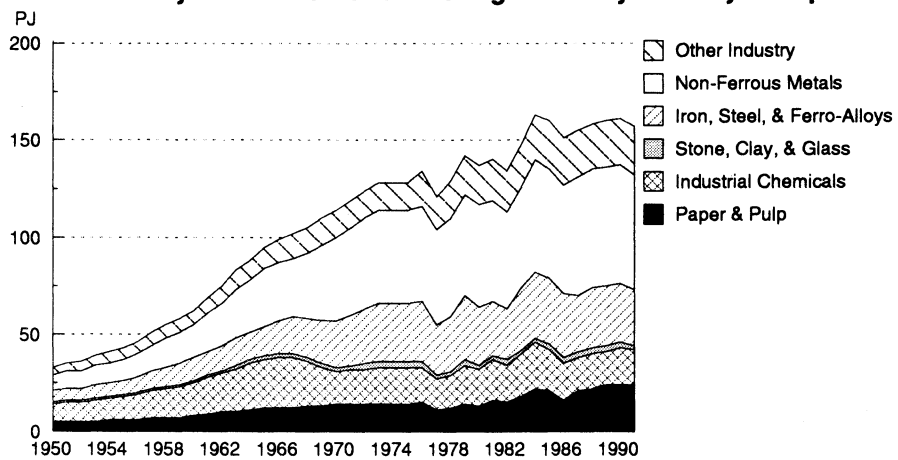
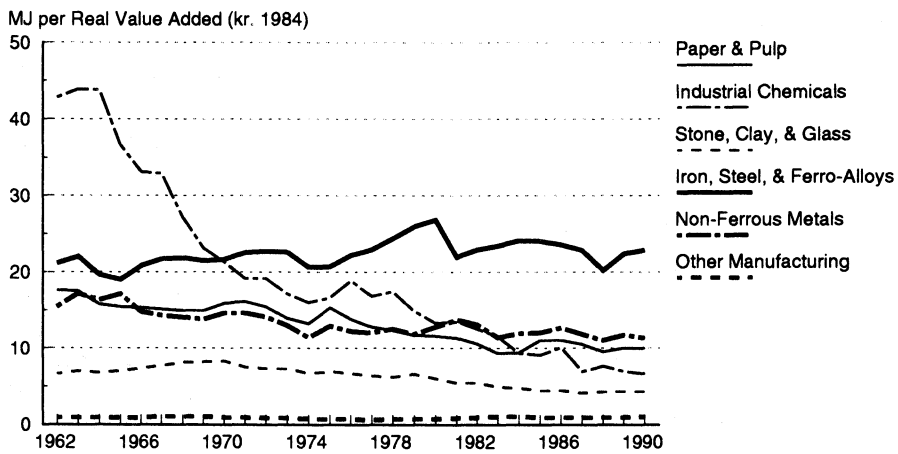


Figure 5-7
Energy Intensities in the Manufacturing Sector by Industry Group



District heating is included in the average intensity, but excluded from the industry group intensities.

industry groups' total energy demand (with the exception of the stone, clay, and glass industry group, where it represented 30 percent of demand). The non-ferrous metals industry group met 90 percent of its total energy demand from the use of electricity, and accounted for 37 percent of the electricity used in this sector.

5.4 The Intensity of Energy Use

Figure 5-7 illustrates the differences in energy intensities among the industry groups, and the changes in the groups' intensities from 1962 to 1990. From 1962 to 1970, the average intensity of energy use in the manufacturing sector increased slightly from 3.5 to 3.9 MJ per real kroner of valued added. This was due to increases in the intensity of energy use in the non-intensive industries group. The 55 percent reduction in the energy intensity in the industrial chemicals group somewhat offset this increase, and led to a decline in the average energy intensity of energy-intensive industry groups. This intensity decreased from 17.6 to 15.6 MJ per kroner.

From 1970 to 1974, there were reductions in all groups, and the sectoral average energy intensity fell to 3.2 MJ per kroner. (Most of this reduction occurred between 1973 and 1974.) The average intensity of energy-intensive industry groups fell by almost 9 percent during this period. These reductions were larger in the groups that were more dependent on the use of oil.

By the late 1970s, the average intensity of energy use in the manufacturing sector had again increased, and returned to above its 1974 level. This was due to increases in the energy intensity in the iron, steel, and ferro-alloy industry group. (In 1980, the intensity of energy use in this group reached 26.8 MJ per kroner.) The intensities in the other groups either declined or remained fairly constant between 1976 and 1980.

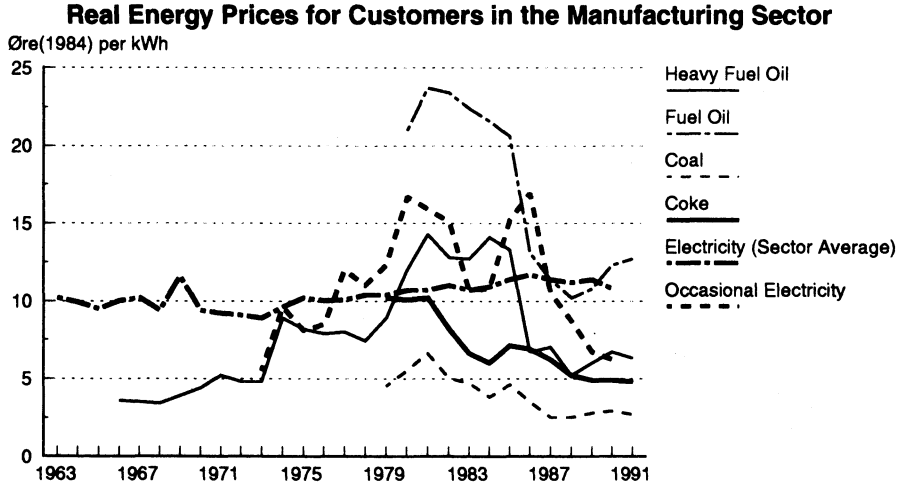
From 1980 to 1985, the sectoral average intensity increased steadily at an annual rate of 2.4 percent (increasing from 3.4 to 3.9 MJ per kroner). The average energy intensity in non-energy-intensive industries grew at an annual rate of 4.8 percent during this period. Somewhat offsetting this growth were declines in average intensity of the energy-intensive industries. From 1985 to 1990, the sectoral average energy intensity remained fairly constant at 3.8 MJ per kroner, but the average energy intensity of the energy-intensive industry groups declined from 12.1 to 10.7 MJ per kroner. While the total manufacturing sector's average intensity of energy use was at its 1970 level in 1990, the energy-intensive industries' average intensity was around less.

5.5 Energy Prices

Figure 5-8 illustrates real energy prices in the manufacturing sector. From 1973 to 1981, the real price of heavy fuel oil (in 1984 kroner) increased at an annual average rate of nearly 15 percent. During the same period, the average real price of electricity increased slightly. The large shifts in relative prices between 1973 and 1974 led, in part, to dramatic reductions in oil use. Reductions in oil use were reinforced by declining output in this sector. Favorable electricity prices promoted the substitution of electricity for oil. Furthermore, regulations governing water deposits and SO_2 emissions also led to fuel switching.

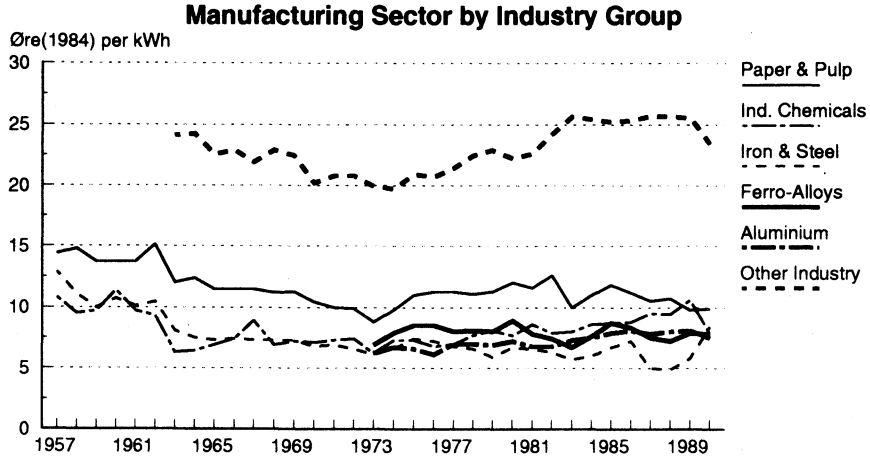
There are significant variations in the electricity prices among industrial customers as illustrated in Figure 5-9.[5] Industrial customers in non-energy-intensive industries have paid two to three times more per kWh than their energy-intensive counterparts.

Figure 5-8
Real Energy Prices for Customers in the Manufacturing Sector



5 There are also variations in industrial electricity prices among customers in the same industry group because of long-term price contracts.

Figure 5-9
Real Electricity Prices for Customers in the Manufacturing Sector by Industry Group



5.6 Changes Relative to 1973

Again, following Schipper, *et. al.* (1992), the identity used to isolate changes in intensity, structure, and activity in the manufacturing sector is:

$$E_M = Q \; \Sigma \, S_i I_i \, ,$$

where E_M is manufacturing energy use, and Q is activity (measured in real value added). The energy intensity of the i^{th} subsector is I_i , where $I_i = E_i/Q_i$ (Q_i is the i^{th} subsector's real value added.) Structural change, S_i, is equal to Q_i/Q.

Figures 5-10 through 5-13 illustrate the impacts of changes in activity, intensity and structure on total energy use, and on the use of oil, solid fuels, and electricity in this sector relative to 1973. From 1973 to 1990, structural changes contributed to increase energy use in the manufacturing sector by 22 percent. However, changes in energy intensities and activity contributed to decrease energy use by 15 and 10 percent, respectively. (See Figure 5-10.)

Reductions in energy intensities contributed to a 79 percent reduction in oil use between 1973 and 1990, while the effects of changes in structure and activity tended to have offsetting effects. (See Figure 5-11.)

Figure 5-10
Relative Impacts of Changing Activity, Intensity, and Structure on Energy Use in the Manufacturing Sector

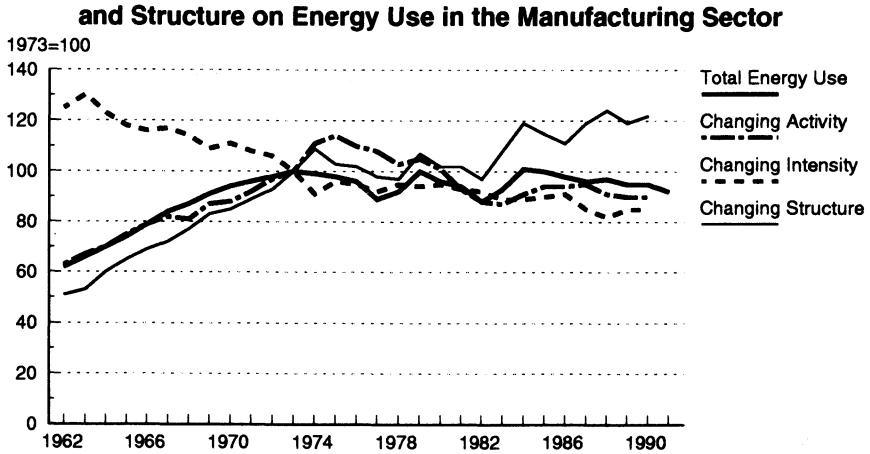


Figure 5-11
Relative Impacts of Changing Activity, Intensity, and Structure on Oil Use in the Manufacturing Sector

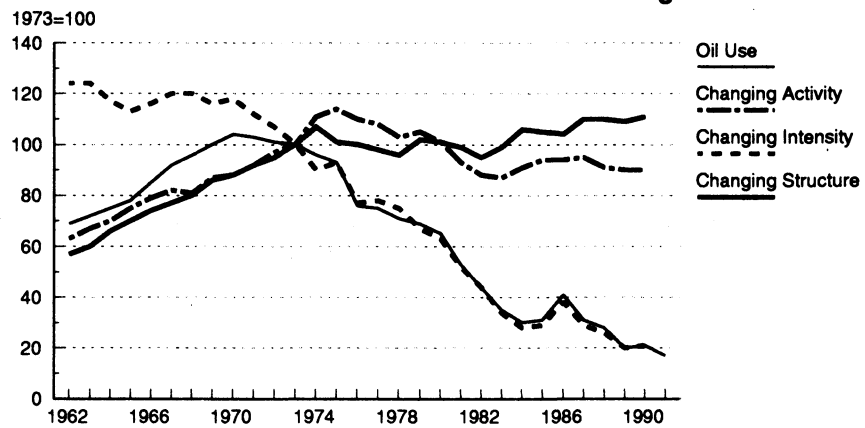


Figure 5-12
Relative Impacts of Changing Activity, Intensity, and Structure on Solid Fuels Use in the Manufacturing Sector

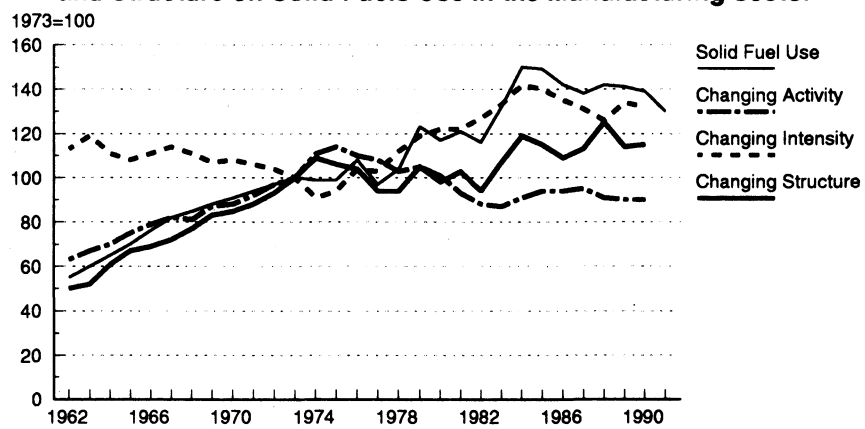
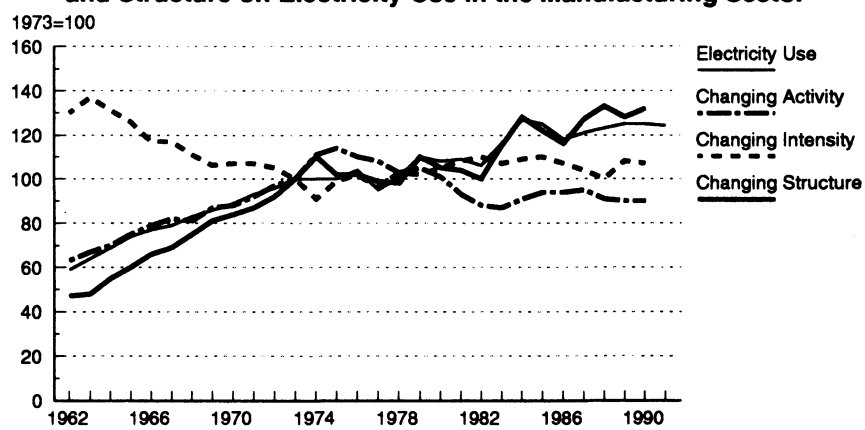


Figure 5-13
Relative Impacts of Changing Activity, Intensity, and Structure on Electricity Use in the Manufacturing Sector



Between 1973 to 1990, changes in intensities and structure contributed to increase solid fuels use by 32 and 15 percent, respectively, while changes in activity were responsible for a 10 percent reduction in the use of these fuels. (See Figure 5-12.)

Changes in intensities and structure contributed to increase electricity use by 32 and 7 percent, while these effects were dampened by reductions in activity, which contributed to decrease electricity use by 10 percent. (See Figure 5-13.)

5.7 Conclusion

From 1950 to 1991, there was a significant transformation of the manufacturing sector, in terms of output, the composition of this output, energy use, the types of energy used, and the intensity of energy use. From the 1950s to the mid-1970s, there was rapid growth in output, especially in the output of the energy-intensive industry groups, which generated an increasing demand for energy.

From the mid-1970s to the early 1980s, output remained constant, but the composition of output changed to a more energy-intensive mix of industries. While energy use fluctuated during this period, electricity and, to a lesser degree, solid fuels were substituted for oil, in response to the large relative price increases between 1973 and 1974 and between 1979 and 1981. Regulations on water deposits and on SO_2 emissions have also encouraged fuel switching. While there was a large reduction in the sectoral average energy intensity between 1973 and 1974, by the early 1980s, the average intensity had returned to above the 1974 level. The greatest reductions in energy intensities occurred in the industry groups which were more dependent on the use of oil.

From the mid-1980s to 1990/1991, sectoral output declined, but again, the average output of the energy-intensive industries continued to increase, and thus the composition of output was altered. While the sectoral average intensity remained constant during this period, the average energy intensity of the energy-intensive industry groups declined slightly. Aside from an upturn in oil use between 1984 and 1986, electricity continued to be substituted for oil. Even though relative prices (heavy fuel oil prices relative to sectoral average electricity prices) have favored the use of heavy fuel oil since 1986, all of the energy-intensive industry groups (with the exception of the stone, and glass industry group) pay below the sectoral average electricity price, and thus have had little incentive to increase their use of oil.

6. Transportation Sector

6.1 Introduction

The transportation sector can be divided into passenger, freight, and miscellaneous transport (e.g., transport in the agriculture and forestry sectors), telecommunciations, and pipeline transport.[1] Energy use for passenger transportation is dependent on the relationships among structural variables (i.e., the characteristics of the transport modes), activity (the utilization of the modes), infrastructure (i.e., the relative locations of homes to work places, businesses and leisure activities, and the availability of mass transit), economic factors (i.e., disposable income, and the relative costs of the transport modes), and demographics. Energy use for freight transportation is dependent on the relationships among structural variables, activity, infrastructure (i.e., the relative location of industries to markets), economic factors (i.e., the output of firms and the relative costs of the transport modes), and the composition of the freight (in terms of perishability, weight, and value). In this section, we examine the evolution of these variables, and how changes in these variables have influenced long-term energy use in this sector.

6.2 The Structure of the Transportation Sector[2]

6.2.1 The Automobile Fleet

Automobile ownership increased dramatically from 1950 to 1991. (See Figure 6-1.) From 1950 to 1970, automobile ownership, measured as the number of automobiles per person, increased from around 0.02 to nearly 0.2. This growth was supported by growth in real disposable income. Automobile ownership continued to increase after 1970, and there were 0.39 automobiles per person in 1987. By 1991, automobile ownership declined slightly to 0.38 automobiles per person because of a 63 percent decline in new automobile sales from 1986 to 1990, which, in turn, can be attributed to a lack of growth in real per capita disposable income.

The automobile fleet is almost entirely comprised of gasoline-driven vehicles. Nonetheless, the share of diesel automobiles has increased over the study period. From 1968 to 1991, this share increased from 1 percent (15 percent for taxi's and other vehicles registered for non-personal use) to 3 percent (24 percent for taxi's and other non-personal vehicles). Differences in relative fuel prices have promoted fuel-switching, especially among those who annually drive large distances.[3]

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1 Following Schipper, *et.at.* (1990), this analysis will focus on domestic passenger and freight transport.

2 There is not consistent long-term data on the number of ships (in domestic routes) and airplanes.

3 According to Nytt om bil (1993), the share of new diesel automobiles could increase from almost 10 to 20 percent of total new personal automobile sales from 1992 to 1993. The reasons given for this projected increase include: Favorable relative fuel prices, reductions in diesel-driven automobile prices relative to their gasoline-driven counterparts, technological improvements in diesel-driven crs, and the replacement of a kilometer-based tax with a daily tax (for automobiles registered after January 1, 1993). However, after this article was published, it was announced that a new kilomter-based tax is planned for October 1993, and this may influence the above projections.

Figure 6-1
Motor Vehicle Stock

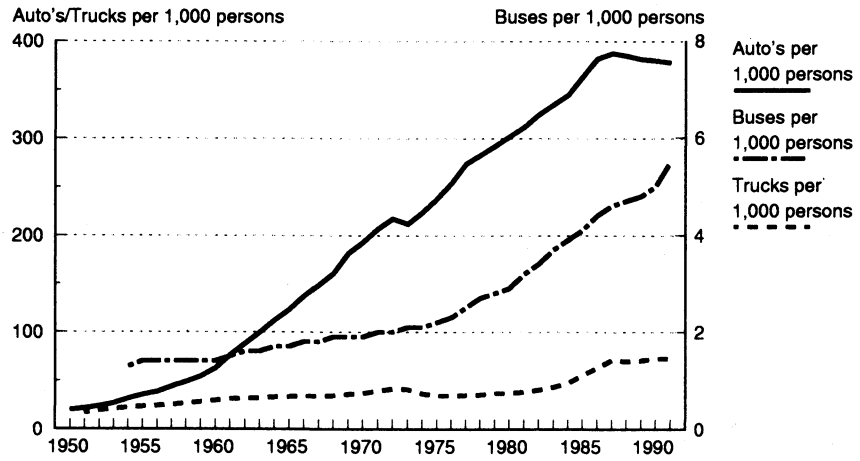
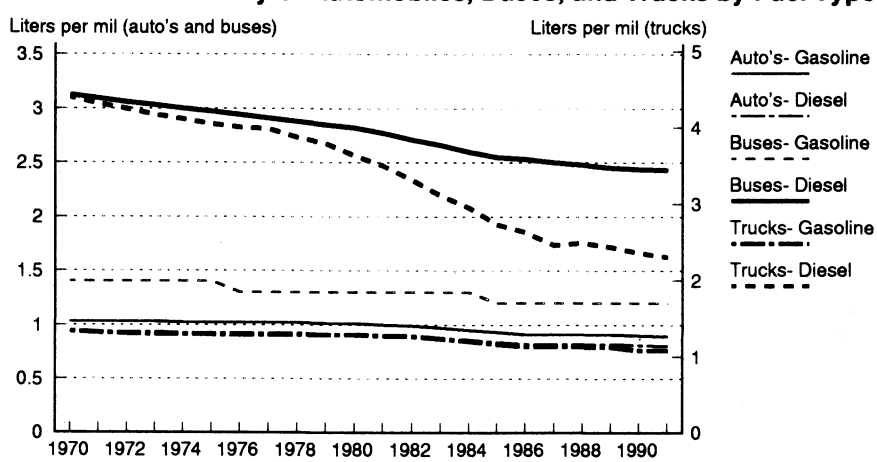


Figure 6-2
Actual Fuel Economy of Automobiles, Buses, and Trucks by Fuel Type



The average fuel economy of automobiles, measured in liters of fuel per 10 kilometers (or mil), remained constant at 0.90 in the 1950s, before decreasing to 0.95 in the mid-1970s. (See Figure 6-2.) Since 1975, fuel economy has steadily improved, and reached 0.82 liters per mil in 1990.[4] The increases in fuel economy were dampened by changes in the composition of the automobile fleet. (Increases in disposable income and consumer credit allowed households to purchase bigger and more powerful automobiles in the late 1970s and early 1980s. However, the improvements in fuel economy outweighed this trend.)

6.2.2 The Bus Fleet

The number of buses per 1,000 persons increased steadily from 1.3 in 1950 to 5.5 in 1991. (See Figure 6-1.) From 1980 to 1990, the bus fleet increased more rapidly than the automobile fleet. Furthermore, according to the report *Transporter i Norden 1960-1988* (1990), increases in average bus size have increased average seat capacity per bus.

4 These data refer to actual fuel economies from 1950 to 1974 and to estimated fuel economies from 1975 to 1990.

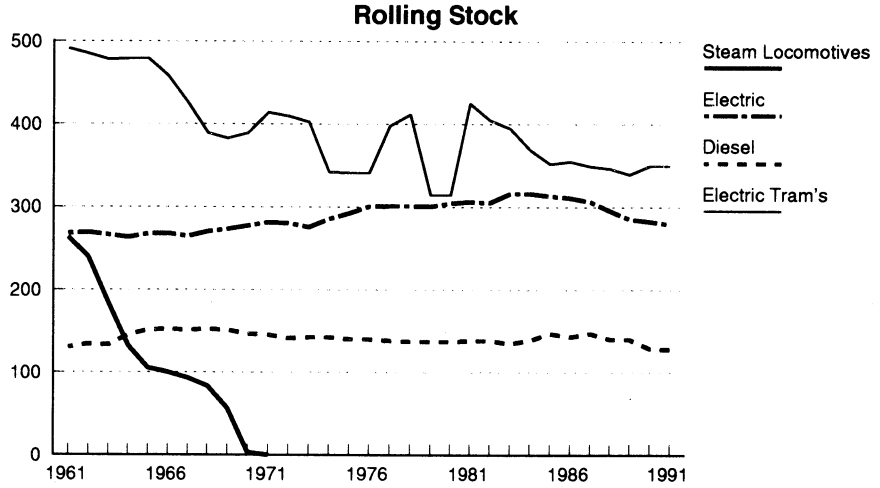
From 1965 to 1972, the share of diesel-driven buses increased from 83 to 93 percent of the bus fleet. However, from 1972 to 1988, there was a reversal of this trend, and the share of the diesel-driven bus fleet declined to 75 percent. In 1991, 79 percent of the buses were diesel driven.

The average actual fuel economy of the bus fleet remained fairly constant at 2.9 liters per mil from 1970 to 1974. (See Figure 6-2.) However, the average actual fuel economy of diesel-driven buses increased slightly during this period (from 3.1 to 3.0). By 1991, the average actual fuel economy of the fleet had increased to 2.2 liters per mil (1.2 for gasoline-driven buses and 2.4 for diesel-driven buses).

