Profiling Energy and CO_2 Emissions in the Services Sector

SUSTAINABLE ENERGY IRELAND
Energy Policy Statistical Support Unit

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Report prepared by
Fergal O' Leary, Martin Howley and Dr. Brian Ó Gallachóir

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Sustainable Energy Ireland

Sustainable Energy Ireland (SEI) is Ireland's national energy agency. Established on May 1st 2002 under the Sustainable Energy Act 2002, SEI has a mission to promote and assist the development of sustainable energy. This encompasses environmentally and economically sustainable production, supply and use of energy, in support of Government policy, across all sectors of the economy. Its remit relates mainly to improving energy efficiency, advancing the development and competitive deployment of renewable sources of energy and combined heat and power, and reducing the environmental impact of energy production and use, particularly in respect of greenhouse gas emissions.

SEI is charged with implementing significant aspects of the Green Paper on Sustainable Energy and the National Climate Change Strategy as provided for in the National Development Plan.

SEI manages programmes aimed at:

- assisting deployment of superior energy technologies in each sector as required;
- raising awareness and providing information, advice and publicity on best practice;
- stimulating research, development and demonstration;
- stimulating preparation of necessary standards and codes;
- publishing statistics and projections on sustainable energy and achievement of targets.

SEI is responsible for advising Government on policies and measures on sustainable energy; implementing programmes agreed by Government and stimulating sustainable energy policies and actions by public bodies, the business sector, local communities and individual consumers.

Energy Policy Statistical Support Unit

SEI has a lead role in developing and maintaining comprehensive national and sectoral statistics for energy production, transformation and end use. This data is a vital input to meeting international reporting obligations, for advising policy makers, meeting international reporting obligations and informing investment decisions. Based in Cork, the Energy Policy Statistical Support Unit is SEI's specialist statistics team. Its core functions are to:

- collect, process and publish energy statistics to support policy analysis and development in line with national needs and international obligations;
- conduct statistical and economic analyses of energy services sectors and sustainable energy options;
- contribute to the development and promulgation of appropriate sustainability indicators.

Highlights

Context

- The services sector's primary energy consumption increased by 88% during the period 1990 to 2003. Services sector primary energy was 2,808 ktoe in 2003, representing 19% of Ireland's total primary energy requirement (TPER). The average annual primary energy growth rate over the period 1990 to 2003 was 5% for the services sector, compared with 6.4% for transport, 1.9% for the residential sector 1.6% for industry and 1.6% for agriculture.

- Over the period 1990 to 2003 final energy consumption in the services sector grew by 75%, second only to the transport sector, which increased by 123%. Industry and the residential sector, by contrast, increased by 26% and 27% respectively over the same period. The final energy consumption of the services sector in 2003 was 1,758 ktoe, representing 15% of Ireland's total final consumption (TFC).

- The growth in energy-related carbon dioxide (CO_2) emissions in the services sector of 71% (4.2% per annum) over the period 1990 to 2003 is second only to the transport sector (127% or 6.5% per annum). The services sector's share of the total energy-related emissions increased as a result, from 16% to 19% over the same period. In 2003, total services sector energy-related CO_2 emissions were 6,835 kt CO_2.

- The economic growth of the services sector, measured by Gross Value Added (GVA) increased by 93% (5.2% per annum) over the same period. GVA for the services sector in 2003 was €43 billion.

- Ireland had the largest share of services final energy consumption as a percentage of TFC of all EU-15 countries in 2001, at 14.2%. The EU-15 average in 2001 was 11.7%.

Annual Services Inquiry (ASI) 1999 Data

Data from 1999 is used in this analysis because this is the most recent year for which detailed energy expenditure information was sought as part of the ASI. SEI intend to repeat this analysis in 2006 when ASI 2004 data becomes available, the next inquiry that will contain detailed data on energy expenditure. CSO have indicated that detailed data on the purchase of fuel will be sought on a yearly basis from enterprises from 2004.

- The eleven ASI commercial services sub-sectors[1] analysed in this report accounted for 30% of total energy consumption in the services sector as well as 40% of total CO_2 emissions, 42% of total GVA and 38% of total employment in 1999.

- Total expenditure on energy in 1999 for the eleven sub-sectors was €337 million (current prices) of which 82% was spent on electricity, 11% on heating oil and 7.1% on natural gas. The largest of the eleven sub-sectors in terms of energy spend was the *restaurants, bars and catering* sub-sector which accounted for 22% of the total in 1999. The *retail sale of food* sub-sector was second largest with 17% of total expenditure. Combined these two sub-sectors were responsible for 39% of energy expenditure, 36% of energy consumption, 40% of CO_2 emissions, 28% of employment and 14% of GVA.

- The total estimated TFC for these sub-sectors in 1999 was 432 ktoe. Electricity consumption accounted for 53.7% (232 ktoe), heating oil for 24.5% (106 ktoe) and natural gas for 21.7% (94 ktoe). The largest sub-sector in terms of energy consumption was *restaurants, bars and catering*, responsible for 21% of the total (90.5 ktoe) with second largest being *retail sale of food* (15% or 66 ktoe).

- The eleven sub-sectors analysed were responsible for 2,741 kt CO_2 emissions in 1999. Electricity consumption accounted for 80% (2,198 kt CO_2), heating oil for 11.8% (326 kt CO_2) and natural gas for 7.9% (217 kt CO_2). The largest sub-sector in terms of CO_2 emissions was *restaurants, bars and catering*, responsible for 21% (576 kt CO_2) of the total with second largest being *retail sale of food* (19% or 525 kt CO_2).

- Energy expenditure represented 0.6% of total direct costs for the eleven selected sub-sectors as a whole in 1999.

[1] See figure 1.1, page 7.

- The sub-sectors with the highest energy bill as a proportion of overall costs were *other services* (4%) and *hotels* (3%). These sub-sectors may be more susceptible to the negative effects of increases in energy costs. However, even at these levels, energy costs represent a small proportion of total business costs. Combined these sub-sectors were responsible for 13% of energy expenditure, 18% of energy consumption, 10% of employment and 5% of GVA.

- The largest sub-sector in terms of GVA was the *office and research and development* sub-sector, which accounted for 31% of the total in 1999. *Wholesale trade* accounted for 17% of the total and these two sub-sectors in 1999 represented 48% of GVA, 18% of energy consumption, 21% of energy expenditure, 20% of CO_2 emissions and 31% of employment.

- Only three sub-sectors had an average energy bill to GVA ratio of over 5%, indicating a comparative sensitivity to energy price changes. They were *restaurants, bars and catering* (7.2%), *other services* (5.5%) and *hotels* (5%). Combined these three sub-sectors were responsible for 35% of energy expenditure, 39% of energy consumption, 34% of CO_2 emissions, 23% of employment and 11% of GVA.

- *Other services* had the largest annual energy consumption per employee of the selected sub-sectors (23.1 MWh per employee), but only marginally so over *hotels* (22.3 MWh per employee), *motor trade* (21.2 MWh per employee) and *restaurants bars, and catering* (20.4 MWh per employee). Combined these four sub-sectors were responsible for 43% of energy expenditure, 50% of energy consumption, 29% of employment and 17% of GVA.

- *Restaurants, bars and catering* had highest annual consumption of electricity per employee (11.2 MWh per employee) followed by *retail sale of food* (9.80 MWh per employee). Combined these two sub-sectors were responsible for 39% of energy expenditure, 37% of energy consumption, 40% of CO_2 emissions, 28% of employment and 14% of GVA.

Annual Services Inquiry 1999 to 2002

- Total expenditure on all fuels for the eleven commercial services sub-sectors (electricity, natural gas, oil, motor and other fuels) increased by 38% (11% per annum on average) over the period 1999 to 2002. Total expenditure was €593 million in 1999 (this includes the €337 million above plus expenditure on motor and other fuels) and €817 million in 2002.

- Employment in the eleven sub-sectors increased from 397,114 in 1999 to 615,123 in 2002, an increase of 55% (16% per annum on average). The largest sub-sector in 2002, in terms of employment, was *other office and research and development* with 23% of the total (139,788).

- Total GVA for the selected sub-sectors rose from €18 billion in 1999 to €27 billion in 2002, an increase of 55% or 16% per annum.

Issues and Next Steps

- Energy statistics relating to fuel consumption are calculated as a residual for the services sector in Ireland. This approach is unsatisfactory, not least because the energy consumption in the services sector is affected by uncertainties in all other sectors.

- As a result of the heterogeneous nature of the services sector it is difficult to assess the amount of energy that is consumed in this sector. The increasing number of energy suppliers in the liberalised market makes this task all the more difficult.

- The next step in order to deepen the understanding of energy use in the services sector is to collect data on floor area. In addition, as stated above, the analysis in this report will be repeated once ASI 2004 data becomes available in 2006.

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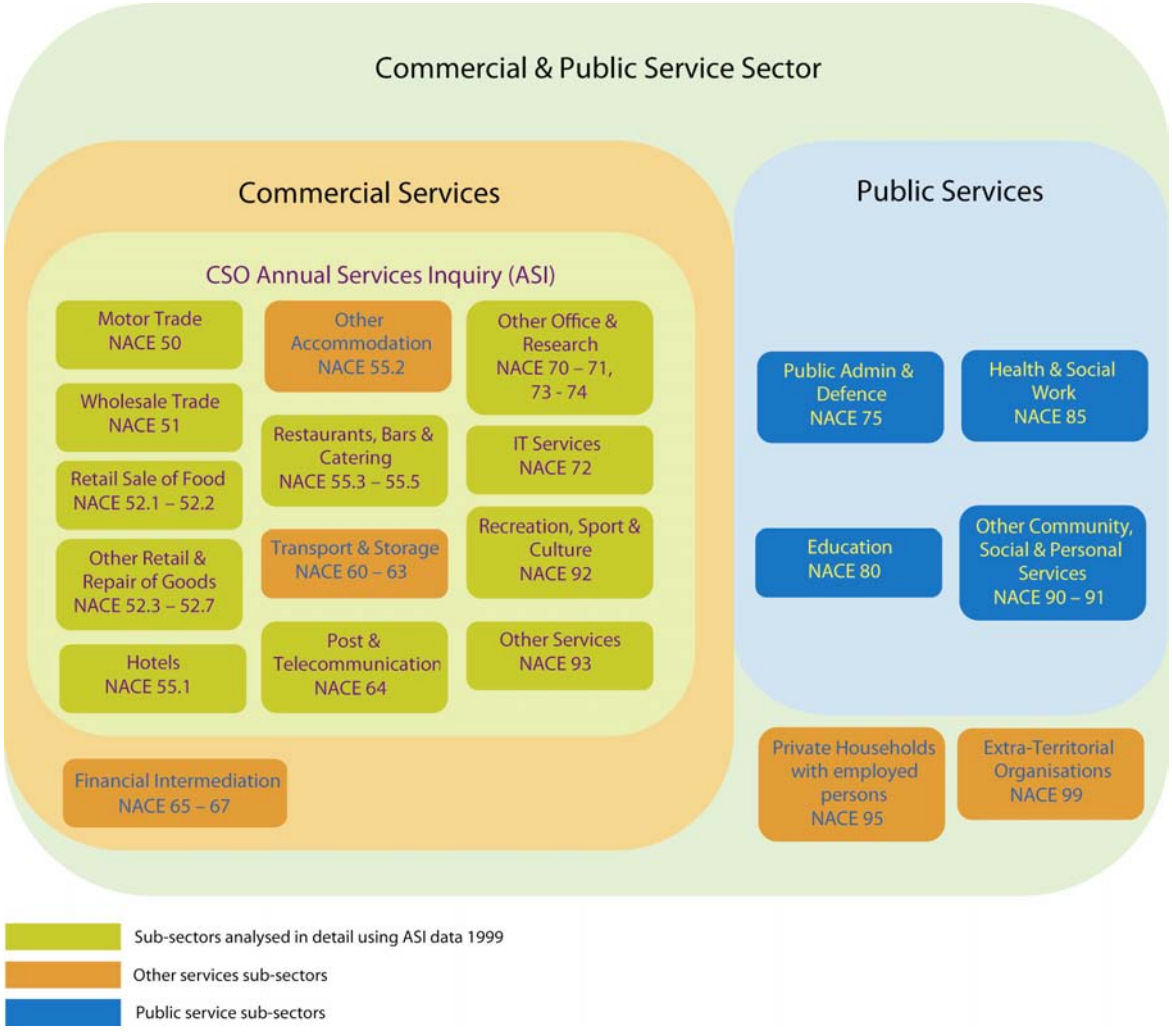
1 Introduction

Energy statistics are generally analysed with respect to the different energy sources used and the individual sectors of the economy that consume energy. This report examines energy consumption within the commercial and public services sector[2] (hereafter referred to as the services sector) and complements existing Sustainable Energy Ireland (SEI) reports on energy consumption trends in the industry[3] and transport[4] sectors.

The services sector is the most heterogeneous of all sectors of the economy and includes both commercial service activities (banking, cinemas, hotels, retail outlets, swimming pools, etc.) and public services (universities, hospitals, local authorities, Government departments, etc.) Figure 1.1 presents an overview of the sector with accompanying NACE[5] codes. A more detailed description of each sub-sector is contained in Appendix 1. Buildings are the predominant point of energy consumption (for space heating, lighting and water heating) within this sector, the balance being mainly represented by certain municipal and civic facilities.

Figure 1.1: Overview of the Commercial and Public Services Sector



[2]The services sector is also sometimes referred to as the tertiary sector with the primary sectors being agriculture and resource extraction and secondary referring to manufacturing.

[3] SEI 2004 *Profiling Energy Consumption and CO_2 Emissions in Industry 2004 Update. Sensitivity to Energy Price Changes.* http://www.sei.ie/uploads/documents/upload/publications/EPSSU_Industry_report_8nov.pdf

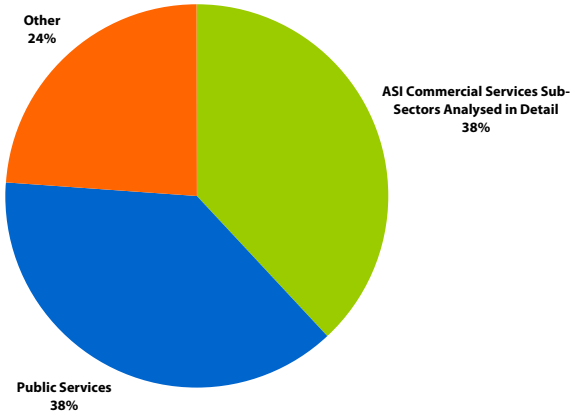
[4] SEI 2003 *Energy and CO_2 Efficiency in Transport. Analysis of new car registrations in year 2000.* http://www.sei.ie/uploads/documents/upload/publications/Transport_Report_11_03.pdf

[5] NACE is an international classification system used to structure the economy into sectors and sub-sectors. A full list of NACE codes is available from http://europa.eu.int/comm/environment/emas/pdf/general/NACEcodes_en.pdf.

This report presents the results of a structural analysis, based on Central Statistics Office (CSO) Annual Services Inquiry (ASI) data for the year 1999, the latest available year detailed energy expenditure data was sought. Sub-sectoral energy consumption is provided for eleven commercial services sub-sectors only (highlighted in green on the left of figure 1.1). The ASI does not cover non-traded public services. Energy expenditure data was not available for the *other accommodation* and *financial intermediation* sub-sectors so they are not included in the analysis. The *transport and storage* sub-sector was not analysed due to difficulties with the data. In 1999 the eleven sub-sectors analysed accounted for 30% of total final energy consumption in the services sector as well as, 40% of total CO_2 emissions, 42% of total Gross Value Added (GVA) and 38% of total employment.

Figure 1.2 illustrates the significance (in employment terms) of the eleven ASI sub-sectors, within the context of the services sector as a whole. As already mentioned, the ASI sub-sectors analysed constituted 38% of total employment in the services sector in 1999. The public services sub-sectors accounted for a further 38% and the remaining 24% of employment is attributed to the following sub-sectors: *transport and storage, financial intermediation, other accommodation, private households with employed persons* and *extra-territorial organisations*.

Figure 1.2: Commercial and Public Services Sector Employment 1999



SOURCE: CSO

It is important to emphasize that due to the heterogeneous nature of the services sector, the results presented in this report for these eleven commercial sub-sectors may not be valid for the services sector as a whole. The nature of activity within the commercial services is quite distinct from that in the public services. This may lead to differences for example, in the share of electricity consumption in the final energy fuel mix. The uncertainties associated with the national energy balance data relating to the services sector do not readily allow for the generation of results for the remaining services sub-sectors based on the analysis of the ASI sub-sectors.

In addition to the ASI data however, this report analyses a dataset for ESB customers for 2002 and 2003, which contains details of both commercial and public services consumption of electricity. Data is available for all sub-sectors shown in figure 1.1 with the exception of *private households with employed pers*ons, which is not included in the dataset.

The services sector consumes a significant amount of energy in Ireland, accounting for 19% (2,808 ktoe) of Ireland's primary energy consumption in 2003. As a result of the diversity within the sector, however, reliable data for sectoral fuel consumption and energy end use are much more difficult to gather than in other sectors, such as industry and residential. Consequently, the energy statistics for the services sector are often estimated as a residual after energy use is attributed to the other sectors. This approach is unsatisfactory, not least because the energy consumption in the services sector is affected by uncertainties in all other sectors.

In recent years, energy consumption and the resulting carbon dioxide (CO_2) emissions in the services sector have grown considerably, with a 75% (4.4% per annum, on average) increase in final consumption and a 71% (4.2% per annum) increase in CO_2 emissions over the period 1990 to 2003. Final electricity consumption, in particular, has grown significantly in recent years. Average growth in final consumption of electricity in the services sector was 8.6% per annum from 1990 to 2003 (5.2% between 1990 and 1995, 8.9% between 1995 and 2000 and 14% between 2000 and 2003).

In addition to the fact that energy statistics relating to fuel consumption are calculated as a residual for the services sector, data at sub-sectoral level and data on end use has not been compiled in detail to date in Ireland. As a result, there is only limited information available to policy-makers with which to formulate and target energy efficiency policies and measures for the sector.

The analysis in this report begins to address this information gap. SEI has used the ASI and ESB data to produce an analysis of energy and electricity consumption and of energy-related CO_2 emissions for a number of services sub-sectors, detailed above. In addition to providing new information based on this data, the report also identifies key data gaps including the lack of end use and floor area information and suggests areas for further study. This is the first time such an exercise has been conducted to this level of detail for Ireland.

The report is structured as follows:

- The relevant trends in energy and CO_2 emissions are outlined in section 2 to provide a context for the work.
- Section 3 explores the major policy developments which have, or are intended to have, an impact on energy use and emissions in the services sector at international, European and national level.
- Section 4 presents the results of a structural analysis, based on ASI data for the year 1999.
- Section 5 examines electricity consumption data for ESB customers for the year 2002 and 2003.
- In section 6 trends in the services sector in Ireland are compared with trends internationally, using data from the EU Odyssee project. Comparative UK statistics are then examined separately and in more detail, including end use data.
- Finally, section 7 presents conclusions and next steps.

The national energy balance data presented in this report are the most up-to-date at the time of writing. The national energy balance is updated whenever more accurate information is known. To obtain the most up-to-date balance figures visit the statistics publications section of the SEI website[6].

Feedback and comment on the report are welcome and should be addressed by post to the address on the rear cover or by email to epssu@sei.ie.

[6] http://www.sei.ie/uploads/documents/upload/publications/Final_2003_Balance.pdf

2 Energy and Environmental Context

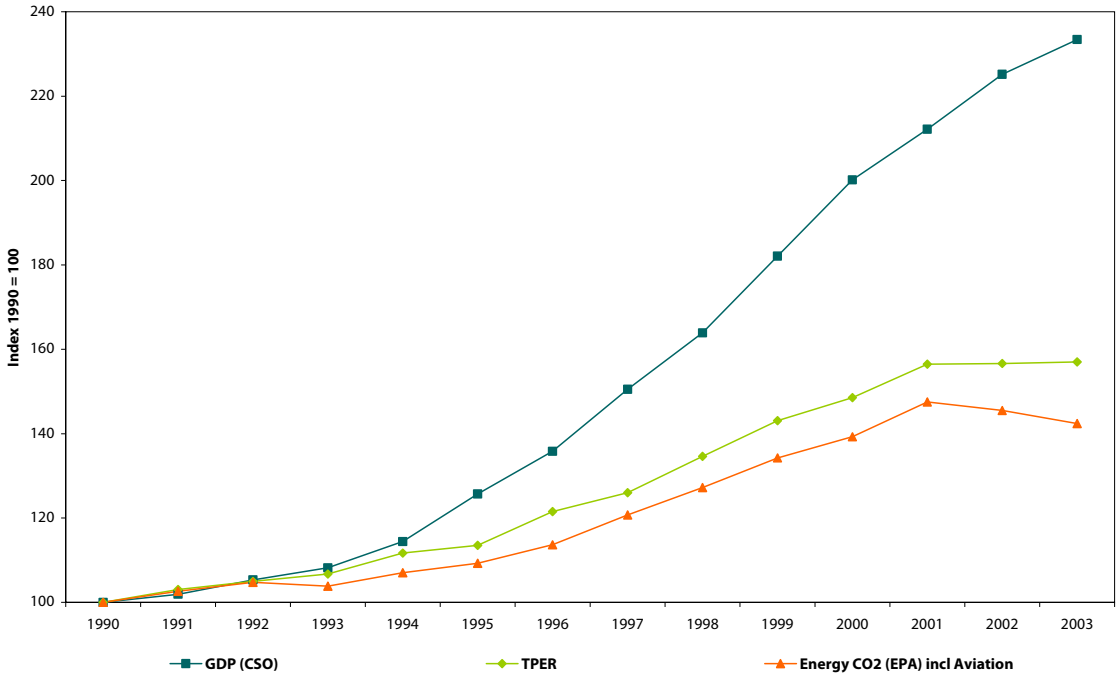
2.1 Energy Trends

This section provides an overview of energy trends in Ireland, covering the period 1990 to 2003, with a particular emphasis on the services sector. A more detailed discussion of energy trends in Ireland generally over the period 1990 to 2003 is available in a separate SEI publication[7].

Energy supply depends firstly on the demand for energy services and secondly on how that demand is delivered. Energy demand in turn is driven primarily by economic activity. Throughout the 1990s economic growth has been particularly strong, especially from 1993 onwards. This resulted in Gross Domestic Product (GDP, a measure of economic growth) in 2000 being almost double that of 1990.

Figure 2.1 shows a relative decoupling of total primary energy requirement (TPER[8], also known as gross inland consumption) from GDP at the economy level since 1992. This is a result of changes in the structure of the economy and improvements in energy efficiency. To a lesser extent, a decoupling of carbon dioxide (CO_2) emissions from energy consumption is also evident, but in both cases a marked decoupling has taken place since 2001. The main factors contributing to this decoupling have been changes in the fuel mix for electricity generation as a result of the commissioning of the new plant and some significant closures in industry.

