Constructing the Future

BRE

Sustainable Construction – the Data

prepared by
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EXECUTIVE SUMMARY

This work was undertaken by BRE between January and March 1999 on behalf of the DETR as a component of a project entitled "Sustainable Construction - Developing an Industry Agenda". The objectives of this study were to:

- marshal key available data on the social, economic, environmental and resource implications of construction
- determine the important factors and interrelationships between sustainability issues and construction

The research identifies the characteristics of the construction industry in terms of the economy, society, construction activity and materials, building operation, and transport and waste implications. The combined performance of these issues represents the sustainability of construction and the built environment.

This work provides a timely source of background information from which many groups can draw in devising their strategies and action plans for improving the sustainability of UK construction and for responding to the Governments own strategy.

This project was funded by the Department of the Environment, Transport and the Regions. The views expressed here are not necessarily those of the Secretary of State for the Environment, Transport and the regions.

Sustainable Construction – the Data

1 Introduction

This work was undertaken between January and March 1999 on behalf of the DETR as a component of a project entitled "Sustainable Construction - Developing an Industry Agenda" – SC 4234 (cc 1667). The project was undertaken under the auspices of the Centre for Sustainable Construction and draws on expertise from across BRE and from BRE associate contractors on the following aspects:

- Energy and Water
- Waste & Recycling
- Land Use
- Social
- Economic
- Materials

2 Background

The DETR are responsible for implementing government policy on sustainable construction. In current government policy, sustainability is described as:

- Social progress that meets the needs of everyone.
- Economic growth
- Effective protection of the environment
- Efficient use of resources

DETR have consulted widely with the construction industry to ascertain the industry's views on sustainable construction and how best to promote it effectively. The DETR 'Strategy for More Sustainable Construction' leads policy development in this field.

Sustainable construction is an inherently complex subject, with a very large range of variables that interact, and are often contradictory. Objective studies have often shown that many of the interactions are counter-intuitive and there are many misconceptions about sustainable construction issues perceived by the industry.

For example, it is commonly held as self-evident that waste recycling will substantially reduce the quantities of materials extracted. Objective studies show that the quantities of waste arising from demolition are too small compared to the current demand for materials for recycling to dramatically reduce the quantities of material extracted. Recycling is nonetheless very important as a strategy for preserving landfill capacity.

Hence, there is a need for objectively compiled data on sustainable construction in order to counteract misconceptions and inform new thinking on sustainable construction.

3 Objective

The objectives of this study are:

- To marshal key available data on the social, economic, environmental and resource implications of construction

4 Approach

The approach consisted of:

1. Constituting a working group of experts on key topics of sustainable construction drawing from across BRE and from associate consultants as necessary

2. Gathering and collating the key data and mapping it across the construction sectors. Much of the data were not available at the levels of detail required and considerable approximation and interpolation was necessary.

This report could be continuously improved as more extensive and up to date data becomes available and as the increasing priority given to sustainability results in new research. The data presented was the best available information at the time of the research.

5 Key Data

The results presented in this section of the report pick out key data from the different facets of the construction industry and illustrate these graphically. This information is not presented in any particular priority order.

5.1 Economic Perspectives

5.1.1 Types of Work: New, Refurbishment and Repair and Maintenance.

Official statistics show the breakdown of construction work into new-build, refurbishment and repair and maintenance. They also break it down by sector - housing and other. DIY and the unofficial economy also contribute to construction output significantly.

If, as experts in the field typically assume, half of housing repair and maintenance is actually refurbishment and that the unofficial economy does two thirds of repair and maintenance and one third refurbishment, then the industry output is as shown in *Table 1.*

The total output of construction may well be an underestimate. The figures of “total output at basic prices” for construction, published in the Blue Book (ONS 1998 *Table 2.2*) for the first time show a total figure of £90 billion in 1996 compared with £63.5 billion in *Table 1*. The ONS figures are for the UK while DETR figures are for Great Britain. However, construction output in Northern Ireland is only about 2% of UK output (Northern Ireland Statistics and Research Agency, 1997 and ONS 1998a) so that the discrepancy on that account is small. It is understood that the ONS figures do not include DIY. There are several possible reasons for the difference, none of which would individually account for it, except perhaps the unofficial economy.

Table 1 - Overall Estimated Breakdown of Industry Work by Types at Current Prices 1997

Type of Work	**Value £Bn**	**%**
New Work		
Housing	8.0	
Other	7.3	
total	*15.3*	*24.1*
Refurbishment		
Housing	7.9	
Other	14.6	
Unofficial Economy	1.7	
total	*24.2*	*38.1*
Repair & Maintenance		
Housing	7.9	
Other	12.7	
Unofficial Economy	3.4	
total	*24.0*	*37.8*
Grand Total	**63.5**	**100.0**

Sources – DETR (1998a), BSRIA & DLC (1995), Business Strategies Ltd (1998), Davidson M, Redshaw J and Mooney A (1997) plus assumptions in text.

The key observation from these results is that although new-build projects get most media and professional attention (especially commercial projects), repair, maintenance and refurbishment are much more significant and housing is more significant than commercial.

5.1.2 Size of Projects

Table 2 shows that there is a large amount of small and medium sized new work and refurbishment work. A little over a quarter (27%) of the value of new work and refurbishment (excluding housing refurbishment) is in new orders received by contracts of over £5 million. A further 29% is in orders of over £1 million. At the other end of the scale 16% are under £200,000 (and this excludes those less than £25,000) and 29% are between £200,000 and £1 million.

Table 2 - **Summary of value of new orders by size, 1995 – 1997 - GB**

Value Range £ thousand	**1995 %**	**1996 %**	**1997 %**	**Average %**
25 < 100	7.7	7.2	7.2	7.4
100-< 200	8.1	8.5	8.2	8.3
200-< 400	11.3	11.3	12.0	11.5
400-< 750	11.7	11.8	11.6	11.7
750-<1,000	5.7	5.5	5.7	5.6
1,000-<2,000	14.4	13.4	14.8	14.2
2,000-<3,000	5.9	6.3	6.8	6.3
3,000-<5,000	8.1	7.9	8.2	8.1
5,000	27.2	28.2	25.4	26.9
Total	**100**	**100**	**100**	**100**

Source – DETR (1998a) Table 1.4

5.1.3 Fluctuations in Work Load

Table 3 shows the fluctuations in construction output of new work at constant 1995 prices and cement deliveries 1987-1997. Cement deliveries are a good indicator of construction activity, especially of new work, because cement is used in almost all types of building and civil engineering works. Value figures at constant prices rely on price indices that during periods of rapid change are not always reliable. From both sets of figures it is clear that there have been wide fluctuations in output over the ten-year period, with a range 13% in value terms and 50% in terms of cement consumption. The lack of stability of both the construction and materials industries is considered damaging to their economic sustainability. Deliveries of other building materials over the period show similar violent fluctuations, e.g. brick deliveries showed a range of 63% by volume.

Table 3 - Comparison of Construction Output at Constant 1995 prices and Cement Deliveries 1987-1997.

Year	Output New Work		Cement Deliveries	
	£M (1995 prices)	Index	Tonnes M	Index
1987	50,629	96.2	14,364	120.6
1988	55,438	105.3	16,558	139.0
1989	58,137	110.4	16,791	140.9
1990	58,375	110.9	14,826	124.4
1991	54,133	102.8	12,160	102.1
1992	51,927	98.6	11,046	92.7
1993	50,980	96.8	11,081	93.0
1994	52,692	100.1	12,600	105.8
1995	52,643	100.0	11,914	100.0
1996	53,863	102.3	12,808	107.5
1997	55,468	105.4	12,965	100.8

Source – DETR (1998a)

5.1.4 Construction Output in the UK and Selected European Countries

The United Kingdom shows the lowest construction output as a percentage of GDP and the lowest per capita construction output except for Portugal. This implies that the industry is either much more efficient than in other countries (more sustainable) and/or it is much less profitable (less sustainable) and/or it is not attracting the same level of investment per capita which might imply a deteriorating building stock (less sustainable). The figures do not include estimates for the unofficial economy or for DIY.