6.2.3 Trains

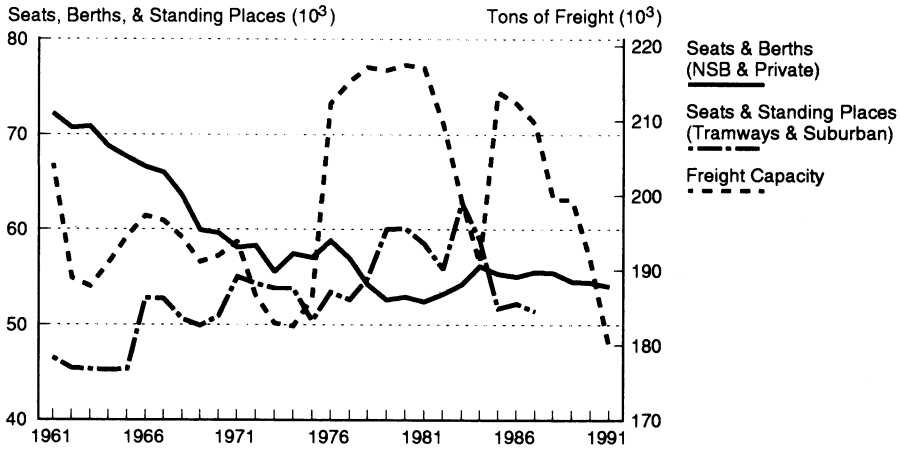
Figure 6-3 illustrates the rolling stock by fuel type from 1961 to 1991. The stock of locomotives, rail motor vehicles, and sets declined by 38 percent during this period. The stock of steam locomotives decreased until their use was curtailed in 1970. The stock of electric locomotives, rail motor vehicles, and sets increased almost continuously from 1961

Figure 6-3
Rolling Stock



Electric and diesel include locomotives, rail motor vehicles, and sets.

Figure 6-4
Rail System Capacity



to 1983/4, but decreased thereafter. After increasing from 1961 to 1965, the diesel rolling stock gradually declined until 1985. After an upturn in 1985, the stock continued to decrease until 1991. The stock of tramway and suburban vehicles declined by nearly 29 percent from 1961 to 1991.

Figure 6-4 shows the capacity of the rail system measured as the number of seats and berths available on passenger trains (NSB and private), seats and standing places available on tramways and suburban railways, and the carrying capacity of freight cars. From 1961 to 1991, declines in passenger and freight capacity can be attributed to decreases in the number of cars. Somewhat offsetting these declines were increases in the capacity per car. (Large increases in the freight capacity per car between 1975 and 1976, and between 1984 and 1985 accounted for the corresponding increases in freight capacity.)

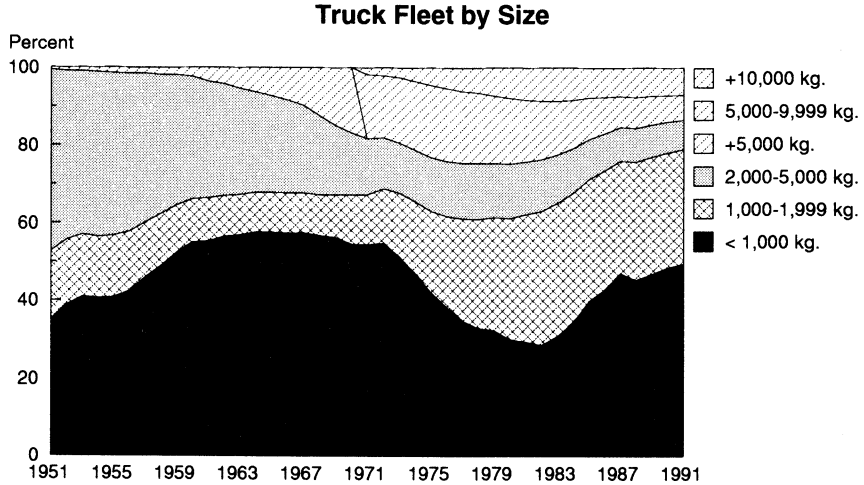
6.2.4 The Truck Fleet

The number of trucks (and vans) per 1,000 persons increased steadily from 17 in 1951 to 42 in 1972, before declining to 35 in 1975. By 1991, there were 73 trucks per 1,000 persons. Most of this growth occurred in the mid-1980s. (See Figure 6-1.)

The composition of the truck fleet, in terms of size and fuel used, changed significantly from 1951 to 1991. (See Figure 6-5.) From 1951 to 1967, the shares of trucks with a gross weight of under 1 ton and over 5 tons increased rapidly, while the share of trucks with a gross weight of between 1 and 5 tons decreased. However, between 1971 and 1982, the share of trucks weighing under 1 ton declined, while the shares of heavier trucks increased. From 1982 to 1991, the share of trucks weighing under 1 ton increased to 50 percent of the truck stock, while the shares all but the heaviest trucks (those weighing 10 or more tons) decreased.[5] Rekdal and Rideng (1990) cite three factors for the growth in the share of small trucks (and vans). First, many of the attributes of these vehicles (e.g., comfort, safety features, and performance standards) have become more attractive. Secondly, the selection of these vehicles, in terms of makes and models, has increased. Finally, the import tax placed on these vehicles has been significantly lower than that placed on personal vehicles.

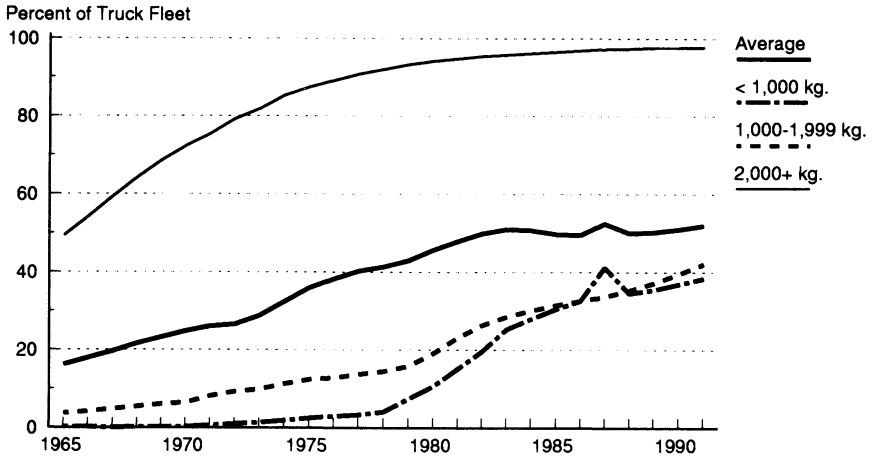
From 1965 to 1991, the share of diesel trucks increased from 16 to 52 percent of truck fleet. (See Figure 6-6.) Slightly more than one-half of the truck fleet is diesel driven. While nearly all of the trucks weighing more than 2 tons are diesel-driven, only around 40 percent of the smaller trucks use this fuel.

Figure 6-5
Truck Fleet by Size



5 Rekdal and Rideng (1991) reported that only 7.5 percent of the vans and 1.8 percent of the combination vehicles (weighing under 1 ton) were used solely for the transport of freight, while 30 percent of the vans, and 16 percent of the combination vehicles were used only for passenger transport.

Figure 6-6
Diesel-Driven Truck Fleet by Size



The average actual fuel economy of the truck fleet has improved considerably since 1970. (See Figure 6-2.) From 1970 to 1991, the average fuel economy of diesel-driven trucks increased by 48 percent, and the average fuel economy of gasoline-driven trucks increased by 19 percent. Although a small portion of these improvements can be attributed to shifts in the composition of the truck fleet, the majority of these gains are due to actual increases in fuel economy.

6.3 Activity

6.3.1 Evolution of Passenger Travel

Passenger travel, measured as passenger-kilometers traveled per capita, grew rapidly from 1,843 to 11,889 from 1950 to 1991. However, as shown in Figure 6-7, the largest growth occurred from the mid-1960s to the late 1970s. After slower growth in the late 1970s and early 1980s, passenger travel again increased during the mid-1980s. From 1986 to 1991, passenger travel remained fairly constant.

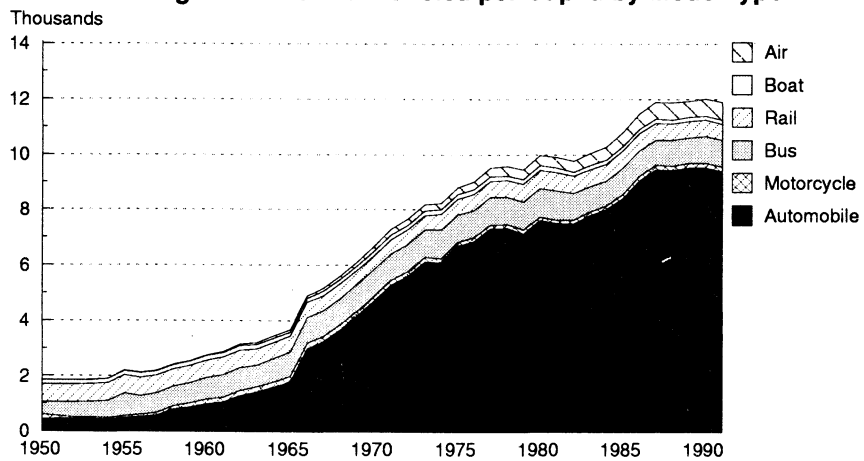
Modal choice is, in part, dependent on an individual's or household's access to the transport modes, disposable income, the relative costs of these modes, the type of trip taken, and the length of the trip. However, growth in automobile travel supported the majority of growth in passenger travel throughout the study period. The largest growth occurred between 1960 and 1970, where passenger-kilometers traveled per capita increased at an average annual rate of 17 percent. From 1985 to 1991, travel by automobile grew at a slower rate of nearly 2 percent per year.

Aside from large increases in air travel, passenger travel by other mass-transport modes (e.g., bus, train, and boat) experienced little to no growth from 1950 to 1991.[6] During this period, air travel increased from 2 to almost 630 kilometers traveled per capita. While passenger travel by bus increased slightly over the study period, nearly all of this growth occurred before 1970. The only growth in passenger travel by rail occurred between 1970 and 1980. Passenger travel by boat per capita remained fairly constant throughout the study period.

As a consequence of the differing growth rates, the shares of passenger travel by mode changed significantly over the study period. From 1950 to 1990, personal travel, that is,

6 Access to mass transit is very dependent on the size of the community in which people live. Seventy-five percent of the rural respondents surveyed in the Reisevaneundersøkelse i Norge 1984/85 (1984/85 Norwegian Travel Survey) felt their access to mass transit was either bad or very bad, while only 4 percent of the respondents who lived in the Oslo-Akershus area had the same responses.

Figure 6-7
Passenger-Kilometers Traveled per Capita by Mode Type



travel by automobile and motorcycle, continually replaced mass-transit modes. In 1950, passenger travel was dominated by mass-transit modes, which accounted for 67 percent of passenger travel. However, by 1970, the share of passenger travel by automobile and motorcycle had increased to 73 percent, while the share of travel by rail, bus, and boat declined to 24 percent. While the share of the other mass-transit modes declined, the share of travel by air increased from less than 1 percent in 1950 to 3 percent in 1970. From 1970 to 1985, the passenger travel shares continued to follow the same trend, but the transformations among the shares were not as large as before 1970. From 1985 to 1991, the shares remained relatively stable. In 1991, these shares were ranked as follows: automobile (79 percent), bus (8 percent), air (5 percent), rail (5 percent), motorcycle (1.5 percent), and boat (1.5 percent).

6.3.2 Evolution of Freight Transport

Freight activity, measured as freight ton-kilometers (tkm), increased rapidly from 4.1 billion in 1950 to nearly 17 billion in 1973. After remaining relatively constant during the remainder of the 1970s, activity increased again in the 1980s and reached 22.5 billion freight ton-kilometers in 1991. (See Figure 6-8.)

Freight transport modal choice depends, in part, on the differences in the cost per ton-kilometer of the mode choices (based on weight or volume), the distance from firms to terminals (e.g., harbors and train stations), and the time differentials between the modes. In 1986, the average costs were kr. 0.20 per ton-kilometer for freight transported by ship, kr. 0.42 for rail, and kr. 2.02 for trucks. As a consequence, bulk-freight (such as raw materials) and freight transported over long distances is mainly transported by ship or rail. In 1988, the average trip lengths for freight ships (excluding ferries) and freight trains (excluding the Ofot line) were 313 and 200 kilometers, respectively. Perishables, expensive freight, and/or other freight subject to time constraints is generally transported by truck, or to a lesser extent by air. In addition, smaller trucks are used for shorter trips. In 1988, the average trip length for trucks was 29 kilometers.

Many industries are located in rural areas along Norway's long coastline, and as a consequence, freight transport has been dominated by the use of ships and boats throughout the study period. From 1950 to 1970, the share of freight-tons transported by this mode increased from 49 to 68 percent (from 2 billion to 10.3 billion tkm). However, by 1991 this share had declined to 59 percent (13.3 billion tkm).

Freight transported by truck increased from 0.7 to 1.1 billion tkm from 1950 to 1959. From 1960 to 1991, transport by this mode increased steadily at an annual average growth rate of nearly 8 percent. As a result of this growth, the share of freight transported by truck increased from 17 percent in 1950 to 33 percent in 1991.

Figure 6-8
Freight Ton-Kilometers Transported by Mode Type

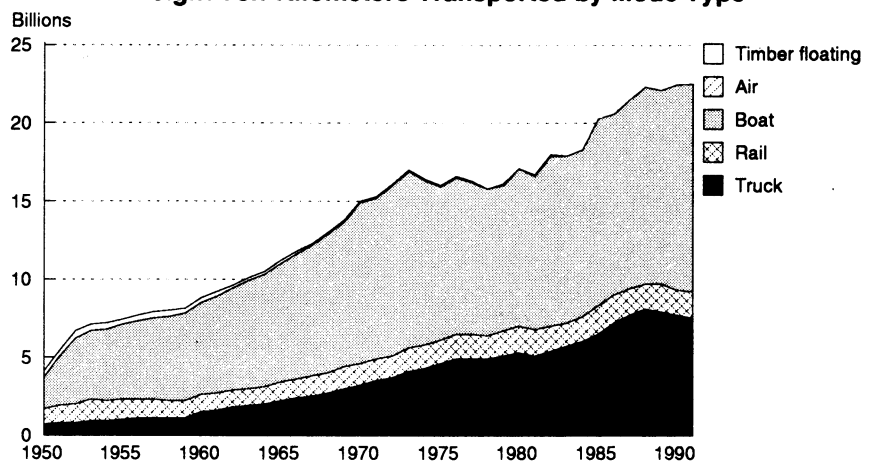
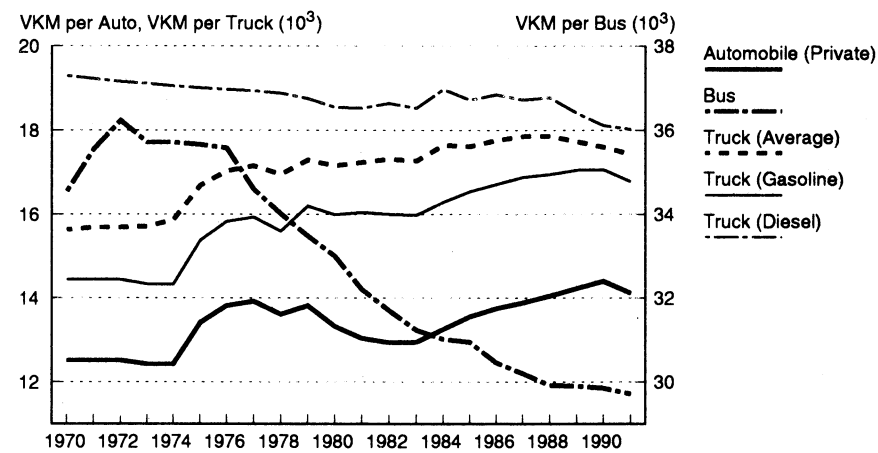


Figure 6-9
Vehicle-Kilometers Traveled per Vehicle



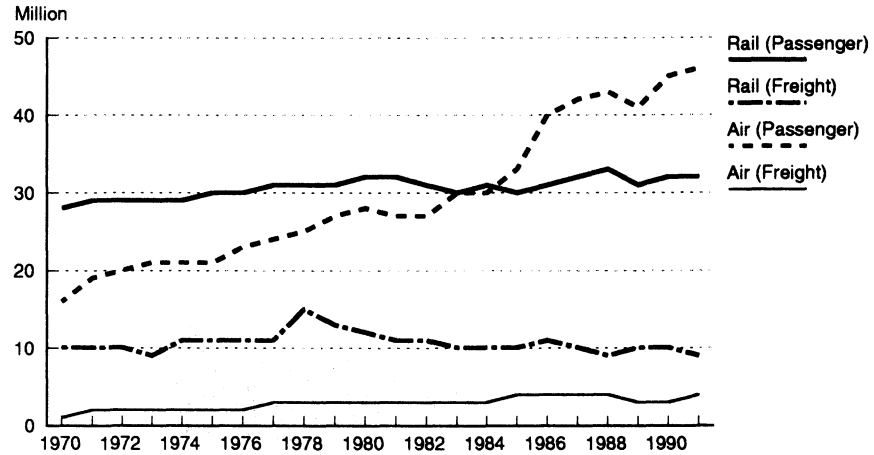
Freight transported by rail remained fairly constant (between 1.0 and 1.8 billion tkm) throughout the study period. However, the share of freight ton-kilometers transported by this mode declined from 25 percent in 1950 to 7 percent in 1990.

While timber floating accounted for nearly 10 percent of freight activity in 1950, this share declined steadily until it was discontinued in 1983.

6.3.3 Vehicle-Kilometers Traveled

After remaining almost constant between 1970 and 1974, vehicle-kilometers traveled per automobile increased by 12 percent from 12.4 to 13.8 thousand kilometers from 1974 to 1979. (See Figure 6-9.) After a slight decline from 1979 to 1982, travel per automobile increased to 14.4 thousand kilometers in 1990. It is interesting to note that it is generally assumed that as vehicle ownership increases, automobile travel per vehicle decreases. However, from 1982 to 1990, both vehicle ownership and travel per vehicle increased. Furthermore, the average trip length and annual mileage per automobile for households with more than 1 car was the same as for households owning only 1 car (TØI (1987) and Lian (1990)).

Figure 6-10
Vehicle-Kilometers Traveled by Train and Airplane



Vehicle-kilometers traveled per bus increased slightly from 34.5 to 36.2 thousand kilometers from 1970 to 1972, and then declined continuously, reaching 29.7 thousand kilometers in 1991. The average vehicle-kilometers traveled per truck increased from 15.6 to 17.3 thousand kilometers from 1970 to 1979. Since 1979, vehicle-kilometers traveled per truck has remained fairly constant.

Figure 6-10 illustrates the total vehicle-kilometers traveled by rail (tractive vehicle kilometers) and air from 1970 to 1991. Vehicle-kilometers traveled by rail (both passenger and freight) remained fairly constant during this period. Vehicle-kilometers traveled by air increased at an annual average growth rate of 5.2 percent. Nearly all of this growth is due to increases in passenger travel.

6.4 Energy Use

6.4.1 Passenger Transportation Energy Use

The energy used per capita for passenger transportation increased at an annual average growth rate of almost 5 percent from 1962 to 1991. (See Figure 6-11.) Most of this growth occurred between 1960 and 1970, and to a lesser extent between 1970 and 1980. Since 1985, energy use per capita has been fairly constant.

Nearly all of the growth in passenger transportation energy use can be attributed to increases in automotive gasoline use, and to a lesser extent the energy used for passenger transport by airplane. While the energy used for transportation by automobiles represented 53 percent (11 PJ) of total passenger transportation energy use in 1962, this share increased to 73 percent (66 PJ) in 1991. Almost one-quarter of the energy used for passenger transport was used by airplanes in 1991. Most of this growth occurred after 1970. (From 1985 to 1991, energy use increased at an annual average growth rate of 5.5 percent.) From 1962 to 1991, per capita energy use for transport by bus increased slightly, and per capita energy use for passenger transport by train declined.

6.4.2 Freight Transportation Energy Use

As illustrated in Figures 6-11 and 6-12, freight and passenger transportation energy use evolved differently from 1962 to 1991. After increasing slowly from 1962 to 1967, freight transportation energy use per capita more than doubled between 1967 and 1973. Energy use declined slightly between 1974 and 1975 in response to the large oil price increase in 1973. After this short-term decline, energy use increased slowly until the early 1980s, before

Figure 6-11
Passenger Transportation Energy Use by Mode Type

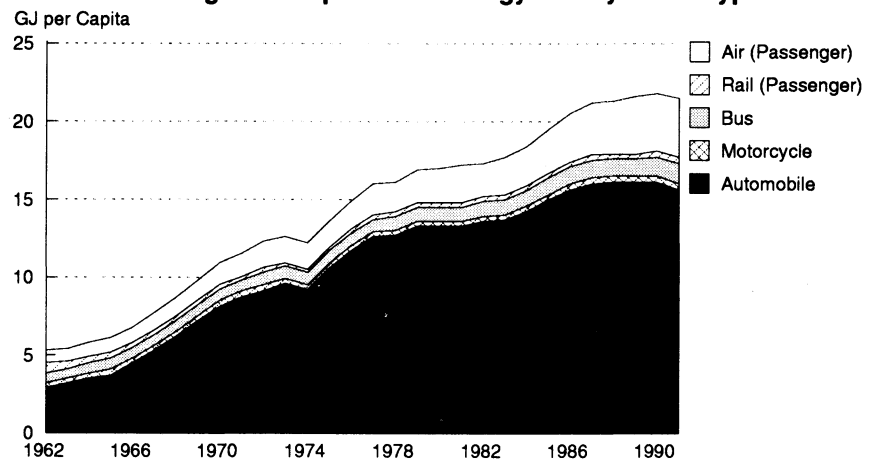
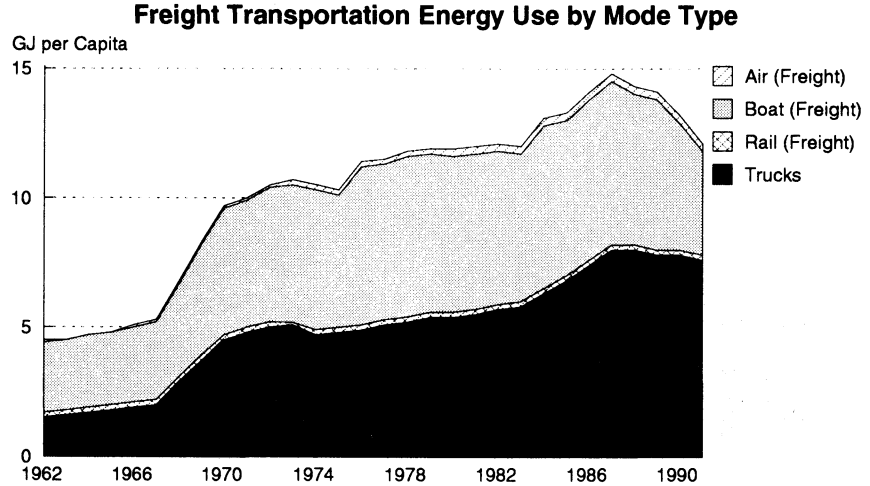


Figure 6-12
Freight Transportation Energy Use by Mode Type



experiencing stronger growth in the mid-1980s. From 1987 to 1991, energy use decreased by almost 20 percent.

In 1950, the energy used for freight transportation by ship represented nearly 60 percent of total freight transportation energy use, followed by truck (34 percent), train (5 percent), and airplane (1 percent). By 1991, trucks accounted for 59 percent of total freight transportation energy use, followed by ships (37 percent), airplanes (2 percent), and trains (1 percent).

6.5 Economics

Passenger travel grew faster than disposable income from the early 1960s to the mid-1970s and as a consequence, households devoted a greater share of their total expenditures to transport. (See Figures 6-13 and 6-14.)

After remaining fairly constant for the remainder of the 1970s and early 1980s, passenger travel grew more rapidly than disposable income until 1987. Between 1986 and 1988, households allocated nearly 19 percent of their expenditures to transport, and 17 percent of these expenditures were related to automobiles (purchase, fuel, maintenance,

Figure 6-13
Passenger Activity per Kroner of Real Disposable Income and Freight Activity per Kroner of Real GDP

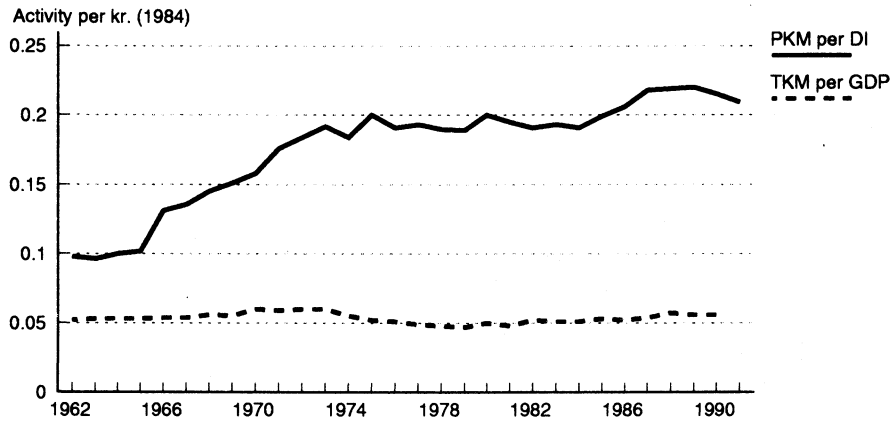
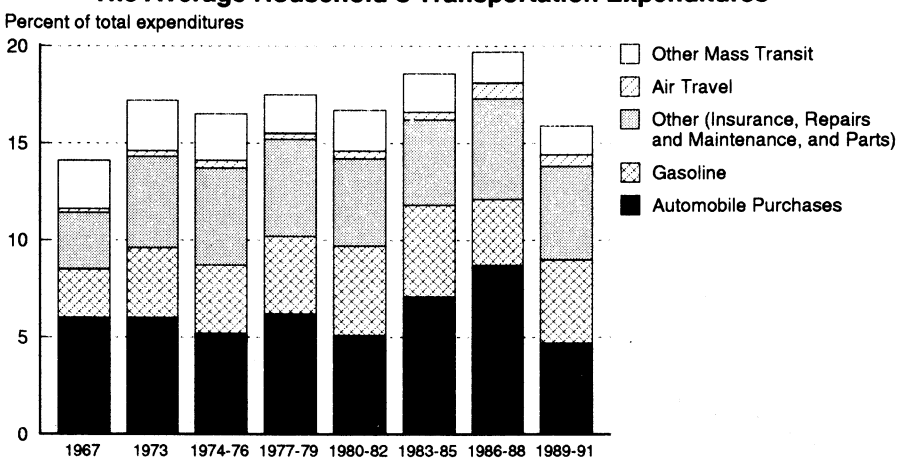


Figure 6-14
The Average Household's Transportation Expenditures

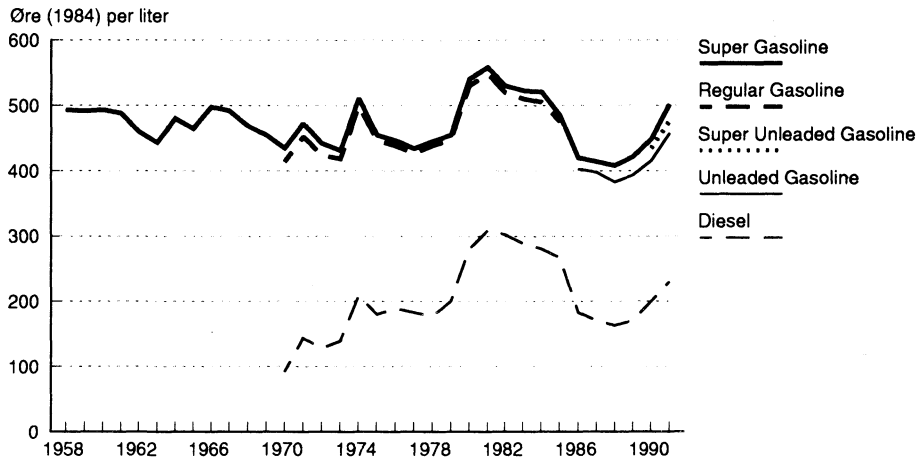


repairs, and insurance). The average household's transport expenditures declined to 15 percent of their total expenditures between 1989 and 1991. Nearly all of this decrease can be attributed to declining automobile sales.