Figure 2.1: Index of GDP, Primary Energy and Energy-Related CO_2 1990 - 2003



SOURCE: CSO, EPA AND SEI

Turning our attention to the services sector (figure 2.2) there is clearly greater correlation between the economic growth of the services sector, measured by Gross Value Added[9] (GVA), and energy consumption than for the economy as a whole. From 1990 to 1994 energy consumption by the services sector was increasing at a faster rate than its economic growth. From 1995 to 2003, this situation was reversed with GVA increasing at a faster rate than energy consumption. There was a slight decoupling of energy consumption from GVA in 2001 and 2002 but this was reversed in 2003. Over the full period, GVA increased by 93% (5.2% per annum on average) while energy consumption increased by 88% (5% per annum).

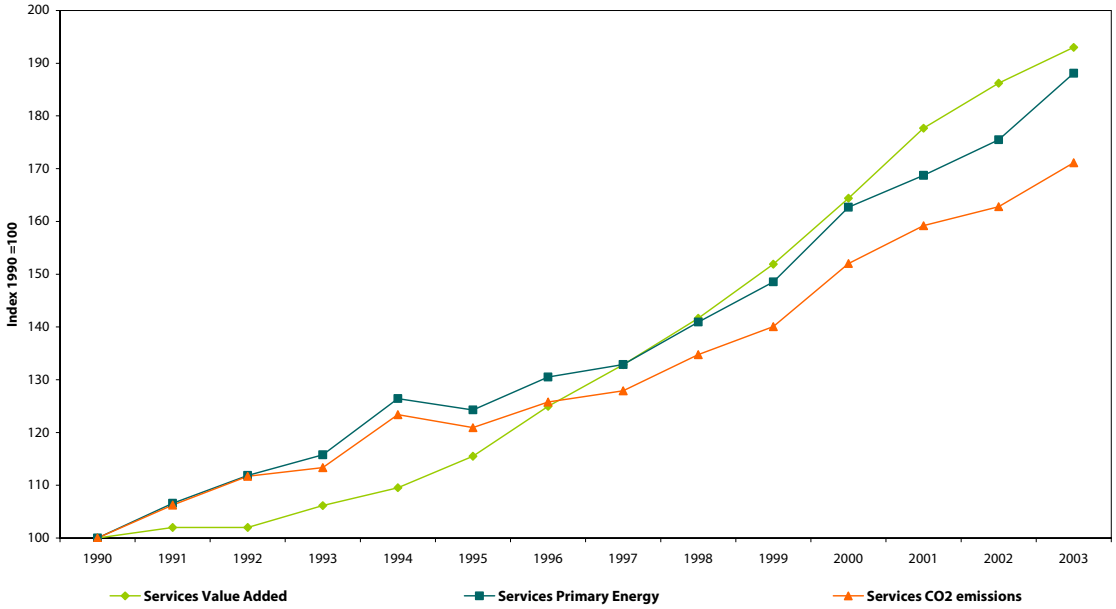
[7] SEI, 2005. *Energy in Ireland 1990 – 2003 Trends, issues and indicators.* http://www.sei.ie/uploads/documents/upload/publications/Energy_in_Ireland_1990-2003_Final.pdf

[8] Primary energy consumption includes all the fuels used directly by each sector plus the primary energy used to generate electricity attributed to each sector in proportion to its electricity demand.

[9] Gross Domestic Product at market prices is equal to Gross Value Added at basic prices plus taxes on products less subsidies on products. It represents total expenditure on the output of final goods and services produced in the country ("final" means not for further processing within the country) and valued at the prices at which the expenditure is incurred.

Since 1992, there has been a growing decoupling of CO_2 emissions from energy consumption in the services sector. This reduction in carbon intensity of the sector is due to fuel switching and increased efficiency of electricity generation. Total CO_2 emissions increased by 71% (4.2% per annum) over the period. The pattern of decoupling of energy consumption from economic growth and emissions growth from energy growth since 2001 is not as pronounced in the services sector as seen in figure 2.2 as in the economy as a whole, which was shown in figure 2.1.

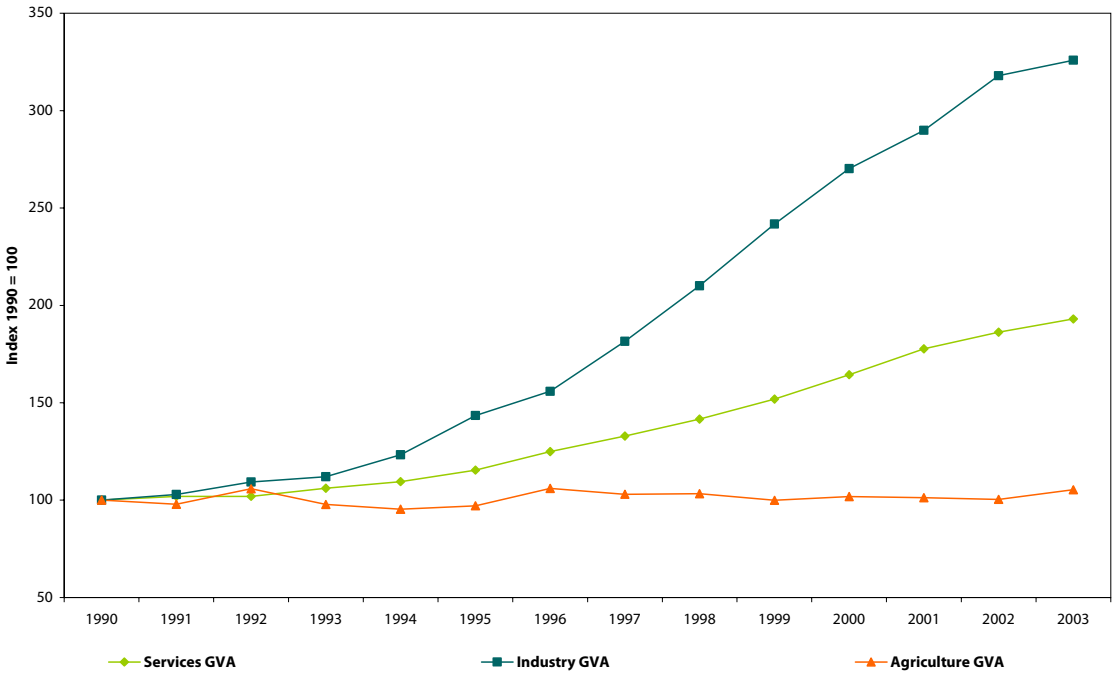
Figure 2.2: Index of GVA, Primary Energy and Energy-Related CO_2 – Services Sector 1990 - 2003



SOURCE: CSO, EPA AND SEI

A further intensity trend to note is that the relative contribution of the services sector to overall GVA is declining, down from 58% in 1990 to 48% in 2003. By contrast, industry's relative share of total GVA increased from 32% of the total in 1990 to 47% in 2003. Agriculture's relative share of the total declined from 10% in 1990 to 5% in 2003.This is reflected by figure 2.3, which illustrates the growth in GVA for services, industry and agriculture, relative to1990 levels.

Figure 2.3: Index of Sectoral GVA 1990 – 2003



SOURCE: CSO

Examining absolute growth, in terms of GVA, shows that industry GVA increased by 226% (9.5% per annum) over the period 1990 to 2003 while services GVA increased by 93% (5.2% per annum) and agriculture remained fairly constant with a 5.4% increase over the period (0.4% per annum).

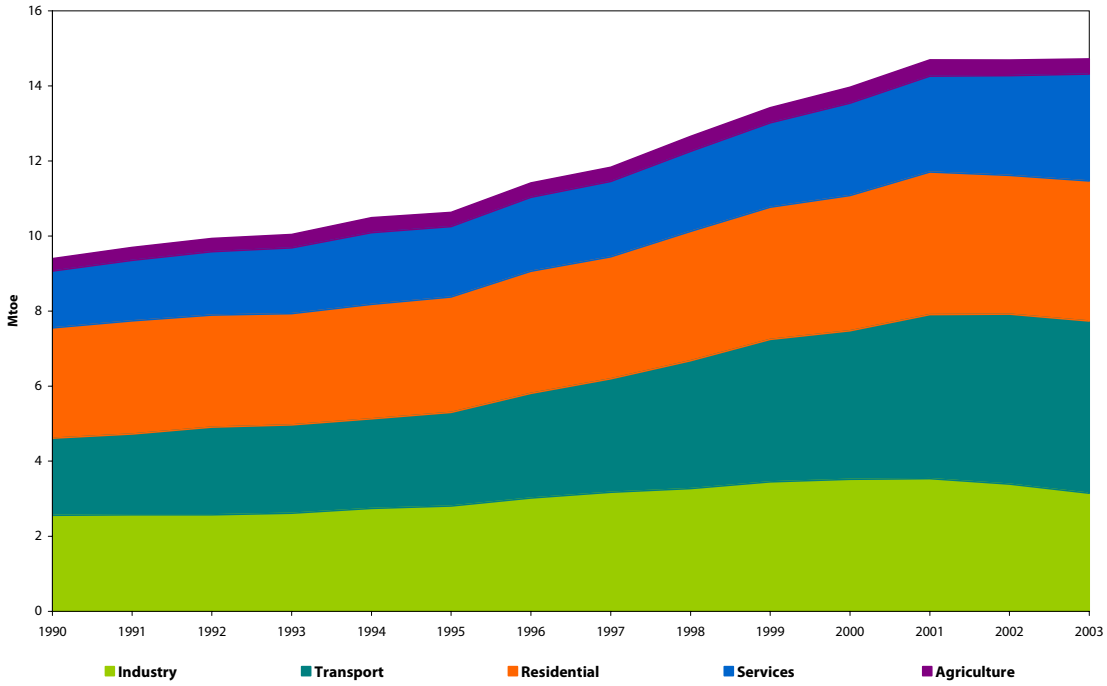
These different growth patterns reflect the changing structure of the economy and the increased importance of high value added industrial sectors, in particular those in the pharmaceuticals and electronics sub-sectors[10].

2.2 Energy Supply

Figure 2.4 shows the TPER of the five principal sectors of the economy in Ireland for the period 1990 to 2003. The average annual growth rate in energy consumption within the services sector during this period was 5%, compared with 6.4% for transport, 1.9% for the residential sector 1.6% for industry and 1.6% for agriculture.

[10] SEI, 2004. *Profiling Energy Consumption and CO_2 Emissions in Industry 2004 Update.* http://www.sei.ie/uploads/documents/upload/publications/EPSSU_Industry_report_8nov.pdf

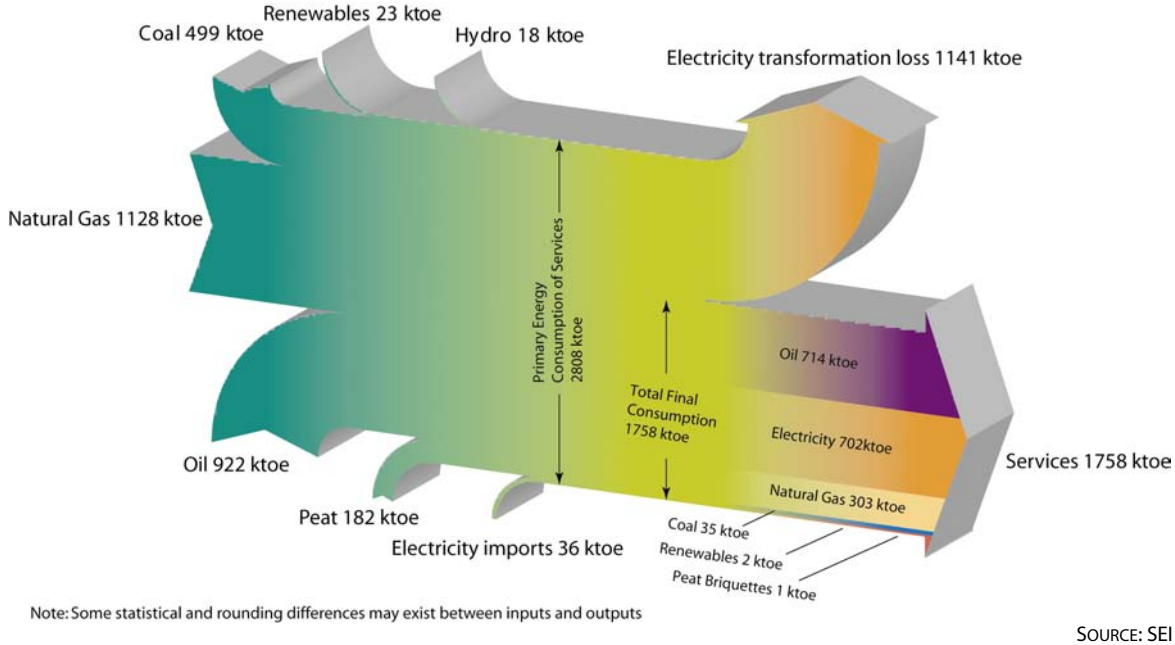
Figure 2.4: Total Primary Energy Requirement by Sector 1990 - 2003



SOURCE: SEI

The services sector's relative share of TPER has increased from 16% (1,512 ktoe) in 1990 to 19% (2,808 ktoe) in 2003. The sector was second only to the transport sector in terms of growth and these were the only two sectors that increased in their relative share of TPER over the period. Primary energy consumption in the services sector increased by 88% over the period whereas energy consumption in the transport sector increased by 123%.

Figure 2.5: Services Sector Energy Balance 2003



Note: Some statistical and rounding differences may exist between inputs and outputs

SOURCE: SEI

Figure 2.5 shows Ireland's services sector energy balance as a flow diagram. Fuel inputs on the left include the input fuel used to generate the electricity consumed by the sector.

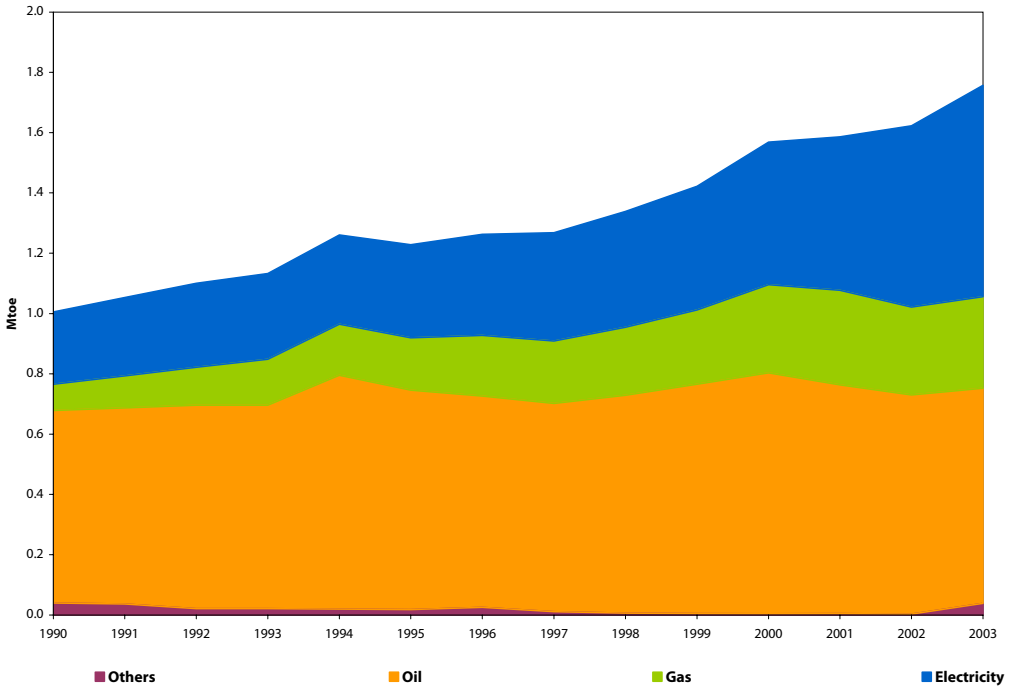
The final energy consumption of the services sector in 2003 was 1,758 ktoe, as indicated in figure 2.5. This represents 15% of Ireland's overall total final consumption (TFC), and is the amount of energy for which the entities within the sector are billed directly[11]. The energy flow diagram highlights the significance of transformation losses, which represent 39% of the primary energy consumed by the sector.

Over the period 1990 to 2003 final energy consumption in the services sector grew by 75%, again second only to the transport sector, which increased by 123%. Industry and the residential sector increased by 26% and 27% respectively over the same period.

Figure 2.6 shows the change in the fuel mix contributing to the overall energy bill of the services sector for the period 1990 to 2003. An interesting feature of energy use in this sector is the small range of fuels used, essentially oil, gas and electricity. Oil and natural gas are primarily used for space heating purposes but also for water heating, cooking and in some sub-sectors, laundry. It should be noted that there is also a small quantity of LPG used in the services sector. It is included in the oil portion of figures 2.5 and 2.6.

[11] TFC is essentially TPER less the quantities of energy required to transform and distribute primary sources such as crude oil into forms suitable for use by consumers such as refined oils and electricity.

Figure 2.6: Total Final Energy Consumption by Fuel- Services Sector 1990 – 2003



SOURCE: SEI

Oil consumption increased by 11.7% over the period (a rise of 0.9% per annum) while natural gas increased by 250%, (10% per annum) albeit from a much lower base. There are also small quantities of coal, peat (used for example in open fires in hotels and public houses) and renewables (biogas in waste water treatment plants) used in the sector and are shown in figure 2.6, table 2.1 and 2.2 as others.

The changes in the relative shares of each of the fuels (shown in table 2.1 and 2.2) point to the increasing importance of electricity in the sector. Electricity consumption increased by 192% between 1990 and 2003 making it, after oil, the most significant energy source in the fuel mix. Its share of final consumption in services increased as a result from 24% in 1990 to 40% in 2003. Electricity consumption increased by 17% in 2003 alone. This growth over the period was fuelled by the volume of growth of the sector, allied to the changing structure of the sector and the increasing use of information and communication technologies as well as air-conditioning.

Table 2.1: Final Energy Consumption in the Services Sector

ktoe	1990	1993	1996	1999	2000	2001	2002	2003
Oil	639	675	701	761	799	759	727	714
Gas	87	152	201	246	293	314	291	303
Electricity	240	285	336	411	473	510	602	702
Others	40	21	25	4	4	4	3	38
Total	1006	1133	1263	1422	1569	1587	1623	1758

SOURCE: SEI

Table 2.2: Growth Rates and Shares of Final Energy Consumption in the Services Sector

	Growth %	Average annual growth rates %					Shares %	
	1990 – '03	1990 – '03	1990 – '95	1995 – '00	2000 – '03	2003	1990	2003
Oil	11.7	0.9	2.6	1.9	-3.7	-1.8	63.5	40.6
Gas	250.4	10.1	14.9	11.0	1.2	4.3	8.6	17.3
Electricity	192	8.6	5.2	8.9	14.1	16.6	23.9	39.9
Others	-3.1	-0.2	-14.9	-25.7	*	*	4.0	2.2
Total	74.8	4.4	4.1	5.0	3.9	8.3	100	100

* Due to a reclassification 2003 data is not directly comparable with other years.

SOURCE: SEI

In 2003, 35% of all electricity in Ireland was consumed in the services sector, up from 23% in 1990. For the first time, the services sector has replaced industry as the largest electricity consuming sector. In the same period industry's share of total electricity consumption declined from 39% to 32%.

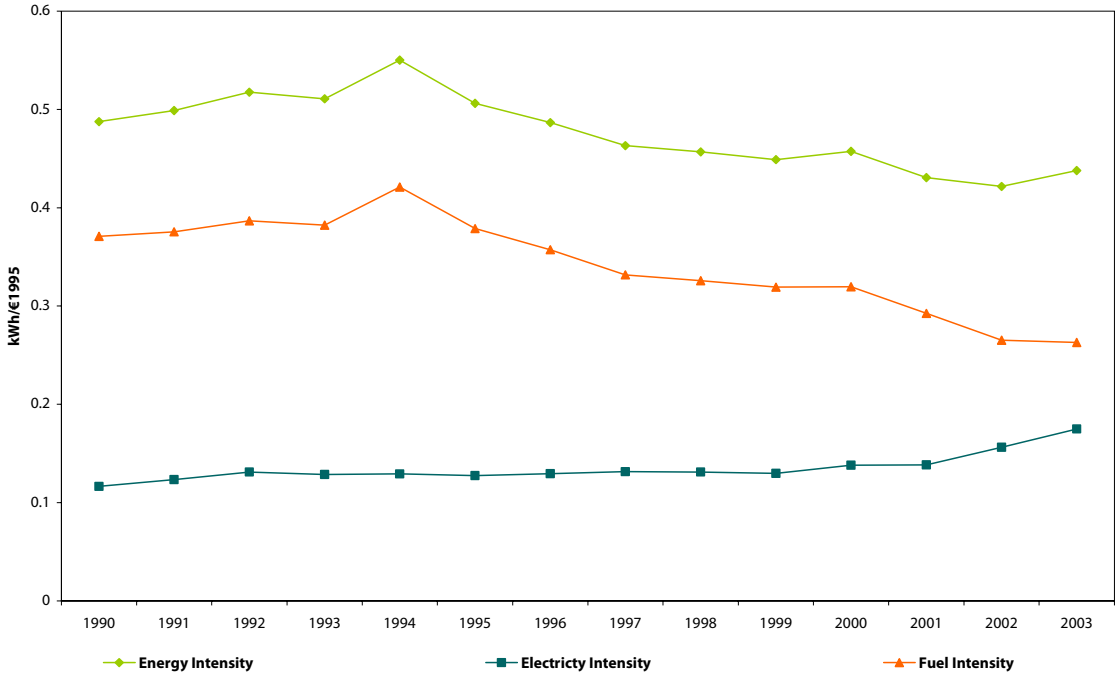
2.3 Energy Intensity

Energy intensity is defined as the energy required to produce a unit of functional output. It may be viewed as the inverse of the energy productivity of the economy, or of a particular sector. For the services sector, an appropriate choice of functional output is GVA, which represents the contribution of the sector to Ireland's economic growth. Figure 2.7 shows the trend in energy intensity for the services sector, measured as final energy consumption divided by GVA (measured in constant 1995 prices to remove the influence of inflation). The energy intensity of the services sector was 10% lower in 2003 than it was in 1990 (indicating an average 0.8% improvement in energy productivity per annum) principally because of the rapid growth in the value added (that was shown in figure 2.2) in the sector since 1995, largely associated with increased activity. This *activity* effect is only one of the factors that can influence energy intensity, others being *fuel switching, energy efficiency and structural changes* in the sector i.e. moving away from high energy consuming sub-sectors sectors to relatively low energy consuming, high value added activities.

The electricity intensity of the services sector is also shown in figure 2.7. As already noted, electricity is the second most dominant fuel in this sector after oil and consumption increased by 192% from 1990 to 2003. The growth rate in electricity consumption was higher than that for GVA, and as a result the electricity intensity of the service sector was 50% higher in 2003 than in 1990 (3.2% increase per annum). Significant increases (11%) in 2002 and 2003 (12%) are particularly evident.

The (non-electricity) fuel intensity is also shown for completeness. Its pattern is markedly different from the electricity intensity, declining by 29% or 2.6% per annum over the period.