Table 4 - Gross Construction Output as a Percentage of GDP and per capita in selected West European Countries 1993.

Country	Construction Output £ per capita	Construction Output as % of GDP
Austria	2,618	17.6
Belgium	1,541	11.8
Denmark	1,763	10.5
Finland	1,224	11.5
France	1,315	9.0
Germany	1,856	13.4
Ireland	945	11.5
Italy	1,164	10.1
Netherlands	1,374	10.5
Norway	1,637	10.4
Portugal	655	13.6
Spain	894	12.0
Sweden	1,728	12.4
Switzerland	2,959	13.4
UK	798	7.3

Source – Davis Langdon and Everest (ed) (1995)

The gross output data are taken from DL&E (1995) and for the UK from DETR data and for other countries from Euroconstruct (1993, 1994) data or from other published statistics. If ONS figures are used for the UK (which are thought to have a high allowance for the unofficial economy) then the UK performance is improved greatly. However, if the unofficial economy were accounted for, the figures for other countries would also rise, but in some cases, e.g. France and Spain, not by as much.

5.1.5 Structure of the Industry - Size of Firm

Table 5 shows that the structure of the construction industry follows the structure of the work put to the industry. The figures of employment represent those directly employed by the firms and are therefore only an indication of relative sizes. The figures of value of work done represent work actually carried out directly by the firms concerned, that is, they do not include the value of the work subcontracted either on a supply and fix basis or on a labour-only subcontracting basis.

The largest 2,434 contractors – those directly employing 35 persons or more – representing 1.2% of the industry's firms, did 56% of the work in 1997. This is the same proportion of new work which comprised orders of £1 million or over (see Table 2). The other 44% of new work (which includes some refurbishment) and repair and maintenance is done by the other 157,700 firms. Hence, if the sustainability of the industry is to be improved, then there must be greater emphasis on the smaller firms or mechanisms in place to ensure that action taken by large firms is matched by that from smaller (sub-contracting) ones.

Table 5 - Number of Contractors and Value of Work Done by Size of Direct Employment 1997 GB. and Value of Work Done at Current Prices.

Numbers directly employed	Number of Firms		Value of Work done £ million (a)	
	1993	1997	1993	1997
1	93,385	86,269	2,918	4,382
2 - 3	64,438	47,644	3,472	4,120
4 - 7	26,072	15,737	3,515	3,441
8 - 13	4,630	3,787	2.036	2.124
14 - 24	3,129	3,101	2,683	3,080
25 - 34	1,066	1,176	1,370	2,058
35 - 59	1,098	1,156	2,712	3,249
60 - 79	294	396	1,208	1,873
80 - 114	283	296	1,587	2,077
115 - 299	330	381	3,299	4,898
300 - 599	96	107	2,262	3,034
600 –1,199	53	60	2,911	4,079
1,200 +	33	38	4,392	4,877
Total	**195,107**	**160,148**	**34,364**	**43,292**

Notes (a) 3rd Quarter Figures multiplied by four, totals do not sum exactly due to rounding.
Source – DETR (1998a) Tables 3.1 & 3.3

5.1.6 Structure of the Industry - Subcontracting

Table 6 shows the turnover of the thirty-three largest contracting firms compared to their value of work done in 1993. The work actually undertaken by them is 18% of total turnover suggesting that they subcontract about 80% of their work.

Much of this will be supply and fix subcontractors for large projects, but they will also subcontract using labour only subcontractors.

Table 6 - Comparison of Turnover and Value of work done by 33 largest contracting firms 1993.

Item	Current prices GB.
Turnover	£24,298 M
Value of Work Done	£ 4,392 M
Percentage of Turnover as Work Done	18%

Source – Hillebrandt PM, Cannon J and Lansley P (1995) Table 2.1, DETR (1998a) Tables 3.1 & 3.3.

Table 7 shows the self-employment rate in the construction labour force. The proportion of self-employed in the industry labour force, many of whom would act as subcontractors, has increased over a ten year period by around 10 percentage points. This reinforces the need to promote sustainability to the SME's and SOC's.

Table 7 - Total Employees in Employment and Self-Employed in the Construction Labour Force 1987 –1997 GB.

Year	Total Employees thousands	Self-Employed thousands	Total Manpower thousands	Self-employed %
1987	1,058	535	1,592	33.6
1988	1,086	592	1,677	35.3
1989	1,109	698	1,806	38.6
1990	1,117	715	1,832	39.0
1991	1,041	657	1,698	38.7
1992	923	597	1,520	39.3
1993	840	571	1,410	40.5
1994	781	604	1,384	43.6
1995	753	621	1,375	45.2
1996	745	625	1,370	45.6
1997	792	593	1,384	42.8

Source - DETR (1998a) Table 2.1

5.1.7 The Health of the Industry

A sustainable construction industry needs to be able to meet the demands upon it, giving value for money, not only in the present but also in the future. This requires that there should be adequate investment in men (training and management) and machines and in the construction process which in turn requires an industry making sufficient profits to afford such outlays.

The health of the industry is examined below in terms of profits, insolvency, productivity and plant and equipment and other fixed assets

Profitability

Table 8 shows the gross trading profits of construction companies at current prices in each year from 1987 to 1996. A company is a limited or public limited company. In these statistics only those with a positive income are included.

The fluctuation in profits from the boom of 1988 and 1989 to the lowest point in 1992 is considerably less then the changes recorded in pre-tax profits in the annual accounts of 70 of the top 80 construction companies. (Hillebrandt et al, 1995). For these companies the profit of £2 billion in 1988 turned into a substantial loss in 1992, although because of a change in the accounting rules exact magnitude is not known.

The profits of the contracting activity of the 70 large firms analysed also fell, but never actually made a loss. However, housing property development and other activities showed large falls in profits.

Table 8 - Gross Trading Profits of Construction Companies, 1987-1996, Current UK prices.

Year	Profit £ M
1987	3,444
1988	5,011
1989	4,860
1990	4,013
1991	3,649
1992	3,014
1993	3,384
1994	3,680
1995	3,714
1996	3,631

Notes - These data refer only to companies with a positive income. Year refers to financial year to end of March in year following i.e. 1996 = 1996/97.
Source - Inland Revenue Statistics (several issues), (HMSO for earlier issues)

Insolvencies

Table 9 shows the number of insolvencies in construction and in the total economy and compares them with the total number of companies having a positive income from the Inland Revenue. Construction has a higher rate of insolvency than in the wider economy, ranging from 14% to over 60% more. The rate of insolvencies rose considerably, more than doubling during the early 1990s.

Construction insolvencies are often quoted as a percentage of all insolvencies. This is the presentation given in Housing and Construction Statistics (DETR 1998) *Table 3.2*. This is misleading. The main reason that construction has a high proportion of insolvencies is that it has a large number of companies. Such presentation is damaging to the public image of the industry.