As illustrated in Figure 6-13, the ratio of freight activity (tkm) per unit of GDP remained relatively stable from 1962 to 1990; freight activity tends to follow GDP because it is a necessary input to production.

Figure 6-15 illustrates the evolution of gasoline and diesel prices. The 12 percent increase in the real price of gasoline between 1963 and 1966 did not lead to reductions in energy use or passenger-kilometers traveled, because of the strong growth in disposable income during this period. The 19 percent increase in the price of super gasoline between 1973 and 1974 contributed to a 3 percent reduction in automotive gasoline use (and a corresponding reduction in total passenger energy use). However, much of the effect of the price increase was again offset by increases in disposable income. Furthermore, while automobile travel per capita, measured in passenger-kilometers traveled per capita, followed the same trend as energy use, total passenger-kilometers traveled per capita did not decrease from 1973 to 1974. As gasoline prices stabilized in the mid-1970s, passenger energy use resumed its upward trend. From 1979 to 1981, the real price of gasoline increased by 23 percent. During this period, automotive gasoline use remained constant, and there were

Figure 6-15
Real Gasoline and Diesel Prices



Gasoline and diesel prices include taxes and value added taxes (VAT).

only slight reductions in passenger travel by automobile (measured in passenger-kilometers traveled per capita or vehicle-kilometers traveled per automobile). As real gasoline prices fell in the mid-1980s, energy use and passenger travel increased. Between 1988 and 1991, passenger travel and energy use remained almost constant, in spite of a 23 percent increase in the real gasoline price. Disposable income remained also fairly constant during this period. The widening gap between gasoline and diesel prices has also contributed to increases in diesel-driven automobile sales since the mid-1980s.

The 50 percent increase in real diesel fuel prices between 1973 and 1974 contributed to only a 9.5 percent reduction in the diesel fuel used for freight transport by truck between 1974 and 1976, because of the offsetting effect of increases in GDP. There were no reductions in freight ton-kilometers traveled by truck, and the average vehicle-kilometers traveled per truck increased during this period. After a 74 percent increase in the real price of diesel fuel between 1978 and 1981, freight energy use and activity remained almost constant. Again, GDP growth outweighed the effect of the price increase. From 1984 to 1988, real diesel fuel prices decreased from 41 percent. During this period, freight energy use and activity also increased.

6.6 Changes Relative to 1973

The identity used to isolate the effects of changes in structure, activity, and intensity on energy use in the transportation sector is

$$E_T = Q \Sigma S_i I_i,$$

where Q is activity measured in passenger-kilometers traveled for passenger transportation and freight-ton kilometers transported for freight transportation. The structural component, S_i, is Q_i/Q, and the intensity component, I_i, is E_i/Q_i. The passenger transportation modes are: automobiles, buses, rail, and air. The freight transportation modes are: truck, rail, ship, and air.

From 1973 to 1991, changes in activity (passenger-kilometers traveled) increased passenger transportation energy use by close to 60 percent. (See Figure 6-16.) Structural changes (i.e., changes in the shares of passenger-kilometers traveled by mode) increased energy use by 12 percent. In spite of the increases in fuel economy, increases in the energy intensity of passenger transportation (i.e., energy use per passenger-kilometer traveled) increased energy use by 7 percent from 1973 to 1991. Most of the changes in these factors occurred prior to 1987.

Figure 6-16
Relative Impacts of Changing Activity, Intensity, and Structure on Passenger Transportation Energy Use

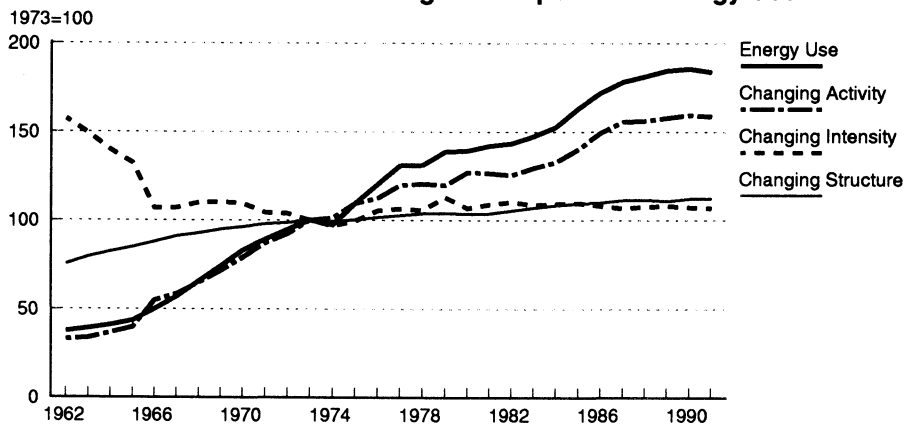
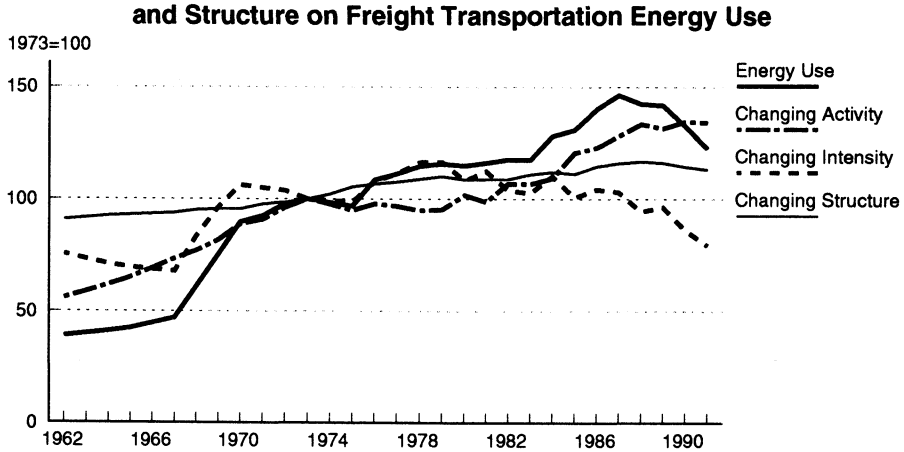


Figure 6-17
Relative Impacts of Changing Activity, Intensity, and Structure on Freight Transportation Energy Use



From 1973 to 1980, structural changes and increases in the intensity of freight transport each pushed upwards on freight transportation energy use, as less efficient trucks were substituted for fuel-efficient ships. (See Figure 6-17.) Declining activity somewhat offset these increases. From 1980 to 1987, increases in activity, and to a lesser degree, structural changes led to increases in freight transport energy use. However, this growth was partially offset by reductions in the average energy intensity. This can be attributed, in part, to increases in the average fuel economy of the truck fleet. From 1987 to 1991, freight transport energy use declined by 16 percent. During this period, activity and structure stabilized, but further declines in the average energy intensity of energy use contributed to decrease energy use.

6.7 Conclusion

From 1950 to 1991, energy use in the transportation sector grew at an annual average rate of 4.8 percent, increasing from 21 to 144 PJ. The most rapid growth occurred between 1962 and 1970, but there was continued growth until the mid-1980s. Since 1987, energy use has remained almost constant. From the early 1960s to the early 1980s, growth in real

disposable income supported large increases in vehicle ownership and utilization. The increases in disposable income also supported increases in air travel, especially after 1970. Growth in passenger transportation energy use tended to follow growth in passenger travel throughout the study period. However, travelers' substitution of the use of automobiles and airplanes for buses and trains also contributed to increase energy use. The large real gasoline price increases between 1963 and 1966, 1973 and 1974, and 1979 and 1981 had virtually no short- or long-term impacts on energy use because of the growth in real disposable income.

Freight transportation energy use also increased rapidly from the early 1960s to 1987. However, after 1970, it grew slower than passenger energy use, and as a consequence, the share of energy used for freight transport declined from 47 to 36 percent of total energy use in the transportation sector from 1970 to 1990. From the early 1960s to the mid-1970s, increases in freight activity, measured by freight ton-kilometers transported, led to the increases in energy use. While freight activity levelled off from the mid-1970s to 1979, the substitution of the use of trucks for ships for freight transport contributed to slightly increase energy use. Between 1980 and 1987, increases in freight activity and the further substitution of trucks for ships for freight transport led to large increases in energy use. This growth was somewhat offset by decreases in the average intensity of freight transportation energy use. While freight activity stabilized from 1987 to 1991, the continued reductions in the average intensity of freight transportation energy use contributed to decrease energy use. The large real fuel prices increases had no impact on long-term freight transportation energy use.

Appendix A

Table A-1
Delivered Energy Use by Sector (PJ(CC))

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Total	189	192	196	199	203	206	219	231	244	256
Residential	58	59	59	60	61	61	64	66	69	71
Service	21	21	21	21	20	20	21	21	22	22
Energy-Intensive Industries	64	67	70	72	75	78	84	89	95	101
Other Industry	24	24	24	23	23	23	25	26	28	30
Transport	21	22	22	23	23	24	26	28	30	31

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Total	268	282	296	312	329	346	373	400	421	442
Residential	74	73	73	76	79	82	90	98	99	100
Service	23	25	28	29	30	32	34	36	37	38
Energy-Intensive Industries	107	116	124	134	144	154	161	168	177	186
Other Industry	32	33	34	35	36	37	43	48	48	47
Transport	33	35	37	38	39	41	45	49	60	70

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total	463	478	496	509	506	518	523	523	533	570
Residential	101	104	109	110	107	114	113	120	121	128
Service	39	42	46	49	55	57	57	61	61	67
Energy-Intensive Industries	195	200	205	210	207	204	205	190	194	213
Other Industry	47	47	47	47	47	47	42	40	43	44
Transport	80	84	89	93	91	96	106	113	114	118

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total	559	556	549	570	600	599	619	626	634	638
Residential	129	127	134	138	140	137	150	150	152	157
Service	65	66	66	68	70	69	72	79	83	85
Energy-Intensive Industries	205	199	185	197	214	210	206	202	205	201
Other Industry	42	42	42	44	45	47	46	45	44	43
Transport	118	120	122	124	131	137	145	151	151	152

	1990	1991
Total	644	618
Residential	162	153
Service	89	85
Energy-Intensive Industries	201	193
Other Industry	44	43
Transport	149	144

Table A-2
Delivered Energy Use (PJ (CC)) by Consumer and Producer Group (%)

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Consumers										
Residential	24.6	24.3	24.0	23.7	24.2	24.6	23.6	22.7	21.9	21.8
Passenger Transport	6.4	6.4	6.4	6.4	6.8	7.2	7.9	8.4	9.0	9.4
Personal Services	3.8	3.7	3.7	3.7	3.6	3.6	3.5	3.4	3.4	3.5
Producers										
Business Services	5.7	5.6	5.6	5.5	5.5	5.4	5.3	5.2	5.1	5.3
Energy-Intensive Industries	42.1	43.0	43.8	44.5	43.1	41.9	42.0	42.1	42.2	41.9
Other Industry	11.4	11.2	11.0	10.8	11.5	12.1	11.4	10.7	10.2	9.8
Freight Transport	5.4	5.3	5.2	5.1	5.0	4.9	6.1	7.1	8.1	8.1

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Consumers										
Residential	22.0	21.6	21.1	22.0	21.7	22.9	22.7	22.4	23.0	22.9
Passenger Transport	9.6	9.9	9.8	10.7	11.3	12.4	12.1	11.9	12.3	12.6
Personal Services	3.7	3.8	4.3	4.4	4.3	4.6	4.5	4.7	4.6	4.8
Producers										
Business Services	5.5	5.7	6.5	6.6	6.5	7.0	6.8	7.0	6.9	7.2
Energy-Intensive Industries	41.3	41.3	40.9	39.4	39.2	36.3	36.5	37.4	36.6	35.8
Other Industry	9.5	9.3	9.3	9.1	8.0	7.7	8.1	7.7	7.6	7.6
Freight Transport	8.3	8.3	8.3	8.0	8.7	8.9	9.0	8.4	8.6	8.7

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Consumers										
Residential	24.5	24.2	23.3	22.9	24.2	23.9	24.0	24.6	25.2	24.7
Passenger Transport	13.0	13.1	12.8	13.2	13.7	14.0	14.3	14.7	14.7	14.9
Personal Services	4.8	4.8	4.6	4.6	4.6	5.0	5.2	5.3	5.5	5.5
Producers										
Business Services	7.2	7.2	7.0	6.9	6.9	7.5	7.8	8.0	8.3	8.3
Energy-Intensive Industries	33.7	34.5	35.6	35.0	33.3	32.2	32.2	31.4	31.1	31.2
Other Industry	7.6	7.6	7.6	7.8	7.4	7.2	6.9	6.7	6.7	6.9
Freight Transport	9.1	8.8	9.1	9.0	9.5	9.7	9.5	9.6	8.9	8.5

Table A-3
Indicators of Activity (1973=100)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
GDP										
Manufacturing (VA)										
Freight Transport (TKM)	24.6	32.0	39.5	41.8	43.0	44.2	45.5	46.8	47.7	48.6
Residential Floor Area (m^2 (htd.))										
Passenger Transport (PKM)	18.6	18.7	18.9	19.2	19.9	23.1	22.5	23.5	26.2	27.8
Service (VA)										

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
GDP			65.2	67.9	71.0	74.6	77.3	81.9	83.0	88.5
Manufacturing (VA)			48.0	49.2	56.6	61.1	65.7	68.7	75.3	82.2
Freight Transport (TKM)	51.8	54.3	57.1	59.8	62.8	65.9	69.5	73.7	77.4	81.9
Residential Floor Area (m^2 (htd.))	85.0	85.7	86.5	87.3	88.0	88.8	89.5	90.3	92.0	93.7
Passenger Transport (PKM)	30.2	31.9	35.1	36.0	39.0	42.1	56.6	60.3	66.0	72.6
Service (VA)			66.7	69.0	71.7	74.6	76.7	81.1	82.7	89.6

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
GDP	88.6	92.5	96.6	100.0	106.2	109.8	114.2	117.7	117.5	121.3
Manufacturing (VA)	84.7	88.8	92.4	100.0	108.0	98.1	98.9	95.7	95.4	105.9
Freight Transport (TKM)	88.8	90.7	96.0	100.0	97.5	94.9	97.9	96.6	94.7	95.2
Residential Floor Area (m^2 (htd.))	95.5	97.0	98.5	100.0	101.2	102.4	103.6	104.8	105.9	107.1
Passenger Transport (PKM)	79.6	87.7	92.8	100.0	101.1	108.8	111.9	118.8	119.7	118.8
Service (VA)	89.3	92.7	96.7	100.0	104.1	108.3	114.9	120.3	124.0	129.3

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
GDP	122.4	123.0	123.0	124.7	128.9	136.1	141.0	141.9	140.8	140.0
Manufacturing (VA)	102.4	102.5	99.1	111.7	122.1	117.3	112.8	123.6	128.9	124.1
Freight Transport (TKM)	101.4	98.4	106.6	106.4	109.0	120.2	122.6	127.4	132.9	130.9
Residential Floor Area (m^2 (htd.))	108.3	112.3	114.8	117.3	117.6	118.0	118.4	118.8	119.3	118.9
Passenger Transport (PKM)	125.5	125.0	123.8	127.8	131.1	138.4	147.3	153.4	153.9	155.5
Service (VA)	132.4	135.8	137.9	139.8	143.8	152.8	160.1	163.9	165.4	163.8

	1990	1991
GDP	143.0	
Manufacturing (VA)	127.3	
Freight Transport (TKM)	133.9	133.3
Residential Floor Area (m^2 (htd.))	119.9	
Passenger Transport (PKM)	157.2	156.4
Service (VA)	166.5	

Note: "GDP" refers to gross domestic product, "VA" to real value added, "TKM" to ton-kilometers transported, "m2 (htd.)" to heated floor area, and "PKM" to passenger-kilometers traveled.

Table A-4
Intensity-Related Indicators of Energy Use (1973=100)

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Energy/GDP	91.2	92.8	92.4	93.0	95.8	96.1	100.5	99.2	104.1	102.1
Manufacturing (EU/VA)	123.4	129.8	121.1	119.8	116.4	116.2	111.8	107.9	109.8	107.4
Service (EU (Useful(CC))/m^2(htd.))	71.5	74.3	76.9	79.4	83.5	87.1	86.2	85.1	83.8	89.5
Residential (EU (Useful(CC))/m^2(htd.))	86.4	88.5	90.4	92.2	99.0	105.4	103.6	102.0	100.4	100.2
Passenger Transport (EU/PKM)	110.4	112.3	108.7	105.8	90.0	95.3	100.3	103.2	105.0	102.2
Freight Transport (EU/TKM)	68.0	66.6	65.3	64.2	64.1	63.4	78.9	91.6	100.7	101.8

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Energy/GDP	101.0	100.0	92.1	91.6	91.1	87.9	90.3	94.2	91.1	90.1
Manufacturing (EU/VA)	105.7	100.0	91.3	99.0	98.8	94.3	97.0	95.8	95.1	92.4
Service (EU (Useful(CC))/m^2(htd.))	94.8	100.0	111.6	115.2	113.5	117.7	115.5	125.1	119.7	122.7
Residential (EU (Useful(CC))/m^2(htd.))	101.7	100.0	96.6	100.0	97.7	101.2	99.3	102.1	100.1	96.0
Passenger Transport (EU/PKM)	102.6	100.0	95.8	99.9	106.7	109.1	108.7	115.8	110.1	112.7
Freight Transport (EU/TKM)	101.7	100.0	100.6	101.7	110.8	115.0	120.8	121.3	113.0	117.7

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Energy/GDP	87.6	88.8	90.6	88.6	87.3	88.1	88.3	87.5	86.2	
Manufacturing (EU/VA)	89.0	83.9	83.3	85.3	87.1	77.6	75.5	77.1	75.1	
Service (EU (Useful(CC))/m^2(htd.))	120.0	122.7	123.5	118.9	120.4	127.6	130.4	131.1	134.4	
Residential (EU (Useful(CC))/m^2(htd.))	98.3	98.1	98.6	95.7	102.2	100.5	100.2	102.5	104.0	
Passenger Transport (EU/PKM)	114.8	114.4	115.6	116.7	115.6	115.0	116.4	117.3	167.1	116.2
Freight Transport (EU/TKM)	110.1	110.1	117.5	108.8	114.4	114.8	107.1	108.2	98.9	91.9

Note: "GDP" refers to gross domestic product "EU" to energy use, "VA" to real value added, "m2 (htd.)" to heated floor area, "PKM" to passenger-kilometers traveled, and "TKM" to ton-kilometers transported,.

Table A-5
Area per Dwelling and per Capita, Household Size, and Real Disposable Income per Household (kr. 1984)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Area per Dwelling (m^2)	75.0	75.3	75.6	75.9	76.2	76.5	76.8	77.1	77.4	77.7
People per Dwelling	3.5	3.5	3.5	3.5	3.5	3.5	3.4	3.4	3.4	3.4
Area per Capita (m^2)	21.1	21.4	21.6	21.8	22.0	22.2	22.4	22.6	22.8	23.0
Household Disposable Income (10^3)	85.7	86.3	87.8	87.7	92.5	93.8	98.6	97.6	92.4	95.9

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Area per Dwelling (m^2)	78.0	78.7	79.4	80.1	80.9	81.6	82.3	83.0	84.3	85.6
People per Dwelling	3.4	3.3	3.3	3.2	3.2	3.2	3.1	3.1	3.1	3.0
Area per Capita (m^2)	23.2	23.7	24.2	24.7	25.2	25.8	26.3	26.7	27.4	28.1
Household Disposable Income (10^3)	101.0	104.7	103.8	107.0	108.1	113.3	115.9	117.1	118.1	122.1

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Area per Dwelling (m^2)	86.9	88.2	89.5	90.8	91.8	92.9	93.9	94.9	95.9	97.0
People per Dwelling	3.0	3.0	3.0	2.9	2.9	2.9	2.8	2.8	2.8	2.7
Area per Capita (m^2)	28.8	29.6	30.3	31.1	31.8	32.5	33.2	34.0	34.7	35.5
Household Disposable Income (10^3)	126.3	122.3	121.7	124.0	128.4	125.2	132.9	137.3	138.4	135.5

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Area per Dwelling (m^2)	98.0	101.0	103.4	105.7	106.2	106.7	107.2	107.7	108.2	108.6
People per Dwelling	2.7	2.7	2.6	2.6	2.6	2.6	2.5	2.5	2.5	2.5
Area per Capita (m^2)	36.4	37.9	39.2	40.5	41.1	41.8	42.4	42.9	43.4	44.0
Household Disposable Income (10^3)	133.9	134.8	133.8	134.6	137.8	138.0	139.7	135.4	133.9	132.5

	1990	1991
Area per Dwelling (m^2)	110.3	
People per Dwelling	2.4	2.4
Area per Capita (m^2)	45.1	
Household Disposable Income (10^3)	135.2	

Table A-6
Residential Dwelling Stock by Type (%)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Occupied Dwellings (10^3)	1065	1087	1109	1131	1153	1175	1198	1220	1242	1264
Farm Houses	20.4	20.8	21.1	21.4	21.7	22.0	22.3	22.6	20.2	17.8
Single-Family (Detached)	25.8	27.3	28.6	29.9	31.2	32.4	33.6	34.7	36.2	37.7
Single-Family (Attached)	32.3	30.8	29.4	28.1	26.8	25.6	24.4	23.2	23.7	24.2
Multi-Family	18.1	17.8	17.4	17.0	16.7	16.3	16.0	15.7	16.4	17.1
Combined	3.3	3.4	3.5	3.5	3.6	3.6	3.7	3.8	3.4	3.1

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Occupied Dwellings (10^3)	1286	1309	1332	1355	1378	1401	1424	1447	1470	1493
Farm Houses	15.6	16.5	17.3	18.1	17.7	17.2	16.7	16.3	15.9	15.5
Single-Family (Detached)	39.1	38.8	38.5	38.3	38.9	39.5	40.1	40.6	41.1	41.7
Single-Family (Attached)	24.7	24.2	23.7	23.3	22.6	22.0	21.3	20.7	20.1	19.6
Multi-Family	17.8	17.6	17.3	17.1	17.2	17.2	17.3	17.3	17.3	17.4
Combined	2.8	2.9	3.1	3.2	2.9	2.6	2.3	2.0	1.7	1.5

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Occupied Dwellings (10^3)	1516	1538	1559	1581	1603	1625	1647	1668	1690	1712
Farm Houses	16.0	14.7	13.2	11.7	11.5	11.3	11.2	11.0	10.9	9.8
Single-Family (Detached)	43.1	43.8	46.3	48.7	48.7	48.8	48.8	48.8	48.9	48.9
Single-Family (Attached)	20.6	21.4	21.7	22.0	21.9	21.9	21.9	21.8	21.8	21.9
Multi-Family	18.3	17.9	17.2	16.6	15.8	15.0	14.2	13.5	12.8	15.9
Combined	2.1	2.2	1.6	1.0	2.0	2.9	3.8	4.7	5.5	2.9

	1990	1991
Occupied Dwellings (10^3)	1734	1757
Farm Houses	8.8	
Single-Family (Detached)	49.9	
Single-Family (Attached)	21.9	
Multi-Family	19.0	
Combined	0.4	

Table A-7
Principal Space Heating Fuel Used in Residential Dwellings (%)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Dwellings (10^3)	1065	1087	1109	1131	1153	1175	1198	1220	1242	1264
Oil & Kerosine	13.1	15.7	18.2	20.5	22.8	25.0	27.1	29.1	29.8	30.6
Solids	70.8	66.1	61.7	57.4	53.3	49.4	45.6	42.0	40.0	37.9
Electricity	16.1	18.2	20.2	22.1	23.9	25.6	27.3	29.0	30.2	31.5
Other/Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Dwellings (10^3)	1286	1309	1332	1355	1378	1401	1424	1447	1470	1493
Oil & Kerosine	31.4	31.6	31.7	31.9	32.0	32.2	32.1	32.0	31.9	31.8
Solids	35.9	34.9	34.0	33.1	31.5	30.1	28.8	27.6	26.4	25.2
Electricity	32.8	33.5	34.3	35.0	35.6	36.2	36.7	37.3	37.9	38.4
Other/Unknown	0.0	0.0	0.0	0.0	0.8	1.6	2.4	3.1	3.8	4.5