Figure 2.7: Energy, Electricity and Fuel Intensity of the Services Sector 1990 - 2003

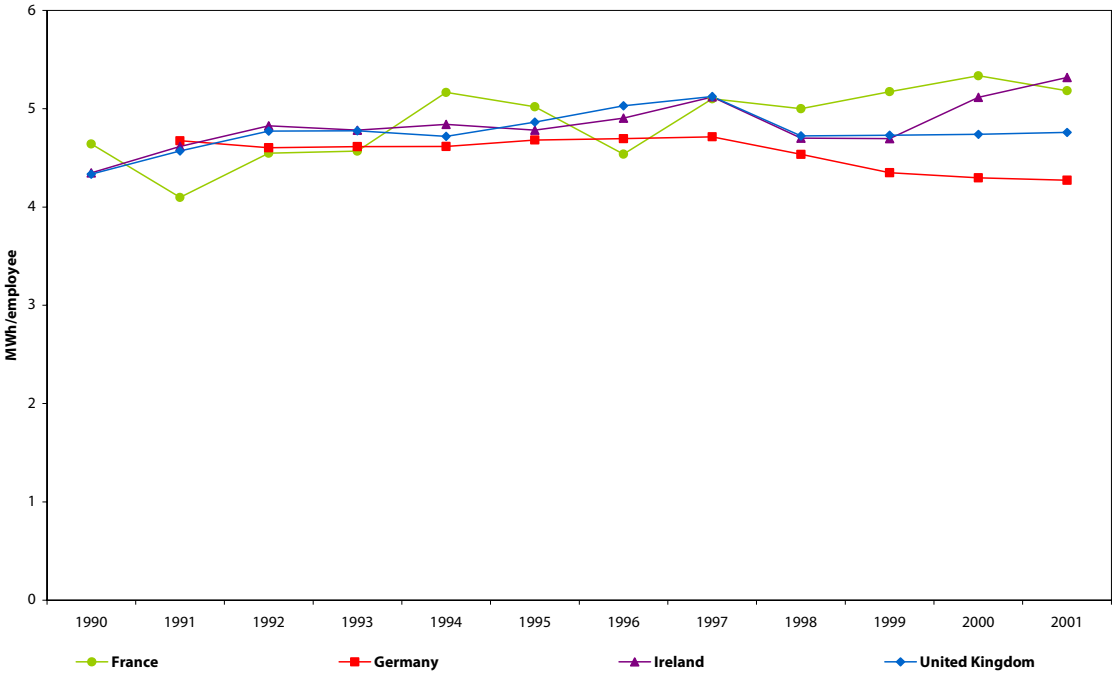


SOURCE: ODYSSEE AND SEI

2.4 Unit Consumption

Two other useful energy intensity indicators in this sector are energy consumption per unit of floor area and per employee. Oil and gas are consumed largely for heating purposes and in principle the heating requirement of a building can be usefully assessed against building size. However, the absence of data on floor area in the services sector does not allow a calculation on this basis. In addition, the heterogeneous nature of the sector makes it difficult to estimate or model this data.

Figure 2.8: Unit Consumption of Energy, Electricity and Fuel in the Services Sector 1990 - 2003



SOURCE: SEI

Unit consumption of electricity per employee is generally used as an indicator of electricity intensiveness in the services sector because the number of people requiring light and using IT equipment, as well as canteen and hot water facilities, directly affects consumption of electricity. Figure 2.8 shows how unit consumption of electricity rose by 58% since 1990 (3.6% growth per annum).

The number of employees is also used in this report to assess fuel consumption in the absence of floor area data, a more appropriate datum for assessing heating fuel requirements. This is not ideal but there is some correlation between floor space and number of employees. From figure 2.8, the fuel consumption per employee trend contrasts significantly with that for unit electricity consumption. It has declined by 26% since 1994 (by 2.2% per annum on average).

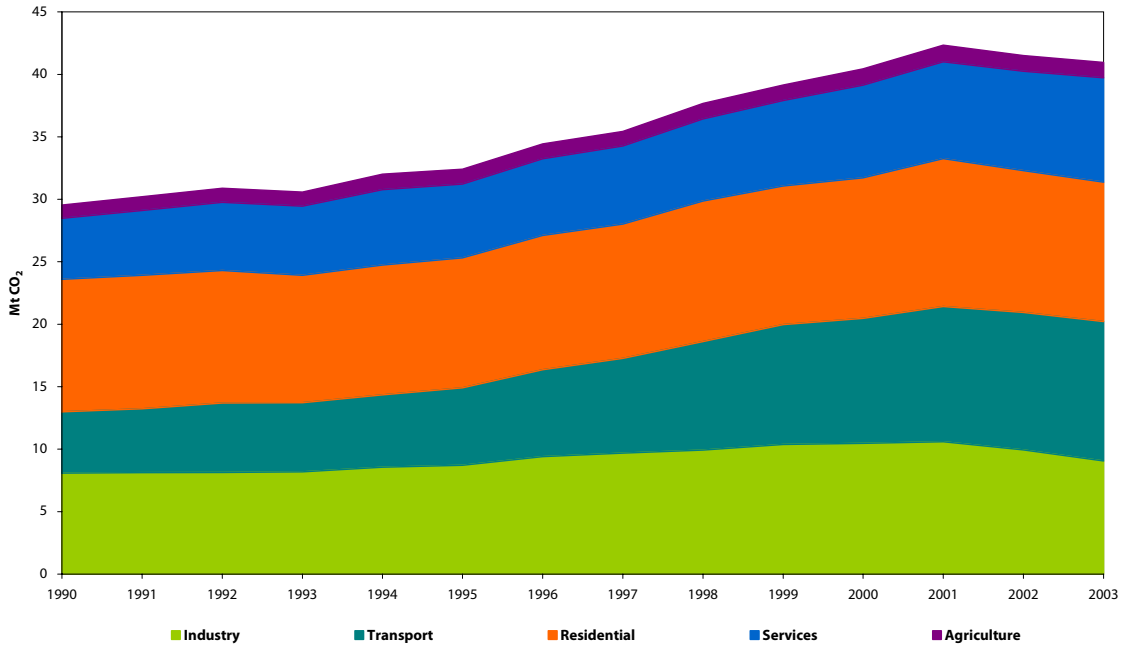
2.5 Environmental Impact

The increase in energy consumption in Ireland since 1990 has resulted in a significant increase in energy-related CO_2 emissions. [12] Figure 2.9 illustrates the sectoral breakdown of energy-related CO_2 emissions, which have increased by 39% during the period 1990 to 2003 (2.5% per annum) after reaching a peak in 2001 at 46% above 1990 levels. In 2003, total services sector energy -related CO_2 emissions were 6,835 kt CO_2.

As stated in section 2.1, the noticeable 4% reduction in energy-related emissions over the two year period 2002 to 2003 is principally due to the increased efficiency of electricity generation, particularly as a result of the two large scale combined cycle gas turbines (CCGT) that were commissioned in 2002. These new generators are less carbon intensive due to their higher efficiency and also because they use fuel with a lower carbon content.

[12] CO_2 emissions accounted for 96% of energy-related green house gas emissions in 2003, the other 4% being accounted for by energy-related nitrous oxide (N_2O) and methane (CH_4).

Figure 2.9: Energy-Related CO_2 Emissions by Sector 1990 - 2003



SOURCE: SEI

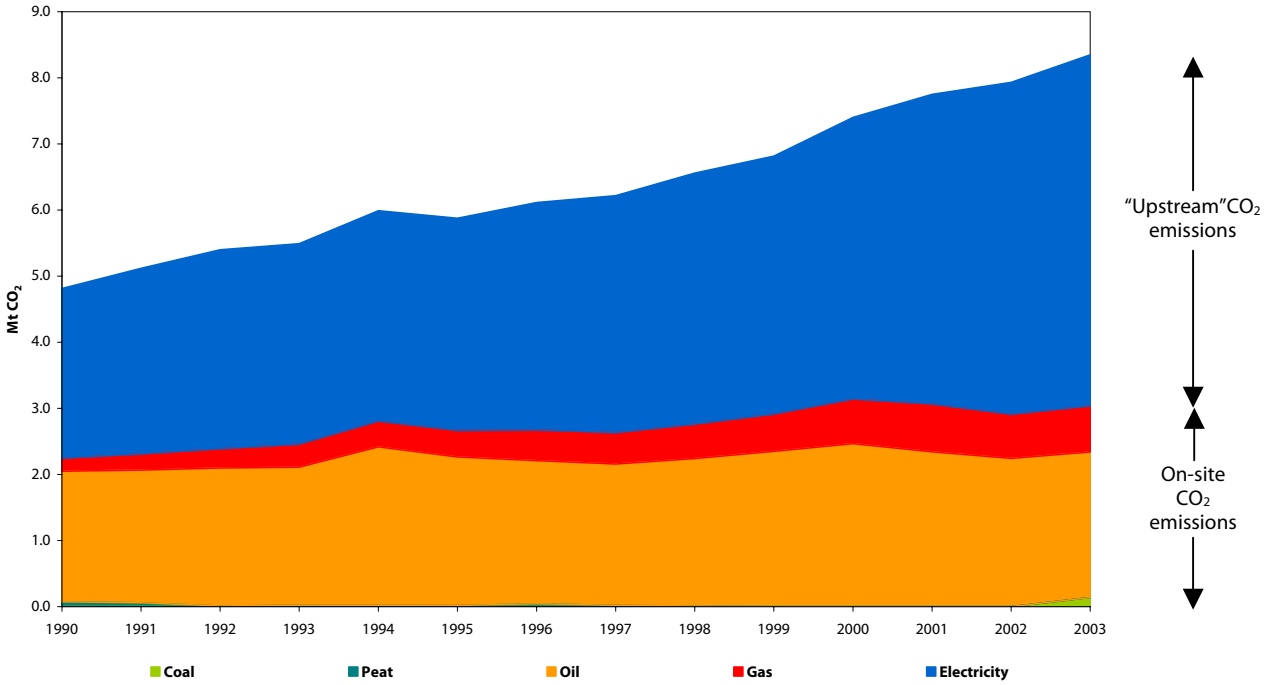
The 71% growth in energy-related CO_2 emissions from the services sector over the period 1990 to 2003 (4.2% per annum) is second only to the transport sector (127% or 6.5% per annum). By contrast, energy-related emissions from industry increased by 12% (0.9% per annum), agriculture recorded an increase of 17% (1.2% per annum) and emissions from the residential sector were reduced by 5% (0.4% per annum). The services sector's share of the total energy-related emissions increased as a result, from 16% in 1990 to 19% in 2003.

Energy-related CO_2 emissions in the services sector are examined in more detail in figure 2.10, which distinguishes between on-site emissions associated with direct fuel (oil, gas, etc.) use and the upstream emissions associated with electrical consumption. This distinction is important because the data in the National Climate Change Strategy (NCCS) attributed to individual sectors capture only the on-site emissions, whereas the upstream emissions are contained in the energy supply section of that document.

On-site emissions increased by 32% (2.1% per annum) over the period whereas the upstream emissions associated with electricity consumption increased by 107% (5.8% per annum). In 2003, on-site emissions increased by 4% while the upstream emissions in services continued to rise by 5.8% in spite of a decrease in carbon intensity of electricity generation. This was due to the unusually high level of growth (17%) in electricity consumption in 2003.

Energy-related CO_2 emissions associated with electricity consumption represented 64% of the total for the services sector in 2003 (the highest proportion in the 1990 to 2003 period), compared to 36% from direct fuel combustion. In 1990 the proportions were more evenly split between the two (53% for electricity and 47% for direct fuels).

Figure 2.10: Services Sector Energy-Related CO_2 Emissions by Fuel 1990 – 2002



SOURCE: SEI

2.6 Combined Heat and Power

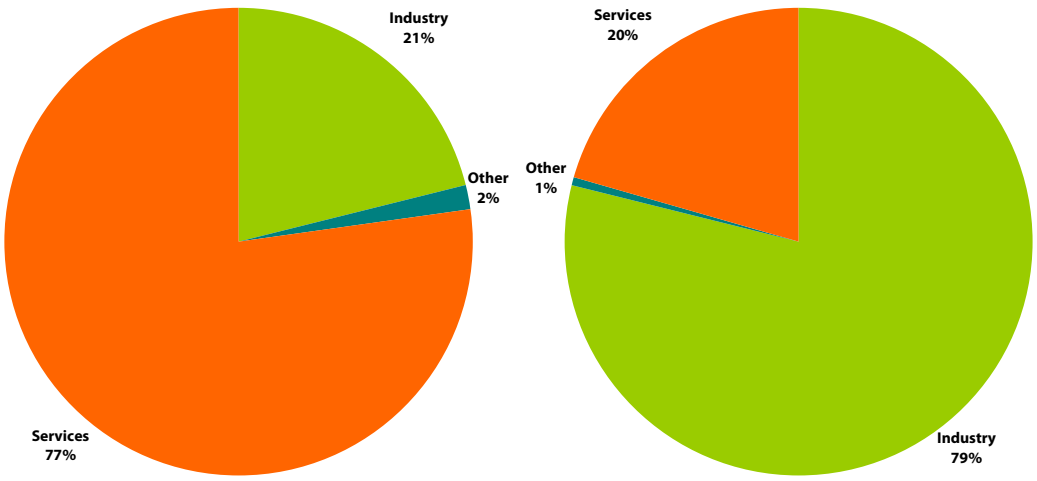
Combined Heat and Power (CHP) is a technology designed to increase energy efficiency and has particular market potential within certain services sub-sectors. CHP is the simultaneous generation of usable heat and electricity[13] in a single process. In the right circumstances, CHP can be an economic means of improving the efficiency of energy use and achieving environmental targets for emissions reduction. CHP usually involves the burning of fossil fuels, but heat and electricity are also produced from biomass (including biogas and waste).

Data in this section is from a survey conducted by SEI in late 2004. A more detailed discussion of CHP trends in Ireland over the period 1991 to 2002 is available in a separate publication[14]. The figures used here provide a partial update to that report.

Figure 2.11 presents the number of units and installed electricity generation capacity for CHP in Ireland in 2003. In that year, the services sector accounted for 99 (77%) of the 128 units[15] and 27.8 MW_e (20%) of the 137 MW_e installed capacity[16]. Most CHP units are thus in the services sector, while the bulk of CHP installed capacity is in industry, indicating that there are a large number of relatively small units in the services sector. Traditionally, CHP was more suited to large industrial concerns but the availability of ready made, small scale, reliable, gas units in the 1990s allowed the services sector to avail of the technology. Their heat and electricity demands would not previously have justified the investment.

[13] In a small number of cases internationally, mechanical rather than electrical power is produced, in addition to heat.
[14] SEI, 2004. *Combined Heat and Power in Ireland 1991 – 2002 Trends and Issues.*
http://www.sei.ie/uploads/documents/upload/publications/SEI_CHP_Report_Final.pdf
[15] Note that units are distinct from CHP plants or schemes and that there may be more than one CHP unit at a site.
[16] Megawatt electrical or MW_e is the unit which represents the installed electricity generating capacity or size of a CHP plant.

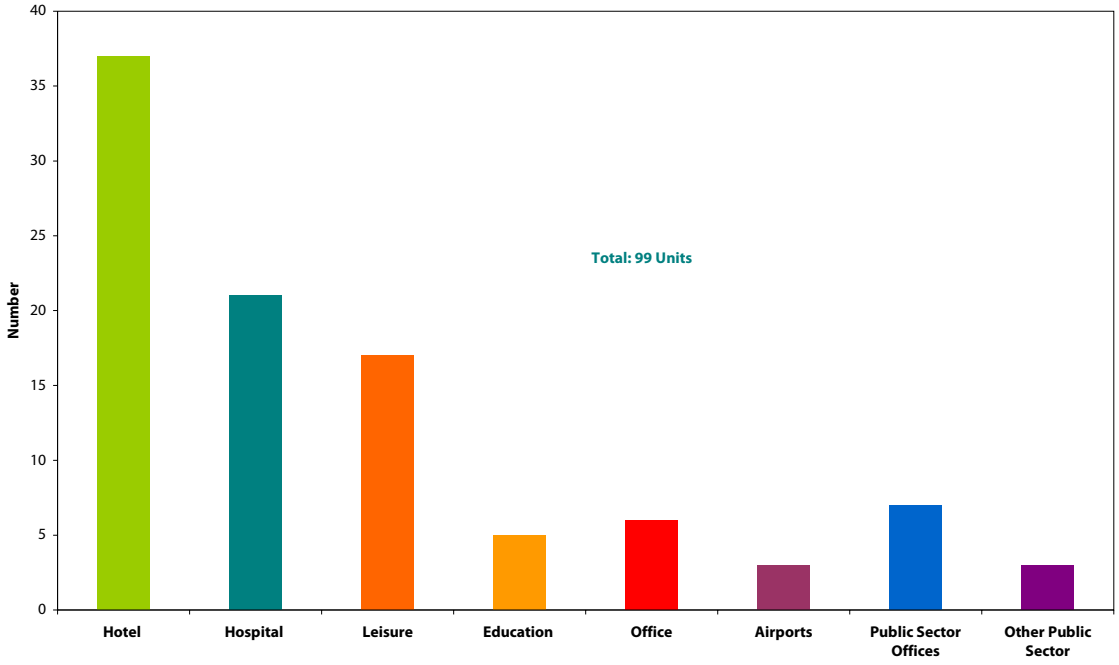
Figure 2.11: Number of CHP Units and Installed Capacity by Sector 2003



SOURCE: SEI

Figure 2.12 provides a sub sectoral breakdown of CHP units within the services sector further highlighting that hotels and hospitals accounted for the bulk of units in 2003 (59% or 58 out of 99 units), while the leisure sub-sector accounted for another 17%. These sub-sectors in particular, benefit from having a relatively constant demand for heat and electricity. The technology however, may also be suited to any site that has a simultaneous and sustained demand for both heat and electricity, depending on the individual site characteristics.

Figure 2.12: Number of CHP Units by Services Sub-Sector 2003



SOURCE: SEI

For sites that also have a significant cooling requirement, a new technology known as trigeneration may be suitable. Heat in a CHP plant in this case is used to produce cooling, via absorption refrigeration so that a single trigeneration unit can supply a site with electricity all year round, in addition to heat and air-conditioning when required.

3 Energy and the Services Sector – the Policy Context

The significant recent growth in energy consumption and related environmental emissions has raised concerns regarding climate change and air quality. Governments and policy makers are responding by introducing policies and measures designed to manage energy more effectively and mitigate against increased human impact on the environment.

Energy use in the services sector is essentially comprised of energy use in buildings (including for heating, cooling and lighting) and certain facilities (for example municipal water pumping) where the services are delivered. Energy policy measures targeting the built environment have an important influencing role in improving energy efficiency and in reducing associated emissions in this sector. This section identifies the major policy developments that have had an impact on the services sector, which have evolved at global, European and national level.

3.1 Global Developments

The first World Climate Conference in Geneva in 1979 concluded that anthropogenic greenhouse gas (GHG) emissions could have a long term effect on climate thereby linking increasing energy consumption to climate change. The establishment of the World Climate Programme was one of the conference outcomes and provided the framework for international research into, and the platform for identifying, the important climate issues of the 1980s and 1990s.

Linking energy and environmental concerns within policy debates intensified during the 1980s with the establishment in 1983 of the World Commission on Environment and Development (WCED) also known as the Brundtland Commission and the publication of the Brundtland report[17] in 1987. The report identified the need for sustainable development defined as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*".

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 under the auspices of the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO). This reflected the consensus amongst Governments that the issue of climate change needed to be investigated impartially by an independent body. The IPCC presented its First Assessment Report published in 1990[18]. The report reflected the views of hundreds of experts and stated that 60% to 80% cuts in GHG emissions would be needed to stabilise the current level of greenhouse gases in the atmosphere.

In 1992 the UN organised a Conference on Environment and Development (UNCED, also known as the Earth Summit), which was held in Rio de Janeiro. The IPCC provided evidence to the Summit of the threat posed by climate change, thereby playing a key role in Governments agreeing the text of the UN Framework Convention on Climate Change (UNFCCC) in May 1992. There were 166 parties to the Convention when it came into force in March 1994 and by March 2005 this had grown to 194 countries.[19]

The primary goal of the UNFCCC is to stabilise GHG emissions at levels that will prevent interference with the global climate. An initial target set by the parties to the Convention was to reduce GHG emissions to 1990 levels by the year 2000.

3.1.1 The Kyoto Protocol

This target was enhanced in 1997 through the Kyoto Protocol[20], whereby individual (industrialised) countries agreed to quantified GHG emission reductions that would result in an overall reduction for Annex 1 countries[21] of 5.2% below 1990 levels by the period 1998 to 2012. While this is a step in the right direction, it is essentially an initial step towards stabilising global GHG emissions into the atmosphere. The Protocol assigns a specific target to each country, for example Iceland is committed to a limiting growth to 10% above 1990 levels, while the EU has agreed to an 8% reduction on 1990 levels (see section 3.2.1). The combined impact of the individual targets would then achieve the overall 5.2% target for the industrialised countries.

The Kyoto Protocol entered into force on February 16th 2005, following the ratification of the Protocol by Russia in November 2004. The targets then became legally binding for the 37 (of the 41[22]) Annex I parties that ratified the

[17] WCED, 1987. *Our Common Future.*
[18] Intergovernmental Panel on Climate Change, 1990. *First Assessment Report.* See http://www.ipcc.ch for more information.
[19] UNFCCC, 2005. List of Parties available from http://unfccc.int/parties_and_observers/parties/items/2352.php.
[20] UNFCC, 1997. *The Kyoto Protocol.* http://unfccc.int/resource/docs/convkp/kpeng.pdf
[21] Annex 1 Parties are industrialised countries (OECD members and Economies in Transition), which have historically emitted the most GHG. Currently there are 41 Annex 1 countries.
[22] Australia, Croatia, Monaco and the USA have not ratified the Protocol.

Protocol. If a party to the agreement does not meet its Kyoto target by 2012 may face[23] a *"deduction from the Party's assigned amount for the second commitment period of a number of tonnes equal to 1.3 times the amount in tonnes of excess emissions"*. This may have significant financial implications, depending on the level of the breach.

3.2 European Policy

3.2.1 Burden Sharing Agreement

The EU target under the Kyoto Protocol is to achieve an 8% reduction in GHG emissions on 1990 levels by the period 2008 – 2012. Council Decision 2002/358[24] stipulates the targets for individual Member States according to a Burden Sharing Agreement. The UK for example has committed to reducing its emissions by 12.5% while Greece will be allowed to increase its emissions to 25% above 1990 levels. Individual national targets reflect a number of factors, including the amount of historical emissions a country has emitted and the stage of development of its economy in the base year.

3.2.2 Emissions Trading

The Kyoto Protocol established a number of mechanisms that a Party may use to help meet its emissions target, provided that it is complying with its methodological and reporting obligations under the Protocol. Emissions trading between UN FCC Annex I parties under the International Emissions Trading (IET) scheme is one of the mechanisms provided.