Table 9 - Insolvencies in Construction and Total Economy 1987 – 1997

	Construction Industry			All Industry		
Year	**No of Insolvencies**	**No of Companies**	**%**	**No of Insolvencies**	**No of Companies**	**%**
1987	1,490	61,387	2.4	11,439	536,495	2.1
1988	1,471	65,316	2.2	9,427	564,778	1.7
1989	1,638	64,929	2.5	10,456	581,674	1.8
1990	2,445	61,333	4.0	15,051	576,095	2.6
1991	3,373	59,168	5.7	21,827	560,271	3.9
1992	3,830	55,660	6.9	24,425	561,621	4.3
1993	3,189	60,972	5.2	20,708	651,544	3.2
1994	2,401	53,759	4.5	16,728	594,251	2.8
1995	1,844	52,042	3.5	14,536	567,010	2.6
1996	1,610	47,389		13,461	559,146	
1997	1,419					

Notes - The figures for Insolvencies are for England & Wales only. The figures for number of companies are for the UK. Insolvencies in England and Wales are about 96% of those in the UK (ONS 1998b). The figures for number of companies is the number of cases of Corporation Tax. A "case" as a company with a positive income.
Sources - Inland Revenue (several issues), ONS (1998b), DETR (1998a)

Productivity

Table 10 shows a calculation of output per head engaged in the construction industry. It will be seen that productivity has increased at about 2.3% per annum since 1987, but that the increase is erratic. However, it is essential to include in manpower both those directly employed and those working on their own account directly to the client or as labour-only sub-contractors.

Table 10 - Output per Head 1987-1997, GB 1995 prices

Year	Output £ million	Manpower thousand	Output per head £	Index 1987 =100	% p.a. Increase
1987	50,629	1,592	31,802.1	100	
1988	55,438	1,677	33,057.8	103.9	3.9
1989	58,137	1,806	32,191.0	101.2	-2.6
1990	58,375	1,832	31,864.1	100.2	-1
1991	54,133	1,698	31,880.4	100.2	0
1992	51,927	1,520	34,162.5	107.4	7.2
1993	50,980	1,410	36,156.0	113.7	5.9
1994	52,692	1,384	38,072.3	119.7	5.3
1995	52,643	1,375	38,285.8	120.4	0.6
1996	53,863	1,370	39,316.1	123.6	2.7
1997	55,468	1,384	40,078.0	126.0	1.9

Source: DETR (1998a) Tables 1.6 and 2.1

The increasing productivity of the construction industry is good news for sustainability.

Capital Investment by Construction Industry

Table 11 shows the gross capital formation by the construction industry. The figures include plant-hire firms who supply operatives with their plant – the usual practice for large plant. They do not include plant hire firms who do not supply operatives.

Table 11 - Gross Capital Formation by Construction Industry 1989 – 1996, Current Prices UK

Year	Value £ M
1989	1,716
1990	2,204
1991	767
1992	26
1993	791
1994	1,854
1995	1,590
1996	1,028

Source: ONS (1998a) Table 2.2

The dramatic fall in capital formation by the construction industry in recession can seriously delay the recovery of the industry when recession passes which is bad news for sustainability.

5.2 Construction Materials and Resources

These are discussed in terms of:
- Resources – land, energy, transport, minerals and timber
- Pollution – acid gasses, CO_2, photochemical ozone creation
- Wastes and recycling

5.2.1 Resources

The construction industry is the largest consumer of resources of all UK industries, both directly and from its supply chain of materials producers, fabricators and stockists. About 6 tonnes of materials are consumed per person per year. However, most of the resources consumed are massively abundant minerals or renewable wood.

For the less abundant resources, there doesn't appear to be any consistent data and forecasting supply and demand for scarce resources continues to be problematic. Equally, scarcity is already accounted for in the prices of commodities and is therefore subject to market mechanisms. Environmental economists argue that the market reacts too little and too late in its price signals for scarce resources.

5.2.2 Land as a Resource

Detailed statistics on the land coverage of the built environment are lacking, and estimates made from different sources do not correlate to accurately account for total urban land use. Using average housing density data with total housing stock statistics gives an estimate of about 20 - 40% of urban land use given over to housing and associated parks and gardens etc.

From the total length of road network it is possible to estimate the land use by roads alone. However, estimates vary from 40 – 60% of urban land use, depending on assumptions, such as the average width of a road. This leaves approximately 20% of urban land use for community space, railways, vacant land etc.

Overall land use is dominated by agricultural uses – 76 -77% at either UK or England level with forest and woodland accounting for 10-11% and urban and unspecified accounting for about 13% (DETR 1998b).

The rural land use statistics also reveal some 35% of land devoted to National Parks in England, areas of outstanding natural beauty and greenbelt land, although some areas are counted in more than one category (ONS 1997b).

Land use change from rural to urban has been reasonably constant at some 6,000 hectares per annum over the past 10 years (for England), some 0.05% of land per annum. The final use following that change varies year on year, but residential use is always the largest component - about 45%; transport & utilities next at about 25%; industry and commerce next at about 13%; community services and vacant make up the remainder in roughly equal proportions at about 8% each.

Land use change is projected to accelerate slightly and by 2016 urban land use is expected to rise to about 12% of all land (for England) (equivalent to a rate of 6,800 hectares per annum between 1991 and 2016) (DoE 1996).

Since urban land use has a large ecological footprint – i.e. needs a very large area of cultivated and natural landscape to provide food and remediate man's wastes and pollution, increasing proportions of urban land use reduce sustainability.

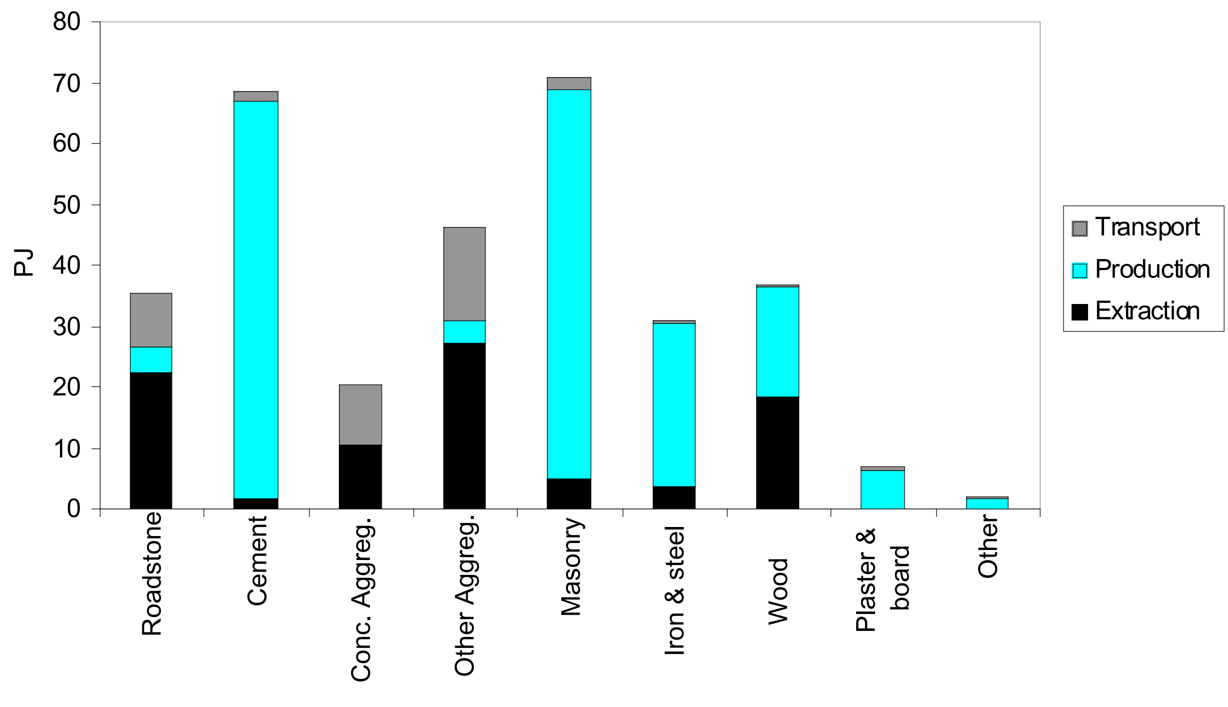
5.2.3 Energy and CO_2

Of the resources consumed by and indirectly embodied in the materials used in construction, energy is the most likely to be subject to future supply constraints. Energy is consumed in both the production and transport of construction materials (Figure 1). In delivered energy terms, transport energy can for some materials, be as high as manufacturing energy, but in primary energy terms, the transport energy is less. Also, much of the energy assumed here for extraction is also predominantly energy used to transport materials.