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Dwellings (10^3)	1516	1538	1559	1581	1603	1625	1647	1668	1690	1712
Oil & Kerosine	31.6	33.0	28.2	23.6	22.7	21.7	22.1	22.4	22.7	20.0
Solids	24.1	24.0	25.3	26.7	26.7	26.8	26.5	26.3	26.0	23.0
Electricity	39.1	43.1	46.4	49.6	50.4	51.2	51.0	50.8	50.6	55.8
Other/Unknown	5.2	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.5

	1990	1991
Dwellings (10^3)	1734	1757
Oil & Kerosine	17.4	
Solids	20.1	
Electricity	60.3	
Other/Unknown	0.8	

Table A-8
Household Appliance Ownership (%)

	1967	1968	1969	1970	1971	1972	1973	1974	1975
Occupied Dwellings (10^3)	1220	1242	1264	1286	1309	1332	1355	1378	1401
Dishwashers	1.3	1.7	2.0	2.4	2.7	3.1	3.4	4.1	4.9
Clotheswashers	69.3	69.7	70.2	70.6	71.0	71.5	71.9	73.6	75.3
Clothesdryers									
Microwave Ovens									
Kitchen Ventilators									
Waterbeds									

	1976	1977	1978	1979	1980	1981	1982	1983	1984
Occupied Dwellings (10^3)	1424	1447	1470	1493	1516	1538	1559	1581	1603
Dishwashers	6.1	8.0	10.1	11.6	13.8	16.8	17.2	16.2	19.2
Clotheswashers	72.8	76.9	75.2	75.3	74.9	77.7	78.0	82.2	80.2
Clothesdryers									
Microwave Ovens									
Kitchen Ventilators									
Waterbeds									

	1985	1986	1987	1988	1989	1990	1991
Occupied Dwellings (10^3)	1625	1647	1668	1690	1712	1734	1757
Dishwashers	23.5	29.6	32.0	24.7	35.1	37.1	37.3
Clotheswashers	83.2	84.9	87.1	87.8	87.9	89.9	90.1
Clothesdryers		21.9	25.6	29.6	29.8	31.5	34.4
Microwave Ovens						37.0	
Ktichen Ventilators						80.2	
Waterbeds						15.0	

Table A-9
Energy Use in the Residential Sector by Fuel Type (PJ (CC))

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Total	58.0	58.6	59.3	60.0	60.6	61.3	63.8	66.2	68.7	71.2
Oil	4.8	5.7	6.6	7.5	8.4	9.3	10.1	11.0	11.8	12.6
City Gas	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2
Solid Fuels	38.8	37.4	36.1	34.7	33.4	32.0	32.2	32.4	32.6	32.9
Electricity	13.9	15.1	16.3	17.4	18.6	19.8	21.2	22.6	24.1	25.5

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Total	73.7	73.2	72.7	75.8	78.9	82.0	90.3	98.5	99.3	100.2
Oil	13.5	14.9	16.3	18.1	19.9	21.7	28.0	34.3	34.7	35.2
City Gas	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Solid Fuels	33.1	29.7	26.3	25.2	24.1	23.0	21.8	20.6	18.7	16.7
Electricity	26.9	28.5	30.1	32.4	34.8	37.2	40.4	43.5	45.9	48.3
District Heating	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total	101.2	104.3	109.1	109.8	106.6	114.0	113.3	119.9	120.8	127.8
Oil	35.7	37.5	40.6	41.1	32.1	36.4	34.4	34.5	34.1	35.1
City Gas	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
Solid Fuels	14.8	14.6	13.6	11.9	12.6	12.9	12.0	12.6	13.0	15.3
Electricity	50.6	52.1	54.8	56.8	61.8	64.7	66.9	72.7	73.6	77.5
District Heating	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total	128.5	127.5	134.3	137.8	140.0	137.2	149.9	149.8	152.1	157.4
Oil	32.6	26.6	24.8	22.3	20.3	20.1	25.0	24.9	24.9	24.4
City Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solid Fuels	17.0	17.1	18.4	19.3	19.7	17.4	18.5	18.2	19.5	21.6
Electricity	78.9	83.8	91.1	96.0	99.5	99.2	105.8	105.9	106.7	110.3
District Heating	0.0	0.0	0.0	0.2	0.4	0.5	0.6	0.8	1.0	1.1

	1990	1991
Total	162.4	152.9
Oil	21.4	17.7
City Gas	0.0	0.0
Solid Fuels	23.8	21.9
Electricity	116.1	112.1
District Heating	1.1	1.2

Table A-10
Energy Use in the Residential Sector (PJ (CC)) by End Use (%)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Total	58.0	58.6	59.3	60.0	60.6	61.3	63.8	66.2	68.7	71.2
Space Heating	73.8	74.1	74.5	74.8	75.1	75.4	74.4	73.5	72.6	71.8
Water Heating	11.3	11.5	11.7	11.9	12.1	12.3	12.9	13.5	14.0	14.5
Cooking	8.7	7.9	7.1	6.4	5.6	4.9	4.9	4.9	4.8	4.8
Lighting	2.7	3.0	3.4	3.7	4.0	4.3	4.3	4.3	4.2	4.2
Appliances	3.5	3.4	3.3	3.2	3.1	3.0	3.5	3.9	4.3	4.7

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Total	73.7	73.2	72.7	75.8	78.9	82.0	90.3	98.5	99.3	100.2
Space Heating	71.0	68.8	66.6	66.2	65.8	65.5	67.0	68.3	67.7	67.0
Water Heating	15.0	16.4	17.8	18.2	18.6	18.9	18.1	17.4	17.7	18.1
Cooking	4.8	4.9	4.9	4.7	4.5	4.4	3.9	3.6	3.5	3.5
Lighting	4.2	4.4	4.7	4.7	4.8	4.8	4.5	4.4	4.4	4.5
Appliances	5.0	5.5	6.0	6.2	6.3	6.5	6.4	6.4	6.7	6.9

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total	101.2	104.3	109.1	109.8	106.6	114.0	113.3	119.9	120.8	127.8
Space Heating	66.3	66.5	66.8	65.3	63.3	64.2	63.4	63.8	63.2	64.1
Water Heating	18.4	18.0	17.4	18.0	18.5	17.5	17.6	17.1	17.3	16.8
Cooking	3.5	3.3	3.2	3.2	3.2	3.0	2.9	2.8	2.8	2.6
Lighting	4.6	4.9	5.0	5.4	5.5	5.1	5.5	5.5	5.9	5.9
Appliances	7.2	7.3	7.6	8.2	9.5	10.2	10.6	10.8	10.8	10.5

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total	128.5	127.5	134.3	137.8	140.0	137.2	149.9	149.8	152.1	157.4
Space Heating	64.2	63.3	64.5	65.3	63.7	59.5	60.7	59.4	60.3	61.4
Water Heating	16.5	17.0	16.3	15.3	15.8	17.4	16.8	17.3	16.8	16.2
Cooking	2.6	2.6	2.5	2.4	2.6	3.0	3.0	3.2	3.2	3.2
Lighting	5.5	5.9	5.8	5.9	6.3	7.2	7.1	7.4	7.3	7.1
Appliances	11.1	11.2	10.9	11.0	11.5	12.9	12.4	12.8	12.4	12.0

	1990	1991
Total	162.4	152.9
Space Heating	60.7	58.1
Water Heating	16.0	17.0
Cooking	3.5	3.7
Lighting	7.5	8.0
Appliances	12.4	13.2

Table A-11
Residential Sector Energy Intensity Indicators

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Space Heating EU per HH/HDD/m^2 (100 KJ)	0.90	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98	0.99
Water Heating EU per Capita (GJ)	2.01	2.05	2.09	2.13	2.16	2.20	2.38	2.56	2.74	2.91
Cooking EU per Capita (GJ)	1.54	1.41	1.27	1.14	1.01	0.88	0.90	0.92	0.94	0.96
Lighting EU per m^2 (100 MJ)	0.23	0.25	0.28	0.30	0.32	0.35	0.35	0.36	0.36	0.37
Appliances EU per Capita (GJ)	0.63	0.61	0.59	0.58	0.56	0.54	0.65	0.75	0.84	0.94

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Space Heating EU per HH/HDD/m^2 (100 KJ)	1.00	0.95	0.90	0.91	0.93	0.95	1.05	1.15	1.13	1.11
Water Heating EU per Capita (GJ)	3.08	3.32	3.55	3.76	3.96	4.16	4.34	4.52	4.61	4.71
Cooking EU per Capita (GJ)	0.98	0.98	0.99	0.98	0.97	0.96	0.94	0.93	0.90	0.90
Lighting EU per m^2 (100 MJ)	0.37	0.38	0.39	0.40	0.40	0.41	0.42	0.42	0.42	0.42
Appliances EU per Capita (GJ)	1.03	1.11	1.19	1.27	1.35	1.43	1.55	1.67	1.73	1.80

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Space Heating EU per HH/HDD/m^2 (100 KJ)	1.09	1.09	1.11	1.07	1.01	1.06	1.03	1.08	1.04	1.09
Water Heating EU per Capita (GJ)	4.81	4.81	4.81	4.99	4.94	4.99	4.96	5.06	5.14	5.28
Cooking EU per Capita (GJ)	0.92	0.89	0.87	0.88	0.86	0.85	0.82	0.82	0.83	0.81
Lighting EU per m^2 (100 MJ)	0.42	0.44	0.46	0.48	0.46	0.45	0.46	0.48	0.50	0.52
Appliances EU per Capita (GJ)	1.87	1.96	2.12	2.28	2.54	2.90	2.98	3.20	3.23	3.30

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Space Heating EU per HH/HDD/m^2 (100 KJ)	1.07	1.03	1.08	1.09	1.07	0.96	1.04	0.99	1.01	1.05
Water Heating EU per Capita (GJ)	5.19	5.28	5.31	5.12	5.35	5.76	6.06	6.18	6.08	6.03
Cooking EU per Capita (GJ)	0.82	0.81	0.81	0.80	0.87	0.99	1.09	1.15	1.17	1.21
Lighting EU per m^2 (100 MJ)	0.48	0.48	0.49	0.49	0.52	0.57	0.60	0.61	0.60	0.60
Appliances EU per Capita (GJ)	3.50	3.49	3.56	3.68	3.90	4.26	4.47	4.56	4.48	4.46

	1990	1991
Space Heating EU per HH/HDD/m^2 (100 KJ)	1.04	
Water Heating EU per Capita (GJ)	6.12	6.11
Cooking EU per Capita (GJ)	1.33	1.32
Lighting EU per m^2 (100 MJ)	0.64	
Appliances EU per Capita (GJ)	4.75	4.73

Note: "EU" refers to energy use, "HH" to household, and "HDD" to heating-degree day.

Table A-12
Real Energy Prices for Residential Customers (Øre (1984) per kWh)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Kerosine									21.6	21.1
Fuel Oil									15.6	15.1
Coal										
Wood	21.7	22.1	24.5	26.2	26.4	29.6	31.8	31.8	30.4	29.7
Electricity									23.9	24.2
District Heat										

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Kerosine	21.5	20.5	19.4	19.0	17.9	17.6	17.0	17.2	16.9	15.8
Fuel Oil	14.3	13.7	13.0	12.7	12.0	11.0	9.9	10.8	9.9	9.4
Coal			10.4	10.5	10.5	10.2	10.5	10.9	10.7	11.0
Wood	29.7	29.3	30.5	31.5	30.9	30.3	32.8	34.6	34.6	33.2
Electricity	23.8	23.5	23.9	23.4	22.5	22.0	22.1	22.3	22.3	22.7
District Heat										

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Kerosine	14.6	15.8	14.8	15.7	23.5	20.1	20.9	20.6	19.8	22.1
Fuel Oil	8.6	10.9	9.5	10.8	18.0	15.4	16.5	16.3	15.8	18.2
Coal	12.2	13.1	13.3	12.3	14.8	17.2	15.8	14.8	14.6	14.7
Wood	34.3	37.9	37.9	35.2	33.6	35.2	36.7	39.5	40.2	39.5
Electricity	23.8	22.4	22.1	21.4	20.5	21.6	21.2	21.5	24.0	25.9
District Heat										

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Kerosine	30.2	34.4	35.0	33.8	32.5	31.1	21.9	20.3	19.6	20.6
Fuel Oil	26.2	29.3	28.9	27.9	26.9	25.7	17.1	15.9	15.0	15.7
Coal	19.6	20.2	18.2	16.7	16.0	16.8				
Wood	41.7	40.4								
Electricity	25.5	25.8	26.8	28.6	30.5	30.9	31.4	30.8	31.7	31.7
District Heat				26.6	25.7	24.9	20.4	15.0	14.4	16.2

	1990	1991
Kerosine	23.7	27.1
Fuel Oil	19.5	21.6
Coal		
Wood		
Electricity	31.9	
District Heat	18.5	21.1

Note: Energy prices include energy and value added taxes (VAT).

Table A-13
Relative Useful Energy Prices for Residential Customers

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Kerosine/Electricity	1.2	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.0	1.0
Fuel Oil/Electricity	1.2	1.1	1.1	1.1	1.0	1.0	1.0	0.9	0.8	0.9
Coal/Electricity					0.7	0.7	0.8	0.8	0.8	0.8

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Kerosine/Electricity	1.0	0.9	0.8	0.9	0.9	1.0	1.5	1.2	1.3	1.3
Fuel Oil/Electricity	0.8	0.7	0.7	0.9	0.8	0.9	1.6	1.3	1.4	1.4
Coal/Electricity	0.8	0.8	0.9	1.0	1.0	1.0	1.2	1.3	1.2	1.2

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Kerosine/Electricity	1.1	1.1	1.6	1.8	1.7	1.6	1.4	1.3	0.9	0.9
Fuel Oil/Electricity	1.2	1.3	1.9	2.1	2.0	1.8	1.6	1.5	0.8	0.7
Coal/Electricity	1.0	0.9	1.3	1.3	1.1	1.0	0.9	0.9		

	1988	1989	1990
Kerosine/Electricity	0.8	0.9	1.0
Fuel Oil/Electricity	0.7	0.7	0.9
Coal/Electricity			

Table A-14
Relative Impacts of Changing Activity, Intensity, and Structure on Residential Energy Use (1973=100)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Energy Use	67	67	66	69	72	75	82	90	90	91
Changing Activity	90	91	92	93	93	94	95	96	96	97
Changing Intensity	96	92	89	90	92	93	100	107	104	102
Changing Structure	79	80	82	83	84	86	87	88	90	92

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Energy Use	92	95	99	100	97	104	103	109	110	116
Changing Activity	98	99	99	100	101	101	102	102	102	103
Changing Intensity	100	100	102	100	95	99	96	99	98	101
Changing Structure	94	96	98	100	102	104	106	108	110	112

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Energy Use	117	116	122	125	127	125	136	136	139	143
Changing Activity	103	104	104	104	105	105	105	106	106	107
Changing Intensity	100	96	98	97	98	95	102	101	101	103
Changing Structure	114	118	121	124	126	127	129	130	132	132

	1990
Energy Use	148
Changing Activity	107
Changing Intensity	105
Changing Structure	134

Table A-15
Real Service Sector Value Added (kr. 1984), Share of Real Gross Domestic Product, and Real Service Sector Value Added by Building Group (%)

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Value Added (kr. 1984) (10^9)	94.0	97.4	101.1	105.2	108.1	114.4	116.6	126.3	126.0	130.8
Share of GDP	51.2	50.9	50.6	50.1	49.7	49.6	49.9	50.7	50.5	50.2
Office & Business	60.6	60.5	60.3	59.8	59.7	59.9	59.3	60.4	58.3	58.0
Hotel & Restaurant	5.8	5.6	5.5	5.4	5.4	5.2	5.2	5.1	5.1	5.1
Education & Research	6.1	6.5	6.7	7.1	7.2	7.5	7.7	7.5	7.9	8.0
Health Services	7.4	7.4	7.4	7.6	7.7	7.6	7.8	7.7	8.5	8.8
Assembly	2.0	2.0	2.0	2.0	2.0	2.1	2.2	2.1	2.2	2.2
Other	18.1	18.0	18.1	18.0	17.9	17.8	17.8	17.2	17.9	17.8

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Value Added (kr. 1984) (10^9)	136.4	141.0	146.8	152.8	162.1	169.7	174.8	182.3	186.8	191.5
Share of GDP	50.1	50.1	49.1	49.4	50.4	51.2	52.9	53.4	54.2	55.3
Offices & Business	58.0	57.8	58.3	58.2	58.2	58.4	57.9	57.7	57.9	58.0
Hotel & Restaurant	4.8	4.4	4.5	4.5	4.1	3.9	3.8	3.8	3.5	3.2
Education & Research	8.0	8.1	7.9	8.0	8.0	8.0	8.3	8.2	8.3	8.4
Health Services	9.6	9.9	10.2	10.5	11.0	11.4	11.7	12.0	12.3	12.7
Assembly	2.2	2.3	2.2	2.2	2.3	2.3	2.4	2.5	2.5	2.6
Other	17.5	17.4	16.9	16.7	16.4	16.0	15.9	15.9	15.6	15.1

	1982	1983	1984	1985	1986	1987	1988	1989	1990
Value Added (kr. 1984) (10^9)	194.5	197.2	202.8	215.5	225.8	231.2	233.2	231.0	234.8
Share of GDP	56.1	56.2	55.9	56.3	56.9	57.9	58.8	58.6	58.3
Offices & Business	57.8	57.5	57.9	58.6	59.0	58.9	59.1	59.2	58.8
Hotel & Restaurant	3.0	2.9	2.8	2.9	3.0	3.0	2.7	2.5	2.4
Education & Research	8.8	8.8	8.8	8.7	8.4	8.5	8.5	8.7	8.7
Health Services	13.3	13.6	13.5	13.0	12.7	12.8	13.0	13.4	13.6
Assembly	2.5	2.6	2.6	2.6	2.7	2.8	2.9	3.0	3.1
Other	14.7	14.6	14.3	14.1	14.1	13.9	13.7	13.3	13.4

Table A-16
Service Sector Heated Floor Area by Building Group (%)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Heated Floor Area, $m^2(10^3)$	24904	25034	25225	25475	25785	26155	26593	27101	27677	28321
Office & Business	28.1	28.1	28.1	28.1	28.1	28.1	28.1	28.1	28.2	28.2
Hotel & Restaurant	8.7	8.6	8.5	8.4	8.2	8.0	7.9	7.7	7.4	7.2
Education & Research	24.7	24.7	24.6	24.6	24.6	24.6	24.7	24.8	25.0	25.2
Health Services	26.9	26.7	26.4	26.1	25.8	25.4	25.1	24.8	24.5	24.2
Assembly	5.6	5.5	5.4	5.3	5.2	5.1	5.0	4.9	4.8	4.6
Other	6.0	6.4	6.9	7.4	8.0	8.7	9.2	9.8	10.2	10.6

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Heated Floor Area, $m^2(10^3)$	29032	29730	30415	31094	31765	32430	33134	33930	34815	35787
Office & Business	28.3	28.4	28.7	28.7	28.7	28.4	28.6	29.2	29.8	30.4
Hotel & Restaurant	7.0	6.8	6.6	6.4	6.2	6.1	5.9	5.8	5.7	5.6
Education & Research	25.4	25.6	25.8	26.1	26.7	27.3	27.9	28.2	28.5	28.8
Health Services	23.9	23.6	23.2	22.8	22.5	22.2	21.8	21.3	20.8	20.4
Assembly	4.5	4.3	4.2	4.1	4.0	3.9	3.8	3.7	3.7	3.7
Other	10.9	11.2	11.5	11.8	12.0	12.1	12.0	11.7	11.4	11.1

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Heated Floor Area, $m^2(10^3)$	36847	38077	39230	40249	41371	42758	43985	45144	46488	47605
Office & Business	30.9	31.4	31.8	32.4	33.0	33.5	34.2	34.8	35.3	35.9
Hotel & Restaurant	5.5	5.5	5.4	5.4	5.3	5.3	5.2	5.2	5.2	5.1
Education & Research	29.0	29.2	29.4	29.4	29.3	29.2	28.9	28.6	28.3	28.0
Health Services	20.0	19.7	19.4	19.2	18.9	18.8	18.8	18.7	18.6	18.5
Assembly	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.8	3.8	3.9
Other	10.8	10.5	10.2	10.0	9.7	9.4	9.2	9.0	8.8	8.6

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Heated Floor Area, $m^2(10^3)$	48783	49720	51193	52296	53613	55226	56985	59148	61617	63659
Office & Business	36.5	36.9	37.9	38.5	39.3	40.2	41.2	42.5	43.8	44.8
Hotel & Restaurant	5.1	5.1	5.1	5.1	5.0	5.0	5.0	5.1	5.0	4.9
Education & Research	27.7	27.4	26.9	26.4	25.8	25.2	24.5	23.7	22.9	22.3
Health Services	18.3	18.1	17.9	17.8	17.4	17.0	16.6	16.1	15.6	15.2
Assembly	3.9	4.0	4.0	4.1	4.1	4.2	4.2	4.2	4.2	4.3
Other	8.5	8.4	8.2	8.2	8.3	8.4	8.5	8.5	8.5	8.6

	1990	1991
Heated Floor Area, $m^2(10^3)$	65260	66429
Office & Business	45.3	45.5
Hotel & Restaurant	5.0	5.0
Education & Research	21.8	21.6
Health Services	14.9	14.8
Assembly	4.3	4.3
Other	8.7	8.7

Table A-17
Service Sector Heated Floor Area by Installed Space Heating Fuel Source (%)

	1984	1985	1986	1987	1988	1989	1990	1991
Heated Floor Area, $m^2(10^3)$	53613	55226	56985	59148	61617	63659	65260	66429
Oil (only)	11	11	11	10	10	10	10	10
Electricity (only)	27	28	28	30	30	31	31	31
Wood (only)	2	2	2	2	2	2	2	2
2 or more Fuels	60	59	59	58	57	57	57	57

Table A-18
Energy Use in the Service Sector by Fuel Type (PJ(CC))

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Total	21	21	21	21	20	20	21	21	22	22
Oil	6	6	7	7	7	7	8	8	9	9
Solid Fuels	10	10	9	9	9	8	8	8	8	8
Electricity	5	5	5	5	5	5	5	5	5	5
District Heat	0	0	0	0	0	0	0	0	0	0

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Total	23	25	28	29	30	32	34	36	37	38
Oil	10	11	12	13	13	14	16	18	19	21
Solid Fuels	8	7	6	6	5	5	4	3	4	4
Electricity	5	7	10	11	12	13	14	15	14	14
District Heat	0	0	0	0	0	0	0	0	0	0

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total	39	42	46	49	55	57	57	61	61	67
Oil	22	23	25	26	28	28	25	28	26	27
Solid Fuels	4	3	3	2	2	1	0	0	0	0
Electricity	13	16	18	20	25	29	32	33	35	39
District Heat	0	0	0	0	0	0	0	0	0	0

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total	65	66	66	68	70	69	72	79	83	85
Oil	24	22	20	18	17	15	16	17	15	13
Solid Fuels	0	0	0	0	0	0	0	0	0	0
Electricity	40	44	46	49	52	53	55	61	66	70
District Heat	0	0	0	0	0	0	1	1	1	1

	1990	1991
Total	89	85
Oil	13	11
Solid Fuels	0	0
Electricity	75	73
District Heat	2	2

Table A-19
Service Sector Energy Use (PJ(CC)) by Building Group (%)

	1976	1977	1978	1979	1980	1981	1982	1983	1984
Total	57	61	61	67	65	66	66	68	69
Office & Business	37	37	37	36	35	38	38	38	37
Hotel & Restaurant	8	8	8	8	9	8	8	8	9
Education & Research	16	16	16	16	15	15	15	15	15
Health Services	17	17	17	18	18	18	18	18	19
Assembly	4	3	4	4	4	3	3	3	3
Other	19	19	18	19	19	18	17	17	17

	1985	1986	1987	1988	1989	1990	1991
Total	68	71	78	82	84	87	84
Office & Business	38	37	36	36	36	40	39
Hotel & Restaurant	9	8	9	9	9	6	6
Education & Research	15	17	17	17	17	13	13
Health Services	20	20	20	20	21	18	18
Assembly	3	3	3	3	3	7	8
Other	16	15	15	15	14	16	15

Note: Excludes district heating.

Table A-20
Service Sector Energy Intensities (MJ (Useful, CC) per heated m^2)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Average	569.6	566.1	561.4	555.4	548.3	540.1	544.8	547.9	549.5	549.7
Heating	468.1	466.7	464.3	460.8	456.3	450.9	456.9	461.6	464.9	467.0
Non-Heating	146.8	146.9	146.7	146.2	145.3	144.1	144.2	144.0	143.4	142.5

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Average	548.7	620.8	690.0	716.8	742.2	766.2	805.8	841.1	831.8	821.1
Heating	467.8	492.1	515.4	522.8	530.0	537.1	573.0	605.8	623.3	638.3
Non-Heating	141.4	199.3	254.6	277.4	298.8	318.9	328.7	336.8	314.2	292.1

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Average	809.2	863.3	914.7	965.1	1076.7	1111.8	1095.4	1136.3	1115.0	1207.3
Heating	651.0	674.5	697.9	722.4	791.9	793.2	747.8	805.1	758.7	830.5
Non-Heating	270.7	304.3	335.3	364.6	408.4	443.0	473.3	462.0	481.0	511.6

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Average	1154.9	1184.2	1158.3	1184.2	1192.3	1148.0	1162.4	1231.4	1259.0	1265.3
Heating	770.6	773.2	763.4	792.8	780.0	712.8	734.1	772.4	784.3	792.4
Non-Heating	505.2	526.4	497.3	487.5	505.5	529.9	520.4	556.9	564.5	553.2

	1990	1991
Average	1296.4	1230.0
Heating	807.7	738.0
Non-Heating	568.7	568.4

Note: Heating includes water heating.