The scheme will not be in operation until 2008 but in advance, Directive 2003/87/EC[25] established a pilot, EU-wide IET scheme, which came into effect in all EU member states on 1st January 2005. The Directive applies to all combustion installations across the EU with a rated thermal input exceeding 20 MW as well as a range of other sites with activities such as steel and cement production, paper, ceramics and glass manufacturing. The scheme is expected to cover 45% to 50% of the EU's total CO_2 emissions.

Operators of all installations involved are required from January 2005 to hold a permit issued by a competent authority (Environmental Protection Agency, EPA in the case of Ireland). These operators will receive an allocation of CO_2 emission allowances for the period 2005 to 2007. If actual emissions exceed the allowance allocated, the operator must purchase allowances from other operators within the EU. If emissions are lower than the allocation, the operator can sell the excess allowances to those with a shortfall. Operators must accumulate sufficient allowances to cover annual emissions, or else face a penalty of €40/tCO_2 in the period 2005 to 2007 and €100/tCO_2 in the period 2008 to 2012. While this scheme will apply, for the most part, to the industrial sectors, a number of entities within the services sector are also included (hospitals and universities).

3.2.3 Energy Performance of Buildings Directive

Buildings have a large part to play in the abatement of GHG emissions in order to meet Europe's Kyoto targets (as well as decreasing Europe's dependence on imported energy). It has been estimated that the operation (lighting, space heating and cooling) of buildings is responsible for about 40%[26] of final energy use in the EU. According to the European Commission, research has shown that more than 20% of present energy consumption could be saved by 2010 by applying stricter standards to buildings undergoing refurbishment and to new buildings[27]. This Directive has implications for energy consumption in the services sector, due to the amount of energy that is consumed in buildings within the sector.

Directive 2002/91/EC on the energy performance of buildings[27] responds to the key role buildings play in the energy field. The most significant requirement of the Directive is that energy performance certificates be available when buildings are constructed, sold or rented out. The Directive imposes an additional requirement for public sector buildings over 1,000 square metres to display an energy rating certificate.

The Directive also sets minimum standards for new buildings and for buildings that undergo significant renovations as well as allowing for the inspection of boilers, heating and cooling systems. The Directive requires that each

[23] United Nations Framework Convention on Climate Change, 2002. *Procedures and mechanisms relating to compliance under the Kyoto Protocol.* Report from COP 7, Marrakech October 29th – November 10th 2001 page 76 (FCCC/CP/2001/13/Add.3).
[24] European Union, 2002. *Decision 2002/358/EC on a EU Burden Sharing Agreement.* http://europa.eu.int/eur-lex/pri/en/oj/dat/2002/l_130/l_13020020515en00010020.pdf
[25] European Union, 2003. *Directive 2003/87/EC of the European Parliament and of the council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC.* http://europa.eu.int/eur-lex/pri/en/oj/dat/2003/l_275/l_27520031025en00320046.pdf
[26] European Union, 2002. *Directive 2002/91/EC of the European Parliament and of the council of 16 December 2002 on the energy performance of buildings.* http://europa.eu.int/scadplus/leg/en/lvb/l27042.htm
[27] European Commission, 2000. *Green Paper Towards a European Strategy for the Security of Energy Supply.* http://europa.eu.int/comm/energy_transport/en/lpi_lv_en1.html

country develop their own methods for certifying energy performance of services sector buildings and each Member State must transpose the Directive into national legislation by the beginning of 2006.

The EU has a range of additional policies, proposals and supporting measures that impact on energy consumption in the services sector. These include additional proposals relating to energy efficiency, the EU 6th Framework Programme support for energy demonstration projects and the EU Intelligent Energy in Europe programme supporting analysis and promotional activities.

3.3 Irish Policy

3.3.1 Green Paper on Sustainable Energy

The Government's Green Paper on Sustainable Energy in 1999[28] presented growth projections for energy consumption up to 2010 and set out a number of options for meeting our energy requirements in a more environmentally and economically sustainable way. The Green Paper identified the significance of the services sector and also that the lack of available data hindered a comprehensive sectoral analysis. It suggested the following programmes and measures aimed at large services sector energy consumers:

- best practice schemes /awards;
- information exchange;
- labelling of service sector buildings and building standards;
- an obligation to include energy efficiency in annual reports.

Additionally, the Green Paper stated that *"the non-commercial public sector will adopt energy efficiency targets, practices and procurement policies which will give leadership to the rest of the community by setting an example of best practice where possible".*

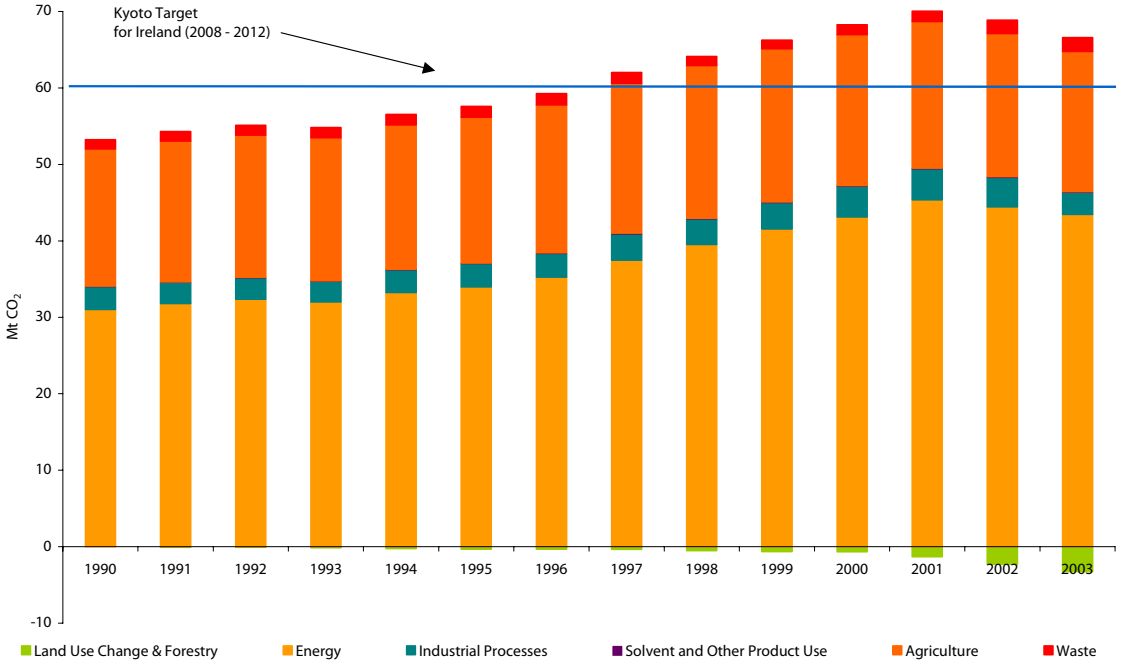
3.3.2 Response to Kyoto

Ireland's target under the Kyoto Protocol arising from the EU Burden Sharing Agreement is to limit annual GHG emissions to 13% above 1990 levels by the period 2008 to 2012. Ireland's national target reflects a number of factors, including the relatively underdeveloped state of the economy in the base year (1990), as well as subsequent economic growth levels, available projections of GHG emissions at the time of the agreement and anticipated wealth by the commitment period.

As shown in figure 3.1, Ireland's upper limit for the period 2008 to 2012 under the Kyoto Protocol was reached in 1997. By 2001, emissions levels reached 31% above 1990 levels, and this was followed by a reduction in emissions since then. Based on EPA data, Ireland's GHG emissions[29] in 2003 were 25.3% above 1990 levels. Given that energy consumption in 2002 and 2003 remained at 2001 levels this constitutes a significant decoupling of emissions growth from energy growth. It is largely attributed to fuel mix changes associated with the increased consumption of gas and renewable energy, which are less carbon intensive than oil and the solid fuels. In 2001, the most recent year comparable data is available; of Annex 1 countries only Spain, Portugal and Monaco were at a higher level than Ireland compared to the base year and their emissions had increased by 33%, 36% and 41% respectively[30].

[28]Government of Ireland, 1999. *Green Paper on Sustainable Energy.* http://www.dcmnr.gov.ie/Energy/
[29] Energy consumption, required to meet our demand for electricity, heating (and cooling) and transportation, was responsible for 58% of Ireland's GHG emissions in 1990, rising to 66% in 2003.
[30] UNFCCC, 2004. *United Nations Framework Convention on Climate Change The First Ten Years.* http://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/first_ten_years_unfccc.pdf

Figure 3.1: Greenhouse Gas Emissions in Ireland 1990-2003



SOURCE: EPA[31]

3.3.3 National Climate Change Strategy

The Government in October 2000 published the National Climate Change Strategy[32] (NCCS). This strategy provides a framework for achieving GHG emissions reductions in the most efficient and equitable manner while continuing to support economic growth. The NCCS projects that in the absence of the measures detailed in the strategy, Ireland is likely to overshoot the Kyoto target by up to 13 Mt CO_2 (37% above 1990 levels).

With regard to the services sector the strategy targets a 0.175 Mt CO_2 reduction in emissions that is to be achieved through energy efficiency measures in the sector. There is some degree of overlap with the 0.9 Mt savings targeted for the built environment, which includes the residential sector as well as the services sector. These targets relate to direct fuel use within the sector, or on-site emissions (see section 2.5).

In addition, the NCCS advocates the introduction of negotiated agreements with representative bodies in the sector in order to promote energy efficiency when new buildings are being designed and existing buildings undergo retrofitting. The strategy also proposed emissions trading and targeted taxation as a means of achieving efficiency gains.

Finally, there was a proposal *"for each (building) unit to be benchmarked against best international practice for each type of building (for example; naturally ventilated, air conditioned, etc.) by 2002 and to achieve energy savings by 2005"*.

A progress report on the implementation of the NCCS published in May 2002[33] stated that there were approximately 4,500 to 5,000 buildings in the public services sector with a total energy spend of €180m annually. It was estimated that the on-site energy-related CO_2 emissions were 2.9Mt per annum. The progress report details the programmes that were put in place to improve the energy efficiency of these buildings, for example, introducing building management systems in the larger buildings as well as design studies, model solutions and support for a energy management bureau. The last three of these schemes are operated by SEI[34].

[31] EPA, 2003. *Ireland National Greenhouse Gas Inventory Report*.
[32] Government of Ireland, 2000. *National Climate Change Strategy*.
[33] Government of Ireland, 2002. *Progress Report on the Implementation of the National Climate Change Strategy*. http://www.environ.ie/DOEI/doeipub.nsf/0/fecdecefd52bc7bc80256b76005db5ee/$FILE/ccrpt2%5B1%5D.pdf
[34] See www.sei.ie for more details.

3.3.4 Emissions Trading

Under the EU Emissions Trading Scheme each country is obliged to submit a National Allocation Plan. The European Commission approved Ireland's National Allocation Plan for the pilot phase of the EU Emissions Trading Scheme (2005-2007) on the 7th July 2004. In the second public consultation of the National Allocation Plan the majority of allocations are to industrial enterprises but fourteen permits were granted to ten enterprises in the services sector.

Under the EU Emissions Trading Directive, EPA is responsible for Ireland's National Allocation Plan, which allocates an overall 67 Mt CO_2[35] emissions allowances to individual sectors and enterprises. As mentioned, the majority of allocations are to industrial enterprises but there were fourteen sites included from the services sector associated with ten separate enterprises. The allocation of allowances was based on detailed historical data of CO_2 emissions relating.

[35] This results in 22.3 Mt per annum on average over the period 2005 to 2007 and represents approximately 33% of Ireland's projected GHG emissions in that period.

4 Commercial Services Sector Profiling

4.1 Methodology

The analysis in section 2 points to the availability of high-level energy data by fuel for the services sector in Ireland. SEI uses this high level data to produce the national energy balance and meet a number of Ireland's requirements with respect to international reporting obligations for energy statistics. The data available are not sufficiently detailed, however, to carry out an in depth analysis of energy consumption in the services sector. Furthermore, the boundaries between some industrial and services sector customers are not always harmonised within the energy supply industry, which results in uncertainties even in the high level data.

In order to address the information gap associated with energy use in the services sector, SEI has investigated a number of different data sources, among them the Central Statistics Office (CSO) Annual Services Inquiry (ASI).

The ASI is an enterprise survey, where an enterprise (which may conduct its activities at more than one site) is defined as the smallest legally independent unit. The survey covers sampled enterprises in the retail, wholesale, real estate, renting and business services and other selected commercial services sectors (see figure 1.1). However detailed expenditure on energy is not collected for all sub-sectors.

The ASI employs different sampling fractions, which vary by region, by sub-sector and by size class. The sampling frame is the CSO Central Business Register. The ASI is designed to provide grossed estimates of variables such as Gross Value Added (GVA) and turnover. Details of the sampling frame and the method used to gross sample data to the population are contained in Appendix 2. It should be noted that while the grossed data used in this report are the best estimates available, they remain approximations of the true data.

Each year one of the questions in the ASI seeks expenditure on energy, in the form of a single question on the total expenditure on all fuels. A number of additional questions are asked each year, which alternate on a five-year cycle. Every five years enterprises are asked to submit details of their purchases on energy, disaggregated by fuel. The latest available detailed energy expenditure dataset covers the year 1999. This data was then grossed to provide the estimates of expenditure by sub-sector and population that were published by CSO.

SEI together with CSO has carried out an analysis[36] on ASI 1999 energy expenditure data in order to calculate energy consumption (using assumptions on energy prices based on expenditure bands) and carbon dioxide (CO_2) emissions (using fuel specific emission factors from EPA data, given in Appendix 3). This is then related to other variables such as GVA, direct costs and operating surplus (a proxy for profit).

The fuels analysed in this report are electricity, natural gas and heating oil. Data on motor fuel is collected in the ASI but is not included as motor fuels are included separately in the transport sector. There is also an *other fuel* category but, because this grouping is a mix of fuels such as coal, LPG, bottled gas etc, it was not possible to analyse the data using the current methodology. Further detail on the methodology used to estimate energy consumption from expenditure data is contained in Appendix 4.

The results of the analysis have been grouped into the following eleven sub-sectors (with NACE[37] classification).

1. *Motor Trade* (NACE 50)
2. *Wholesale Trade* (NACE 51)
3. *Retail Sale of Food* (NACE 52.1 to 52.2)
4. *Other Retail and Repair of Goods* (NACE 52.3 to 52.7)
5. *Hotels* (NACE 55.1)
6. *Restaurants Bars and Catering* (NACE 55.3 to 55.5)
7. *Post and Telecommunications* (NACE 64)
8. *Other Offices, Research and Development* (NACE 70, 71, 73,74)
9. *IT Services* (NACE 72)
10. *Recreation, Sport and Culture* (NACE 92)
11. *Other Services* (NACE 93)

(See figure 1.1 for a graphical representation and Appendix 1 for a more detailed description)

[36] A similar analysis has been conducted by SEI for the Industry sector using data obtained from the Census of Industrial Production (CIP), published by the CSO entitled *Profiling Energy Consumption and CO2 Emissions in Industry 2004 Update.* http://www.sei.ie/uploads/documents/upload/publications/EPSSU_Industry_report_8nov.pdf.

[37] NACE is an international classification system used to structure the economy into sectors and sub-sectors. A full list of NACE codes is available from http://europa.eu.int/comm/environment/emas/pdf/general/NACEcodes_en.pdf.

Combined, the eleven sub-sectors constitute a significant proportion of the total commercial and public services sector in 1999 (42% in terms of GVA, 40% of CO_2 emissions and 38% of employment). However it is important to highlight the missing sub-sectors.

Most notably, the public services sector is not included in this analysis. This includes the activities conducted in the *public administration and defence* (NACE 75), *education* (NACE 80,) *health and social work*, (NACE 85) and *other community, social and personal services* (NACE 80) sub-sectors. As illustrated in figure 1.2, public services accounted for 38% of services sector employment in 1999.

Energy expenditure data is also not available for the following sub-sectors: *financial intermediation* (NACE 65 – 67), *other accommodation* (NACE 55.2), *private households with employed persons* (NACE 95) and *extra-territorial organisations* (NACE 99). The *transport and storage* (NACE 60 – 63) sub-sector is not included because of some difficulties with the data in that sub-sector. These sub-sectors accounted for 24% of employment in 1999.

The final energy consumption of the eleven sub-sectors (see section 4.2.2) is 432 ktoe. This compares with the total services sector national energy balance figure for 1999 of 1422 ktoe. Therefore, the eleven sub-sectors analysed in this report represent 30% of total final energy consumption in the overall sector. The energy balance includes energy consumed in all the commercial and public services sub-sectors listed above.

It is important to emphasize that due to the heterogeneous nature of the services sector, the results presented in this report for these eleven commercial sub-sectors may not be valid for the services sector as a whole. The nature of activity within the commercial services is quite distinct from that in the public services. This may lead to differences for example, in the share of electricity consumption in the final energy fuel mix. The uncertainties associated with the energy balance data relating to the services sector do not readily allow for the generation of results for the remaining services sub-sectors based on the analysis of the ASI sub-sectors.

The use of data from 1999 is not ideal as clearly a number of changes have taken place since then but the analysis still provides a useful indication of the energy consumption in the sub-sectors covered. SEI intend to repeat this analysis in 2006 when ASI 2004 data becomes available, the next inquiry that contains the detailed energy expenditure questions by fuel. CSO have indicated that detailed data on the purchase of fuel will be sought on a yearly basis from enterprises from 2004.

While detailed energy expenditure by fuel will not be available until 2006, total energy expenditure data, employment and GVA is available up to the year 2002 and this allows trends to be identified and discussed.

4.2 ASI Analysis

4.2.1 Gross Value Added by Sub-Sector 1999

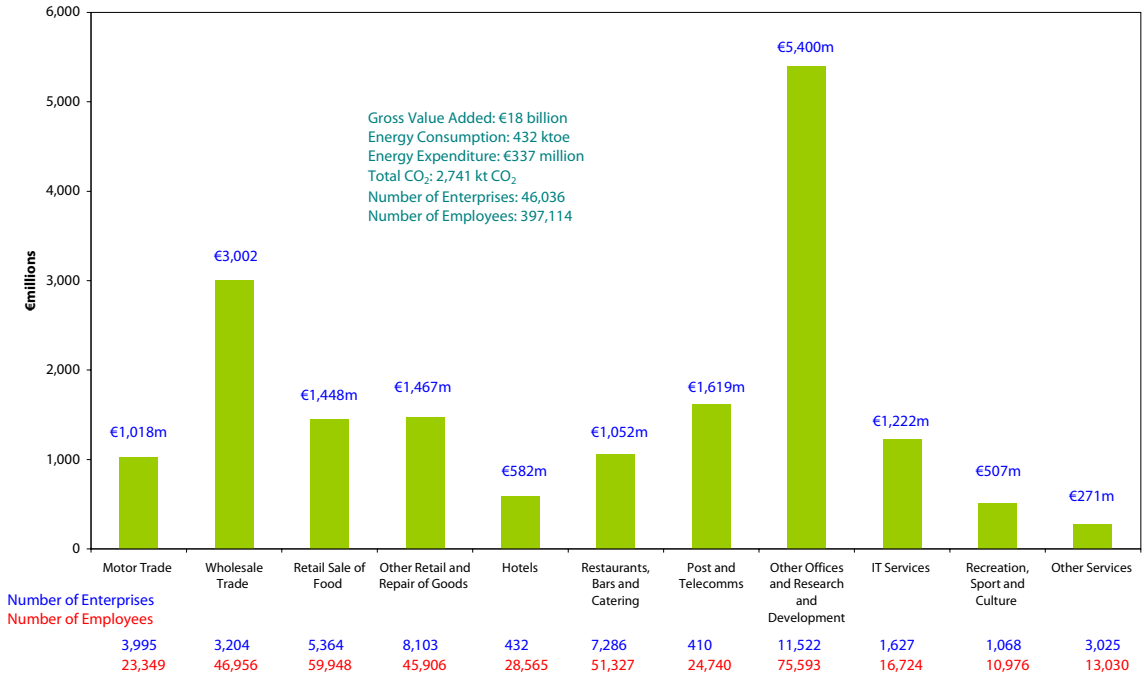
Figure 4.1 presents the contribution of the individual commercial services sub-sectors to Ireland's economic growth levels as measured by GVA[38], which represents the services sector's contribution to GDP, for 1999. Total GVA for the eleven ASI commercial services sub-sectors (as defined in the section 4.1) in 1999 was €18 billion. GVA for the total services sector in 1999 was €43 billion; therefore 42% of services GVA is represented in this analysis. In comparison, the GVA for industry in 1999 was €33 billion (see section 2.1).

The totals referred to in this section refer to the combined total of the eleven sub-sectors, unless stated otherwise. The total number of employees was 397,114 and the total number of enterprises was 46,036. It is worth reiterating that an enterprise may conduct its activities at more than one site. For example in 1999 there 432 enterprises in the *hotels* sub-sector which corresponds to approximately 850 hotels.

The largest sub-sector in terms of GVA was the *office and research and development* sub-sector, which accounted for 31% of the total in 1999. This is a large and quite diverse sub-sector but the uniting feature of the sub-sector is that the work of the enterprise is conducted in an office environment (with the exception of some research enterprises which are also included here). *Wholesale trade* accounted for 17% of the total and these two sub-sectors represented 48% of the GVA contribution from these sub-sectors in 1999. The remaining 52% of GVA is relatively well spread across the other sub-sectors.

[38] Excluding VAT.

Figure 4.1: Commercial Services Sub-Sectors Gross Value Added 1999 (Current Prices)



SOURCE: CSO

4.2.2 Energy Expenditure by Sub-Sector 1999

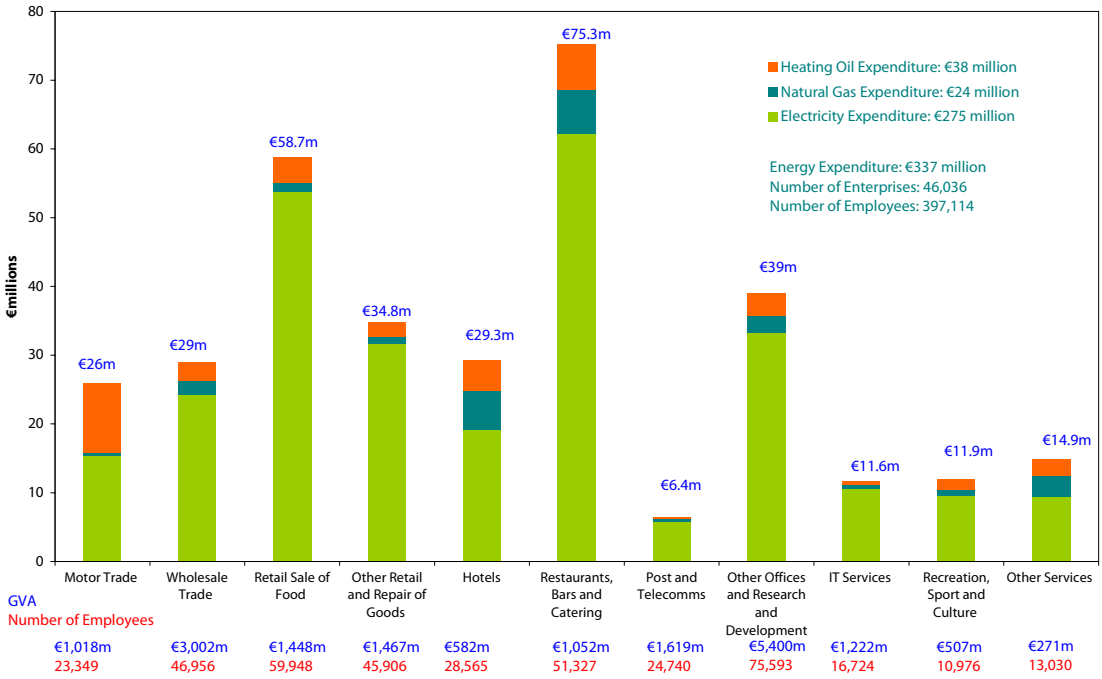
Figure 4.2 shows the energy expenditure profile for 1999, across eleven sub-sectors, segmented between natural gas, heating oil (also known as gasoil) and electricity consumption. Table 4.1 presents the results of a ranking exercise on the ASI sub-sectors; total energy expenditure is ranked alongside GVA, number of employees and number of enterprises[39].