The use of locally sourced materials might offer potential to significantly reduce the energy used to transport materials, but the practicality of this may be limited – see minerals sourcing below.

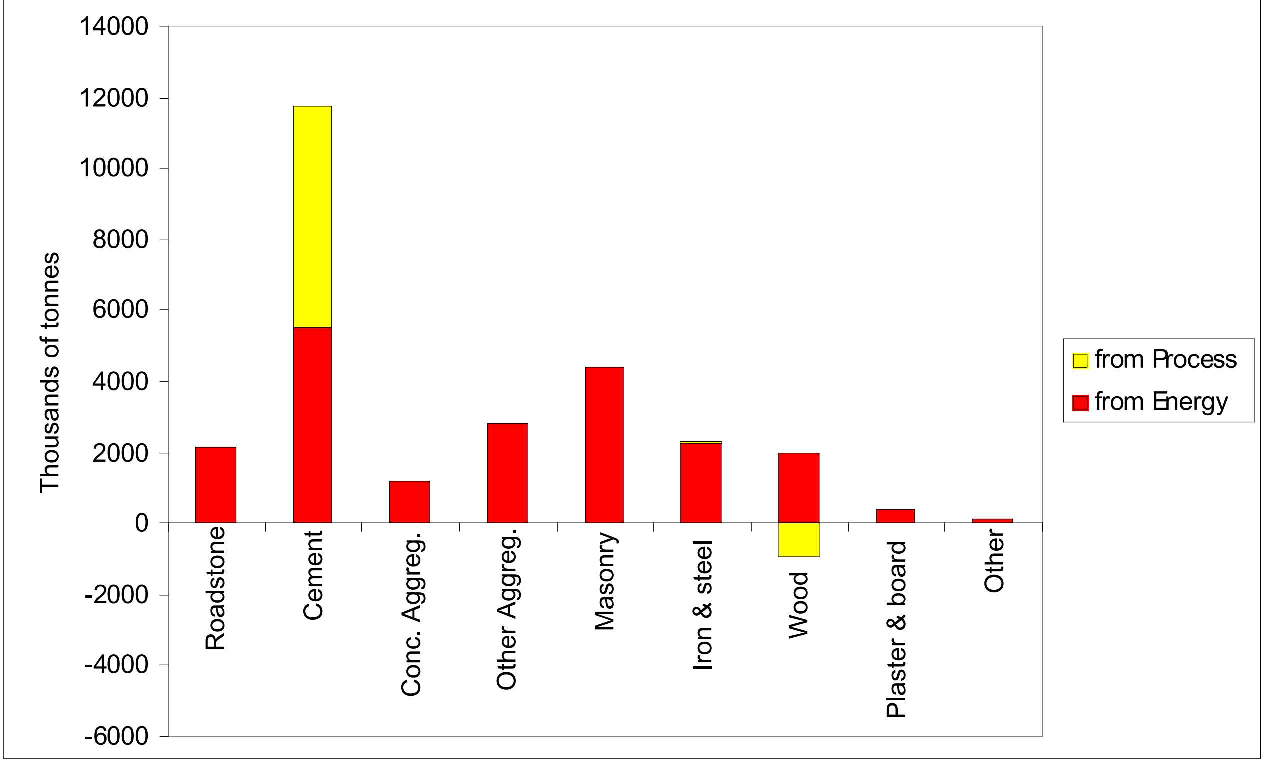
The majority of the UK's energy comes from sources that emit greenhouse gases, such as CO_2. The CO_2 emissions that result from the energy consumed in material production, as well as those emitted as a result of the chemistry of the production processes are shown in Figure 2. Growing the timber absorbs CO_2, resulting in the negative CO_2 output.

Figure 1 - Primary Energy Embodied in UK Construction Materials



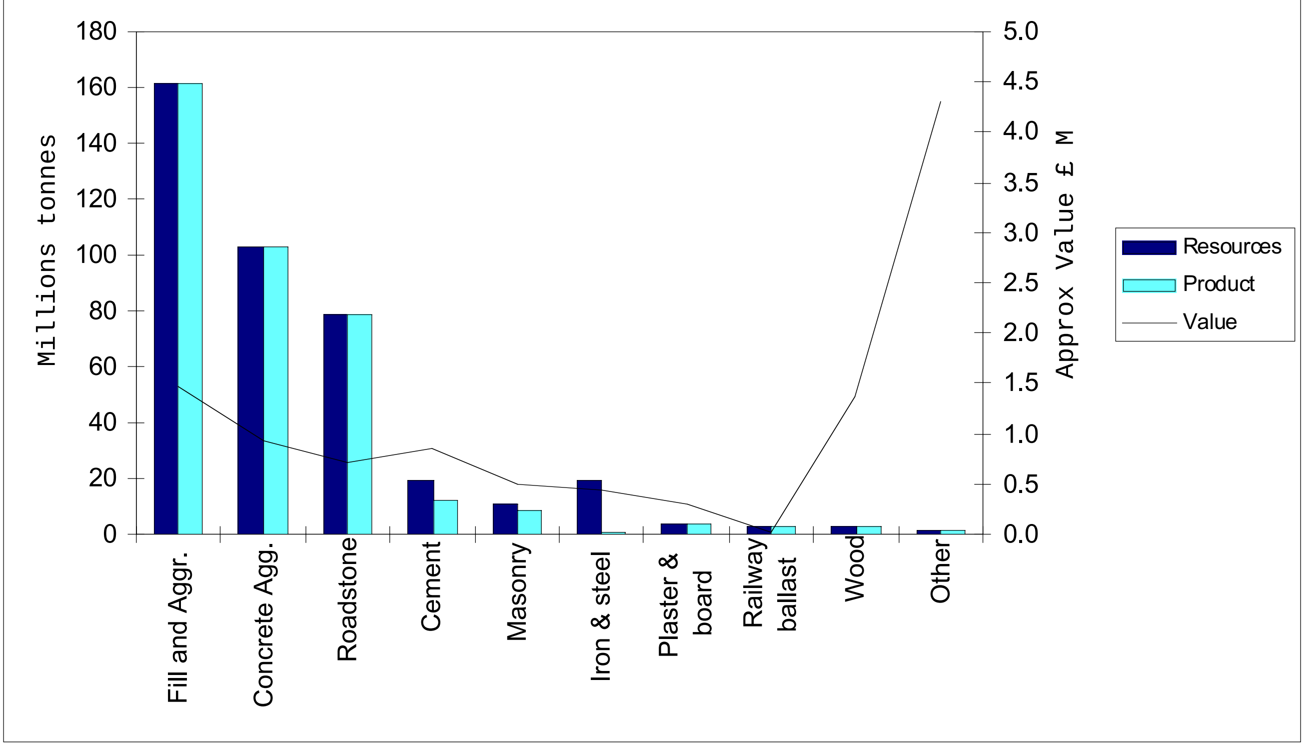
Source: BGS (1996) Pg 3-1 to 3-33, DETR (1998a) Tables 4.2 to 4.6, BRE (1998) Database