Table A-21
Energy Use per Heated m^2 by Building Group (MJ (CC))

	1976	1977	1978	1979	1980	1981	1982	1983	1984
Average	1291	1346	1303	1402	1325	1336	1291	1304	1301
Office & Business	1388	1423	1357	1393	1280	1369	1291	1270	1215
Hotel & Restaurant	2005	2098	2077	2296	2191	2089	2040	2091	2252
Education & Research	696	749	732	790	741	748	726	751	769
Health Services	1142	1199	1208	1357	1326	1304	1315	1342	1417
Assembly	1241	1242	1186	1307	1198	1124	1064	1061	1066
Other	2716	2868	2726	3037	2963	2826	2732	2734	2594

	1985	1986	1987	1988	1989	1990	1991
Average	1241	1257	1329	1344	1337	1364	1284
Office & Business	1151	1105	1121	1104	1070		
Hotel & Restaurant	2115	2066	2283	2322	2446		
Education & Research	744	843	935	982	1012		
Health Services	1418	1498	1633	1694	1782		
Asembly	973	987	1028	1048	991		
Other	2307	2214	2272	2272	2090		

Note: District heating is included in the average intensity, but excluded from the building group intensities.

Table A-22
Real Energy Prices for Service Sector Customers (Øre (1984)/kWh)

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
Fuel Oil										
Electricity (Private Services)	44.2	44.2	43.5	42.2	42.6	40.0	36.2	35.3	34.0	33.0
Electricity (Public Services)	37.9	39.3	38.2	38.5	35.7	33.6	30.8	28.4	27.3	27.2
District Heat										

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Fuel Oil			7.1	8.8	7.6	8.8	14.8	12.6	13.5	
Electricity (Private Services)	32.9	32.2	32.6	30.4	28.8	27.5	25.8	25.2	25.7	25.9
Electricity (Public Services)	25.9	25.7	26.6	25.2	24.3	23.6	23.2	22.8	23.5	23.8
District Heat										

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Fuel Oil	13.4	13.0	15.0	21.5	24.1	23.8	23.0	22.2	21.2	13.7
Electricity (Private Services)	23.0	24.0	24.8	24.9	25.0	24.2	27.7	28.1	28.0	28.2
Electricity (Public Services)	18.4	21.5	24.2	24.2	24.2	23.6	27.3	28.1	28.1	28.2
District Heat							22.2	21.4	20.7	17.0

	1987	1988	1989	1990	1991
Fuel Oil	12.0	10.8	11.3	11.3	11.5
Electricity (Private Services)	27.5	28.2	28.2	28.7	
Electricity (Public Services)	27.4	28.0	28.0	28.5	
District Heat	12.5	12.0	13.5	15.4	17.6

Note: Energy prices include energy taxes, but exclude value added taxes (VAT).

Table A-23
Relative Useful Energy Prices for Service Sector Customers

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Fuel Oil/Electricity (Private Services)	0.4	0.5	0.4	0.5	0.9	0.8	0.8	0.9	0.8	0.9
Fuel Oil/Electricity (Public Services)	0.4	0.6	0.5	0.6	1.0	0.8	0.9	1.1	0.9	1.0

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Fuel Oil/Electricity (Private Services)	1.3	1.5	1.5	1.3	1.2	1.2	0.8	0.7	0.6	0.77
Fuel Oil/Electricity (Public Services)	1.4	1.5	1.6	1.3	1.2	1.2	0.8	0.7	0.7	0.7

	1990
Fuel Oil/Electricity (Private Services)	0.7
Fuel Oil/Electricity (Public Services)	0.7

Table A-24
Relative Impacts of Changing Activity, Intensity, and Structure on Service Sector Energy Use (1973=100)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Energy Use	43	43	42	42	42	42	43	44	45	46
Changing Activity	0	0	0	0	0	0	0	0	0	0
Changing Intensity	70	70	69	67	66	65	65	65	65	65
Changing Structure	0	0	0	0	0	0	0	0	0	0

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Energy Use	47	52	57	60	63	65	70	74	76	78
Changing Activity	0	0	70	72	75	77	79	84	85	94
Changing Intensity	65	70	76	77	79	80	84	88	88	88
Changing Structure	0	0	114	112	111	109	108	104	105	100

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Energy Use	80	87	93	100	113	118	117	125	124	137
Changing Activity	90	93	97	100	105	109	116	122	124	129
Changing Intensity	87	92	96	100	110	111	107	111	108	116
Changing Structure	103	102	101	100	99	98	95	93	93	91

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Energy Use	133	136	136	140	143	141	147	161	170	175
Changing Activity	133	136	138	139	144	155	163	167	169	168
Changing Intensity	110	110	107	108	107	102	103	109	110	109
Changing Structure	92	91	92	93	93	90	89	90	94	98

	1990	1991
Energy Use	183	175
Changing Activity	169	0
Changing Intensity	111	105
Changing Structure	99	0

Table A-25
Output of Energy-Intensive Industries
(% of Manufacturing Sector Real Value Added (kr. 1984))

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Energy Intensive Industries (kr. 1984) (10^9)	7085	7264	8351	9013	9697	10133	11110	12120	12498	13100
Paper & Pulp	3.7	3.6	4.0	4.1	4.0	4.0	4.4	4.5	4.5	4.1
Industrial Chemicals	1.6	1.5	1.6	1.9	2.0	1.9	2.2	2.3	2.2	2.4
Stone, Clay, & Glass	3.8	3.6	3.7	3.6	3.5	3.5	3.7	3.8	3.9	4.2
Iron, Steel, & Ferro-Alloys	2.9	2.8	3.2	3.3	3.2	3.2	3.4	3.4	3.5	3.4
Non-Ferrous Metals	4.0	3.7	4.2	4.1	4.7	4.7	5.5	5.8	5.9	5.9
Other Industries	84.1	84.8	83.3	83.1	82.7	82.7	80.8	80.3	80.0	79.9

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Energy Intensive Industries (kr. 1984) (10^9)	13631	14753	15932	14470	14587	14122	14075	15618	15114	15128
Paper & Pulp	4.0	4.2	3.8	3.1	3.3	3.3	3.5	3.9	4.0	4.7
Industrial Chemicals	2.2	2.4	2.3	2.1	2.2	2.3	2.5	3.2	3.4	3.8
Stone, Clay, & Glass	4.1	4.0	3.8	3.5	3.5	3.4	3.5	3.5	3.7	3.8
Iron, Steel, & Ferro-Alloys	3.4	3.6	3.5	3.4	3.4	2.9	3.0	3.4	3.1	3.8
Non-Ferrous Metals	6.0	6.5	6.7	5.7	6.2	6.4	6.6	7.0	6.8	6.6
Other Industries	80.3	79.3	79.9	82.1	81.4	81.7	80.8	79.0	79.0	77.2

	1982	1983	1984	1985	1986	1987	1988	1989	1990
Energy Intensive Industries (kr. 1984) (10^9)	14624	16472	18014	17307	16641	18235	19019	18303	18774
Paper & Pulp	4.8	5.2	5.5	5.2	5.3	5.4	6.2	6.2	6.3
Industrial Chemicals	4.2	4.8	6.0	5.1	4.2	5.3	5.2	5.8	6.3
Stone, Clay, & Glass	4.0	3.9	3.5	3.4	3.5	3.7	3.5	3.4	3.3
Iron, Steel, & Ferro-Alloys	3.5	4.2	4.4	4.1	3.9	3.7	4.7	4.0	3.9
Non-Ferrous Metals	7.0	8.6	8.6	8.1	7.9	8.9	9.7	9.2	9.3
Other Industries	76.6	73.4	72.0	74.1	75.1	73.0	70.7	71.4	70.8

Table A-26
Selected Produced Commodities (MT)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Paper	0.5	0.5	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.7
Pulp	0.5	0.6	0.6	0.5	0.7	0.6	0.7	0.7	0.6	0.7
Cement	0.6	0.7	0.7	0.8	0.8	0.8	0.9	1.0	1.0	1.1
Iron	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3
Steel						0.2	0.2	0.3	0.4	0.4
Ferro-Alloys	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
Aluminium (Primary)		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Paper	0.7	0.9	0.9	1.0	1.1	1.2	1.3	1.4	1.4	1.4
Pulp	0.8	0.8	0.8	0.8	0.9	0.9	0.9	1.0	0.8	0.7
Cement	1.2	1.3	1.4	1.5	1.6	1.6	1.9	2.2	2.3	2.5
Iron	0.4	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.6	0.6
Steel	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.8
Ferro-Alloys	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.5
Aluminium (Primary)	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.5

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Paper	1.4	1.4	1.3	1.4	1.4	1.3	1.3	1.2	1.3	1.4
Pulp	0.6	1.1	1.1	1.1	1.1	0.9	0.9	0.8	0.8	0.9
Cement	2.6	2.7	2.7	2.7	2.6	2.7	2.7	2.3	2.2	2.3
Iron	0.6	0.6	0.7	0.7	0.6	0.6	0.7	0.5	0.6	0.7
Steel	0.8	0.9	0.9	1.0	1.0	0.9	0.9	0.7	0.8	0.9
Ferro-Alloys	0.6	0.7	0.7	0.8	0.9	0.9	0.9	0.7	0.8	0.9
Aluminium (Primary)	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Paper	1.4	1.4	1.3	1.4	1.6	1.6	1.5	1.5	1.6	1.0
Pulp	0.9	0.9	0.9	0.9	1.1	1.2	1.1	1.1	1.1	1.2
Cement	2.2	1.8	1.8	1.7	1.5	1.3	1.6	1.7	1.7	1.7
Iron	0.6	0.6	0.5	0.6	0.5	0.6	0.6	0.4	0.4	0.3
Steel	0.9	0.8	0.8	0.9	0.9	1.0	0.8	0.8	0.9	0.7
Ferro-Alloys	0.8	0.8	0.7	0.9	1.0	0.9	0.8	0.8	0.8	0.8
Aluminium (Primary)	0.7	0.6	0.6	0.7	0.8	0.7	0.7	0.9	0.8	0.9

	1990	1991
Paper	1.1	
Pulp	1.2	1.3
Cement	1.4	1.1
Iron	0.2	
Steel		
Ferro-Alloys	0.8	0.9
Aluminium (Primary)	0.9	0.8

Table A-27
Energy Use in the Manufacturing Sector by Industry Group (PJ)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Total	89	91	94	96	98	101	108	116	123	131
Paper & Pulp	17	18	18	19	19	20	21	23	24	25
Industrial Chemicals	14	15	16	17	17	18	19	21	22	23
Stone, Clay, & Glass	7	7	8	8	9	9	9	10	10	10
Iron, Steel, & Ferro-Alloys	16	16	16	17	17	17	19	20	21	23
Non-Ferrous Metals	11	11	12	12	13	14	15	17	18	20
Other Manufacturing	24	24	24	23	23	23	25	26	28	30

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Total	139	148	158	169	180	191	203	216	225	234
Paper & Pulp	27	28	29	30	32	33	34	35	38	41
Industrial Chemicals	25	27	30	32	34	36	37	37	34	32
Stone, Clay, & Glass	10	11	11	12	13	13	15	16	17	19
Iron, Steel, & Ferro-Alloys	24	25	27	29	31	33	37	40	42	44
Non-Ferrous Metals	21	24	27	31	34	38	39	40	45	49
Other Manufacturing	32	33	34	35	36	37	43	48	48	47

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total	242	247	252	257	254	251	247	230	237	257
Paper & Pulp	44	44	43	42	40	39	36	33	32	34
Industrial Chemicals	30	30	30	29	29	29	32	30	32	35
Stone, Clay, & Glass	21	21	21	21	20	19	19	17	16	17
Iron, Steel, & Ferro-Alloys	47	50	54	58	57	57	59	51	54	66
Non-Ferrous Metals	54	56	58	60	60	60	59	59	61	61
Other Manufacturing	47	47	47	47	47	47	42	40	43	44

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total	247	241	227	240	259	257	252	246	248	244
Paper & Pulp	34	35	31	30	33	38	39	38	38	40
Industrial Chemicals	33	34	32	34	36	31	28	25	26	25
Stone, Clay, & Glass	16	14	14	12	11	10	10	10	10	9
Iron, Steel, & Ferro-Alloys	60	56	50	61	68	66	62	57	62	57
Non-Ferrous Metals	62	60	57	61	66	65	67	71	69	69
Other Manufacturing	42	42	42	44	45	47	46	45	44	43

	1990	1991
Total	244	236
Paper & Pulp	40	39
Industrial Chemicals	27	25
Stone, Clay, & Glass	9	8
Iron, Steel, & Ferro-Alloys	57	54
Non-Ferrous Metals	68	66
Other Manufacturing	44	43

Note: Excludes district heating and feedstocks.

Table A-28
Energy Use in the Manufacturing Sector (PJ) by Fuel Type (%)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Total (PJ)	89	91	94	96	98	101	108	116	123	131
Oil	36.0	36.3	36.6	36.9	37.2	37.5	37.7	37.9	38.1	38.2
Solid Fuels	27.4	25.8	24.3	22.9	21.6	20.3	19.3	18.4	17.6	17.0
Electricity	36.7	37.9	39.1	40.2	41.2	42.2	43.0	43.7	44.3	44.8
District Heat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Total (PJ)	139	148	158	169	180	191	203	216	225	234
Oil	38.4	36.8	35.5	34.6	33.8	33.1	33.9	34.7	34.7	34.8
Solid Fuels	16.3	16.6	16.8	17.2	17.5	17.7	18.0	18.2	18.2	18.1
Electricity	45.3	46.6	47.7	48.3	48.8	49.2	48.1	47.1	47.1	47.1
District Heat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total (PJ)	242	247	252	257	254	251	247	230	237	257
Oil	34.8	33.7	32.6	31.6	30.8	30.0	24.9	26.6	24.4	22.0
Solid Fuels	18.1	18.3	18.5	18.7	18.8	19.0	21.1	20.3	21.2	23.1
Electricity	47.1	48.0	48.9	49.7	50.4	51.0	54.1	53.0	54.4	54.9
District Heat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total (PJ)	247	241	227	240	259	257	253	247	249	244
Oil	21.4	17.9	15.8	11.8	9.4	9.7	13.1	10.3	9.0	6.7
Solid Fuels	22.7	24.2	24.5	26.5	27.9	27.9	27.0	26.8	27.5	27.8
Electricity	55.9	57.9	59.6	61.7	62.6	62.2	59.7	62.6	63.2	65.3
District Heat	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.3	0.3

	1990	1991
Total (PJ)	245	236
Oil	6.9	6.0
Solid Fuels	27.3	26.4
Electricity	65.5	67.3
District Heat	0.3	0.3

Table A-29
Oil Use in the Manufacturing Sector by Industry Group (PJ)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Total	33	32	35	35	36	38	41	44	47	49
Paper & Pulp	9	9	10	10	11	12	13	14	15	15
Industrial Chemicals	3	3	3	3	3	4	4	4	4	4
Stone, Clay, & Glass	3	3	4	5	6	6	7	7	7	8
Iron, Steel, & Ferro-Alloys	0	0	1	1	1	1	1	1	1	1
Non-Ferrous Metals	1	1	1	1	1	1	1	1	1	1
Other Industry	17	16	16	15	14	14	15	17	19	20

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Total	53	55	56	59	61	63	69	75	78	81
Paper & Pulp	16	16	17	17	18	18	19	19	22	24
Industrial Chemicals	5	6	6	7	7	7	7	7	7	7
Stone, Clay, & Glass	8	8	9	9	10	10	12	13	14	16
Iron, Steel, & Ferro-Alloys	1	1	1	1	1	1	1	1	1	1
Non-Ferrous Metals	1	2	2	3	3	4	4	5	5	5
Other Industry	22	22	21	22	22	23	26	30	29	28

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total	85	83	82	81	78	75	61	61	58	56
Paper & Pulp	27	26	25	24	22	20	17	18	17	15
Industrial Chemicals	8	7	7	6	6	6	9	9	11	11
Stone, Clay, & Glass	17	17	17	17	16	16	15	14	12	13
Iron, Steel, & Ferro-Alloys	1	1	1	2	1	1	0	1	1	1
Non-Ferrous Metals	5	6	6	6	6	6	4	4	4	4
Other Industry	27	27	27	27	27	27	15	15	14	13

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total	53	43	36	28	25	25	33	26	23	16
Paper & Pulp	16	12	10	5	3	6	11	6	5	3
Industrial Chemicals	9	10	9	7	7	4	4	3	3	2
Stone, Clay, & Glass	11	6	3	2	2	2	2	2	2	1
Iron, Steel, & Ferro-Alloys	1	1	1	1	1	1	1	1	1	1
Non-Ferrous Metals	4	3	2	3	2	3	4	4	3	2
Other Industry	12	11	11	11	10	10	11	10	9	7

	1990	1991
Total	17	14
Paper & Pulp	3	2
Industrial Chemicals	2	2
Stone, Clay, & Glass	2	2
Iron, Steel, & Ferro-Alloys	1	1
Non-Ferrous Metals	1	1
Other Industry	8	6

Table A-30
Solid Fuels Use in the Manufacturing Sector by Industry Group (PJ)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Total	24	24	23	22	21	21	21	21	22	22
Paper & Pulp	4	4	3	3	3	2	2	2	2	2
Industrial Chemicals	3	3	3	3	3	3	3	3	3	3
Stone, Clay, & Glass	3	3	3	2	2	2	2	1	1	1
Iron, Steel, & Ferro-Alloys	9	9	9	9	9	9	10	10	10	11
Non-Ferrous Metals	1	1	1	2	2	2	2	2	2	3
Other Industry	3	3	3	3	3	3	3	3	3	2

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Total	23	25	27	29	32	34	37	39	41	42
Paper & Pulp	2	3	3	3	3	3	3	4	4	4
Industrial Chemicals	3	3	4	4	4	4	4	4	4	5
Stone, Clay, & Glass	1	1	1	1	1	1	1	1	1	1
Iron, Steel, & Ferro-Alloys	11	12	13	15	16	18	19	20	21	21
Non-Ferrous Metals	3	3	3	3	4	4	4	5	5	6
Other Industry	2	3	3	3	4	4	5	5	6	6

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total	44	45	47	48	48	47	52	47	50	59
Paper & Pulp	4	4	4	4	4	4	4	4	4	4
Industrial Chemicals	5	5	5	4	5	5	4	4	4	5
Stone, Clay, & Glass	1	1	1	1	1	1	1	1	1	2
Iron, Steel, & Ferro-Alloys	22	23	25	26	26	26	28	24	25	32
Non-Ferrous Metals	6	6	6	6	6	6	6	6	6	5
Other Industry	6	6	6	6	6	6	8	8	10	11

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total	56	58	56	64	72	72	68	66	69	68
Paper & Pulp	5	7	6	7	8	11	11	12	11	13
Industrial Chemicals	4	4	4	4	5	6	5	5	6	6
Stone, Clay, & Glass	3	5	8	8	7	6	6	5	5	5
Iron, Steel, & Ferro-Alloys	29	27	23	28	33	31	28	27	29	25
Non-Ferrous Metals	6	5	5	6	6	7	7	6	6	6
Other Industry	10	10	10	11	13	12	12	11	12	12

	1990	1991
Total	67	62
Paper & Pulp	13	13
Industrial Chemicals	6	5
Stone, Clay, & Glass	5	4
Iron, Steel, & Ferro-Alloys	26	24
Non-Ferrous Metals	6	5
Other Industry	12	11

Table A-31
Electricity Use in the Manufacturing Sector by Industry Group (PJ)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Total	33	35	37	39	41	43	47	51	55	59
Paper & Pulp	5	5	5	5	6	6	6	7	7	7
Industrial Chemicals	9	10	10	11	11	12	13	14	15	16
Stone, Clay, & Glass	1	1	1	1	1	1	1	1	1	1
Iron, Steel, & Ferro-Alloys	6	6	6	7	7	7	8	9	10	11
Non-Ferrous Metals	8	9	9	10	10	11	12	13	15	16
Other Industry	4	4	5	5	6	6	6	7	7	7

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Total	63	69	75	82	88	94	98	102	106	110
Paper & Pulp	8	9	10	10	11	12	12	12	13	13
Industrial Chemicals	17	19	20	22	24	25	26	26	23	20
Stone, Clay, & Glass	1	1	1	2	2	2	2	2	2	2
Iron, Steel, & Ferro-Alloys	12	12	13	14	14	15	17	19	20	22
Non-Ferrous Metals	17	20	22	25	27	30	30	30	34	39
Other Industry	7	8	9	10	10	11	12	13	13	14

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total	114	119	123	128	128	128	134	122	129	141
Paper & Pulp	14	14	14	14	14	14	15	11	12	14
Industrial Chemicals	17	18	18	19	19	19	18	16	17	20
Stone, Clay, & Glass	2	2	3	3	3	3	3	2	2	3
Iron, Steel, & Ferro-Alloys	24	26	28	30	30	30	31	26	28	33
Non-Ferrous Metals	43	45	47	48	48	48	49	49	51	52
Other Industry	14	14	14	14	14	14	18	17	19	20

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total	138	140	135	148	162	160	151	155	157	160
Paper & Pulp	13	16	15	18	22	21	16	21	22	24
Industrial Chemicals	19	21	19	22	24	21	19	17	18	17
Stone, Clay, & Glass	2	2	3	2	2	3	3	3	3	3
Iron, Steel, & Ferro-Alloys	30	28	26	32	34	34	33	29	31	31
Non-Ferrous Metals	53	52	50	52	58	56	56	61	61	61
Other Industry	20	21	21	22	23	25	24	24	23	24

	1990	1991
Total	161	159
Paper & Pulp	24	24
Industrial Chemicals	19	18
Stone, Clay, & Glass	3	2
Iron, Steel, & Ferro-Alloys	30	29
Non-Ferrous Metals	61	59
Other Industry	24	25

Table A-32
Energy Intensities in the Manufacturing Sector by Industry Group
(MJ per Real Value Added (kr. 1984))

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Sector Average	3.5	3.5	3.6	3.6	3.6	3.7	3.9	3.8	3.9	3.8
Energy-Intensive Industry	17.6	18.5	17.2	17.0	16.6	16.5	15.9	15.4	15.6	15.3
Paper & Pulp	17.6	17.5	15.7	15.4	15.3	15.1	14.9	14.9	15.9	16.1
Industrial Chemicals	42.8	43.9	43.8	36.6	33.1	32.9	27.1	23.1	21.3	19.1
Stone, Clay, & Glass	6.6	7.0	6.8	7.0	7.4	7.7	8.1	8.2	8.3	7.5
Iron, Steel, & Ferro-Alloys	21.1	22.0	19.6	19.0	20.8	21.7	21.8	21.4	21.6	22.5
Non-Ferrous Metals	15.4	17.2	16.3	17.1	14.7	14.3	14.0	13.8	14.6	14.6
Other Manufacturing	0.9	0.9	0.9	0.8	0.9	1.0	1.0	1.0	0.9	0.9

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Sector Average	3.7	3.6	3.2	3.1	3.2	3.0	3.2	3.5	3.4	3.6
Energy-Intensive Industry										
Paper & Pulp	15.4	13.9	13.2	15.3	13.8	12.8	12.3	11.7	11.6	11.3
Industrial Chemicals	19.2	17.1	16.0	16.6	18.9	16.8	17.4	14.8	13.3	13.5
Stone, Clay, & Glass	7.3	7.3	6.7	6.9	6.7	6.4	6.2	6.6	6.0	5.4
Iron, Steel, & Ferro-Alloys	22.7	22.6	20.6	20.7	22.2	22.9	24.3	25.9	26.8	21.9
Non-Ferrous Metals	14.1	13.0	11.4	12.9	12.2	12.0	12.5	11.8	12.8	13.7
Other Manufacturing	0.8	0.8	0.7	0.7	0.7	0.6	0.7	0.7	0.7	0.8

	1982	1983	1984	1985	1986	1987	1988	1989	1990
Sector Average	3.6	3.9	4.0	3.9	3.8	3.7	3.8	3.8	3.8
Energy-Intensive Industry	12.7	11.9	11.9	12.1	12.4	11.1	10.8	11.0	10.7
Paper & Pulp	10.6	9.3	9.4	11.0	11.0	10.5	9.5	10.0	9.9
Industrial Chemicals	12.5	11.5	9.3	9.1	10.1	6.9	7.6	6.9	6.6
Stone, Clay, & Glass	5.4	4.9	4.7	4.4	4.4	4.1	4.3	4.3	4.3
Iron, Steel, & Ferro-Alloys	22.9	23.4	24.1	24.0	23.5	22.8	20.2	22.4	22.8
Non-Ferrous Metals	13.1	11.4	11.9	12.0	12.6	11.8	11.0	11.7	11.3
Other Manufacturing	0.9	1.0	1.0	0.9	0.9	0.9	0.9	0.9	1.0

Note: District heating is included in the average intensity, but excluded from the industry group intensities.