The total expenditure on energy in 1999 for the eleven commercial services sub-sectors was €337 million (current prices) of which 82% was spent on electricity, 7.1% on natural gas and 11% on heating oil. The *restaurants, bars and catering* sub-sector recorded the largest energy and electricity expenditure accounting for 22% of the total spent on both in 1999. *Restaurants, bars and catering* as well as the *retail sale of food* sub-sectors were the dominant sub-sectors in 1999 and when combined, accounted for 39% of total energy expenditure (42% of electricity expenditure) and 28% of employees and enterprises.

It is worth noting that the two sub-sectors that contribute 48% of GVA (*other offices and research and development* and *wholesale trade*) were responsible for 21% of energy expenditure from these sub-sectors.

[39] The number of enterprises and employees refers to the total number in the sub-sector as opposed to the number associated with the use of a particular fuel. Not all enterprises use natural gas or heating oil but all enterprises use electricity.

Figure 4.2: Commercial Services Sub-Sectors Expenditure on Energy 1999 (Current Prices)



SOURCE: CSO

Table 4.1: Ranking of Energy Expenditure 1999

	Energy Expenditure % of Total	GVA % of Total	Number of Employees % of Total	Number of Enterprises % of Total
Restaurants, Bars and Catering	22	6	13	16
Retail Sale of Food	17	8	15	12
Other Offices and Research and Development	12	31	19	25
Other Retail and Repair of Goods	10	8	12	18
Hotels	9	3	7	1
Wholesale Trade	9	17	12	7
Motor Trade	8	6	6	9
Other Services	4	2	3	7
Recreation, Sport and Culture	4	3	3	2
IT Services	3	7	4	4
Post and Telecommunications	2	9	6	1

SOURCE: CSO

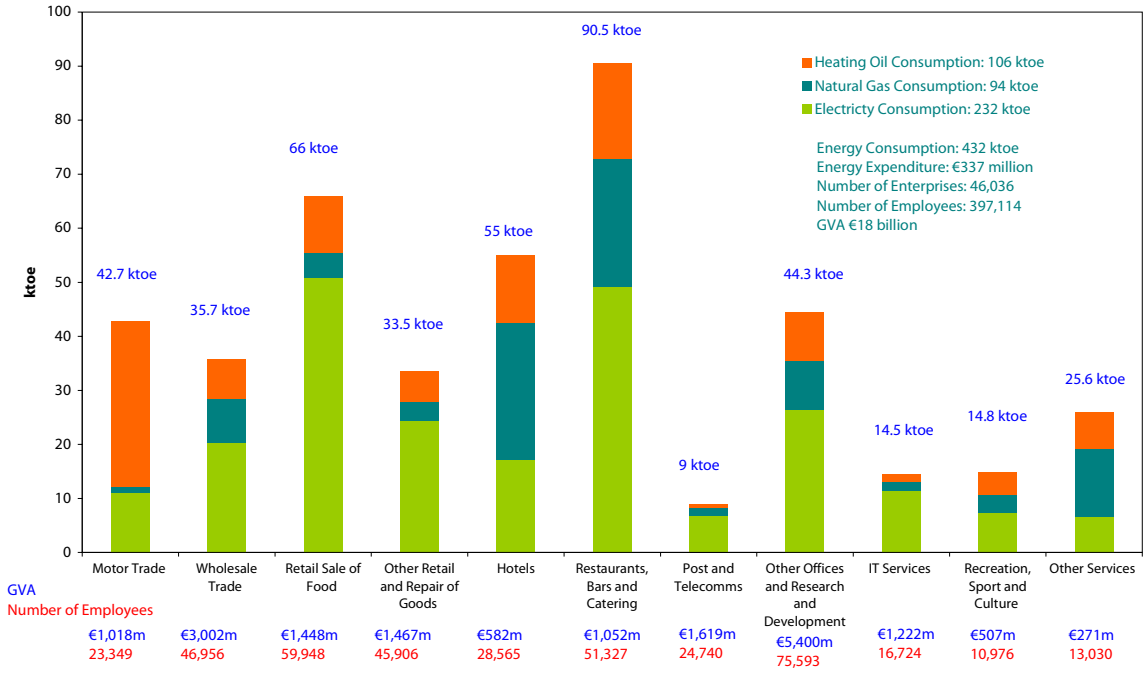
4.2.3 Final Energy Consumption by Sub-Sector 1999

Figure 4.3 presents the calculated values (using assumptions on energy prices based on expenditure bands) for final energy consumption for the eleven selected sub-sectors in 1999, expressed in thousands of tonnes of oil equivalent (ktoe). Table 4.2 shows the results of the ranking analysis. The total calculated energy consumption in 1999 was 432 ktoe. As mentioned in section 4.1 the eleven sub-sectors represented 30% of total energy consumption in the services sector in 1999. Electricity consumption accounted for 53.7% (232 ktoe), heating oil for 24.5% (106 ktoe) and natural gas for 21.7% (94 ktoe). Therefore, the split between electricity and fuel (heating oil and natural gas only) was 53.7% electricity and 46.3% for fuel. The split between electricity and fuel from the 1999 national energy balance was 71% fuel and 29% electricity.

As stated previously due to the heterogeneous nature of the services sector, the results presented in this report for the eleven services commercial sub-sectors may not be valid for the services sector as a whole. The nature of activity within the commercial services is quite distinct for example, from that in the public services and this may lead to the differences seen above in the share of electricity consumption in the final energy fuel mix. The uncertainties

associated with the national energy balance data relating to the services sector do not readily allow for the generation of results for the remaining services sub-sectors based on the analysis of the ASI sub-sectors.

Figure 4.3: Commercial Services Sub-Sectors Estimated Final Energy Consumption 1999



SOURCE: BASED ON CSO DATA

Table 4.2: Ranking of Energy Consumption 1999

	Energy Consumption % of Total	Electricity Consumption % of Total	GVA % of Total	Number of Employees % of Total	Number of Enterprises % of Total
Restaurants, Bars and Catering	21	21	6	13	16
Retail Sale of Food	15	22	8	15	12
Hotels	13	7	3	7	1
Motor Trade	10	5	6	6	9
Other Offices and Research and Development	10	11	31	19	25
Wholesale Trade	8	9	17	12	7
Other Retail and Repair of Goods	8	11	8	12	18
Other Services	6	3	2	3	7
IT Services	3	5	7	4	4
Recreation, Sport, Culture	3	3	3	3	2
Post and Telecommunications	2	3	9	6	1

SOURCE: BASED ON CSO DATA

The largest sub-sector in terms of energy consumption was *restaurants, bars and catering,* responsible for 21% of the total (90 ktoe), as well as 6% (€1,052m) of GVA, 13% (51,327) and 16% (7,286) of employees and enterprises, respectively.

Given the importance of electricity to the sector and that fact that the recent introduction of the EU emissions trading scheme will impact on electricity prices, it is useful to examine electricity consumption separately, also shown in figure 4.3 and table 4.2. The *retail sale of food* and the *restaurants, bars and catering* sub-sectors were the largest sectors in terms of electricity and overall energy consumption and when combined, accounted for 43% of electricity consumption, 14% of GVA and 28% of employees and enterprises.

Reference again to figure 4.2 shows that the *restaurants, bars and catering* sub-sector spent more per enterprise for electricity than the *retail sale of food* sub-sector while figure 4.3 indicates that they consumed a similar amount of electricity. This points to interesting electricity price differences between different sub-sectors.

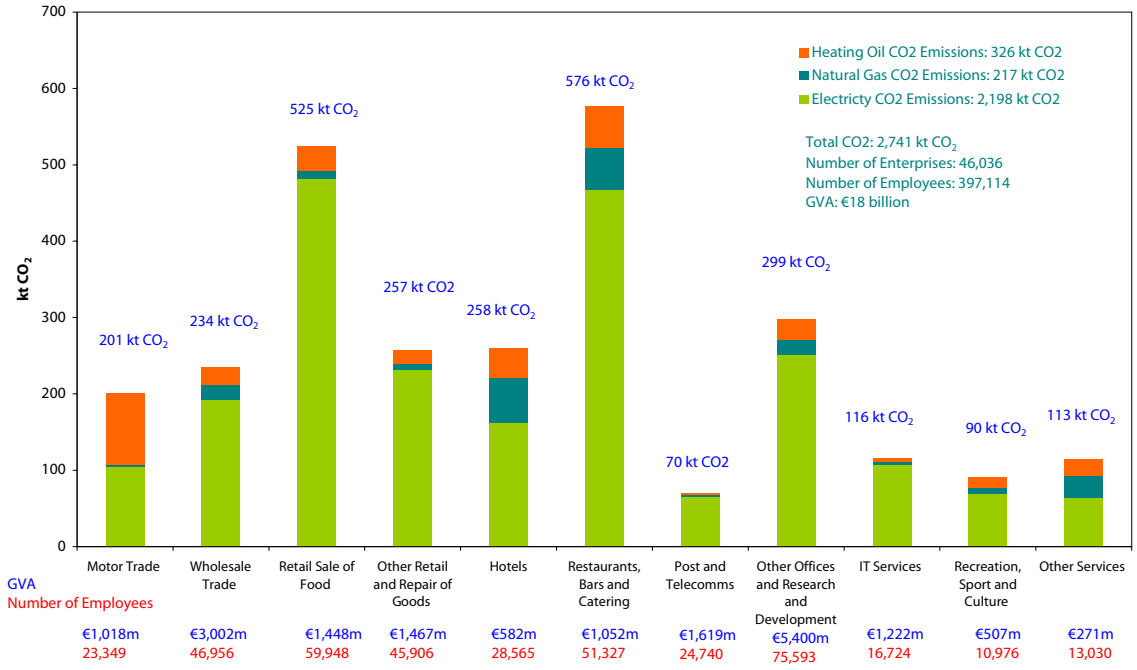
4.2.4 Energy-Related CO_2 Emissions by Sub-Sector 1999

Figure 4.4 and table 4.3 show the calculated levels of energy-related CO_2 emissions for the selected eleven commercial services sub-sectors.

It is worth reiterating the distinction between the approach adopted here and that in the National Climate Change Strategy (NCCS) in terms of attributing emissions to the end use sector. In the NCCS the only energy-related CO_2 emissions directly attributed to the services sector are those from fuel used on site, whereas emissions associated with consumed electricity are attributed to the energy supply sector. In the current analysis, the upstream emissions associated with electricity consumed by the commercial services are attributed to the individual sub-sectors, although distinguished separately.

According to these calculations, the eleven sub-sectors analysed were responsible for 2,741 kt CO_2 emissions in 1999. This compares with 6,835 kt CO_2 emissions for the services sector as a whole, based on the national energy balance for 1999. Therefore, 40% of total CO_2 emissions are included in the ASI dataset. Industry, by comparison was responsible for 10,376 kt CO_2 in 1999 (see figure 2.9). In the ASI in respect of the eleven commercial services sub-sectors, electricity consumption accounted for 80% (2,198 kt CO_2), heating oil for 11.8% (326 kt CO_2) and natural gas for 7.9% (217 kt CO_2).

Figure 4.4: Commercial Services Sub-Sectors Estimated Energy-Related CO_2 Emissions 1999



SOURCE: BASED ON CSO DATA

Furthermore, it can be seen that upstream emissions associated with electricity consumption are dominant in all sub-sectors. With reference to table 4.3 *restaurants, bars and catering* and the *retail sale of food* sub-sectors were the largest in terms of CO_2 emissions with a combined 40% of the total (1,101 kt CO_2).

Table 4.3: Ranking of CO_2 Emissions 1999

	CO_2 Emissions % of Total	GVA % of Total	Number of Employees % of Total	Number of Enterprises % of Total
Restaurants, Bars and Catering	21	6	13	16
Retail Sale of Food	19	8	15	12
Other Offices and Research and Development	11	31	19	25
Other Retail and Repair of Goods	9	8	12	18
Hotels	9	3	7	1
Wholesale Trade	9	17	12	7
Motor Trade	7	6	6	9
IT Services	4	7	4	4
Other Services	4	2	3	7
Recreation, Sport, Culture	3	3	3	2
Post and Telecommunications	3	9	6	1

SOURCE: BASED ON CSO DATA

Comparing figures 4.3 (energy consumption) and 4.4 (energy-related emissions) shows general alignment between each sub-sector's share of energy consumption and emissions. Where differences occur, this is due to the weighting of the fuels used by each of the sub-sectors. The reason for this is clear from Appendix 3, which shows the variation in CO_2 emission factors (or CO_2 intensity) for each energy source. In 1999, for every kWh of natural gas used, 198 grams of CO_2 were emitted, whereas 816 grams of CO_2 were emitted for every 1 kWh of electricity[40] consumed. Therefore, when a large proportion of the energy used in the sub-sector is electricity, this will increase the amount of CO_2 emissions relative to the energy consumed.

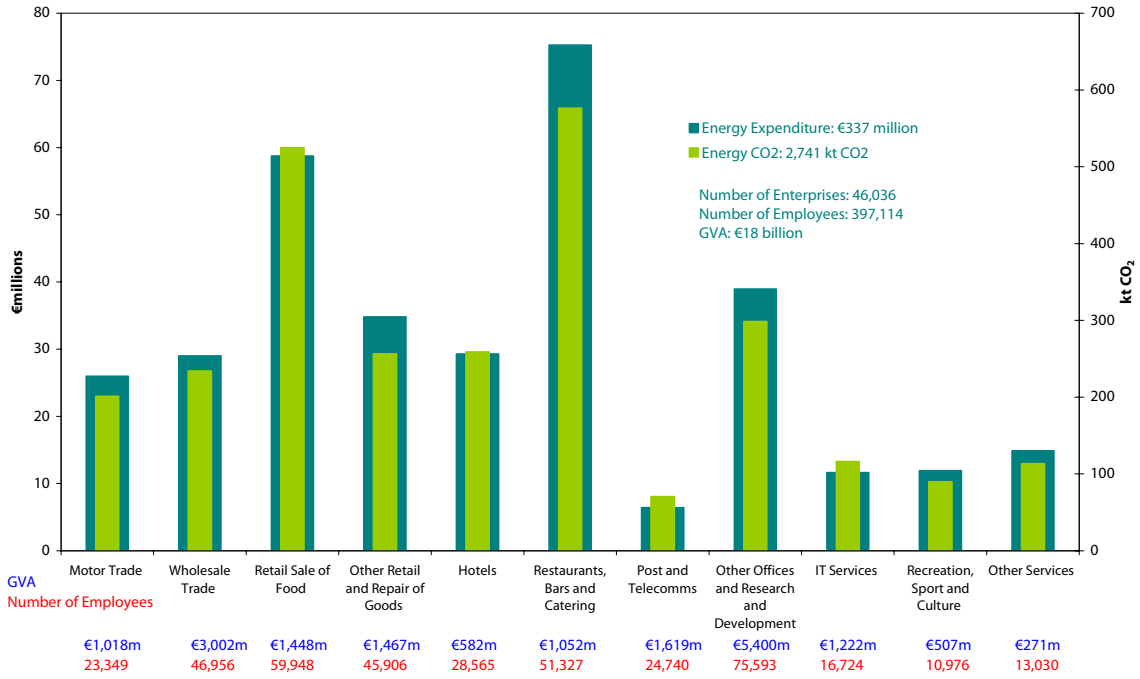
Comparing certain sub-sectors, the split between electricity and fuel (heating oil and natural gas) consumption varies greatly, which affects the emissions split. In the case of *IT services*, for example, emissions associated with natural gas and heating oil accounted for just 7.3% of total emissions in that sub-sector whereas in the case of *motor trade* the figure is 48%. Arising from this and the price differential between electricity and the other fuels, there was closer alignment between energy-related CO_2 emissions and energy expenditure rather than energy consumption.

This is illustrated in figure 4.5. Where differences occur this points to a higher ratio of electricity consumption compared to other fuels. This is also a feature of energy consumption and CO_2 emissions in industry[41].

[40] The amount of CO_2 emitted from the production of electricity will vary depending on the fuels used to produce it. This is known as the generation fuel mix. The generation fuel mix has become more efficient in recent years due to fuel switching away from traditional fossil fuels such as oil, peat and coal to cleaner fuels such as natural gas and renewables and also due to more efficient generators coming online.

[41] SEI, 2004. *Profiling Energy Consumption and CO2 Emissions in Industry 2004 Update.* http://www.sei.ie/uploads/documents/upload/publications/EPSSU_Industry_report_8nov.pdf

Figure 4.5: Energy Expenditure and Related CO_2 Emissions 1999



SOURCE: BASED ON CSO DATA

4.2.5 Energy Expenditure in Relation to Business Activity by Sub-Sector 1999

Table 4.4 summarises the results thus far. It is interesting to note that the two largest sub-sectors in terms of GVA (representing 48%) accounted for 20% of energy-related emissions. The two largest sub-sectors in terms of energy-related emissions (*restaurants, bars and catering* and *retail sale of food*), responsible for 40% of emissions, accounted for 14% of GVA in 1999.

Table 4.4: Ranking of GVA 1999

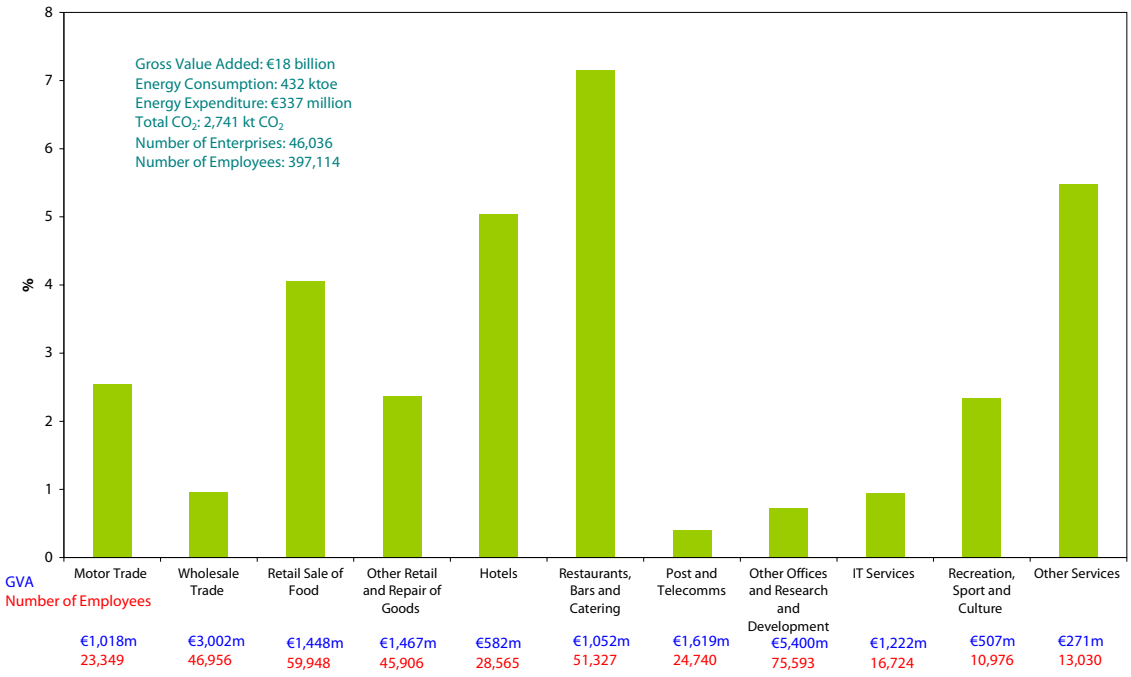
	GVA % of Total	Energy Consumption % of Total	Energy Expenditure % of Total	CO_2 Emissions % of Total	Number of Employees % of Total	Number of Enterprises % of Total
Other Offices and Research and Development	31	10	12	11	19	25
Wholesale Trade	17	8	9	9	12	7
Post and Telecommunications	9	2	2	3	6	1
Other Retail and Repair of Goods	8	8	10	9	12	18
Retail Sale of Food	8	15	17	19	15	12
IT Services	7	3	3	4	4	4
Restaurants, Bars and Catering	6	21	22	21	13	16
Motor Trade	6	10	8	7	6	9
Hotels	3	13	9	9	7	1
Recreation, Sport, Culture	3	3	4	3	3	2
Other Services	2	6	4	4	3	7

SOURCE: CSO

Figure 4.6 illustrates the expenditure on energy as a percentage of GVA for each sub-sector. This gives a crude indication of sensitivity of specific sub-sectors to changes in energy prices. It is a limited indicator, however, because the appropriate unit to assess price sensitivity is the individual firm, not at the aggregate level presented in figure 4.6. It is likely that significant variations exist between individual firms, as was shown to be the case for industry in a separate SEI report[42].