Figure 2 - Embodied CO_2 in UK Construction Materials

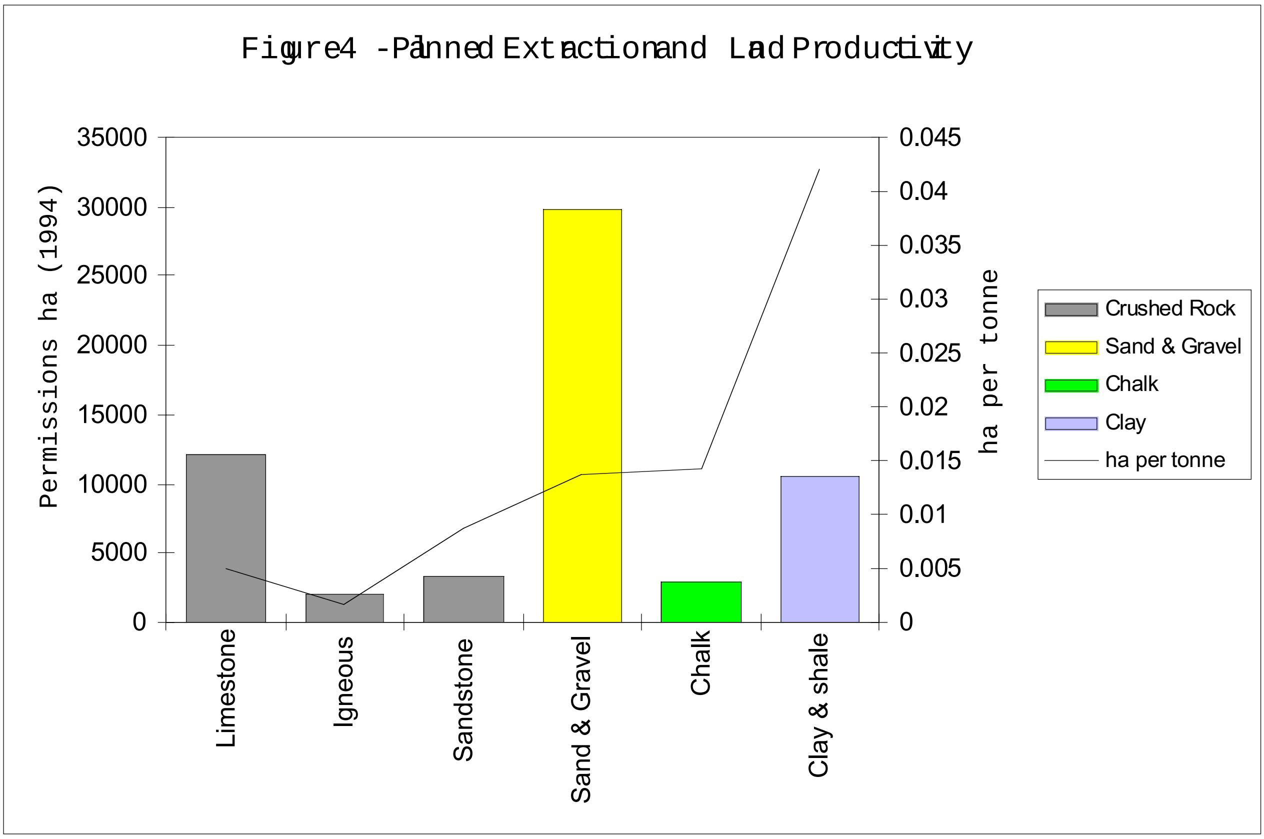


Source: dti - Figure 1

Figure 3 - Main Construction Resources, Products and their Value



Source: BGS (1996) Pg 3-1 to 3-33, DETR (1998a) Tables 4.2 to 4.6, ONS (1998a), SPONS (1997)



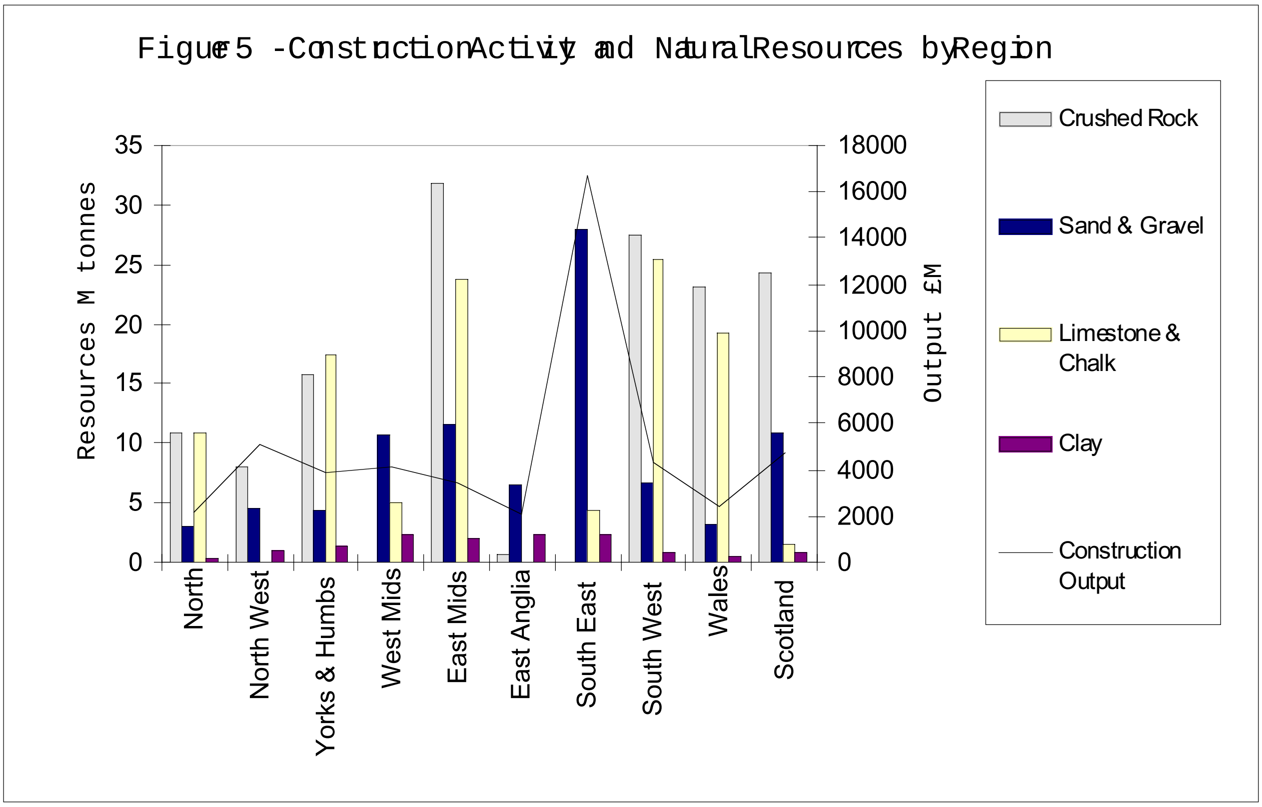
Source: BGS (1995) Pg 1-12 (1994 data), BGS (1996) Pg 1-8 (1994 data)
Assumption - That 20 years of reserves are "proven" and planned at any time

5.2.4 Minerals

The main resources consumed by the industry, the quantities of products generated and their value are shown in Figure 3. Four materials contain over 99% of the mass of construction products – aggregates, cement, brick and clay products and wood. Although very large quantities of mineral resources are consumed, most are very abundant. The key issues are of land use (see Figure 4), where they are extracted and their transport to the point of use (see Figure 5).

Figure 4 shows the planning permissions granted for the extraction of materials in 1994 together with the hectares of land needed to recover 1 tonne of each mineral. Figure 5 shows the regional availability of mineral resources for construction together with the level of construction output.