Table A-33
Real Energy Prices for Customers in the Manufacturing Sector (Øre (1984) per kWh)

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Heavy Fuel Oil				3.6	3.5	3.4	3.9	4.4	5.2	4.8
Fuel Oil										
Coal										
Coke										
Electricity	10.2	9.9	9.5	10.0	10.2	9.4	11.6	9.4	9.2	9.1
Occasional Electricity										

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Heavy Fuel Oil	4.8	8.9	8.2	7.9	8.0	7.4	8.9	12.0	14.3	12.8
Fuel Oil								21.0	23.7	23.4
Coal							4.5	5.5	6.6	5.0
Coke							10.2	10.1	10.2	8.2
Electricity	8.9	9.6	10.2	10.0	10.1	10.4	10.4	10.7	10.7	11.0
Occasional Electricity	5.5	9.6	8.1	8.5	12.0	11.0	12.3	16.7	15.9	15.1

	1983	1984	1985	1986	1987	1988	1989	1990	1991
Heavy Fuel Oil	12.7	14.1	13.3	6.7	7.0	5.2	6.0	6.7	6.3
Fuel Oil	22.4	21.6	20.6	13.1	11.4	10.2	10.8	12.3	12.7
Coal	4.7	3.8	4.6	3.5	2.5	2.5	2.8	2.9	2.7
Coke	6.6	6.0	7.1	6.9	6.2	5.2	4.9	4.9	4.8
Electricity	10.7	10.9	11.4	11.7	11.4	11.2	11.4	10.8	
Occasional Electricity	10.7	10.8	15.2	16.9	10.5	8.7	6.7	6.2	

Table A-34
Real Electricity Prices for Customers in the Manufacturing Sector (Øre (1984) per kWh)

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
Paper & Pulp	14.4	14.8	13.7	13.7	13.7	15.1	12.0	12.4	11.5	11.5
Industrial Chamicals	10.8	9.5	9.7	11.4	9.7	9.3	6.3	6.4	6.9	7.4
Iron & Steel	12.9	11.1	10.0	10.7	10.1	10.4	8.1	7.5	7.3	7.4
Ferro-Alloys										
Aluminium										
Other Industry							24.1	24.2	22.5	22.9

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Paper & Pulp	11.5	11.2	11.3	10.4	10.0	9.9	8.8	9.8	11.0	11.3
Industrial Chamicals	8.9	6.9	72	7.1	7.3	7.4	6.2	7.3	7.3	6.8
Iron & Steel	7.3	7.3	7.3	6.8	6.9	6.6	6.1	6.6	7.4	7.2
Ferro-Alloys							6.9	7.9	8.5	8.5
Aluminium							6.2	6.7	6.6	6.1
Other Industry	21.9	22.9	22.4	20.2	20.8	20.8	19.9	19.7	20.9	20.7

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Paper & Pulp	11.3	11.1	11.3	12.0	11.6	12.6	10.0	11.0	11.8	11.2
Industrial Chamicals	7.0	7.7	8.1	7.7	8.6	7.9	8.0	8.6	8.7	8.8
Iron & Steel	6.8	6.6	5.9	6.7	6.6	6.3	5.7	6.0	6.7	7.2
Ferro-Alloys	8.0	8.1	8.0	8.9	7.8	7.4	6.7	7.6	8.7	8.3
Aluminium	7.0	7.0	6.9	7.2	6.8	6.8	7.3	7.5	7.9	8.1
Other Industry	21.4	22.4	22.9	22.2	22.6	24.2	25.6	25.4	25.2	25.3

	1987	1988	1989	1990
Paper & Pulp	10.5	10.7	9.8	9.9
Industrial Chamicals	9.5	9.4	10.6	7.9
Iron & Steel	5.0	4.9	5.8	8.4
Ferro-Alloys	7.5	7.2	7.9	7.8
Aluminium	7.8	8.0	8.1	7.5
Other Industry	25.7	25.6	25.5	23.4

Table A-35
Relative Impacts of Changing Activity, Intensity, and Structure on Energy Use in the Manufacturing Sector (1973=100)

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Total Energy Use	62	66	70	74	79	84	87	91	94	96
Changing Activity	63	67	70	75	79	82	81	87	88	92
Changing Intensity	125	130	123	118	116	117	114	109	111	108
Changing Structure	51	53	60	65	69	72	77	83	85	89

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Total Energy Use	98	100	99	98	96	89	92	100	96	94
Changing Activity	97	100	111	114	110	108	103	105	101	93
Changing Intensity	106	100	91	96	95	92	95	94	95	93
Changing Structure	93	100	109	103	102	98	97	107	102	102

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Total Energy Use	88	93	101	100	98	96	97	95	96	92
Changing Activity	88	87	91	94	94	95	91	90	90	
Changing Intensity	92	89	89	90	91	85	82	85	85	
Changing Structure	97	108	119	115	111	119	124	119	122	

Table A-36
Relative Impacts of Changing Activity, Intensity, and Structure on Oil Use in the Manufacturing Sector (1973=100)

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Oil Use	69	72	75	78	85	92	96	100	104	103
Changing Activity	63	67	70	75	79	82	81	87	88	92
Changing Intensity	124	124	117	113	116	120	120	116	118	112
Changing Structure	57	60	66	70	74	77	80	86	88	92

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Oil Use	101	100	96	93	76	75	71	69	65	53
Changing Activity	97	100	111	114	110	108	103	105	101	93
Changing Intensity	107	100	90	93	77	78	75	67	63	52
Changing Structure	95	100	107	101	100	98	96	102	101	99

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Oil Use	44	35	30	31	41	31	28	20	21	17
Changing Activity	88	87	91	94	94	95	91	90	90	
Changing Intensity	44	34	28	29	38	29	26	20	21	
Changing Structure	95	99	106	105	104	110	110	109	111	

Tabell A-37
Relative Impacts of Changing Activity, Intensity, and Structure on Solid Fuels Use in the Manufacturing Sector (1973=100)

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Solid Fuel Use	55	60	65	70	76	82	85	88	91	94
Changing Activity	63	67	70	75	79	82	81	87	88	92
Changing Intensity	113	119	111	108	111	114	111	107	108	106
Changing Structure	50	52	61	67	69	72	77	83	85	88

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Solid Fuel Use	97	100	99	99	108	97	104	123	117	121
Changing Activity	97	100	111	114	110	108	103	105	101	93
Changing Intensity	104	100	91	94	104	103	112	119	122	122
Changing Structure	93	100	109	106	104	94	94	105	98	103

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Solid Fuel Use	116	132	150	149	142	138	142	141	139	130
Changing Activity	88	87	91	94	94	95	91	90	90	
Changing Intensity	127	133	142	140	135	131	126	134	132	
Changing Structure	94	107	119	115	109	113	125	114	115	

Table A-38
Relative Impacts of Changing Activity, Intensity, and Structure on Electricity Use in the Manufacturing Sector (1973=100)

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Electricity Use	59	64	69	74	77	79	83	86	89	93
Changing Activity	63	67	70	75	79	82	81	87	88	92
Changing Intensity	130	137	131	126	117	117	111	106	107	107
Changing Structure	47	48	55	60	66	69	75	81	84	87

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Electricity Use	96	100	100	100	104	95	101	110	108	109
Changing Activity	97	100	111	114	110	108	103	105	101	93
Changing Intensity	105	100	91	99	102	96	103	102	105	108
Changing Structure	92	100	110	102	102	99	98	110	105	104

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Electricity Use	106	116	127	125	118	121	123	125	125	124
Changing Activity	88	87	91	94	94	95	91	90	90	
Changing Intensity	110	107	109	110	107	104	100	108	107	
Changing Structure	100	115	128	122	116	127	133	128	132	

Table A-39
Motor Vehicle Stock (per 1,000 persons)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Automobiles	19.9	21.1	23.6	27.0	31.8	35.6	38.7	43.9	49.0	54.2
Buses					1.3	1.4	1.4	1.4	1.4	1.4
Trucks		17.0	19.4	21.0	22.3	23.3	24.2	25.4	26.8	28.5

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Automobiles	62.9	76.5	88.5	99.4	112.5	123.5	137.4	148.9	160.6	181.7
Buses	1.4	1.5	1.6	1.6	1.7	1.7	1.8	1.8	1.9	1.9
Trucks	30.0	31.0	31.9	32.5	33.3	33.6	34.1	34.4	34.8	36.1

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Automobiles	192.7	206.6	217.2	211.6	223.4	238.0	254.1	273.7	282.6	292.1
Buses	1.9	2.0	2.0	2.1	2.1	2.2	2.3	2.5	2.7	2.8
Trucks	37.3	39.7	41.5	41.2	36.4	34.5	34.5	35.4	35.8	37.2

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Automobiles	301.9	311.9	325.1	335.1	345.3	364.5	382.2	387.7	385.3	381.5
Buses	2.9	3.2	3.4	3.7	3.9	4.1	4.4	4.6	4.7	4.8
Trucks	37.3	38.7	40.5	43.5	47.8	56.0	63.5	71.6	69.9	71.0

	1990	1991
Automobiles	380.3	378.5
Buses	5.0	5.5
Trucks	72.7	72.9

Table A-40
Actual Fuel Economy of Automobiles, Buses, and Trucks by Fuel Type (liters per mil)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Auto's- Gasoline	1.03	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.01
Auto's- Diesel	0.93	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.91
Buses- Gasoline	1.40	1.40	1.40	1.40	1.40	1.40	1.30	1.30	1.30	1.30
Buses- Diesel	3.12	3.09	3.06	3.03	3.00	2.97	2.94	2.91	2.88	2.85
Trucks- Gasoline	1.33	1.31	1.30	1.29	1.29	1.29	1.28	1.28	1.28	1.28
Trucks- Diesel	4.39	4.31	4.24	4.17	4.11	4.05	4.00	3.98	3.87	3.79

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Auto's- Gasoline	1.01	1.00	0.99	0.97	0.95	0.93	0.91	0.91	0.91	0.91
Auto's- Diesel	0.91	0.90	0.89	0.87	0.86	0.84	0.82	0.82	0.82	0.82
Buses- Gasoline	1.30	1.30	1.30	1.30	1.30	1.20	1.20	1.20	1.20	1.20
Buses- Diesel	2.82	2.77	2.71	2.66	2.60	2.55	2.53	2.50	2.48	2.45
Trucks- Gasoline	1.28	1.27	1.26	1.23	1.20	1.16	1.13	1.13	1.13	1.12
Trucks- Diesel	3.63	3.50	3.31	3.11	2.95	2.73	2.63	2.46	2.49	2.43

	1990	1991
Auto's- Gasoline	0.90	0.89
Auto's- Diesel	0.81	0.80
Buses- Gasoline	1.20	1.20
Buses- Diesel	2.44	2.43
Trucks- Gasoline	1.08	1.08
Trucks- Diesel	2.36	2.30

Table A-41
Rolling Stock

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Steam Locomotives	263	239	184	132	105	100	93	83	56	3
Electric	268	269	266	263	267	268	264	270	273	277
Diesel	130	134	133	145	151	152	151	152	151	146
Electric Tram's	491	485	478	479	479	458	426	389	383	389

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Steam Locomotives	0	0	0	0	0	0	0	0	0	0
Electric	281	280	275	285	292	300	301	301	300	304
Diesel	145	141	142	142	140	140	138	137	137	137
Electric Tram's	414	409	402	342	341	341	398	412	314	314

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Steam Locomotives	0	0	0	0	0	0	0	0	0	0
Electric	306	305	316	316	313	311	306	295	285	282
Diesel	138	138	135	139	147	143	147	140	140	129
Electric Tram's	425	405	395	369	352	355	349	346	339	350

	1991
Steam Locomotives	0
Electric	279
Diesel	128
Electric Tram's	350

Note: Electric and diesel include locomotives, rail motor vehicles, and sets.

Table A-42
Rail System Capacity (10^3)

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Seats & Berths (NSB & Private)	72.2	70.7	70.8	68.8	67.6	66.6	66.0	63.5	59.9	59.6
Seats & Standing Places (Tramways & Suburban)	46.5	45.4	45.3	45.2	45.3	52.8	52.7	50.6	49.9	50.9
Freight Capacity	204.1	188.9	187.8	190.9	194.5	197.2	196.6	194.3	191.1	191.9

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Seats & Berths (NSB & Private)	58.1	58.3	55.5	57.4	57.0	58.8	56.9	54.2	52.6	52.9
Seats & Standing Places (Tramways & Suburban)	55.0	54.3	53.8	53.8	50.4	53.4	52.6	54.9	60.0	60.1
Freight Capacity	193.8	186.6	182.9	182.5	186.2	212.3	215.2	217.1	216.7	217.4

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Seats & Berths (NSB & Private)	52.4	53.2	54.2	56.1	55.3	55.0	55.5	55.4	54.5	54.4
Seats & Standing Places (Tramways & Suburban)	58.5	55.8	62.8	58.9	51.7	52.2	51.4			
Freight Capacity	217.0	209.5	199.2	190.9	213.8	212.3	209.6	199.4	199.4	191.3

	1991
Seats & Berths (NSB & Private)	54.0
Seats & Standing Places (Tramways & Suburban)	
Freight Capacity	179.8

Table A-43
Truck Fleet by Size (%)

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
< 1,000 kg	34.8	38.8	40.9	40.5	40.8	42.4	45.8	48.8	52.2	55.0
1,000-1,999 kg	17.9	16.8	16.1	15.9	15.9	15.4	14.3	13.5	12.3	11.1
2,000-5,000 kg	46.7	43.5	42.1	42.4	41.9	40.6	38.3	35.7	33.5	31.5
+5,000 kg	0.6	0.9	0.9	1.2	1.5	1.5	1.5	2.0	2.0	2.4
5,000-9,999 kg										
10,000 + kg										

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
< 1,000 kg	55.2	56.4	56.9	57.6	57.6	57.4	57.5	56.7	56.2	54.5
1,000-1,999 kg	11.1	10.6	10.4	10.3	10.3	10.4	10.3	10.5	11.1	12.7
2,000-5,000 kg	30.2	28.8	27.4	25.8	24.8	23.8	22.5	20.3	17.8	16.0
+5,000 kg	3.5	4.3	5.3	6.4	7.4	8.7	10.0	12.5	14.9	16.8
5,000-9,999 kg										
10,000 + kg										

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
< 1,000 kg	54.4	54.7	51.2	46.8	42.0	38.1	34.7	32.8	32.3	30.0
1,000-1,999 kg	12.9	14.1	16.5	18.7	21.1	23.6	26.3	28.1	29.1	31.2
2,000-5,000 kg	14.4	13.1	13.0	13.3	13.8	14.3	14.4	14.5	14.0	14.0
+5,000 kg	18.2	18.1	19.3	21.2	23.1	24.0	24.6	24.6	24.6	24.9
5,000-9,999 kg	16.4	16.0	16.7	17.7	18.6	18.7	18.4	18.1	17.3	16.9
10,000 + kg	1.8	2.1	2.6	3.5	4.5	5.3	6.2	6.5	7.3	8.0

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
< 1,000 kg	29.3	28.5	30.9	34.3	39.8	42.7	46.9	45.2	46.7	48.5
1,000-1,999 kg	32.9	34.6	34.2	33.4	31.6	30.9	29.1	30.6	30.3	29.7
2,000-5,000 kg	13.6	13.3	12.5	11.5	10.3	9.5	8.6	8.7	8.3	7.9
+5,000 kg	24.3	23.6	22.4	20.7	18.4	16.9	15.3	15.4	14.7	13.9
5,000-9,999 kg	15.9	15.0	13.8	12.4	10.5	9.2	8.0	7.9	7.4	6.8
10,000 + kg	8.3	8.6	8.6	8.4	7.8	7.6	7.3	7.6	7.3	7.1

	1991
< 1,000 kg	49.5
1,000-1,999 kg	29.5
2,000-5,000 kg	7.6
+5,000 kg	13.4
5,000-9,999 kg	6.3
10,000 + kg	7.1

Table A-44
Diesel-Driven Truck Fleet by Size (% of Truck Fleet)

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Average	16.1	17.9	19.6	21.6	23.1	24.7	26.0	26.5	28.7	32.3
< 1,000 kg	0.1	0.1	0.0	0.1	0.1	0.2	0.6	0.9	1.3	1.8
1,000-1,999 kg	3.6	4.1	4.7	5.4	6.0	6.3	8.1	9.2	9.8	11.2
2,000 + kg	49.3	54.2	59.4	64.2	68.5	72.4	75.5	79.3	81.8	85.3

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Average	35.9	38.2	40.2	41.3	42.9	45.6	47.8	49.8	50.9	50.7
< 1,000 kg	2.4	2.9	3.3	4.0	7.4	10.5	15.0	19.5	25.3	27.9
1,000-1,999 kg	12.3	12.8	13.7	14.4	15.7	19.0	23.0	26.2	28.4	30.1
2,000 + kg	87.4	89.1	90.8	92.0	93.2	94.0	94.7	95.3	95.7	96.1

	1985	1986	1987	1988	1989	1990	1991
Average	49.7	49.5	52.4	50.0	50.2	50.9	51.9
< 1,000 kg	30.5	32.5	41.2	34.5	35.4	36.9	38.4
1,000-1,999 kg	31.5	32.6	33.7	35.3	37.1	39.5	42.1
2,000 + kg	96.4	96.8	97.1	97.3	97.5	97.5	97.7

Table A-45
Passenger-Kilometers Traveled per Capita by Mode Type (10^3)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Total	1843	1843	1843	1852	1901	2188	2111	2184	2415	2540
Automobile	435	441	447	446	419	472	515	567	777	858
Motorcycle	166	108	51	41	51	64	79	103	133	158
Bus	447	502	555	579	630	825	678	694	712	726
Rail	643	639	634	628	634	650	654	642	620	622
Boat	150	151	152	153	159	166	168	157	149	148
Air	2	2	3	5	7	11	16	20	23	28

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Total	2737	2868	3132	3186	3424	3671	4893	5168	5608	6115
Automobile	971	1046	1268	1415	1593	1775	2991	3242	3665	4164
Motorcycle	179	178	181	183	180	214	205	196	188	182
Bus	775	811	850	782	841	876	913	912	943	963
Rail	629	639	631	597	574	565	552	552	531	502
Boat	156	159	155	150	163	154	154	155	155	160
Air	26	35	47	59	73	88	79	112	127	145

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total	6660	7290	7655	8189	8227	8810	9018	9530	9566	9458
Automobile	4696	5284	5605	6130	6099	6684	6860	7321	7338	7125
Motorcycle	179	174	169	162	155	150	148	147	148	149
Bus	961	966	983	986	1018	989	973	986	968	1013
Rail	498	505	514	503	555	567	581	588	603	647
Boat	163	170	175	177	170	165	173	169	164	160
Air	163	192	210	231	230	255	283	318	344	364

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total	9963	9890	9762	10044	10269	10813	11470	11881	11861	11934
Automobile	7603	7511	7501	7786	8004	8420	9047	9454	9429	9513
Motorcycle	123	126	134	139	143	152	168	171	164	167
Bus	1042	1048	960	923	897	951	931	894	927	936
Rail	673	675	626	613	610	618	620	612	585	582
Boat	162	155	146	148	149	155	153	151	151	152
Air	361	374	395	435	466	517	552	598	605	584

	1990	1991
Total	12024	11889
Automobile	9528	9389
Motorcycle	166	164
Bus	976	970
Rail	573	583
Boat	156	153
Air	625	629

Table A-46
Freight Ton-Kilometers Transported by Mode Type (10^9)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Total	4.1	5.4	6.7	7.0	7.2	7.5	7.7	7.9	8.0	8.2
Truck	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.1	1.1	1.1
Rail	1.0	1.1	1.2	1.4	1.3	1.3	1.2	1.2	1.1	1.1
Boat	2.0	3.1	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6
Air	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Timber floating	0.4	0.4	0.5	0.4	0.4	0.3	0.4	0.4	0.4	0.3

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Total	8.7	9.2	9.6	10.1	10.6	11.1	11.7	12.4	13.1	13.8
Truck	1.5	1.6	1.8	1.9	2.0	2.2	2.4	2.5	2.7	3.0
Rail	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.3	1.3	1.4
Boat	5.9	6.2	6.5	6.9	7.2	7.6	8.0	8.4	8.9	9.3
Air	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Timber floating	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total	15.0	15.3	16.2	16.9	16.4	16.0	16.5	16.3	16.0	16.1
Truck	3.2	3.5	3.7	4.1	4.3	4.6	4.9	4.9	4.9	5.1
Rail	1.4	1.4	1.4	1.5	1.5	1.5	1.6	1.6	1.5	1.6
Boat	10.3	10.3	10.9	11.3	10.5	9.8	10.0	9.7	9.4	9.3
Air	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Timber floating	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total	17.1	16.6	18.0	17.9	18.4	20.3	20.7	21.5	22.4	22.1
Truck	5.3	5.1	5.4	5.7	6.0	6.5	7.2	7.7	8.1	7.9
Rail	1.7	1.7	1.6	1.5	1.6	1.8	1.8	1.7	1.6	1.8
Boat	10.1	9.8	10.9	10.7	10.7	12.0	11.6	12.1	12.6	12.4
Air	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Timber floating	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	1990	1991
Total	22.6	22.5
Truck	7.7	7.5
Rail	1.6	1.7
Boat	13.2	13.3
Air	0.0	0.0
Timber floating	0.0	0.0

Table A-47
Vehicle-Kilometers Traveled per Vehicle

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Automobile (Private)	12515	12514	12514	12417	12420	13418	13817	13919	13621	13827
Bus	34539	35548	36230	35716	35716	35662	35571	34593	34004	33479
Truck (Average)	15631	15692	15691	15703	15855	16679	17025	17143	16947	17290
Truck (Gasoline)	14433	14450	14438	14330	14325	15377	15821	15934	15589	16186
Truck (Diesel)	19286	19224	19162	19107	19055	19006	18969	18943	18877	18758

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Automobile (Private)	13332	13041	12946	12951	13256	13554	13755	13895	14050	14230
Bus	32994	32206	31702	31229	31024	30952	30458	30192	29923	29893
Truck (Average)	17153	17231	17310	17271	17641	17618	17763	17843	17859	17729
Truck (Gasoline)	15983	16043	15989	15970	16273	16533	16706	16878	16946	17052
Truck (Diesel)	18549	18528	18641	18526	18974	18717	18840	18720	18773	18401

	1990	1991
Automobile (Private)	14403	14118
Bus	29853	29719
Truck (Average)	17596	17423
Truck (Gasoline)	17061	16782
Truck (Diesel)	18112	18017

Table A-48
Vehicle Kilometers Traveled by Train and Airplane (10^6)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total Rail	47	48	47	47	49	49	51	51	55	54
Rail (Passenger)	28	29	29	29	29	30	30	31	31	31
Rail (Freight)	10	10	10	9	11	11	11	11	15	13
Air	18	20	22	23	23	24	25	27	28	30
Air (Passenger)	16	19	20	21	21	21	23	24	25	27
Air (Freight)	1	2	2	2	2	2	2	3	3	3

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total Rail	53	52	52	50	51	51	52	52	51	49
Rail (Passenger)	32	32	31	30	31	30	31	32	33	31
Rail (Freight)	12	11	11	10	10	10	11	10	9	10
Air	31	30	31	33	33	37	44	46	47	44
Air (Passenger)	28	27	27	30	30	33	40	42	43	41
Air (Freight)	3	3	3	3	3	4	4	4	4	3

	1990	1991
Total Rail	50	51
Rail (Passenger)	32	32
Rail (Freight)	10	9
Air	48	49
Air (Passenger)	45	46
Air (Freight)	3	4

Table A-49
Passenger Transportation Energy Use by Mode Type (GJ per Capita)

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Total	5.3	5.5	5.8	6.0	6.8	7.6	8.7	9.8	10.8	11.5
Automobile	2.9	3.2	3.5	3.7	4.5	5.3	6.2	7.2	8.1	8.7
Motorcycle	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.4	0.4
Bus	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Rail (Passenger)	0.7	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.2
Air (Passenger)	0.8	0.8	0.9	0.9	1.0	1.1	1.2	1.3	1.4	1.5

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Total	12.1	12.7	12.2	13.6	14.9	16.1	16.1	17.0	17.0	17.2
Automobile	9.1	9.6	9.2	10.6	11.7	12.6	12.7	13.3	13.3	13.3
Motorcycle	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Bus	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9
Rail (Passenger)	0.3	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Air (Passenger)	1.7	1.7	1.7	1.7	1.8	2.0	1.9	2.1	2.2	2.4

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Total	17.3	17.8	18.4	19.5	20.5	21.1	21.4	21.7	21.7	21.4
Automobile	13.6	13.7	14.2	15.0	15.6	16.0	16.1	16.1	16.1	15.6
Motorcycle	0.3	0.3	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Bus	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.2	1.3
Rail (Passenger)	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.4	0.4
Air (Passenger)	2.1	2.4	2.5	2.8	3.1	3.3	3.4	3.7	3.7	3.8

Table A-50
Freight Energy Use by Mode Type (GJ per Capita)

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Total	4.5	4.6	4.7	4.8	5.0	5.2	6.8	8.2	9.7	10.0
Trucks	1.5	1.6	1.7	1.8	1.9	2.0	2.9	3.7	4.5	4.8
Rail (Freight)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Boat (Freight)	2.7	2.7	2.8	2.8	2.9	3.0	3.6	4.3	4.9	4.9
Air (Freight)	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Total	10.5	10.7	10.4	10.2	11.4	11.6	11.9	12.0	11.8	11.9
Trucks	5.0	5.1	4.7	4.8	4.9	5.1	5.2	5.4	5.4	5.5
Rail (Freight)	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Boat (Freight)	5.2	5.3	5.4	5.1	6.1	6.0	6.2	6.1	6.0	6.0
Air (Freight)	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Total	12.0	12.0	13.0	13.3	14.2	14.8	14.3	14.2	13.2	12.1
Trucks	5.7	5.8	6.3	6.8	7.4	8.0	8.0	7.8	7.8	7.6
Rail (Freight)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Boat (Freight)	5.9	5.7	6.3	6.0	6.2	6.3	5.8	5.8	4.9	4.0
Air (Freight)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Table A-51
Passenger Activity (PKM) per Kroner of Real Disposable Income & Freight Activity (TKM) per Kroner of Real GDP

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
PKM per DI	0.098	0.096	0.100	0.102	0.131	0.136	0.145	0.151	0.158	0.176
TKM per GDP	0.052	0.053	0.053	0.053	0.054	0.054	0.056	0.055	0.060	0.059

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
PKM per DI	0.184	0.192	0.184	0.200	0.191	0.193	0.190	0.189	0.200	0.195
TKM per GDP	0.060	0.060	0.055	0.052	0.051	0.049	0.048	0.047	0.050	0.048

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
PKM per DI	0.191	0.193	0.191	0.199	0.206	0.218	0.219	0.220	0.215	0.209
TKM per GDP	0.052	0.051	0.051	0.053	0.052	0.054	0.057	0.056	0.056	

Table A-52
The Average Household's Transportation Expenditures (% of Total Expenditures)

	1967	1973	1974-76	1977-79	1980-82	1983-85	1986-88	1989-91
Automobile Purchases	6	6	5.2	6.2	5.1	7.1	8.7	4.7
Gasoline	2.5	3.6	3.5	4	4.6	4.7	3.4	4.3
Other (Insurance, Repairs and Maintenance)	2.9	4.7	5	5	4.5	4.4	5.2	4.8
Airplane	0.2	0.3	0.4	0.3	0.4	0.4	0.8	0.6
Other Mass Transit	2.5	2.6	2.4	2	2.1	2	1.6	1.5

Table A-53
Real Gasoline and Diesel Prices (Øre (1984) per liter)

		1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Super Gasoline	~98 okt.	493	491	493	488	460	443	480	464	498	492
Regular Gasoline	92-93 okt.										
Sup. Unleaded Gas.	~98 okt.										
Unleaded Gasoline	95 okt.										
Diesel											

		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Super Gasoline	~98 okt.	469	455	435	472	442	431	511	455	446	434
Regular Gasoline	92-93 okt.			414	452	423	418	499	446	438	426
Sup. Unleaded Gas.	~98 okt.										
Unleaded Gasoline	95 okt.										
Diesel				92	144	128	139	209	180	189	183

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Super Gasoline	~98 okt.	445	455	541	558	530	523	521	485	420	414
Regular Gasoline	92-93 okt.	438	448	530	548	520	510	505	475		
Sup. Unleaded Gas.	~98 okt.										
Unleaded Gasoline	95 okt.									403	397
Diesel		177	200	280	308	303	289	280	267	183	170

		1988	1989	1990	1991
Super Gasoline	~98 okt.	408	421	449	501
Regular Gasoline	92-93 okt.				
Sup. Unleaded Gas.	~98 okt.			435	476
Unleaded Gasoline	95 okt.	383	393	415	458
Diesel		163	170	200	230

Note: Gasoline and diesel prices include energy and value added taxes (VAT).