[42] SEI, 2004. *Profiling Energy Consumption and CO2 Emissions in Industry 2004 Update.* http://www.sei.ie/uploads/documents/upload/publications/EPSSU_Industry_report_8nov.pdf

Figure 4.6: Energy Expenditure as a Percentage of GVA 1999



SOURCE: BASED ON CSO DATA

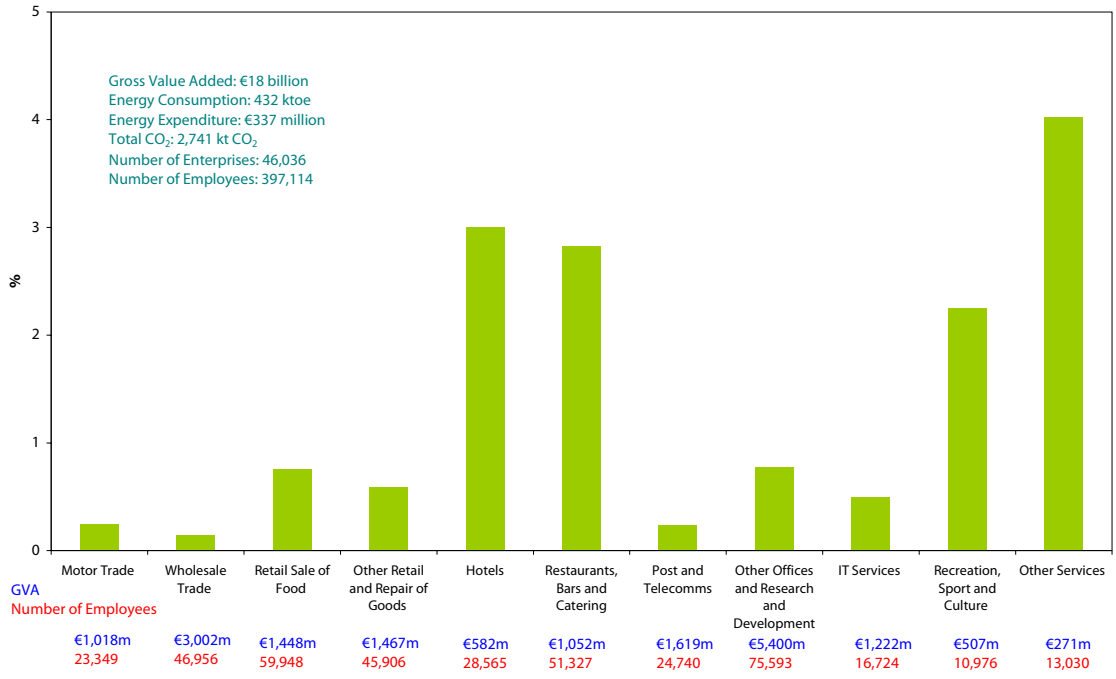
It is evident from figure 4.6 that only three sub-sectors had an average energy bill to GVA ratio of over 5%, indicating a comparative sensitivity to energy price changes. They were *restaurants, bars and catering* (7.2%), *other services* (5.5%) and *hotels* (5%). Combined these three sub-sectors were responsible for 35% of energy expenditure, 39% of energy consumption, 34% of CO_2 emissions, 23% of employment and 11% of GVA.

It is interesting to note that the two sub-sectors that contributed most to GVA (*other offices and research and development* and *wholesale trade)* each had an energy expenditure intensity of less than 1%.

For price sensitivity analysis, it is also interesting to examine how significant energy expenditure is as a proportion of the overall cost base and this is shown graphically in figure 4.7[43]. Direct costs are calculated from published ASI data and defined as inputs plus wages and salaries. Inputs are defined as total purchases minus closing stock plus opening stock.

[43] Excluding VAT.

Figure 4.7: Energy Expenditure as a Percentage of Direct Costs 1999



SOURCE: BASED ON CSO DATA

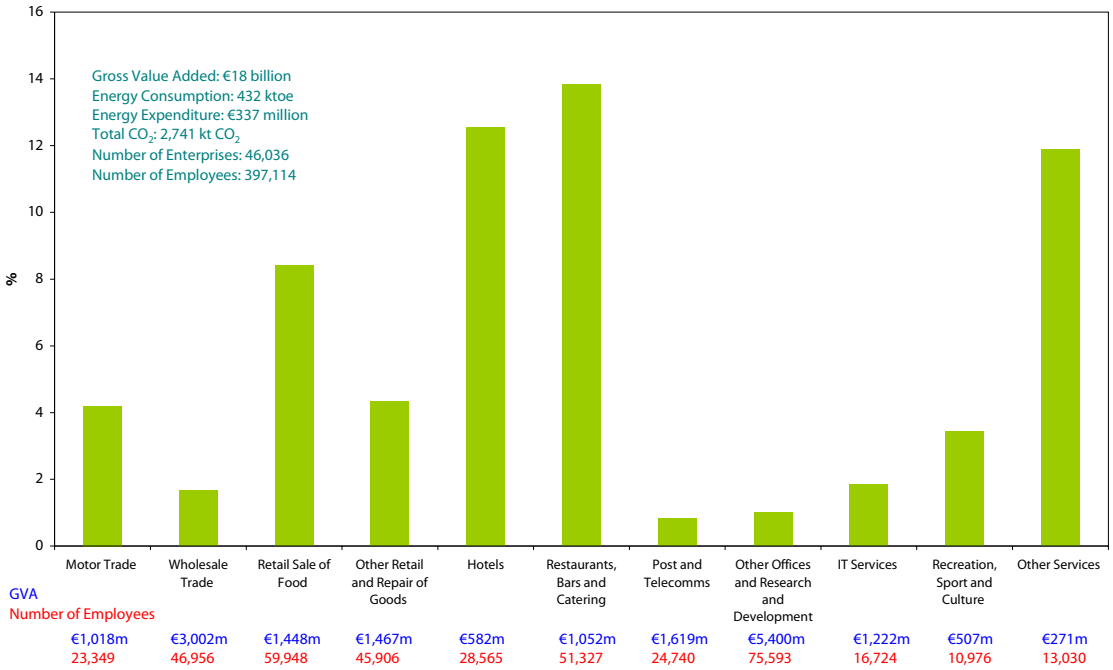
The sub-sectors with the highest energy bill as a proportion of overall costs were *other services* (4%) and *hotels* (3%). These sub-sectors may be more susceptible to the negative effects of increases in energy costs. However, even at these levels, energy costs represent a small proportion of total business costs. Combined these sub-sectors were responsible for 13% of energy expenditure, 18% of energy consumption, 10% of employment and 5% of GVA.

Energy expenditure represented 0.6% of total direct costs for the selected sub-sectors as a whole in 1999. By comparison, in industry 92% of enterprises had an energy to direct costs ratio of less than or equal to 4%[44]. Of course, some enterprises will spend a far higher percentage of their direct costs on energy than is suggested by this analysis depending on their individual circumstances. The above should merely be seen as an indication of the overall situation for each sub-sector.

A further relationship of interest is that between energy price changes and profit margins. A ratio which sheds some light on this is the ratio of energy expenditure to operating surplus[45], shown in figure 4.8. Operating surplus is defined here as GVA minus wages and salaries. Operating surplus is used as a proxy for profit.

[44] SEI, 2004. *Profiling Energy Consumption and CO2 Emissions in Industry 2004 Update.* http://www.sei.ie/uploads/documents/upload/publications/EPSSU_Industry_report_8nov.pdf
[45] Excluding VAT.

Figure 4.8: Energy Expenditure as a Percentage of Operating Surplus 1999



SOURCE: BASED ON CSO DATA

The significant range and variation across sub-sectors is immediately noticeable from figure 4.8 ranging from *post and telecommunications* which had the lowest ratio of expenditure on energy to operating surplus at 0.8% while for the *restaurants, bars and catering* sub-sector, the energy bill in 1999 represented 14% of operating surplus. *Hotels* and *other services* also have a relatively high percentage, at 13% and 12% respectively. The ratio for the eleven selected sub-sectors as a whole was 3.2%.

It is also clear by comparing figures 4.7 and 4.8 that for certain sub-sectors, for example *other office and research and development* sub-sector, the energy bill as a ratio of direct costs (0.8%) was similar to the energy bill as a ratio of operating surplus (1%) whereas for other sub-sectors, the energy bill as a ratio of direct costs and operating surplus differed widely, for example *retail sale of food* (0.8% compared with 8.4%).

It is worth reiterating the point that the indicators used in this section are limited in terms of being aggregated averages, and thus need to be interpreted with caution. Competitive sensitivity is determined at the level of the individual firm and significant firm variations can be expected to occur within the same sub-sector.

4.2.6 Unit Energy Consumption by Sub-Sector 1999

Section 2.4 pointed to the use of unit consumption of electricity per employee as an indicator of energy and electricity intensiveness in the services sector because the number of people requiring light and using IT equipment, as well as canteen and hot water facilities, directly effects the consumption of energy. In the absence of floor area data, unit consumption of direct fuel use per employees is used to measure the intensity of the heating requirement. Consumption of energy per enterprise has potential use as an indicator in order to select particular sub-sectors for specific energy efficiency programmes.

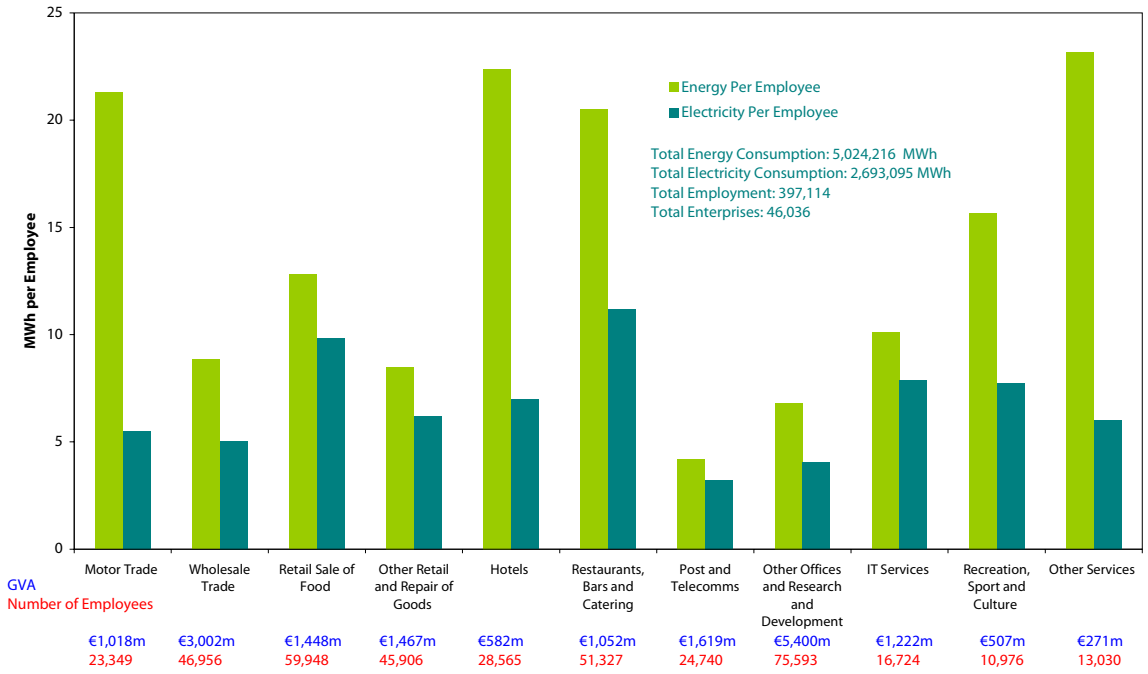
Figure 4.9 presents energy and electricity consumption per employee for the eleven sub-sectors.

Other services had the largest annual energy consumption per employee of the selected sub-sectors (23.1 MWh per employee), but only marginally so over *hotels* (22.3 MWh), *motor trade* (21.2 MWh) and *restaurants bars, and catering* (20.4 MWh). Combined these four sub-sectors were responsible for 43% of energy expenditure, 50% of energy consumption, 29% of employment and 17% of GVA.

Turning our attention to annual consumption of electricity per employee, *restaurants, bars and catering* had highest consumption of electricity (11.2 MWh per employee) followed by *retail sale of food* (9.8 MWh). Combined these two sub-sectors were responsible for 39% of energy expenditure, 36% of energy consumption, 40% of CO_2 emissions, 28% of employment and 14% of GVA.

There is a wide range of variation in the difference between the unit energy and electricity indicators (representing fuel use per employee) from large (for example *motor trade*) to small (for example *retail sale of food)*. This points again to the diversity of activity within the services sector.

Figure 4.9: Energy and Electricity Consumption per Employee 1999



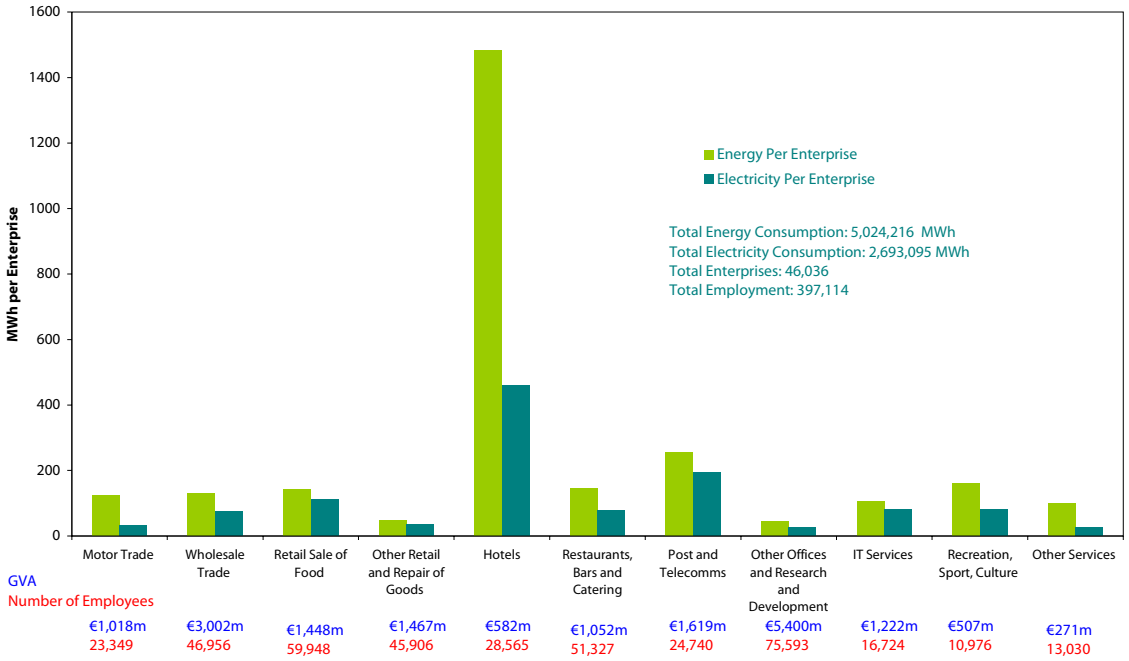
SOURCE: BASED ON CSO DATA

The variations in annual energy consumption per enterprise are presented in figure 4.10. Energy consumption per enterprise is calculated in a similar manner to consumption per employee. It can be, clearly, seen that by far the most intensive sub-sector in terms of energy and electricity consumption per enterprise is *hotels* with 1,480 MWh energy consumption and 460 MWh electricity consumption per enterprise in 1999.

Of the combined total of the twelve sub-sectors the *hotels* sub-sector accounted for 9% of energy expenditure, 13% of energy consumption and 3% of GVA.

It is important to note that in 1999 there were 432 enterprises but approximately 850 *hotels* in this sub-sector. Energy and electricity consumption per hotel was 752 MWh and 234 MWh respectively. Taking this into account the *hotels* sub-sector was still the most intensive.

Figure 4.10: Energy and Electricity Consumption per Enterprise 1999



SOURCE: BASED ON CSO DATA

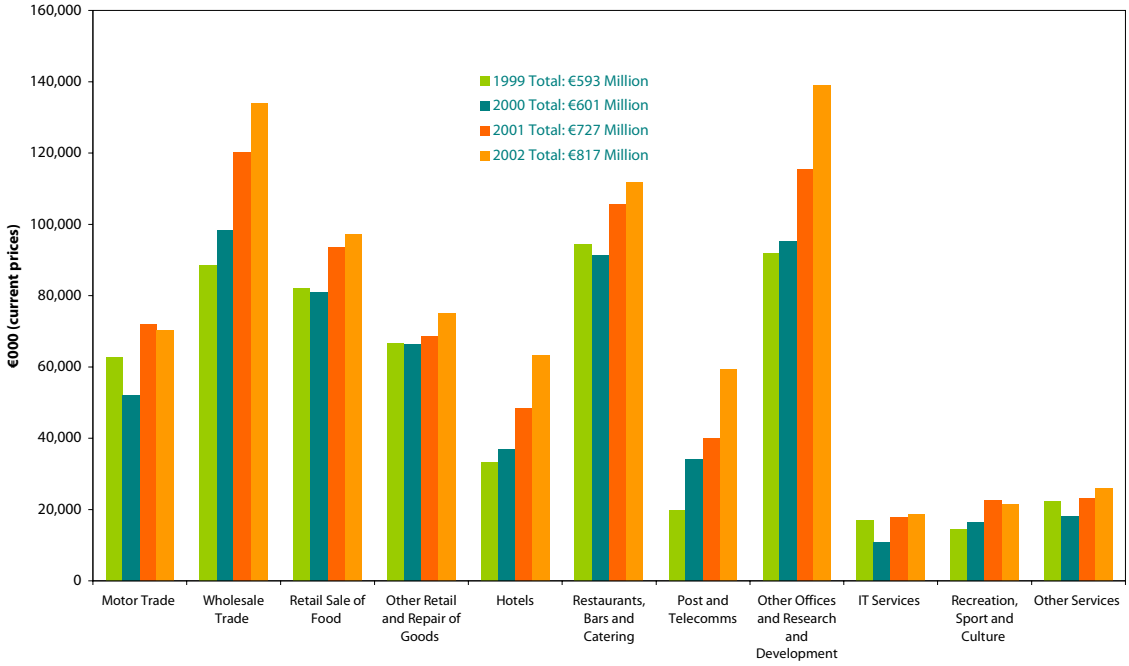
4.2.6 ASI 1999 -2002

As mentioned in section 4.1, more up to date energy expenditure by fuel will not be available until 2006 but total expenditure on energy, GVA and number of employees is available from ASI 2000, ASI 2001 and ASI 2002.

Total expenditure on all fuels (electricity, natural gas, oil, motor and other fuels) is collected each year in the ASI and is presented in figure 4.11 for the period 1999 to 2002. Unfortunately, because the sampling/grossing methodology was revised for ASI 1999 and thereafter, 1999 results are not directly comparable to previous years and this results in a discontinuity in the series.

Total expenditure on energy of the selected sub-sectors (in current prices) increased from €593 million in 1999 (this includes the €337 million seen in figure 4.1 plus expenditure on motor and other fuels) to €817 million in 2002, representing an increase of 38% (11% per annum on average).

Figure 4.11: Energy Expenditure 1999- 2002 (Current Prices)

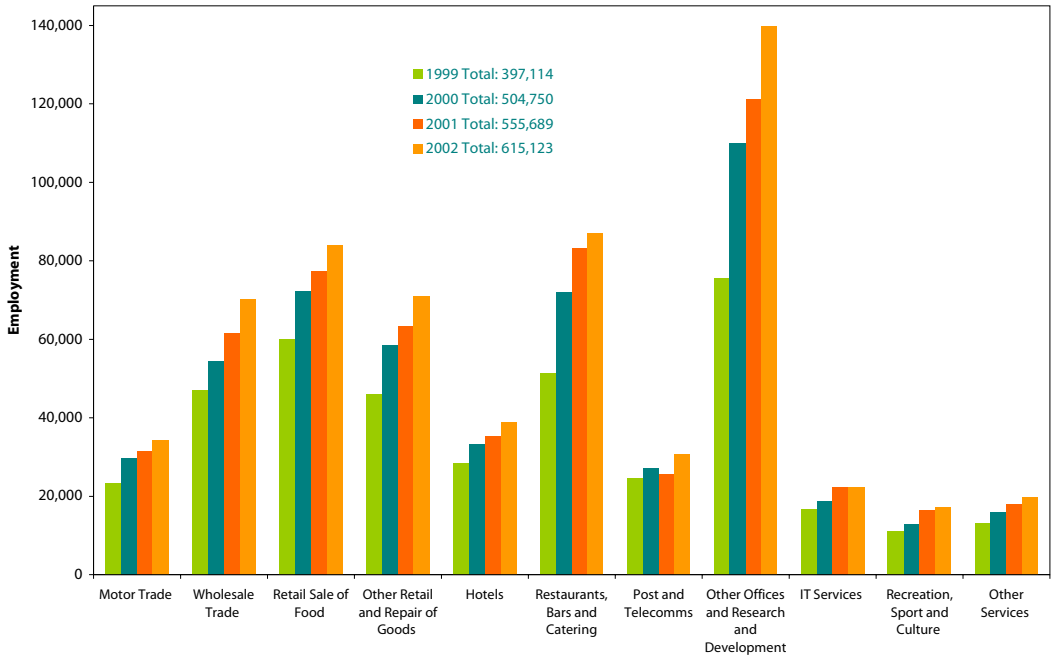


SOURCE: CSO

The largest energy spending sub-sector in 2002 was *other office and research and development* with 17% of total spend (€139 million). *Wholesale trade* was close behind in terms of energy spend in 2002 with 16% of the total (€134 million). The *post and telecommunications* sub-sector exhibited the largest growth over the period 1999 to 2002 and increased from €20 million to €59 million or 199% (44% per annum).

Figure 4.12 illustrates the trend in the number of employees for the selected sub-sectors for the period 1999 to 2002.

Figure 4.12: Number of Employees 1999- 2002

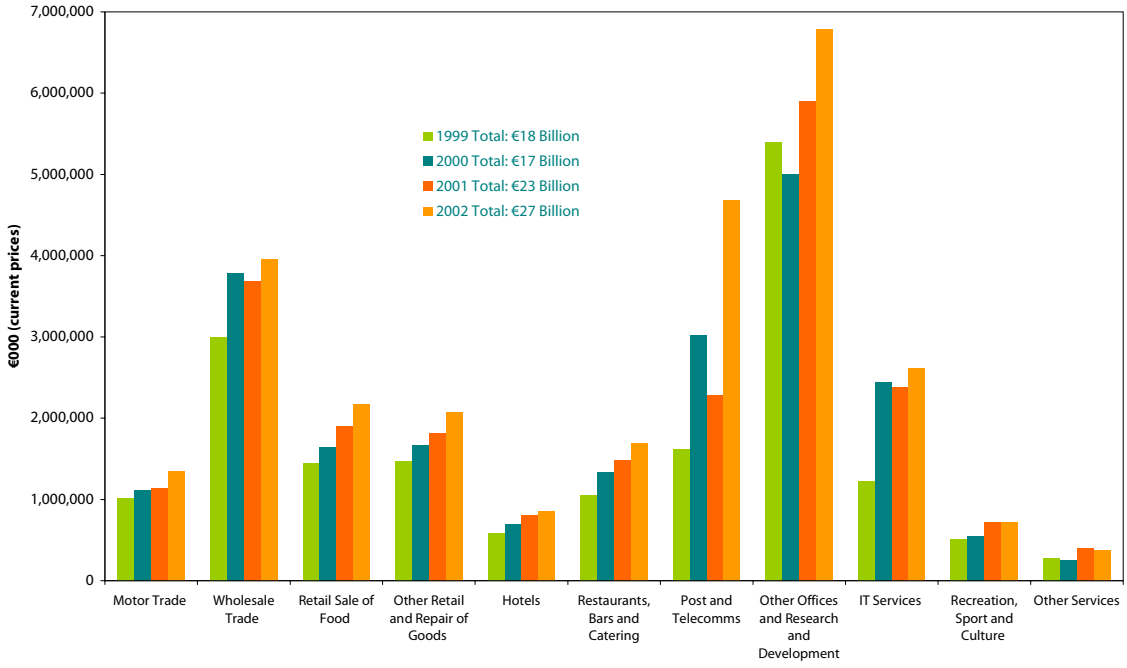


SOURCE: CSO

Employment in the eleven sub-sectors increased from 397,114 in 1999 to 615,123 in 2002, an increase of 55% (16% per annum on average). The largest sub-sector in 2002, in terms of employment, was *other office and research and development* with 23% of the total (139,788). The sub-sector that exhibited the largest growth over the period was *other office and research and development*, which increased from 75,593 employees in 1999 to 139,788 employees in 2002, an increase of 85% (23% per annum).