To meet demand for construction from the use of local materials, the resources and output in figure 5 would need more correlation. The resources available from the local geology are also indicated by the levels of production. The South East planning region appears to have particularly heavy pressure on its mineral resources that can only be met by extended travel distances for mineral resources.



Source: BGS (1996) Pg 3-7, Pg 3-22, Pg 3-24, Pg 3-30, DETR (1998a) Table 1.9

5.2.5 Wood

By far the majority of wood used in construction, over 90%, is imported from northern Europe and North America/Canada. Most comes from managed plantation within the temperate forest. There is some contention over whether this timber is being managed sustainably. Under 1% of wood used in construction comes from tropical forests and these are rarely managed sustainably. (BRE Timber Division, Dr. P Bonfield estimate from DETR (1995) and TTO (1998) unpublished).

Only a very small proportion of the wood used in UK construction comes from UK sources and estimates vary greatly in the range 1%-15%.

5.2.6 Pollution

The manufacture and transport of construction materials releases about 10% of UK CO_2 emissions (discussed above). It also releases about 0.7% of volatile organic carbon compounds (VOCs) (including methane), 2.5% of UK NO_x and nearly 8% of SO_2 emissions.

The VOC's and the NO_x react in the lower levels of the atmosphere in sunlight to produce ozone at ground level where it is toxic to humans, plants and animals. It has been suggested as a contributor to the increased incidence of asthma and respiratory diseases. Many VOC's are toxic in their own right and some are highly toxic. The manufacture and heavy diesel transport of construction materials releases toxic particulates and carbon monoxide.

NO_x and SO_2 are both acidic in combination with rainwater and contribute to acid deposition which is damaging to ecosystems in forests, rivers and lakes worldwide.

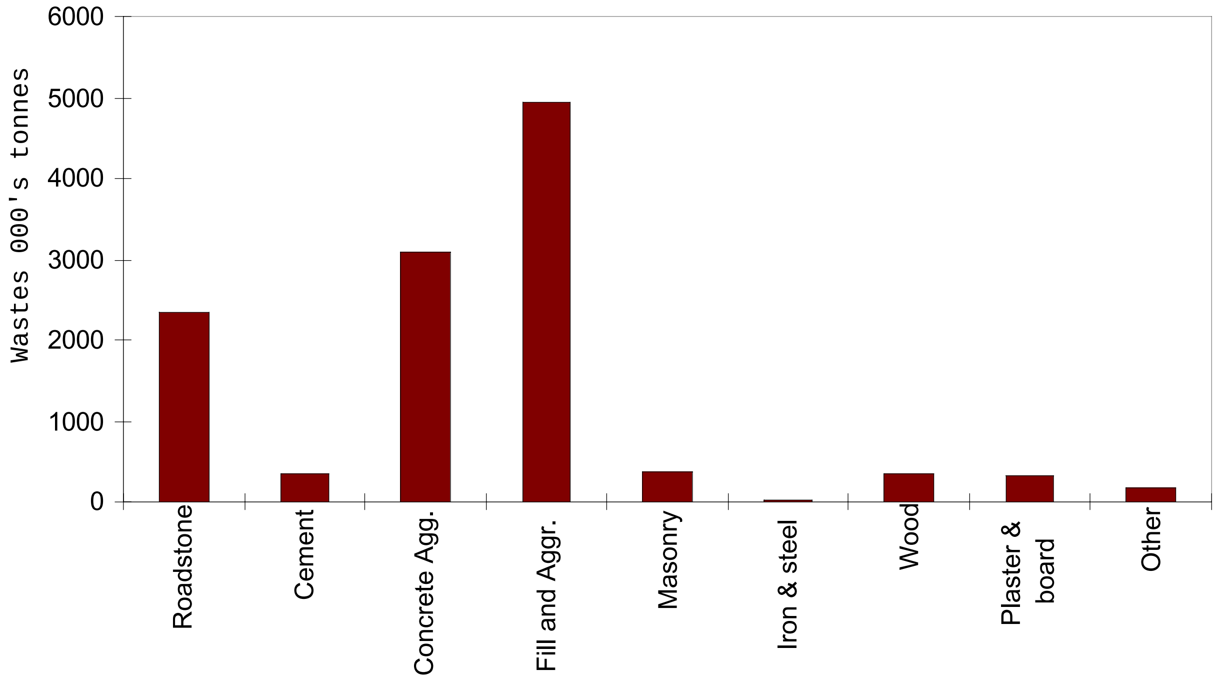
There remains uncertainty about the methane emissions associated with the flooding of valleys for hydroelectric schemes and for water storage. This represents a paradox for renewable electricity and sustaining water supplies (see 5.4.2).

The energy used to manufacture and transport construction materials is usually measured as the embodied energy of the materials used. BRE consultancy services and analysis of the sensitivity of a building's embodied energy to design and specification, suggest that about 50% savings in embodied energy can be achieved from appropriate design and specification. The savings in consequential pollution emissions are likely to be similar.

5.2.7 Wastes from Materials Production

Approximately 12m tonnes of wastes are estimated to be generated from the manufacture of construction materials. (CIRIA (1994) Vol2 Chapter 4 updated by N Howard (1998)). The materials comprising this waste are shown in Figure 6. These data are not considered very reliable and further work is needed to refine these estimates. The levels of waste generated from the manufacture and delivery of construction materials could be as significant as waste from demolition and from accidental wastage on site.

Figure 6 - Wastes from Materials Production



Source: BGS (1996) Pg 3-1 to 3-33, DETR (1998a) Tables 4.2 to 4.6
Assumptions - Approximate estimates of wastage from Skoyles (1973)

5.2.8 Wastes Used as Construction Material

Table 12 shows an inventory of the wastes available from other industries for use as construction material and the estimated levels of their use.

Table 12 - Other Industries Wastes Available for Use in Construction

Material	Production Million tonnes/year	Stockpile Million tonnes	Regions where available	Estimated levels of recovery as % of availability into all uses
Colliery spoil	45	3,600	Coal mining areas	0.1
China clay wastes	27	300 sand 300 other	Cornwall and Devon	0.2
Pulverised fuel ash	7	200	From coal fired power stations	50
Furnace bottom ash	2.5	-		90
Blastfurnace slag	5.8	17.5	N Yorks, Humbs., Wales	75
Steel slag	2	25	N Yorks, Humbs., Wales	13
Slate waste	4.5	500	N Wales, Lake District, SW England	0.5
Spent oil shale	0	150	Lothian	
Road planings	7	-	countrywide	100
Demolition	30	-	countrywide	80
Construction	10	-	countrywide	10
Excavated soil/clay	30	-	countrywide	30

Source - Approximate BRE estimates from various sources including –QPA (1999), DoE (1991), CIRIA (1996).

Estimates of the production of recycled aggregates range between 41 million tonnes (BRE 1999) and 44 million tonnes (QPA 1999).

The Quarry Products Association estimate that 15 million tonnes of recycled aggregate come from colliery, china clay, slate and ash waste; 24 million tonnes from construction and demolition waste; and 5 million tonnes from road planings. This represents a 17% replacement of primary aggregates.

MPG6 (Guidelines for aggregates provision in England, April 1994) establishes the government's target for replacing 20% of primary aggregate by reused or recycled waste material by 2006. To meet this target, 55 million tonnes of primary aggregate will need to be replaced. This constitutes more waste material than can be provided from construction and demolition waste. Therefore, emphasis needs to be placed on sourcing recycled feedstock from under utilised waste materials such as colliery spoil, PFA, incinerator ash, slate and china-clay wastes.