Table A-54
Relative Impacts of Changing Activity, Intensity, and Structure on Passenger Energy Use (1973=100)

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Energy Use	37.6	39.2	41.0	43.2	50.0	57.0	65.7	74.4	83.0	89.2
Changing Activity	32.7	33.6	36.6	39.6	54.7	58.7	64.7	71.5	78.8	87.2
Changing Intensity	157.3	149.2	139.8	132.3	106.8	107.3	110.1	110.4	109.7	104.4
Changing Structure	75.5	79.6	82.3	84.8	87.8	91.1	92.8	94.8	96.3	98.0

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Energy Use	95.0	100.0	97.3	109.5	120.4	130.9	131.3	138.9	139.5	142.2
Changing Activity	92.5	100.0	101.3	109.5	112.6	119.8	120.8	119.8	127.2	126.7
Changing Intensity	104.0	100.0	96.8	99.6	105.4	106.7	105.8	113.0	107.0	109.0
Changing Structure	98.8	100.0	99.3	100.5	101.7	102.8	103.9	104.2	103.5	104.0

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Energy Use	143.3	147.5	152.7	163.2	172.0	178.2	181.1	184.4	185.6	183.7
Changing Activity	125.5	129.6	132.8	140.3	149.4	155.7	156.3	157.9	159.6	158.7
Changing Intensity	110.3	108.7	109.3	109.8	108.1	107.0	107.7	108.2	107.4	107.0
Changing Structure	105.7	107.3	108.5	109.6	110.2	111.6	111.8	111.0	112.2	112.4

Table A-55
Relative Impacts of Changing Activity, Intensity, and Structure on Freight Energy Use (1973=100)

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Energy Use	38.8	39.9	41.0	42.3	44.6	46.8	61.1	75.1	89.5	92.3
Changing Activity	55.9	58.8	61.8	64.9	68.9	73.2	77.0	81.7	88.7	90.5
Changing Intensity	75.5	73.0	70.9	69.5	68.5	67.8	83.6	96.3	106.0	104.8
Changing Structure	90.7	91.6	92.3	92.8	93.4	93.7	94.9	95.3	95.5	97.4

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Energy Use	97.6	100.0	98.1	96.6	108.5	111.1	114.4	115.5	114.7	115.9
Changing Activity	95.9	100.0	97.5	94.8	97.8	96.6	94.8	95.2	101.6	98.5
Changing Intensity	103.5	100.0	99.2	98.4	107.8	111.0	116.3	116.4	108.0	112.3
Changing Structure	98.4	100.0	102.1	105.3	106.4	107.5	108.7	110.0	108.5	108.8

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Energy Use	117.4	117.2	128.0	130.8	140.2	146.3	142.4	141.7	132.4	122.5
Changing Activity	106.7	106.6	109.2	120.4	123.0	128.0	133.4	131.4	134.4	133.9
Changing Intensity	103.8	102.5	110.0	100.5	104.1	103.0	94.4	96.2	86.3	79.2
Changing Structure	108.7	110.9	111.8	111.0	114.4	115.7	116.7	115.9	114.1	112.9

Table A-56
Energy Use in the Agriculture and Forestry, Fishery, Mining, and Construction Sectors (PJ)

	1976	1977	1978	1979	1980	1981	1982	1983	1984
Total Energy Use in the Agriculture and Forestry, Fishery, Mining, and Construction Sectors	44	44	45	48	42	40	39	41	42
Share of Total Energy Use (%)	7.7	7.7	7.7	7.7	6.9	6.7	6.7	6.8	6.6
Stationary Energy Use	16	15	16	17	15	15	14	13	14
Agriculture & Forestry	6.7	6.9	7.4	7.4	6.5	6.0	5.6	5.2	5.3
Fishery	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Mining	5.4	4.7	4.7	5.1	4.6	4.9	4.4	4.7	4.8
Construction	3.5	3.7	3.9	4.1	4.2	4.1	3.6	3.3	3.4
Transportation Energy Use	28	29	29	32	27	25	25	27	29.0
Agriculture & Forestry	4.1	4.2	4.2	4.4	4.6	5.4	5.5	5.4	5.5
Fishery	18.7	19.0	19.0	21.7	16.5	14.3	14.8	16.3	17.2
Mining	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction	5.2	5.4	5.8	5.7	5.6	5.3	5.0	5.7	5.9

	1985	1986	1987	1988	1989	1990	1991
Total Energy Use in the Agriculture and Forestry, Fishery, Mining, and Construction Sectors	44	47	47	47	44	43	40
Share of Total Energy Use (%)	6.7	7.0	6.9	6.9	6.6	6.5	6.2
Stationary Energy Use	14	14	14	14	14	11	11
Agriculture & Forestry	5.4	5.7	5.9	6.6	6.3	4.4	4.1
Fishery	0.5	0.3	0.3	0.1	0.4	0.6	0.5
Mining	4.5	4.2	4.2	3.7	3.4	3.4	3.2
Construction	3.8	4.0	4.0	4.1	3.6	3.0	2.8
Transportation Energy Use	30	33	33	32	31	32	29
Agriculture & Forestry	5.5	5.7	5.6	5.7	5.7	6.7	6.6
Fishery	18.1	19.4	20.0	20.0	19.0	19.8	17.4
Mining	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction	6.3	7.8	7.2	6.7	5.9	5.7	5.4

Table A-57
The Use of Feeedstocks in the Manufacturing Sector (PJ)

	1976	1977	1978	1979	1980	1981	1982	1983	1984
LPG	12	14	25	33	43	41	42	40	50
Share of Total Sectoral Demand (%)	4	6	10	12	15	15	16	14	16

	1985	1986	1987	1988	1989	1990	1991
LPG	52	39	55	52	43	48	47
Share of Total Sectoral Demand (%)	17	13	18	17	15	16	17

Appendix B

This appendix contains information (i.e., units of measure, assumptions, and sources) on the data used in this report. Section 1 contains information on general data and the subsequent sections contain information on sectoral data.

1 General Data

A Energy Use

1 Residential, Service, Manufacturing, and Transportation Sectors

Sources listed in Sections 2.D, 3.E, 4.E, and 5.G.

2 Agriculture and Forestry, Fishery, Mining, and Construction Sectors

The agriculture and forestry, fishery, mining, and construction sectors have been excluded from this analysis in order to follow the convention used in Schipper, *et. al.* (1990). Schipper, *et. al.* (1990) excluded these sectors because of a lack of consistent long-term, time-series data. As illustrated in Figure B-1, the energy use in these sectors represented less than 8 percent of total delivered energy use from 1976 to 1991.

Figures B-2 and B-3 illustrate the evolution of stationary and transport energy use in these sectors.

1976-1991	1991 data are preliminary. Statistisk sentralbyrå. 1992m.

B Heating-Degree Days

Base 18°C
4069=100

The annual average number of heating-degree days (base 18°C) has been constructed by summing SSB's (unpublished) average monthly heating-degree day data (base 17°C), subtracting the summer months (June, July, and August), and then adding 250 to adjust to these data to base 18°C. The index has been obtained by dividing the annual average number of heating-degree days by the long-run average used in Schipper, *et. al.* (1990).

1950, 1955, 1960, 1962, 1965, 1967, 1970	Schipper, *et. al.* 1990.
1973-1991	Statistisk sentralbyrå. 1992l.

C Population

Mean population

1950-1960	Statistisk sentralbyrå. 1978c.
1961-1990	Statistisk sentralbyrå. 1991a.
1991	Statistisk sentralbyrå. 1992f.

Figure B-1
Energy Use in the Agriculture and Forestry, Fishery, Mining, and Construction Sectors (% of Total Energy Demand)

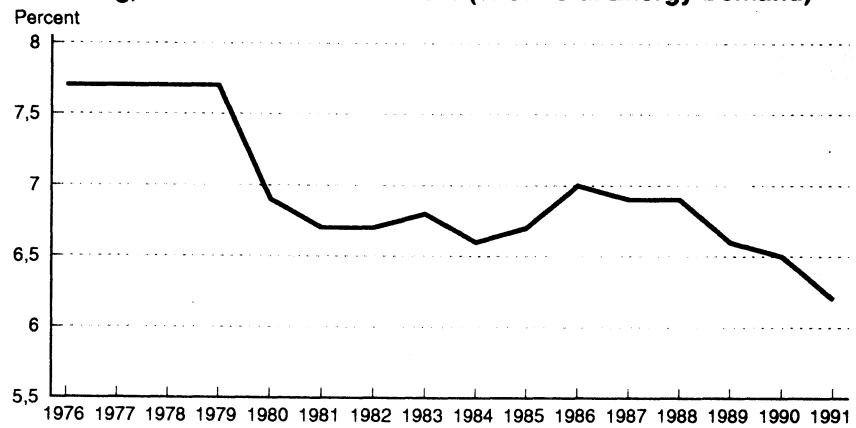


Figure B-2
Stationary Energy Use in the Agriculture and Forestry, Fishery, Mining, and Construction Sectors

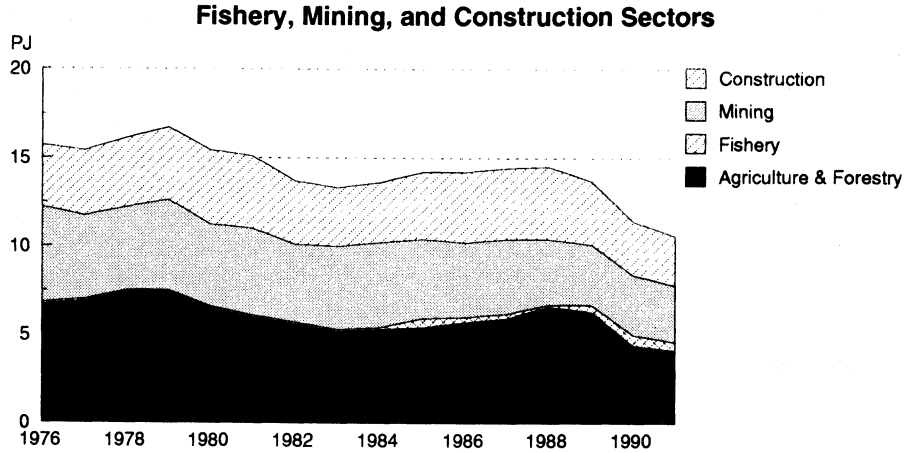
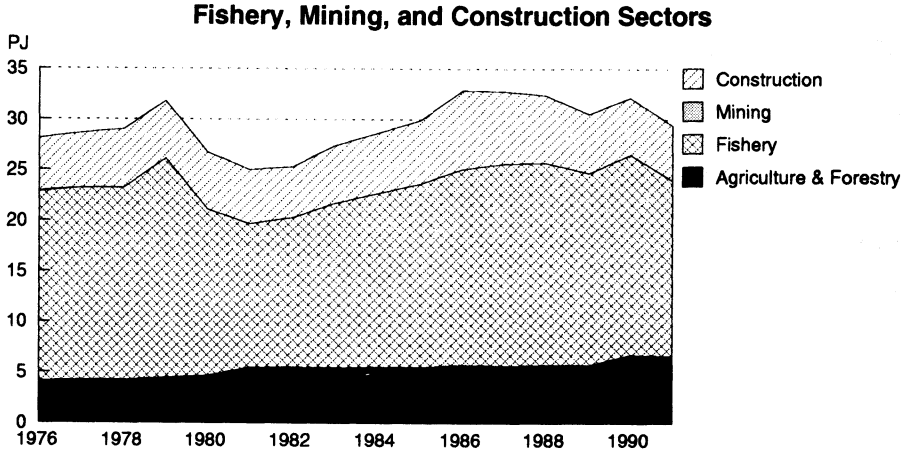


Figure B-3
Transportation Energy Use in the Agriculture and Forestry, Fishery, Mining, and Construction Sectors



D Consumer Price Index

1984=100

1958-1975	Statistisk sentralbyrå. 1978c.
1976-1991	Statistisk sentralbyrå. 1992h.

E Consumer Expenditures and Disposable Income

Converted to kr. 1984 using the consumer price index.

1950-1966	Statistisk sentralbyrå. 1968c.
1954-1963	Statistisk sentralbyrå. 1972d.
1964-1967	Statistisk sentralbyrå. 1979c.
1968-1972	Statistisk sentralbyrå. 1980c.
1973-1974	Statistisk sentralbyrå. 1984d.
1975	Statistisk sentralbyrå. 1986d.
1976-1978	Statistisk sentralbyrå. 1987e.
1979-1989	Statistisk sentralbyrå. 1991d.
1990-1991	Statistisk sentralbyrå. 1992h.

F Gross Domestic Product (GDP)

Gross domestic product is defined as mainland GNP, less crude petroleum and natural gas production, petroleum refining, oil well drilling, and pipeline transport, and is measured in kr. 1984. These data, in a consistent time series, are only available from 1962.

1962-1990	Statistisk sentralbyrå. 1992o.

G Energy Prices

1 Heavy Fuel Oil

Fuel Oil #6
1 kWh = 0.0086 Mt
Prices include fuel taxes, but exclude VAT.

1966-1978	The data series has been constructed by using the 1979 IEA heavy fuel oil price data as a base year, and backcasting using the percentage changes in the SSB unpublished heavy fuel oil data in each year. Statistisk sentralbyrå. 1991e.
1979	International Energy Agency. 1985.
1980-1991	International Energy Agency. 1992.

2 Fuel Oil

a Residential Sector

Fuel Oil #1
1 kWh = 0.103 liter

Prices include fuel taxes and VAT.

1958-1970	Statistisk sentralbyrå. 1984f.
1971-1977	Statistisk sentralbyrå. 1978b.
1978-1986	Statistisk sentralbyrå. 1987c.
1987-1991	Statistisk sentralbyrå. 1992c.

b Manufacturing Sector

Fuel Oil #2
1 kWh = 0.103 liter

1980-1991	International Energy Agency. 1992.

3 Kerosine

Heating Kerosine
1 kWh = 0.103 liter

Prices include fuel taxes and VAT.

Sources listed in Section 1.G.2.a.

4 Coal

1 kWh = 0.013 Mt.

a Residential Sector

1958-1981 Statistisk sentralbyrå. 1984f.

b Manufacturing Sector

Sources listed in Section 1.G.2.1.

5 Coke

1 kWh = 0.013 Mt.

Sources listed in Section 1.G.1.

6 Wood

Birch prices in the Oslo area.
1 MWh = 0.298 Favn

1950-1975	Statistisk sentralbyrå. 1978c.
1976-1981	Statistisk sentralbyrå. 1984f.

7 Electricity

a Households

Electricity prices include electricity taxes and VAT.

1957	Statistisk sentralbyrå. 1960a.
1958	Statistisk sentralbyrå. 1960b.
1959	Statistisk sentralbyrå. 1961a.
1960	Statistisk sentralbyrå. 1962a.
1961	Statistisk sentralbyrå. 1963.
1962	Statistisk sentralbyrå. 1964a.
1963	Statistisk sentralbyrå. 1965a.
1964	Statistisk sentralbyrå. 1965b.
1965	Statistisk sentralbyrå. 1966a.
1966-1989	Statistisk sentralbyrå. 1991c.
1990	Statistisk sentralbyrå. 1992b.

b Other Sectors

Electricity prices are average prices that include electricity taxes, but exclude VAT.

From 1957 to 1972, the industrial sector average price includes mining. Iron and steel includes other basic metals. The energy-intensive industries group excludes stone, clay, and glass industries (ISIC 36).

1957-1965	Sources listed in Section 1.G.7.a.
1966	Statistisk sentralbyrå. 1967a.
1967	Statistisk sentralbyrå. 1968b.
1968	Statistisk sentralbyrå. 1969b.

1969	Statistisk sentralbyrå. 1970a.
1970	Statistisk sentralbyrå. 1971b.
1971	Statistisk sentralbyrå. 1972b.
1972	Statistisk sentralbyrå. 1973b.
1973	Statistisk sentralbyrå. 1975c.
1974	Statistisk sentralbyrå. 1976b.
1975	Statistisk sentralbyrå. 1976c.
1976	Statistisk sentralbyrå. 1977b.
1977	Statistisk sentralbyrå. 1979b.
1978	Statistisk sentralbyrå. 1980b.
1979	Statistisk sentralbyrå. 1981b.
1980	Statistisk sentralbyrå. 1982c.
1981	Statistisk sentralbyrå. 1983a.
1982	Statistisk sentralbyrå. 1984b.
1983	Statistisk sentralbyrå. 1985b.
1984	Statistisk sentralbyrå. 1986c.
1985	Statistisk sentralbyrå. 1987b.
1986	Statistisk sentralbyrå. 1988b.
1987	Statistisk sentralbyrå. 1989b.
1988	Statistisk sentralbyrå. 1990c.
1989	Statistisk sentralbyrå. 1991c.
1990	Statistisk sentralbyrå. 1992b.

c Occasional Electric Power

Sources listed in Section 1.G.7.b.

8 District Heat

1983-1991	Norges Energiverkforbund. 1992.

9 Gasoline and Diesel

Super Leaded Gasoline (approximately 98 RON)
Super Unleaded Gasoline (approximately 98 RON)
Regular Gasoline (between 92 and-93 RON)
Unleaded Gasoline (95 RON)

1958-1969	Statistisk sentralbyrå. 1984f.
1970-1977	Statistisk sentralbyrå. 1978b.
1978-1986	Statistisk sentralbyrå. 1987c.
1987-1991	Statistisk sentralbyrå. 1992c.

2 Residential Sector

A Total Dwelling Stock

1950	Statistisk sentralbyrå. 1957a.
1960	Statistisk sentralbyrå. 1964b.
1970	Statistisk sentralbyrå. 1975d.
1980	Statistisk sentralbyrå. 1982d.
1990	Statistisk sentralbyrå. 1992k.
Other years	Imputed simple averages.

1 Area

Measured from the inside of the outer walls. Includes cellars and lofts.

1950, 1955, 1960, 1962	Schipper and Meyers. 1992.
1967	Imputed using distribution of dwellings by area (Statistisk sentralbyrå (1968a)) and average area by corresponding area group from Ljones (1984)).
1973	Statistisk sentralbyrå. 1975d.
1980	Ljones. 1984.
1981	Statistisk sentralbyrå. 1983b.
1983	Adjusted Ljones (1984) to include cellars and lofts. (Added 13.74 m^2.)
1988	Statistisk sentralbyrå. 1990b.
1990	Energidata. 1991. Note: The imputed area from the distribution of dwellings by area (Statistisk sentralbyrå (1992k)) and average area by corresponding area group (Ljones (1984)) yields a significantly lower area (101 m^2).
Other years	Imputed simple averages.

2 Dwelling Stock by Type

1960	Row houses ("rekke-og kjedehus") which may contain more than 4 dwellings have been included in the 2 to 4 dwelling group. Statistisk sentralbyrå. 1964b.
1967	Applied dwelling stock shares to imputed 1967 total dwellings. Imputed institutional dwellings. Statistisk sentralbyrå. 1968a.
1970	50 percent of the dwellings in the other small house ("annet småhus") group have been allocated to detached single-family dwellings, and the remainder have been allocated to attached single-family dwellings. Statistisk sentralbyrå. 1975d.
1973	Applied dwelling stock shares to imputed 1973 total dwellings. Imputed institutional dwellings. Statistisk sentralbyrå. 1974a.
1980	Imputed farm house dwellings. Statistisk sentralbyrå. 1982d.
1981	Applied dwelling stock shares to imputed 1981 total dwellings. Imputed institutional dwellings. Statistisk sentralbyrå. 1983b.
1983	Applied dwelling stock shares to imputed 1983 total dwellings. Imputed institutional dwellings. Ljones. 1984.
1988	Applied dwelling stock shares to imputed 1988 total dwellings. Imputed institutional dwellings. Statistisk sentralbyrå. 1990b.
1990	Imputed institutional dwellings. Statistisk sentralbyrå. 1992k.
Other years	Imputed simple averages.

3 Vintage of Dwelling Stock

Statistisk sentralbyrå. 1992k.
Statistisk sentralbyrå. 1992a.

4 Insulation, Windows, and Weather-stripping

Statistisk sentralbyrå. 1992j.

5 Principal Space-Heating system

1960	Imputed the heating systems in combined buildings and multi-family dwellings. (The combined building heating systems have been imputed from the institution and combined group, and multi-family and attached single family dwellings imputed from the "more than 2 units" dwelling group.) Statistisk sentralbyrå. 1964b.
1967	Statistisk sentralbyrå. 1968a.
1981	Statistisk sentralbyrå. 1983b.
1983	Imputed combined building heating systems. Ljones. 1984.
1988	Statistisk sentralbyrå. 1990b.
1990	Imputed from Statistisk sentralbyrå (1992j) shares and Statistisk sentralbyrå (1992k) dwelling data. Imputed combined building heating systems (using 1988 shares).
Other years	Imputed simple averages based on shares.

a Central Heating Systems by Fuel Type

1960, 1970, 1973, 1975, 1979, 1980, 1981, 1983, 1985, 1988, 1990	Imputed using Schipper and Meyers (1992) central heating system fuel shares.
Other years	Imputed simple averages based on shares.

1 Note on District Heating Systems

It was assumed that 1 percent of the dwellings used district heat as a principal space heating source from 1983 to 1990. However, this estimate is, in all likelihood, low due to the undersampling of the households who used district heat in SSB's 1990 Residential Energy Use Survey.

b Note on Supplemental Heating Systems

In 1983 and 1990, households surveyed in the SSB's Residential Energy Use Surveys were asked about their space heating possibilities, principal space heating system, and use of supplemental ("tillegg") space heating systems. A comparison was made of the household's responses to these questions and their reported fuel and electricity consumption. It was found that many households may not have been able to distinguish between their principal and supplemental heating systems (i.e., the fuel consumption that could be attributed to the reported supplemental space heating system was greater than the fuel consumption attributed to the reported principal space heating system.) (Ljones (1984) and Statistisk sentralbyrå (1992j)).

6 Thermostats and Night Setback Controls

Sources listed in Section 2.A.4.

B Water-Heating Systems and Cooking Fuels Used

1970, 1973, 1979, 1981	Imputed using Schipper and Meyers (1992) shares and total dwelling stock data.
1990	Imputed from Statistisk sentralbyrå (1992j) water heating system fuel shares and total dwelling stock data. Assumed that households that used oil central heating and had a central hot water heating system, had a oil-based water heating system. Similarly, it was assumed that households that used district heating and used a central (including a shared or "felles") hot water system, used district heating for water heating.

C Appliance Saturations

1967	Statistisk sentralbyrå. 1970b.
1973	Statistisk sentralbyrå. 1973c.
1975-1991	Statistisk sentralbyrå. 1992i.

1 Kitchen Ventilator, Microwave, Mix-Master, and Waterbed Saturations

1991	Statistisk sentralbyrå. 1992j.

D Energy Consumption

1 Oil, City gas, and Electricity

1950, 1955, 1960, 1962, 1965, 1967, 1970-1975	Schipper and Meyers. 1992.
1976-1991	1991 data are preliminary. Statistisk sentralbyrå. 1992m.
Other years	Imputed simple averages.

2 Solid Fuels (Coal, Coke, and Wood)

1950, 1955	Schipper and Meyers. 1992.
1960-1975	Rosland. 1982.
1976-1991	1991 data are preliminary. Statistisk sentralbyrå. 1992m.
Other years	Imputed simple averages.

3 District Heating

1983-1985	Statistisk sentralbyrå. 1987h.
1986-1990	Statistisk sentralbyrå. 1992c.
1991	Consumption estimated by multiplying the 1991 total consumption by the 1990 sectoral shares. Norges Energiverkforbund. 1992.

4 Energy Use by End Use

1950-1976	Schipper and Meyers. 1992.
1977-1983	Imputed end-use totals from Statistisk sentralbyrå (1992m) totals and Shipper and Meyers (1992) end-use shares.
1984-1989	Imputed from 1983 and 1990 end-use shares.
1990	Imputed from Energidata (1991) shares and Statistisk sentralbyrå (1992m) totals.
1991	End-use totals estimated by multiplying 1991 total consumption by 1990 end-use shares.
Other years	Imputed simple averages.

a Note on Appliance Energy Use

The energy used to heat hot water in washing machines is included in the appliance totals.