It is also possible to examine GVA for 1999 to 2002, figure 4.13. Total GVA for the selected sub-sectors rose from €18 billion in 1999 to €27 billion in 2002, an increase of 55% or 16% per annum on average). The sub-sector which experienced the largest increase over the period was *post and telecommunications*. Total GVA for this sub-sector was €1.6 billion in 1999 and €4.6 billion in 2002, a rise of 189% or 43% per annum. The largest sub-sector in 2002 was *other office and research and development* with 25% of total GVA (€6.7 billion).

Figure 4.13: Gross Value Added 1999 - 2002 (Current Prices)



SOURCE: CSO

5 Electricity Consumption in the Services Sector

In addition to the ASI data analysed in section 4, SEI has gained access to electricity consumption data for ESB customers for 2002 and 2003. This dataset contains details of both commercial and public services consumption of electricity and is therefore a useful source of information with which it is possible to fill some of the gaps in the ASI coverage.

There are other licensed electricity suppliers in the market but sub-sectoral breakdowns of consumption are currently unavailable to SEI from these suppliers. This section is thus limited to ESB customers[46]. Access to sub-sectoral information on natural gas and oil usage in the services sector is also not currently available for inclusion in the analysis.

5.1 Electricity Consumption by Sub-Sector 2002 and 2003

Using ESB data, figure 5.1 presents electricity consumption for the eleven commercial services sub-sectors seen in section 4 for 2002 and 2003. Also included, for comparison, is 1999 ASI electricity data again from section 4. These datasets are collected according to very different methodologies for example the ASI is a sample based survey while the ESB data relates to all ESB customers. Nevertheless, the datasets compare well as can be seen from figure 5.1.

One area with considerable disparity is the *recreation, sport and culture* sub-sector. A possible explanation for this is that the ASI grossing in this sub-sector is based on the number of employees and does not take into account the voluntary work that occurs in this sub-sector, therefore ASI data may be underestimated.

Figure 5.1 shows that the largest sub-sector in terms of electricity consumption for 2002 and 2003 is the *retail sale of food* sub-sector, which accounted for 20% of the total in 2003. The leading electricity consuming sub-sector according to ASI data was also *the retail sale of food* sub-sector with 22% of total electricity consumption in 1999.

Total electricity consumption increased by 17% between 1999 and 2002 and fell by 2.4% between 2002 and 2003. A possible reason for the decrease in ESB data between 2002 and 2003 may be the effect of liberalisation in the electricity market, see below.

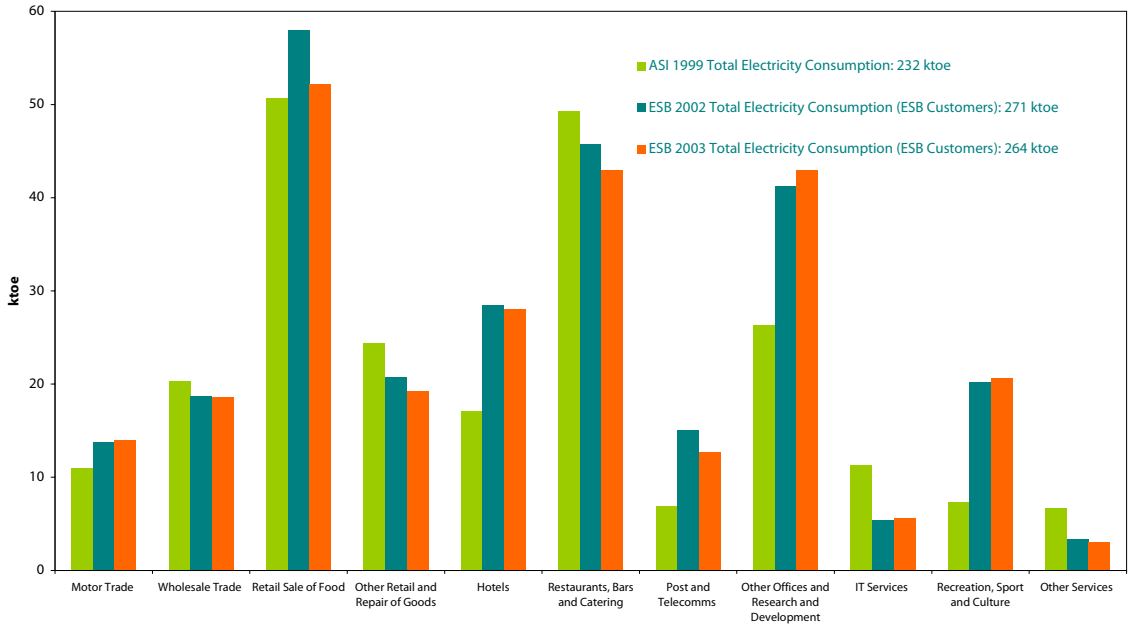
Total electricity consumption in the services sector according to the national energy balance rose by 46% from 1999 to 2002 and between 2002 and 2003 increased by a further 17% (seen previously in section 2). There are a number of possible explanations for the disparity between the national energy balance and ESB data. Firstly, the growth in electricity consumption may have occurred in sub-sectors not analysed in this report.

Secondly, the difference may be as a result of market liberalisation. The liberalisation of the electricity market in Ireland began in February 2000, when customers with an annual demand of over 4 GWh were permitted to source their electricity supply from licensed suppliers other than ESB. The threshold was lowered to 1 GWh in February 2002 and 0.1 GWh in February 2004. All customers, irrespective of their demand, are currently allowed to choose their electricity supplier since February 2005. Therefore, while overall electricity consumption in the services sector has increased, ESB's share of the market has declined between 2002 and 2003.

Another contributing factor, relates to the aforementioned uncertainties surrounding the national energy balance data for the services sector.

[46] This dataset does not include ESB Independent Energy's customers.

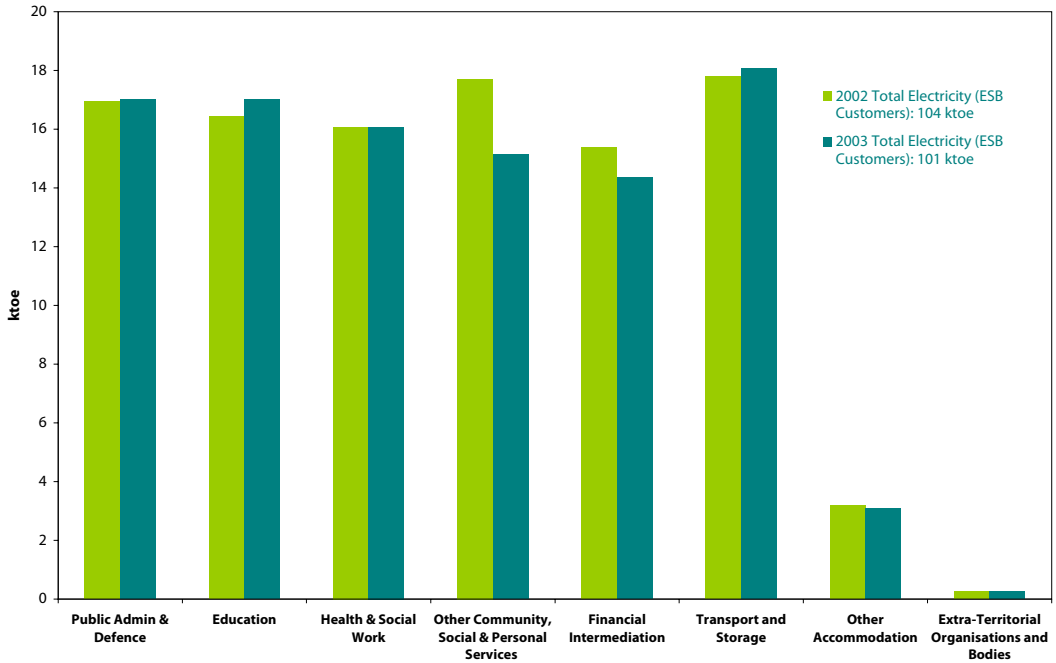
Figure 5.1: Electricity Consumption 1999, 2002 and 2003



SOURCE: BASED ON CSO DATA AND ESB

Using data from the ESB it is possible to fill in some of the gaps in the ASI coverage. Figure 5.2 presents electricity consumption for selected service sub-sectors not included in the ASI analysis (see figure1.1 for a graphical representation and Appendix 1 for a description of each sub-sector).

Figure 5.2: Electricity Consumption 2002 and 2003



SOURCE: ESB

As mentioned previously, a key area not covered by the ASI is the public services sector. Figure 5.2 firstly, shows the electricity consumption by the pubic services in 2002 and 2003 grouped into four sub-sectors. Of the first four sub-sectors it can be seen that the largest category in terms of electricity consumption in 2002 was the *other community, social and personal* (NACE 90 – 91) services sub-sector which consumed 18 ktoe but decreased by 3 ktoe in 2003 (15%).

Public administration and defence (NACE 75) increased from 16.9 ktoe to 17 (0.5%) ktoe between 2002 and 2003. Consumption of electricity in the *education* (NACE 80) sub-sector grew from 16.4 ktoe 17 ktoe (3.6%) in the same period while *health and social work* (NACE 85) remained unchanged at 16 ktoe.

Examining the last four sub-sectors, it can be seen that consumption of electricity in the *financial intermediation* sub-sector in 2003 was 15.3 ktoe falling to 14.4 ktoe in 2003: a decrease of 6.7%. *Transport and storage*[47] increased from 17.7 ktoe in 2002 to 18 ktoe in 2003: an increase of 1.4% while *other accommodation* decreased by 2.7% over the same period. The activities of *extra-territorial organisations* remained unchanged at 0.3 ktoe. The effect of market liberalisation may, again, account for the electricity consumption decrease in the *financial intermediation* and *other accommodation sub-sectors*.

As we have seen in figure 5.1, total electricity consumption for the ASI sub-sectors in 1999 was 232 ktoe compared with 271 ktoe for ESB customers in 2002 and 264 ktoe in 2003. The national energy balance in 1999 states that electricity consumption was 411 ktoe compared with 602 ktoe in 1999 and 702 ktoe in 2003 (as seen in section 2.2). The disparity in results is due to the fact that national energy balance data includes the activities of all services sub-sectors, not just the activities of the eleven sub-sectors.

[47] Transport and storage refers to office-based activities as opposed to any expenditure on fuel for actual road, air or rail transport.

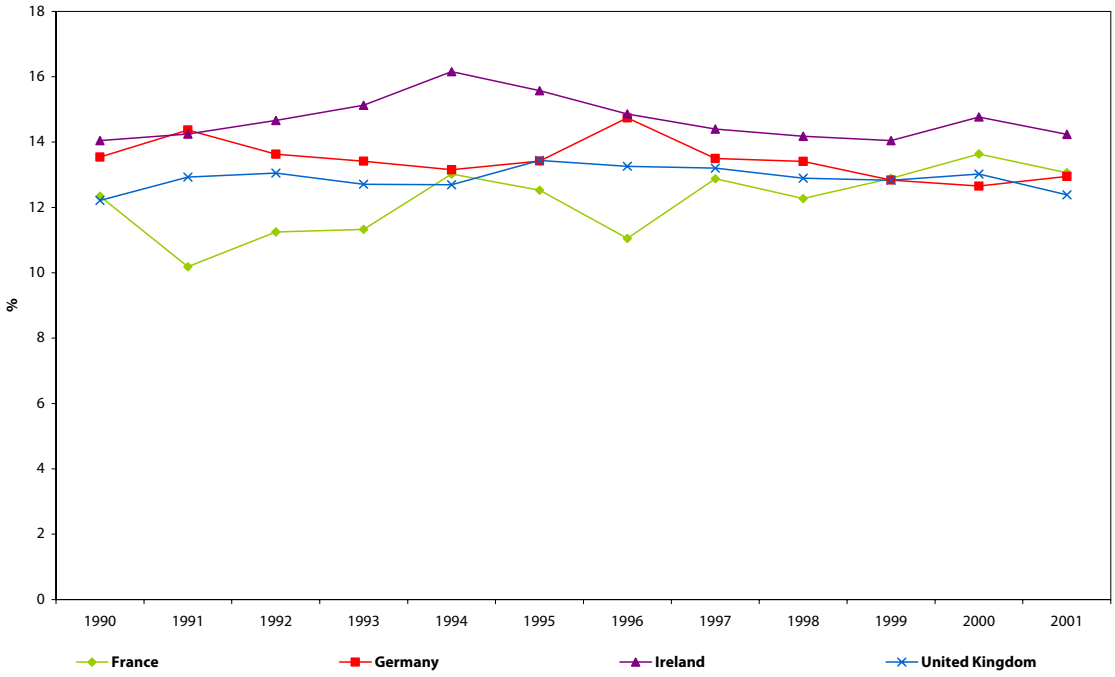
6 International Comparison

6.1 Services Sector - Selected EU Member States

Figure 6.1 shows the ratio between services final consumption of energy and overall total final consumption (TFC) for France, Germany, Ireland and the UK. Ireland had the largest share of services final consumption as a percentage of TFC of all EU-15 countries in 2001, 14.2%. The share was 14% in 1990.

As we have seen in section 2.2 this had increased to 15% in 2003. The share of services final energy consumption in TFC in France increased from 12.3% to 13% during the period 1990 to 2001 while the UK remained unchanged at 12% and Germany's share declined from 13.5% to 12.9%. The EU average (not shown) in 2001 was 11.7%, an increase of 0.7% on 1990.

Figure 6.1: Services Final Consumption as a Percentage of TFC 1990 - 2001



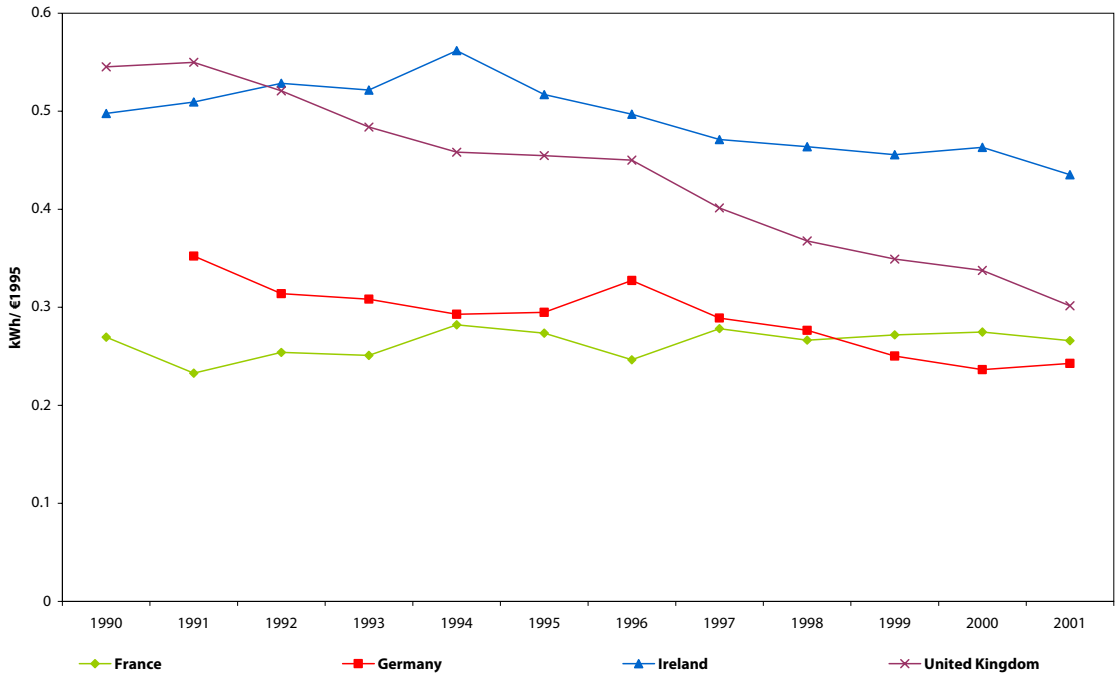
SOURCE: ODYSSEE

As we have seen in section 2.3 energy intensity is defined as the ratio between the final energy consumption of the sector and the value added measured in constant monetary units. Figure 6.2 illustrates the energy intensity for selected countries including Ireland. All the selected countries have shown a decrease in intensity, which indicates an improvement in energy intensiveness.

The UK recorded the largest improvement with a reduction of 45% over the period 1990 to 2001 (-5.2% per annum on average). Data for 1990 is not available for Germany but there was a decrease in intensity of 31% (-3.7% per annum) between 1991 and 2003. Ireland recorded a reduction in energy intensity of 13% (-1.2% per annum) over the period 1990 to 2001[48] and, to complete the picture, energy intensity in the services sector in France fell slightly by 1.3% over the period (-0.1% per annum). Ireland had the highest intensity of the countries shown in 2001.

[48] Compared with a decrease of 10% (-0.8% per annum) over the period 1990 to 2003, as seen in section 2.3.

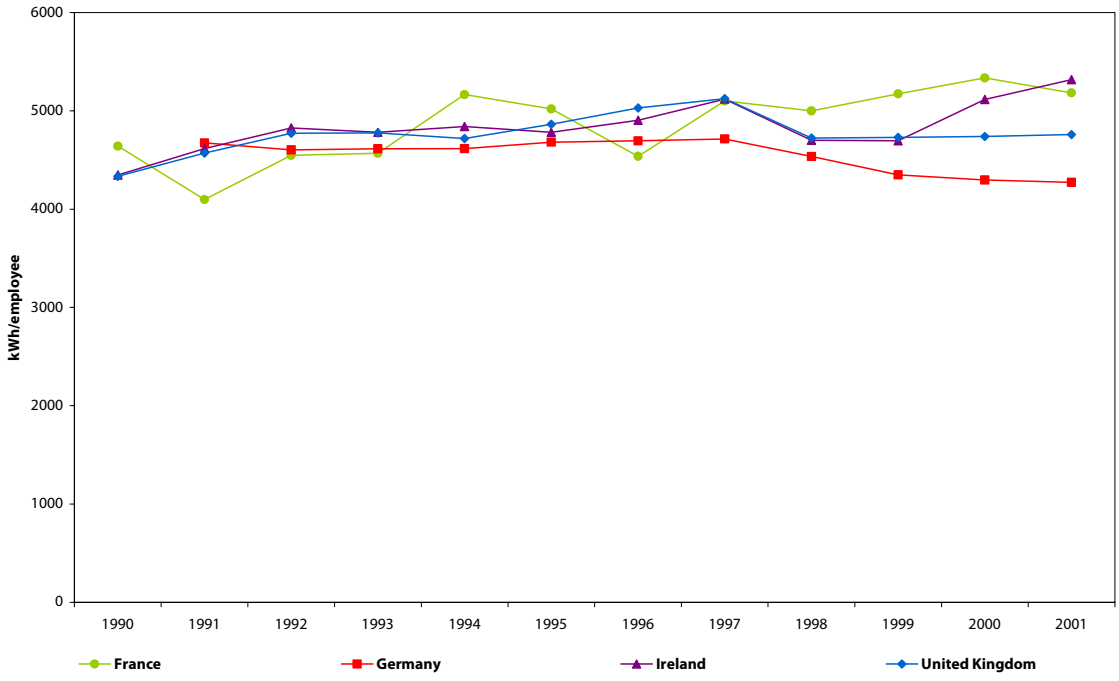
Figure 6.2: Energy Intensity of the Services Sector 1990 – 2001



SOURCE: ODYSSEE

As stated in section 2.4 two useful energy efficiency indicators in the services sector are energy and electricity consumption per employee and per unit of floor area. Figure 6.3 shows consumption of electricity per employee in the services sector for selected EU countries.

Figure 6.3: Unit Consumption of Electricity per Employee in the Services Sector 1990 – 2001

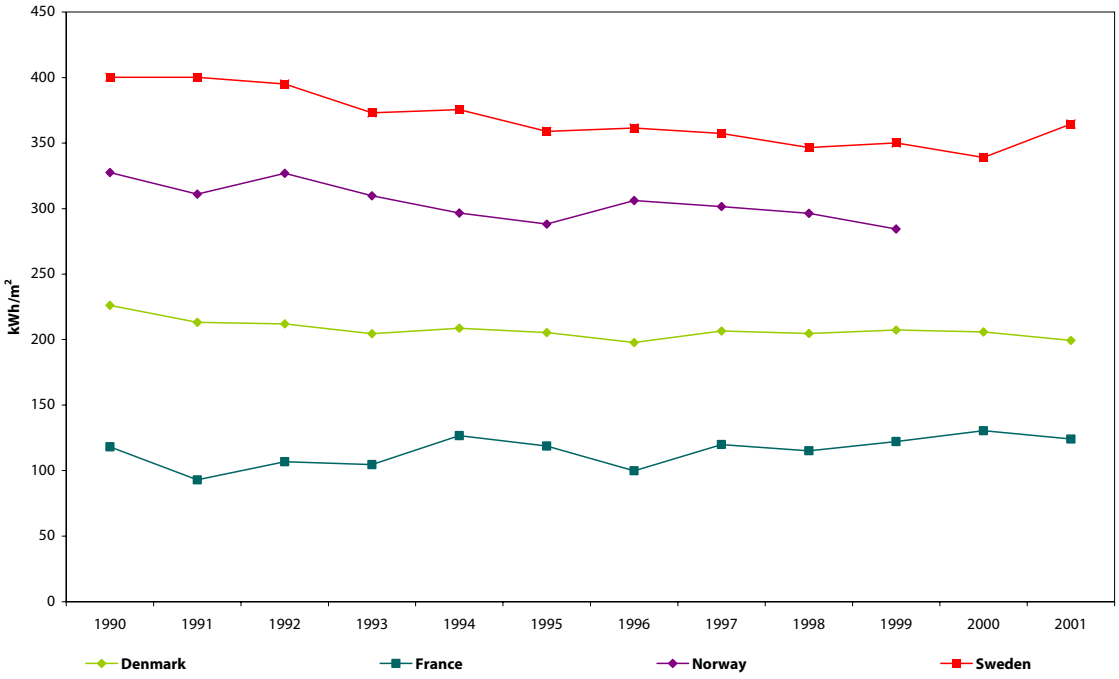


SOURCE: ODYSSEE

Ireland recorded the largest growth over the period 1990 to 2001 (22% or 2.2% per annum) and had the highest unit consumption of the countries shown in 2001. In addition, as stated in section 2.4, Ireland's growth over the period 1990 to 2003 was 58% (3.6% per annum) indicating that significant growth has occurred in 2002 and 2003. France and the UK experienced growth between 1990 and 2001 of 12% and 10%, respectively or 1% or 0.8% per annum. Germany over the period 1991 to 2001 recoded a decrease in electricity consumption per employee of 8.6% or -0.85% per annum.