5.3 Construction Activity

5.3.1 Water Pollution Incidents

In 1997, Industry as a whole was responsible for 19% of the water pollution incidents in England and Wales. Of these, Construction was by far the biggest offender (16% of industrial incidents) with 588 incidents. Landfill/waste contributed 122 incidents and demolition a further 31. Some of the other industrial incidents can also be attributed to building sectors with reasonable confidence.

'Other' sources contribute 35% of the total (6,833 incidents) and many are buildings related. Of these, 41% could not be traced and 33% could be traced but not classified. Of the rest, domestic/residential account for 20% (1379), restaurant/hotel/PH account for 3% (186), Schools account for about 1% (88), hospitals 0.5% (38), crown exempt buildings 0.5% (34) and contaminated land 0.5% (34).

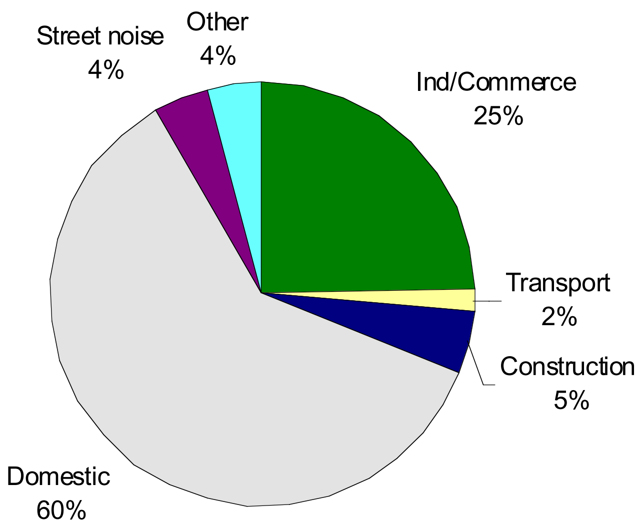
Agriculture accounts for about 10% of substantiated incidents, but relatively few involve buildings (estimated 3% of total agricultural incidents). Specific data for private factories, private offices, private warehouses and shops are not explicitly identified. However, a significant proportion of industrial incidents are almost certainly factory and warehouse related. About 1000 incidents (29%) are in these categories (EA series 1997).

5.3.2 Noise Pollution

Construction work on-site is responsible for 4.7% of noise complaints to Environmental Health Officers across Great Britain (Figure 7). As a proportion of commercial and industrial complaints only, the figure rises to 12%. This is slightly higher than the size of the construction industry as a proportion of GNP – 10%.

Overall, domestic premises gave rise to the largest number of noise complaints - 61%, with industrial/commercial premises next - 25 %. This implies a need for improved design to reduce noise arising from buildings and attenuate noise between buildings (DETR 1998b - Table 6.10).

Figure 7 - Noise Incidents Reported to EHO's



Source: DETR (1998b) - Table 6.10

5.3.3 Dust Pollution

Although the construction industry has a reputation for causing dust nuisance at sites, no comprehensive data could be found to substantiate this and establish its extent. Available air quality data (DETR 1998b), describes particulate emissions from industrial processes and transport. This aspect may require further basic measurement and research.

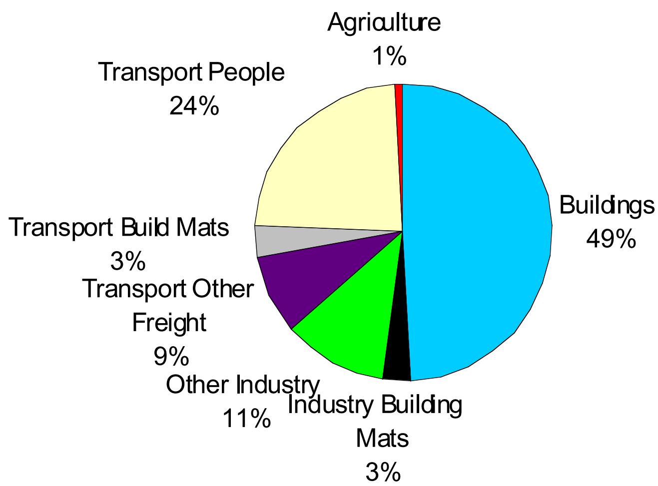
5.4 Buildings Operation

5.4.1 Energy

Energy use in building accounts for 49% of the UK's delivered energy consumption (Figure 8). In terms of primary energy, which better reflects the depletion of fossil fuel reserves, the figure is 50%. Only a small percentage of this energy use is derived from renewable sources. It is generally considered (IPPC) that increased proportions of renewable energy can contribute to sustainability both in resource and anthropogenic climate change terms.

In terms of gaseous pollution, energy used to service buildings accounts for 45% of the UK's annual CO_2 emissions, around a quarter of UK SO_2 and NO_x emissions (largely via the use of electricity) and some 10% of national methane emissions. As NO_x and SO_2 are both acidic, they contribute to acid deposition which is damaging to forests rivers and lakes worldwide.

Figure 8 - UK National Energy Consumption 1996 and Buildings



Source: dti (1997), BGS (1996), BRE (1998) Database

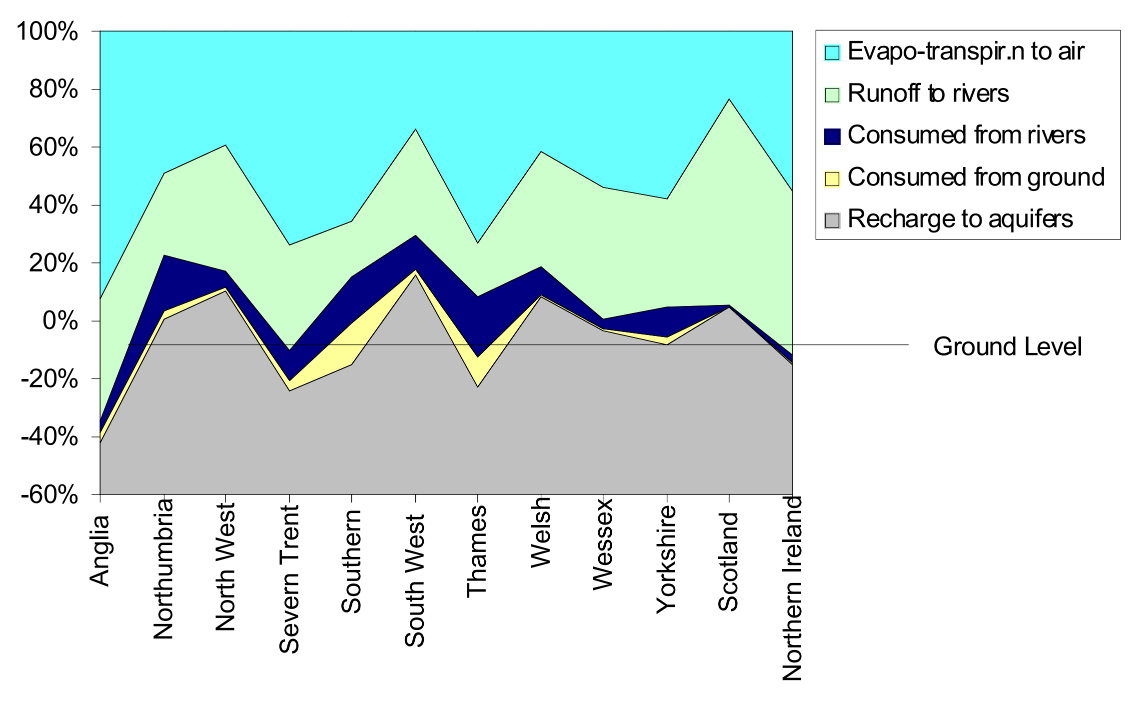
National standards for the conservation of fuel and power in domestic buildings were introduced via the Building Regulations for the first time in 1965, and have subsequently been tightened in 1976, 1982 and 1990. For non-domestic buildings, such standards were introduced for the first time in 1985. As the vast majority of the building stock dates from before this time (65% for housing and 80% for non-domestic buildings) there is considerable scope for reducing energy consumption in the existing building stock.