E Energy Prices

Sources listed in Section 1.G.7.

3 Service Sector

A Building Groups

Table B-1 lists the types of buildings within each of the main building groups used in Section 4 and several of their most commonly associated codes (i.e., ISIC (International Standard Industrial Classification), MODIS (SSB's Energy balances), and national accounts (Nasjonregnskap)).[1]

B Service Sector Value Added

Billion 1984 kroner
See Table B-1 for the corresponding national account codes.
1962-1990 Statistisk sentralbyrå. 1992o.

1 Note on the Use of Service Sector Value Added

In order to follow the convention used in Schipper, *et. al.* (1990), service sector value added was used as the measure of activity. However, a more appropriate measure of activity in this sector is gross output.

Table B-1
Service Sector Building Group Codes

BUILDING GROUP	ISIC CODE	MODIS CODE	NAT'L ACCOUNTS CODE
OFFICE & BUSINESS			
Wholesale & Retail Trade	61, 62	23 721	720
Financial Institutions	8101, 8102, 8103	23 865, 23 869, 23 872	865
Insurance	8201, 8202	23 876	875, 880
Real Estate	83111, 83112, 8319	23 885, 23 891	885, 890, 895
Business Services	832, 833	23 901	900, 905
Public Administration	91 (Except 9122)	21 910, 22 910	911, 9121, 9123, 9124, 9125, 9129
Postal Services	7201	23 855	855
Telecommunication Services	7202	23 860	860
HOTEL & RESTAURANT	63	23 760	760
EDUCATION & RESEARCH	931, 932	21 925, 22 925, 23 925	925
HEALTH SERVICES			
Health Services	933	21 930, 22 930, 23 930	930
Welfare Institutions	934	22 935, 23 935	935
ASSEMBLY			
Organizations (Professional, labor, religious, etc)	935, 939	21 941, 22 941, 23 941	940, 945
Recreation & Culture	94	22 950, 23 950	950
OTHER			
Defense	9122	21 915	915
Sanitary Related Services	92	23 920	920
Repair Services	951	23 955	955
Laundry Services	952, 959	23 961	960, 970
Domestic Services	953	23 965	965
Railway and Subways*	713	23 801	800, 810
Road Transport Services*	7114, 7716, 7116	21 825, 22 825	825
Water Transport Services*	7123	21 840, 23 840	840
Air Transport*	713	21 845	845
Transport Services (Storage)	719	23 850	850

* Energy used in buildings.

1 The building groups were formed to correspond with new building area statistics which are only available at an aggregated level.

C Floor Area

The measure of floor area used is utility floor space which is defined as the floor area measured from the inside of the outer walls, including cellars and attics (Statistisk sentralbyrå 1992a).[2]

Since Norway does not have a building registry, the floor area data has been estimated. Using Sagan (1987), 1984 was established as a based year.[3] The floor area data from 1950 to 1983 are based on the following:

$$Area_t = Area_{t+1} - New\ Area_{t+1} + (Area_{t+1} - New\ Area_{t+1}) * rrate.$$

The data from 1985 to 1991 are based on:

$$Area_t = Area_{t-1} + New\ Area_t - (Area_{t-1} * rrate),$$

where the new area data are published utility floor space (m^2) statistics by building type and the retirement rate, rrate, is equal to 0.0065.

There are several obvious limitations to this simple estimation procedure. Since there are no data on the lifetime of buildings or floor area, the area older than 2 years is retired at the same rate as the total area. In addition, it is unlikely that the floor area will be retired at a uniform rate over time. Furthermore, no allowance has been made for the conversion of the area between the building groups.

1967	Statistisk sentralbyrå. 1969a.
1968-1970	Statistisk sentralbyrå. 1971a.
1971	Statistisk sentralbyrå. 1972a.
1972	Statistisk sentralbyrå. 1973a.
1973	Statistisk sentralbyrå. 1975a.
1974	Statistisk sentralbyrå. 1975b.
1975	Statistisk sentralbyrå. 1976a.
1976	Statistisk sentralbyrå. 1977a.
1977	Statistisk sentralbyrå. 1978a.
1978	Statistisk sentralbyrå. 1979a.
1979	Statistisk sentralbyrå. 1981a.
1980	Statistisk sentralbyrå. 1982a.
1981	Statistisk sentralbyrå. 1982b.
1982	Statistisk sentralbyrå. 1984a.
1983-1984	Statistisk sentralbyrå. 1985a.
1985	Statistisk sentralbyrå. 1986a.
1986	Statistisk sentralbyrå. 1987a.
1987	Statistisk sentralbyrå. 1988a.
1988	Statistisk sentralbyrå. 1989a.
1989	Statistisk sentralbyrå. 1990a.
1990	Statistisk sentralbyrå. 1991b.
1991	Statistisk sentralbyrå. 1992a.

1 Heated Floor Area

Sagen's estimates of the heated floor area shares by building type were applied to the above floor area estimates (Sagen (1987)). Note: Sagen reported that these are likely to vary within the building group and change over time.

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2 Before 1983, the SSB calculated floor area of new buildings as tha area measured from the outside of the walls. While it is stated that these measurements cannot be directly compared, it is also noted that, "The difference is quite small, however, and is probably overshadowed by other errors in the statistics" (Statistisk sentralbyrå (1992a)).

3 Sagen (1987) reported that the most plausible floor area estimates were based on results estimated using data from the Arbeidskraftundersøkelsen.

D Heating System(s)

In 1983, the SSB began reporting the types of heating systems installed in new buildings (measured in m^2) (See sources listed in Section 3.C.) The types of systems published are: Oil-based central heating (only), oil central heating and electricity, oil central heating and wood, oil-based non-central heating (only), oil non-central heating and electricity, oil non-central heating and wood, wood (only), electricity (only), electricity and wood, and other combinations. Sagen (1987) reported the shares of heated floor area by heating system in 1984. Again, using 1984 as a base year, it was possible to calculate the approximate heated floor area by installed space heating system(s) using the approach described in Section 3.C. It is important to note that these data refer to the installed heating systems, and not the systems that may have actually been used. The limitations described in Section 3.C also apply to these calculations. An additional limitation to this analysis is that it does not allow for the conversion of systems over time.

E Energy Use

1 Oil Products, Solid Fuels, and Electricity

1950, 1955, 1960,1962[4], 1965, 1967, 1970, 1973	Schipper, *et. al.* 1990.
1976-1991	1991 data are preliminary. Includes the use of occasional power. Statistisk sentralbyrå. 1992m.
Other years	Imputed simple averages.

2 District Heating

1983-1985	Imputed consumption from total district heating consumption, less consumption in the manufacturing and residential sectors. Statistisk sentralbyrå. 1987h.
1986-1990	Statistisk sentralbyrå. 1992c.
1991	Consumption estimated by multiplying 1991 total consumption by 1990 sectoral shares. Norges Energiverkforbund. 1992.

3 Climate-Corrected Energy Use

Schipper, *et. al.* (1990) assumed that the heating shares were "85 percent for oil, 100 percent for solids, 85 percent for district heating, and a rise for electricity from 25 percent in the 1960s to 42 percent in 1986." These assumptions were also used in this analysis.

Based on these assumptions, and from the use the heating degree-day index (see Section 1.B), the estimated space heating consumption was climate corrected and used to obtain total climate-corrected delivered energy use.

4 Energy Use by End Use

The end-use shares were constructed from the use of the assumptions made by Schipper, *et. al.* (1990). These estimates were based on findings from other countries and from the comparison of the electricity for non-heating purposes per m^2 in 1985/6 and Sagen's (1987) data on the intensity of electricity use in buildings with no electric heat. While the Schipper, *et. al.* (1990) estimate of the end-use share may be correct for 1984, it is likely that these shares have changed over time.

F Energy Prices

Energy prices include fuel and electricity taxes, but exclude VAT. (See Section 1.G.)

4 Schipper, et.al. (1990) stated, "the pre-1965 data (are) very uncertain".

4 Manufacturing Sector

A Composition of the Manufacturing Sector

Table B-2 lists the industries in the manufacturing sector and their associated ISIC (International Standard Industrial Classification), MODIS (SSB's Energy Balances), and national accounts (Nasjonalregnskap) codes.

B Value Added

Billion 1984 kroner

See Table B-2 for the corresponding national account codes.

1962-1990 Statistisk sentralbyrå. 1992o.

1 Note on the Use of Manufacturing Value Added

In order to follow the convention used in Schipper, *et. al.* (1990), manufacturing sector value added was used as the measure of activity. However, a more appropriate measure of activity in this sector is gross output since it is more directly linked to physical output.

Table B-2
INDUSTRIES IN THE MANUFACTURING SECTOR
Energy-Intensive Industries

Industry Group	ISIC Code	Energy Accounts Code	National Accounts Code
Paper & Pulp Products	341	23 380, 23 385, 23 390, 23 395, 23 400	380, 385, 390, 395, 400
Industrial Chemicals	351	23 420, 23 425, 23 430	420, 425, 430
Mineral Products (Stone, Clay, and Glass)	36	23 486, 23 495, 23 501, 23 505	480, 485, 495,490, 500, 505
Iron, Steel, and Other Ferro- Alloys	371	23 510, 23 515, 23 520	510, 515, 520
Non-Ferrous Metals	372	23 525, 23 530, 23 535	525, 530, 535

Table B-2 (Continued)
Other Non-Energy-Intensive Industries

Industry Group	ISIC Code	Energy Accounts Code	National Accounts Code
Food Manufacturing	311, 312	23 201, 23 210, 23 215, 23 220, 23 225, 23 230, 23 235, 23 240, 23 245, 23 250 23 255, 23 260, 23 265, 23 270	200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265, 270
Beverages	313	23 275, 23 280, 23 285	275, 280, 285
Tobacco Products	314	23 290	290
Textiles, Apparel, & Shoes	321 322 324	23 295, 23 300, 23 305, 23 310, 23 321 23 333, 23 346 23 350	295, 300, 305, 315, 320, 321 330, 340, 335, 345 350
Wood & Wood Products	331	23 355, 23 360, 23 365, 23 370	355, 360, 365, 370
Furniture & Fixtures	332	23 375	375
Printing & Publishing	342	23 405, 23 410, 23 415	405, 410, 415
Other Chemical Products	352	23 435, 23 446, 23 450, 23 455	435, 440, 450, 455
Petroleum & Coal Products	354	23 465	465
Rubber Products	355	23 470	470
Plastic Products	356	23 475	475
Metal Products, Machinery, & Equipment	381	23 546, 23 555, 23 566, 23 570	540, 545, 550, 555, 560, 565, 570
Machinery	382	23 575, 23 580, 23 591, 23 595, 23 600, 23 582	575, 580, 585, 590, 595, 600, 582
Electrical Apparatus & Supplies	383	23 605, 23 610, 23 615, 23 620, 23 625	605, 610, 615, 620, 625
Transport Equipment	384	23 630, 23 635, 23 640, 23 645, 23 651	630, 635, 640, 645, 650, 660
Other Industrial Production	385, 3901, 3902, 3903, 3009	23 681	665, 670, 680

C Physical Production Data

1 Paper

"Papir og papp"

1950-1955	"Papir, pakkpapir, trykkpapir, skrivepapir, papp og kartong." Statistisk sentralbyrå. 1957b.
1956-1960	"Papir, pakkpapir, trykkpapir, skrivepapir, papp og kartong." Statistisk sentralbyrå. 1962b.
1961-1962	"Avispapir, papir, heru. ullpapp og- papir og cellulose-vatt, greseproof og pergamyn, kreppet papir, papir og papp overtrukket eller impregnert med bitumen, asfalt eller tjære, trefiberplater til salg." Statistisk sentralbyrå. 1964c.
1965	Varenr. 48, less 4814.200, 4816.209, 4816.300, 4816.400, 4816.902, and 4816.908. Statistisk sentralbyrå. 1966b.
1967	Varenr. 48, less 4814.100, 4814.200 4816.200, 4816.300, 4816.400, 4816.902, 4816.908, 4818.100, and 4818.900. Statistisk sentralbyrå. 1969c.
1970	Varenr. 48, less 4814.100, 4814.200 4816.200, and 4816.300. Statistisk sentralbyrå. 1972c.
1971-1972	Statistisk sentralbyrå. 1972c.
1973-1974	Statistisk sentralbyrå. 1977c.
1975-1978	Statistisk sentralbyrå. 1980a.
1979-1981	Statistisk sentralbyrå. 1984c.
1982-1984	Statistisk sentralbyrå. 1987d.
1985-1988	Statistisk sentralbyrå. 1990d.
1989	Varenr. 48, less 4817.1000, 4819.3000, and 4819.4000. Statistisk sentralbyrå. 1992f.
1990	Statistisk sentralbyrå. 1992n.
Other years	Imputed simple averages.

2 Pulp

"Mekanisk masse, tremasse- våt (beregnet tørrvekt) og tørr"

1950-1955 1956-1960, 1961-1962, 1965, 1967, 1971-1972, 1973-1974, 1975-1978, 1979-1981 1982-1984, 1985-1988, 1989, 1990	Sources listed in Section 4.C.1.
1991	Preliminary data. Statistisk sentralbyrå. 1992n.
Other years	Imputed simple averages.

3 Cement

"Portland sement, aluminatsement, slaggsement, supersulfatsement og liknende hydraulisk sement, også farget eller i form av klinker"

Sources listed in Section 4.C.2.

4 Iron

"Råjern"
Sources listed in Section 4.C.1.

5 Steel

"Råstål, inkl. råstål til støpegods"

Sources listed in Section 4.C.1.

6 Ferro-Alloys

"Ferromangan, ferrosilicium, ferrosilicomangan, ferrokrom, ferrosilicokrom"

Sources listed in Section 4.C.2.

7 Aluminum

"Aluminum, primær"

Sources listed in Section 4.C.2.

D Number of Firms

1970	Statistisk sentralbyrå. 1972c.
1975	Statistisk sentralbyrå. 1977c.
1980	Statistisk sentralbyrå. 1982e.
1985	Statistisk sentralbyrå. 1987d.
1990	Statistisk sentralbyrå. 1992d.

E Energy Use

1950, 1955, 1962, 1965, 1967, 1970-1975	Schipper, *et. al.* 1990.
1976-1991	1991 data are preliminary. Statistisk sentralbyrå. 1992m.
Other years	Imputed simple averages.

1 Fuel Oil

In the Statistisk sentralbyrå's energy accounts, medium distillate fuels are not categorized by type (i.e., fuel oil, auto diesel, and marine diesel) for the manufacturing sector. The coefficients used to estimate fuel oil use in this sector are listed in Table B-3.

Table B-3
Fuel Oil Coefficients for Industry Groups in the Manufacturing Sector
(% of Medium Distillate Fuel Use)

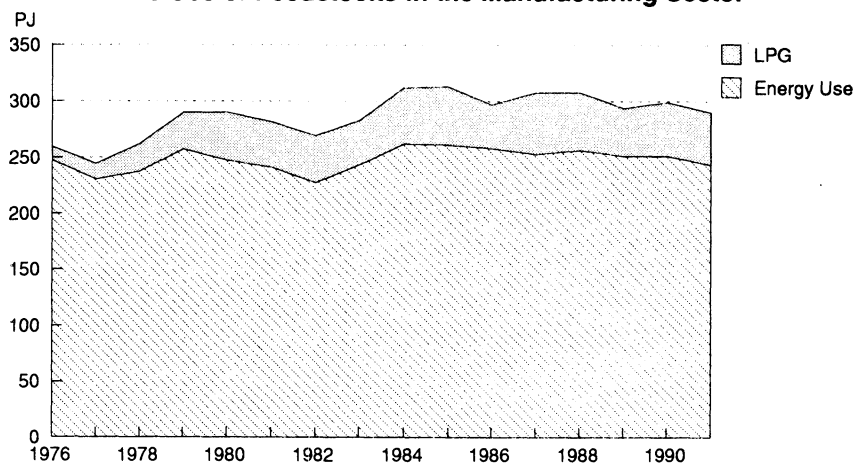
ISIC CODE	1980	1981	1982	1983	1984	1985	1986	1987	1988-1990
341	30	38	43	49	55	54	55	54	58
351	13	14	16	19	21	22	22	22	22
371, 372	11	11	13	12	17	19	21	19	19
313, 314, 321, 322, 324	13	14	15	18	21	22	22	22	22
311, 312	22	22	22	28	30	32	35	32	32
Other Industries	11	13	12	17	19	21	19	19	19

2 LPG

Following the convention of Schipper, *et. al.* (1990) the use of feedstocks has been excluded from this analysis. However, from 1976 to 1991, the use of feedstocks increased from 12 to 47 PJ (from 4 percent to 18 percent of the energy used in this sector). (See Figure B-4.) The industrial chemicals industry group was the largest user of LPG (accounting for 96 percent of total use in 1991).

1976-1991	1991 data are preliminary. Statistisk sentralbyrå. 1992m.

Figure B-4
The Use of Feedstocks in the Manufacturing Sector



F Energy Prices

Energy prices include fuel and electricity taxes, but exclude VAT. (See Section 1.G.)

5 Transportation Sector

A Motor Vehicle Stock (Automobiles, Buses, Vans, Combined vehicles, and Trucks)

1950-1958 Trucks:	Opplysningsrådet for Biltrafikken. 1963. Other motor vehicles: Opplysningsrådet for Biltrafikken. 1959.
1959	Opplysningsrådet for Biltrafikken. 1960.
1960	Opplysningsrådet for Biltrafikken. 1961.
1961	Opplysningsrådet for Biltrafikken. 1962.
1962	Opplysningsrådet for Biltrafikken. 1963.
1963	Opplysningsrådet for Biltrafikken. 1964.
1964	Opplysningsrådet for Biltrafikken. 1965.
1965	Opplysningsrådet for Biltrafikken. 1966.
1966	Opplysningsrådet for Biltrafikken. 1967.
1967	Opplysningsrådet for Biltrafikken. 1968.
1968	Opplysningsrådet for Biltrafikken. 1969.
1969	Opplysningsrådet for Biltrafikken. 1970.
1970	Opplysningsrådet for Biltrafikken. 1971.
1971	Opplysningsrådet for Biltrafikken. 1972.
1972	Opplysningsrådet for Biltrafikken. 1973.
1973	Opplysningsrådet for Biltrafikken. 1974.
1974	Opplysningsrådet for Biltrafikken. 1975.
1975	Opplysningsrådet for Biltrafikken. 1976.
1976	Opplysningsrådet for Biltrafikken. 1977.
1977	Opplysningsrådet for Biltrafikken. 1978.
1978	Opplysningsrådet for Biltrafikken. 1979.
1979	Imputed bus stock. Opplysningsrådet for Biltrafikken. 1980.
1980	Opplysningsrådet for Biltrafikken. 1981.
1981	Opplysningsrådet for veitrafikken. 1982.
1982	Opplysningsrådet for veitrafikken. 1983.
1983	Opplysningsrådet for veitrafikken. 1984.
1984	Opplysningsrådet for veitrafikken. 1985.
1985	Opplysningsrådet for veitrafikken. 1986.
1986	Opplysningsrådet for veitrafikken. 1987.
1987	Opplysningsrådet for veitrafikken. 1988.
1988	Opplysningsrådet for veitrafikken. 1989.
1989	Opplysningsrådet for veitrafikken. 1990.
1990	Opplysningsrådet for veitrafikken. 1991.
1991	Opplysningsrådet for veitrafikken. 1992.

1 Fuel Economy

a Automobiles

1950, 1955, 1960, 1962, 1965, 1967	Actual fuel economy. Schipper, *et. al.* 1990.
1970-1974	Actual fuel economy. Schipper and Meyers. 1992.
1975-1990	Estimated fuel economy. Transportøkonomisk institutt. 1991.
Other years	Imputed simple averages.

b Gasoline and Diesel Automobiles

1950, 1955, 1960, 1962, 1965, 1967	Actual fuel economy. Schipper, *et. al.* 1990.
1970-1990	Actual fuel economy. Schipper and Meyers. 1992.
Other years	Imputed simple averages.

c Buses and Trucks

1970-1990 Actual fuel economy. Schipper and Meyers. 1992.

2 Vintage of the Motor Vehicle Stock (Automobiles and Buses)

Sources listed in Section 5.A.

B Trains (NSB and Private), Tramways, and Suburban Railways (Stock and Type of Trains and Wagons, and Capacity)

1957-1959	Tramways and suburban railways only. Statistisk sentralbyrå. 1961b.
1960-1962	Statistisk sentralbyrå. 1964d.
1963-1965	Imputed 1963 private railway data. Statistisk sentralbyrå. 1967d.
1966-1967	Statistisk sentralbyrå. 1969d.
1968	Statistisk sentralbyrå. 1970c.
1969	Statistisk sentralbyrå. 1971c.
1970	Statistisk sentralbyrå. 1972e.
1971	Statistisk sentralbyrå. 1972f.
1972	Statistisk sentralbyrå. 1974b.
1973-1974	Statistisk sentralbyrå. 1975e.
1975	Statistisk sentralbyrå. 1976d.
1976	Statistisk sentralbyrå. 1977d.
1977	Statistisk sentralbyrå. 1978d.
1978	Statistisk sentralbyrå. 1979d.
1979	Statistisk sentralbyrå. 1980d.
1980	Statistisk sentralbyrå. 1981c.
1981	Statistisk sentralbyrå. 1982f.
1982	Statistisk sentralbyrå. 1983c.
1983	Statistisk sentralbyrå. 1984e.
1984	Statistisk sentralbyrå. 1985c.
1985	Statistisk sentralbyrå. 1987g.
1986	Statistisk sentralbyrå. 1988c.
1987	Statistisk sentralbyrå. 1989c.
1988	Statistisk sentralbyrå. 1990e.
1989-1990	Statistisk sentralbyrå. 1992e.
1991	Statistisk sentralbyrå. 1993a.

C Passenger-Kilometers Traveled and Freight Ton-Kilometers Transported

1950-1951	Imputed from 1946 and 1952 data (1953 passenger-kilometers traveled by automobile data). Statistisk sentralbyrå. 1978d. Statistisk sentralbyrå. 1961b.
1952-1957	Imputed rail (tons and freight-ton kilometers) and ship (freight-ton kilometers) data from 1954 (1953 for ships) to 1959. Statistisk sentralbyrå. 1961b.
1958-1959	Statistisk sentralbyrå. 1964d.
1960	Statistisk sentralbyrå. 1978c.
1961-1964	Imputed trucks (tons and freight-ton kilometers) (1961-1964), rail (freight-ton kilometers) (1961-1963), and ship (tons and freight-ton kilometers) (1961-1964) data. Statistisk sentralbyrå. 1972e.
1965	Statistisk sentralbyrå. 1978c.
1966-1968	Imputed ship (tons and freight-ton kilometers) data. Statistisk sentralbyrå. 1972e.
1969	Statistisk sentralbyrå. 1978d.
1970	Statistisk sentralbyrå. 1993a.
1971-1974	Statistisk sentralbyrå. 1978d.
1975	Statistisk sentralbyrå. 1993a.
1976-1979	Statistisk sentralbyrå. 1983c.
1980	Statistisk sentralbyrå. 1993a.

1981-1983	Statistisk sentralbyrå. 1987g.
1984	Statistisk sentralbyrå. 1990f.
1985-1990	Statistisk sentralbyrå. 1992e.
1991	Statistisk sentralbyrå. 1993a.

D Vehicle Kilometers Traveled (VKM)

1 Automobiles, Motorcycles, Buses, and Trucks

1970-1991 Schipper and Meyers. 1992.

2 Private Automobiles and Taxi's

1973-1990 Transportøkonomisk institutt. 1991.

3 Trains

Tractive vehicle kilometers

Sources listed in Section 5.B.

4 Airplanes

a Passenger and Freight

Imputed by multiplying the share of passenger (freight) ton-kilometers by the total kilometers flown.

Sources listed in Section 5.B.

E Trip Length and Purpose, and Access to Mass Transit

1987 Transportøkonomisk institutt. 1987.

F Average Freight Transport Costs

1986 Nordisk komite for transportforskning. 1990.

G Energy Use

1 Automobiles, Motorcycles, Buses, and Trucks

1950, 1955	Schipper, *et.al.* 1990.
1960, 1962, 1965, 1967	
1970-1990	Schipper and Meyers. 1992.

2 Rail

1950, 1955	Schipper, *et.al.* 1990.
1960-1991	Sources listed in Section 5.B. Note: Imputed 1988 tramways and suburban railway data. Statistisk sentralbyrå. 1990e.
Other years	Imputed simple averages.

a Passenger Rail

Passenger energy use imputed by multiplying the share of passenger train kilometers traveled by total rail energy use. Following the methodology used in Schipper, *et. al.* (1990), it was further assumed that tramways and suburban railways were 75 percent more efficient than private railways and NSB.

b Freight Rail

Freight energy use imputed by multiplying the share of freight train kilometers traveled by total rail energy use.

c Other Rail

Energy used by work trains, etc.

3 Shipping

1950, 1955	Schipper, *et.al.* 1990.
1960, 1962, 1965, 1967	
1970-1989	Schipper and Meyers. 1992.
1990-1991	1991 data are preliminary. Statistisk sentralbyrå. 1992m.
Other years	Imputed simple averages.

4 Airplanes

1950, 1955	Schipper, *et.al.* 1990.
1960, 1962, 1965, 1967	
1970-1986, 1990	Schipper and Meyers. 1992.
1987-1989	Statistisk sentralbyrå. 1992m.
Other years	Imputed simple averages.

a Passenger Air

Passenger energy use imputed by multiplying the share of passenger ton-kilometers traveled by the total energy used by airplanes.

b Freight Air

Freight energy use imputed by multiplying the share of freight ton-kilometers transported by the total energy used by airplanes.

H Transportation Expenditures

Excludes free travel.

1967, 1973, 1974-1976, 1977-1979, 1980-1982, 1983-1985, 1986-1988	Statistisk sentralbyrå. 1993a.
1989-1991	Statistisk sentralbyrå. 1993b.

I Energy Prices

Energy prices taxes and VAT. (See Section 1.G.)

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