Unit consumption of energy per unit of floor area is not available for Ireland but it is for some other EU-15 countries. Figure 6.4 presents climate corrected unit consumption per square metre for Demark, France, Norway and Sweden. Data is climate corrected by scaling the space heating consumption to the average climate in the European Union on the basis of a relative number of degree days[49]. As can be seen Sweden had the highest unit consumption per square metre in 1990 and 2001. Sweden did, however, experience a decline of 8.9% (-0.8% per annum) over the period while Denmark's consumption of energy per square metre fell by 12 (-1.1 per annum). France recorded an increase of 5% (0.4% per annum). Over the period 1990 to 1999 Norway exhibited a fall in consumption per square metre of 13% (-1.6% per annum).

Figure 6.4: Unit Consumption per Square Metre Scaled to EU Average Climate 1990 – 2001



SOURCE: ODYSSEE

6.2 UK Services Sector Energy Consumption and End Use

As an example of the type of data and analysis that is available when a more comprehensive dataset is available this section focuses on the services sector in the UK.

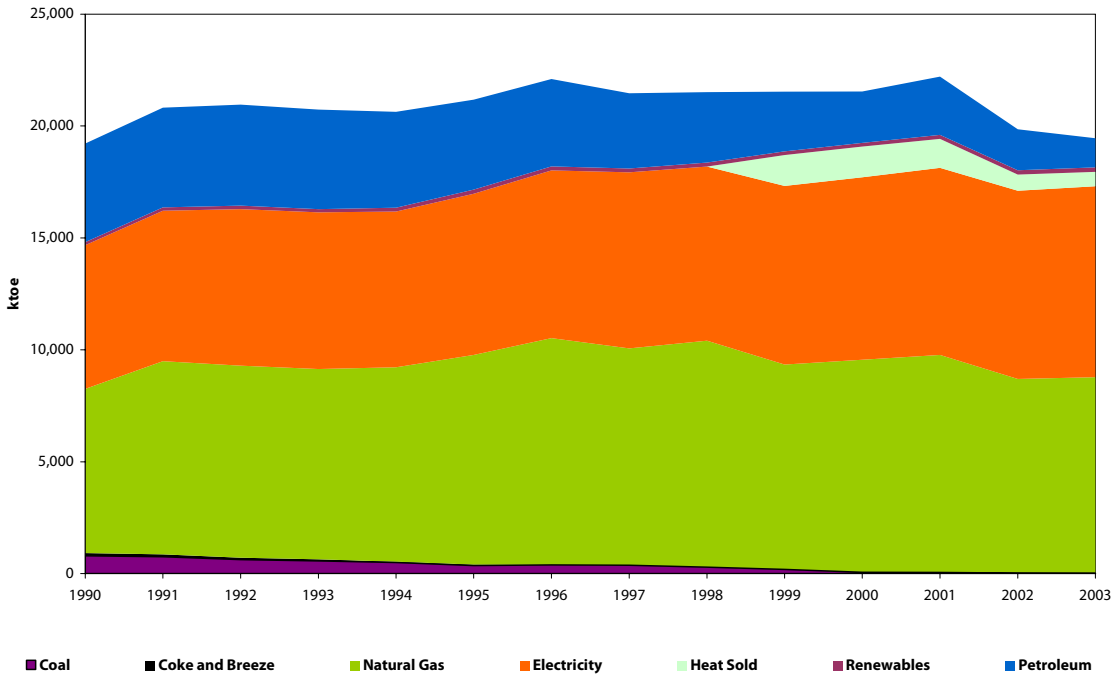
Like Ireland the UK does not have a complete dataset; modelling is used to fill data gaps in the sector. The data presented in this section is based on detailed energy audit data and a variety of other data sources reconciled to "top level" Department of Trade and Industry consumption statistics. The energy end use data is modelled by the Building Research Establishment (BRE) using its (Non-Domestic Energy and Emissions Model) N-DEEM model[50].

[49] A degree day is the measure or index used to take account of the severity of the weather when looking at energy consumption in terms of heating (or cooling) "load" on a building. It is an expression of how cold (or warm) it is outside, relative to a day on which little or no heating (or cooling) would be required. It is thus a measure of cumulative temperature deficit (or surplus) of the outdoor temperature relative to a neutral target temperature (base temperature) at which no heating or cooling would be required.

[50] Department of Trade and Industry, 2004. *Energy Consumption in the United Kingdom* (updated data). http://www.dti.gov.uk/energy/inform/energy_consumption/index.shtm

It is useful to begin by presenting the fuels consumed in the services sector. Figure 6.5 shows that natural gas and electricity have increased while coal and oil have declined over the period 1990 to 2003[51]. Unlike Ireland, the dominant fuel in the UK services sector in 2003 was natural gas, which was responsible for 45% of total. Electricity consumption was, however, nearly as significant with 44% of total consumption. In Ireland, as seen in section 2.2, oil was the dominant fuel in the services sector with 41% of total final consumption in 2003, electricity was second with 40% and natural gas, third, with 17%.

Figure 6.5: UK Services Sector Energy Consumption by Fuel 1990 - 2003



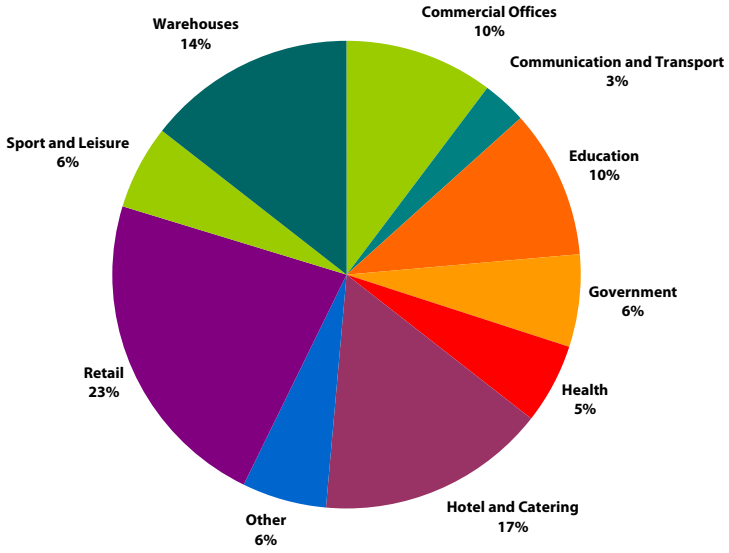
SOURCE: DTI

In 2002 services sector energy consumption in the UK accounted for 12% of final energy consumption, as seen in section 6.1. The services sector in Ireland accounted for 15% of final consumption in 2003.

Figure 6.6 shows UK services sector energy consumption by grouped sub-sectors and shows that *retail* and *hotel and catering* are the largest energy consuming sub-sectors. In the case of Ireland, for 1999, we have seen in section 4.2.3 that the *restaurants, bars and catering* was the largest energy consuming sub-sector with 21% of the combined total of the eleven sub-sectors analysed. *Retail sale of food* was the second largest energy consuming sector with 15% of the total.

[51] Including agriculture.

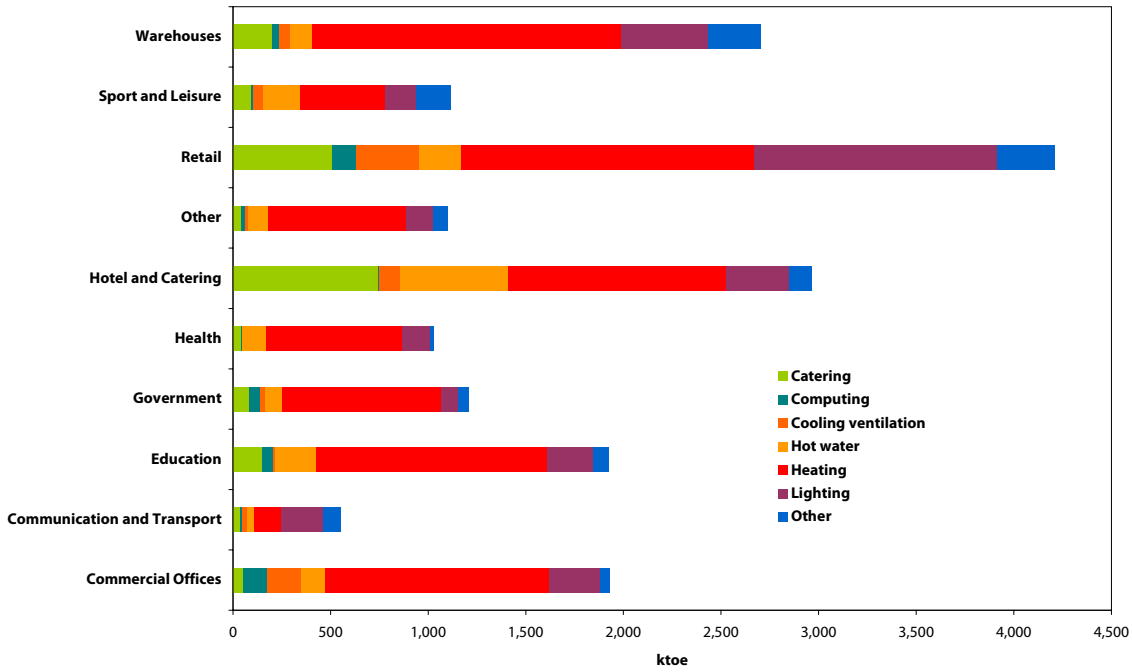
Figure 6.6: UK Services Sub-Sectoral Energy Consumption 2002



SOURCE: DTI

As mentioned at the outset of this section, energy end use data has been estimated for each of the ten sub-sectors seen in figure 6.6. Figure 6.7 shows that just over half (51%) of energy consumed in the services sector was used for space heating in 2002. Lighting accounted for 17% and catering for 10%. The majority of space heating is used in *warehouses, retail, hotels and catering*, *commercial offices* and in the *education* sub-sectors. As for lighting, the highest proportion, 38%, was consumed in the *retail* sub-sector.

Figure 6.7: UK Energy Consumption for Services Sub-Sectoral by End Use 2002



SOURCE: DTI /BRE

7 Conclusion and Next Steps

Energy statistics relating to fuel consumption for the services sector in Ireland are calculated as a residual. This approach is unsatisfactory, not least because the energy consumption in the services sector is affected by uncertainties in all other sectors. In addition, data at sub-sectoral level and data on end use has not been compiled in detail to date in Ireland. As a result, there is only limited information available to policy-makers with which to formulate and target energy efficiency policies and measures for the sector.

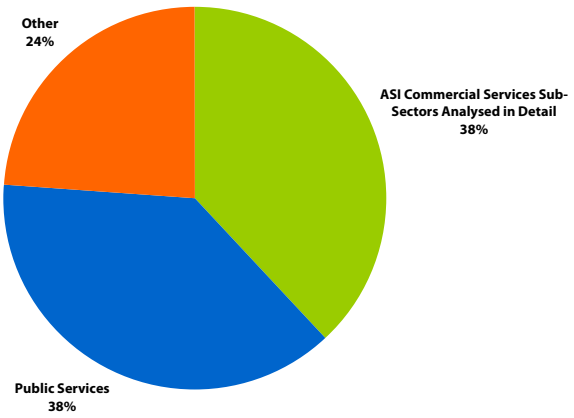
As a result of the heterogeneous nature of the services sector it is difficult to assess the amount of energy that is consumed in this sector. The increasing number of energy suppliers in the liberalised market makes this task all the more difficult.

The analysis in this report begins to address this information gap but it is only one of a number of studies that are seeking to shed more light on energy use and consumption in the services sector. For example, SEI commissioned the Building Research Establishment (BRE)[52] to profile the services sector in Ireland as part of a process designed to identify energy savings potential at a sub-sectoral level.

This report has analysed eleven ASI commercial services sub-sectors and found that they accounted for 30% of total final energy consumption in the services sector as well as, 39% of total CO_2 emissions, 42% of total Gross Value Added (GVA) and 38% of total employment in 1999.

Figure 1.2 illustrates the significance (in employment terms) of the eleven sub-sectors, within the context of the services sector as a whole. As already mentioned, the ASI sub-sectors analysed constituted 38% of total employment in the services sector in 1999. The public services sub-sectors accounted for a further 38% and the remaining 24% of employment is attributed to the following sub-sectors: *transport and storage, financial intermediation, other accommodation, private households with employed persons* and *extra-territorial organisations*.

Figure 7.1: Commercial and Public Services Sector Employment 1999



SOURCE: CSO

Due to the heterogeneous nature of the services sector, the results presented in this report for these eleven commercial services sub-sectors may not be valid for the services sector as a whole. The nature of activity within commercial services is quite distinct from that in public services and this may lead to differences for example, in the share of electricity consumption in the final energy fuel mix. The uncertainties associated with the national energy balance data relating to the services sector do not readily allow for the generation of results for the remaining services sub-sectors based on the analysis of the ASI sub-sectors.

[52] SEI, 2004, *Potential for Energy Savings in the Services Sector in Ireland – A Market Characterisation* prepared by the Building Research Establishment.

The next step in order to deepen the understanding of energy use in the services sector would be to collect data on floor area. In addition, the analysis in this report will be repeated once ASI 2004 data becomes available in 2006.

CSO have indicated that detailed energy expenditure data will be collected on a yearly basis from 2004, as opposed to every five years. This is significant in that this analysis will be conducted on a yearly basis allowing trends to be identified and tracked over time. It also expected that aggregate data from the ESB will be analysed yearly. Both these datasets should provide a useful insight into the services sector in future years.

SEI gratefully acknowledges the co-operation of the CSO and ESB Customer Supply for providing the data that made this analysis possible.

Data Sources

Central Statistics Office, Skehard Road, Cork. www.cso.ie

Department of Trade and Industry, Victoria Street London. www.dti.gov.uk

Electricity Supply Board, Customer Supply, Lower Fitzwilliam St Dublin 2. www.esb.ie

Environmental Protection Agency, Johnstown Castle Estate, Wexford. www.epa.ie

EU funded SAVE II Odyssee Project http://www.odyssee-indicators.org/

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Available from http://unfccc.int/resource/conv/ratlist.pdf

World Commission on Environment and Development, 1987. *Our Common Future.* Oxford University Press, Oxford.

Appendix 1 Sub-Sector Descriptions

This Appendix provides a brief description of the sub-sectors used in this report, as illustrated in figure 1.1. For an exhaustive list of NACE codes and accompanying descriptions go to http://europa.eu.int/comm/environment/emas/pdf/general/NACEcodes_en.pdf.

Commercial Services

Motor Trade (NACE 50) Sale, maintenance and repair of motor vehicles and motorcycles as well as the retail sale of automotive fuel.

Wholesale Trade (NACE 51) Wholesale trade and commission trade, except of motor vehicles and motorcycles.

Retail Sale of Food (NACE 52.1 to 52.2) Retail sale in non-specialised stores and retail sale of food, beverages and tobacco in specialised stores.

Other Retail and Repair of Goods (NACE 52.3 to 52.7) Retail sale of pharmaceutical and medical goods, cosmetic and toilet articles, other retail sale of new an second-hand goods in stores, retail sale not in stores and repair of personal and household goods.

Hotels (NACE 55.1) Hotels and motels, with and without a restaurant.

Other Accommodation (NACE 55.2) Camping sites and other provision of short-stay accommodation.

Restaurants, Bars and Catering (NACE 55.3 to 55.5) Restaurants, bars, canteens and catering.

Transport and Storage (NACE 60 - 63) Land, water and air transport; transport via pipelines. Supporting and auxiliary transport activities and the activities of travel agencies. This category refers to office-based activities as opposed to any expenditure on fuel for actual road, air or rail transport.

Post and Telecommunications (NACE 64) Post, courier and telecommunications

Financial Intermediation (NACE 65 – 67) Insurance, assurance, pension funding, credit granting, security brokering and fund management.

Other Offices, Research and Development (NACE 70, 71, 73,74) Real estate activities. Renting of machinery and equipment without operator and of personal and households goods. Research and development and other business activities.

IT Services (NACE 72) Computer and related activities.

Recreation, Sport and Culture (NACE 92) Motion picture and video production, distribution and projection. Radio and television activities as well as other entertainment and sporting activities.

Other Services (NACE 93) Washing and dry-cleaning. Hairdressing and other beauty treatment. Physical well-being activities. Funeral and related activities.

Public Services

Public Administration and Defence (NACE 75) Administration of the State and Government. Defence, justice and fire activities.

Education (NACE 80) Primary, secondary, third level and adult education.

Health and Social Work (NACE 85) All medical (including dental) and social work activities.

Other Community, Social and Personal Services (NACE 90 - 91) Sewage and refuse disposal, sanitation and similar activities. Activities of membership organizations including professional, political and trade union organisations

Private Households with Employed Persons (NACE 95) Private households employing domestic personnel such as maids, cooks, gardeners, babysitters, tutors, secretaries, etc.

Extra- Territorial Organisations (NACE 99) The activities of international organisations such as the United Nations and embassies.

Appendix 2 ASI Methodology

Central Business Register

The CSO's Central Business Register provides the sampling frame from which the Annual Services Inquiry (ASI) sample is selected each year. The Central Business Register (CBR) is also used as the basis for the sampling frame used to gross sample data to the population. The 1995 inquiry was the first survey based on the CBR, as previous inquiries were sampled and grossed with reference to the 1988 Census of Services register. The CBR is continuously updated, and thus provides a more satisfactory approach to grossing than used previously. However, this change of registers, in addition to changes in classifications, means that the results of the 1995 inquiry and subsequent inquiries are not fully comparable with results from previous years. Also because a more complex sampling/grossing methodology was used for ASI 1999, the 1999 results are not directly comparable to previous years and result in a discontinuity in the series.

Sample Design

The ASI is designed to provide grossed estimates of the principal trading aggregates for all enterprises in the relevant sectors. The *enterprise* is the unit used for survey purposes i.e. one return is sought in respect of each enterprise covering all constituent branches, local units or subsidiaries. The sample is selected based on number of persons engaged in the enterprise i.e. number of proprietors plus number of full-time and part-time staff. A census of enterprises with 20 or more persons engaged is selected. In addition a stratified random sample is selected for the enterprises with less than 20 persons engaged, with decreasing sampling proportions taken in the lower persons engaged ranges. The employment size classes generated for sampling and grossing are as follows:

- 1-4 persons engaged – size class 1
- 5-9 persons engaged – size class 2
- 10-19 persons engaged – size class 3
- 20 + persons engaged – size class 4.

For enterprises with less than 20 persons engaged, the strata were organised by region, NACE Revision 1 and employment size class. The sampling fractions used differed by region, NACE Revision 1 and size class.

Grossing

There are two different grossing factors used in the ASI, one for the number of enterprises and one for all accounting and employment variables. Total persons engaged (from the CBR) is used as the grossing factor for all accounting and employment variables, while the total number of enterprises is used for number of enterprises grossing factor.

As noted above, the CBR forms the basis of the sampling frame used for grossing sample data to population estimates. The grossing variable data (number of persons engaged and number of enterprises) in the sampled portion of enterprises originally selected from the CBR are used to update those data on the Register. Decay and growth factors are then calculated for each size class and sector to adjust the non-sampled portion of the Register. The grossing factors for a particular stratum are then calculated by dividing the total persons engaged (number of enterprises) in that stratum according to the adjusted or updated CBR by the number of persons engaged (number of enterprises) in the sampled enterprises. Because of the independent grossing methods used to provide estimates of the numbers of enterprises (which are taken directly from the CBR) and the accounting data relating to them there cannot be total consistency within tables. For example, this can be seen by comparing the number of persons engaged in one person enterprises and the number of enterprises in this category. These differences are minor and inevitably arise from the independent estimation methods used[53].

[53] Central Statistics Office (1999) Annual Services Inquiry.

Appendix 3 CO_2 Emission Factors

Kilograms CO_2 per Kilowatt Hour

The Electricity produced in 1999 emitted 0.8162 $kgCO_2$/kWh. This figure will change on a yearly basis depending on the fuel mix used to produce the electricity, table A3.1 illustrates.

Table A1: CO_2 Emissions per kWh of Electricity Supplied

	1990	1995	1999	2000	2001	2002	2003
kg CO_2/kWh	0.918	0.893	0.816	0.775	0.791	0.717	0.651

SOURCE: SEI

Heating Oil /Gasoil - 0.264 $kgCO_2$/kWh.

Natural Gas - 0.198 $kgCO_2$/kWh.

SOURCE: EPA

Appendix 4 Expenditure to Consumption Equations

SEI have analysed a sample of consumption and expenditure data for electricity, heating oil and natural gas. Using the results of this sample it was possible to calculate trendlines with accompanying equations, which can approximate the units of electricity, heating oil and natural gas used in larger data sets, such as the Central Statistics Office (CSO) Annual Services Inquiry (ASI), by examining expenditure on energy only.

Separate equations for different fuels and categories or bands of expenditure were formulated, see below. In the following equations Y is units of electricity/natural gas/heating oil consumed and X is expenditure on energy (from ASI).

CSO applied these equations to each company respondent in the 1999 ASI by substituting expenditure on energy for X and solving for Y in order to generate consumption data in total kilowatt hours of energy used, summed by subsector, and reported by 2 digit NACE classification.

The calculated equations for electricity are:

1. Expenditure under €12,697 (£10,000): Y= 9.3957 * X - 405.41
2. Expenditure over €12,697 (£10,000) but under €126,970 (£100,000): Y = 13.365 * X - 46916
3. Expenditure over €126,970 (£100,000) on electricity: Y = 19.321 * X – 774265.

The calculated equations for natural gas are:

4. Expenditure of > € 0 and ≤ € 1200 on natural gas: Y = 31.546 * X – 1201.9
5. Expenditure of ≥ € 1,201 and ≤ € 2,800 on natural gas: Y = 34.247 * X – 4387
6. Expenditure of ≥ € 2,801 and ≤ € 5,200 on natural gas: Y = 37.313 * X – 12840
7. Expenditure of ≥ € 5,201 and ≤ € 12,000 on natural gas: Y = 40.984 * X – 31807
8. Expenditure of ≥ € 12,001 and ≤ € 47,500 on natural gas: Y = 52.471 * X – 83947
9. Expenditure of ≥ €47,501 on natural gas: Y = 56.338 * X – 261816

With regard to heating oil the following prices were applied to the following bands where X is expenditure on oil:

10. 0- ≥ €1000: X / 0.3600 cents per litre
11. €1,001 - €5,000: X / 0.3473 cents per litre
12. €5,001 - €10,000: X / 0.3346 cents per litre
13. €10,001 - €50,000: X / 0.3219 cents per litre
14. €50,001 - €100,000: X / 0.3092 cents per litre
15. ≥ €100,000: X / 0.2965 cents per litre

Sustainable Energy Ireland
Energy Policy Statistical Support Unit
Building 2200
Cork Airport Business Park
Co. Cork
Ireland
t +353 21 454 7050
f +353 21 454 7059
e epssu@sei.ie
w www.sei.ie

Sustainable Energy Ireland
Glasnevin
Dublin 9
Ireland
t +353 1 8369080
f +353 1 8372848
e info@sei.ie
w www.sei.ie

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