5.4.2 Water

For water supplies to be sustainable, extraction from the aquifer must not exceed the rate of replenishment from rainfall. This implies the need to control consumption and design for rainfall to returned to the ground through soak-away strategies rather than run-off to sewers and hence into rivers.

Figure 9 shows the estimated destinations, from the available data, of the total rainwater falling (100%) within different water supply areas (WSA 1997). The regions where the consumption of water is greatest compared to the available rainfall are probably the Thames Valley, Southern, and Severn and Trent.

Figure 9 - Where the Rain Goes



Source: Waterfacts (1997) - Table 3.1, Chandler & Gregory (1976) - Fig 7.2, DETR (1998b) - Table 3.2

Although across the country, we should be able to meet our water needs sustainably, water appears to be being abstracted unsustainably in many regions, with aquifers being progressively depleted. The most vulnerable regions appear to be Anglia (even with no abstraction), Severn & Trent, Thames Valley and Southern. Regions with surplus water for recharge are the South West, North West, Wales and Scotland. Northumbria and Wessex appear to be just about in balance.

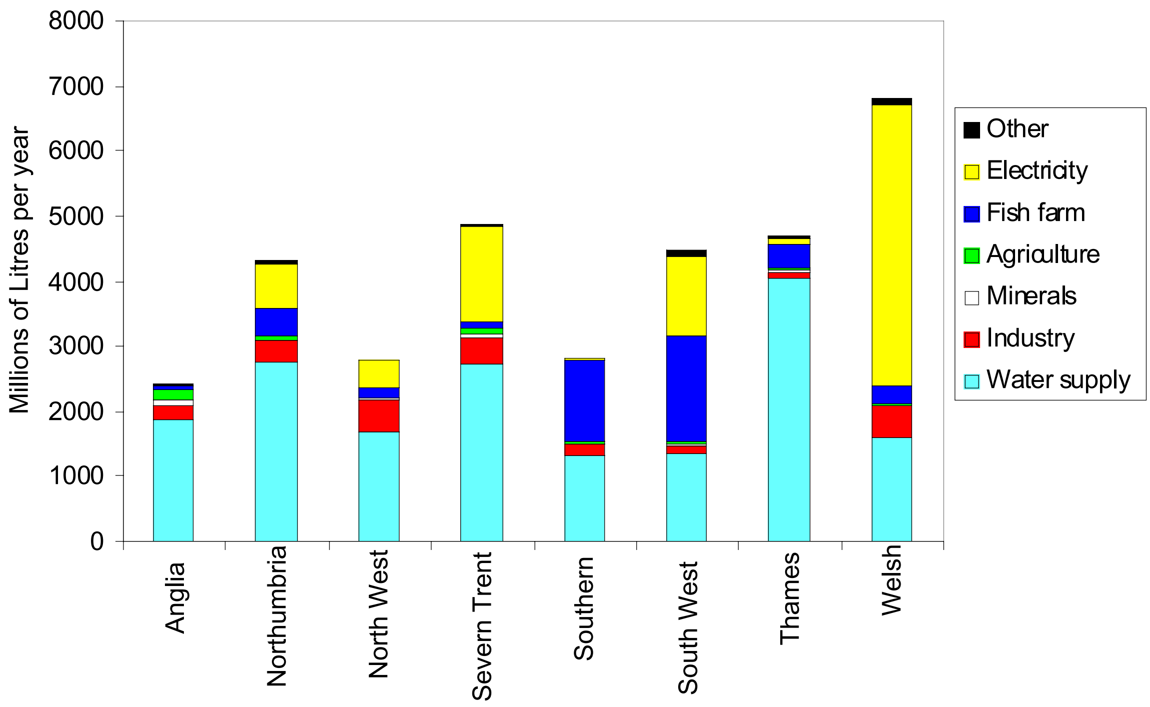
The development of new housing and industrial base changes will impact on water use. Construction is taking place in water scarce regions such as the South East and South West. Planning may well have to take into account the ability of an area to resource new developments with water (as well as provide adequate sewerage).

Sustainability of the water resources will be greatly affected by climate change. Climate change modelling predicts 'wetter winters and drier summers'. Although annual precipitation for the UK is predicted to increase, much of the increase will occur in bursts of high intensity rainfall which will tend to run off via rivers rather than go into storage or permeate into aquifers. Hence, climate change is likely to bring both greater flooding and more frequent drought.

Figure 10 shows how we use water in the regions for which data was available. This reveals surprisingly, that electricity production and fish farms are major water abstractors in addition to domestic water supplies. However, in both of these uses, water may be abstracted and returned to a river in a short period, with little net resource impact (but it may nonetheless be polluted or chemically, biologically or thermally).

Consequently, efforts to promote water efficiency would be more productively targeted at domestic use as the first priority.

Figure 10 - Where and Why we Use Water



Source: DETR (1998b) - Table 3.2.3

5.4.3 Transport

Figure 8 above shows that transport energy is a significant proportion of the UK total energy consumption, especially personal transport (24%). This is a function of how the built environment is planned and co-located. Planning could minimise the need to travel long distances.

At least 3% of UK energy consumption is attributable to the winning and transport of construction materials as discussed earlier (Figure 8). Transport is a major cause of pollution in the UK, accounting for 26% of CO_2 emissions, 57% of all NO_x emissions, 77% of CO emissions, 40% of all VOC emissions, 73% of atmospheric lead emissions, 51% of black smoke and 28% of particulate (PM_{10}) emissions.

Although the number of road traffic accidents has only declined marginally over the last 20 years, the number of fatalities has fallen by 40%. In 1994, the UK had the lowest death rate per passenger km from road traffic accidents apart from Sweden. The number of accidents in 1996 was 235,939 of which 17% were serious and 1.4% were fatal, accounting for just over 1% of all deaths in the UK.

Transport is also noisy and causes vibration and subsidence damage to roads and other structures. In towns and cities, noise and pollution from cars is cited most often as the reason for needing air-conditioned buildings and this in turn results in buildings that consume typically twice as much energy (especially electricity) and cause three times as much CO_2 and other pollution.

Staff commuting to inner city offices that have no car parks and are well served with public transport use half as much energy as staff commuting by car. The key factor has proved to be the availability of car parking. Where provided, singly occupied cars are almost universally the preferred method of transport.

5.5 Transport Infrastructure

5.5.1 Roads

According to TRRL, “vehicles with high axle loadings (mostly heavy goods vehicles, but also some public service vehicles) are responsible for virtually all pavement wear”. Ironically, this will include vehicles that move construction materials (14% of freight transport movements). Figure 11 shows that heavy freight transport of most commodities is dominated by road transport.

Movement of heavy freight by sea is very energy efficient and should be optimised, but this cannot deliver materials to their final destinations. Rail freight can also be energy efficient compared to road haulage and much faster than by sea, but is again hampered by not being able to deliver to final destinations. The movement of construction materials by rail accounts for 5.7% of total construction movements (t.km) (DETR (1997). Further investigation of the prospects for modal shifts in the transport of construction materials and minerals and other commodities is recommended. This would be more energy efficient and less polluting and prolong the lives of existing roads.

Figure 12 shows that although on average, the road network is in fairly good condition, (50% has a residual life of over 19 years), 13.3% is in need of immediate attention. Levels of investment in new roads have declined rapidly in recent years, but are still double the levels of investment in rail.

Figure 11 - Freight Transport by Mode

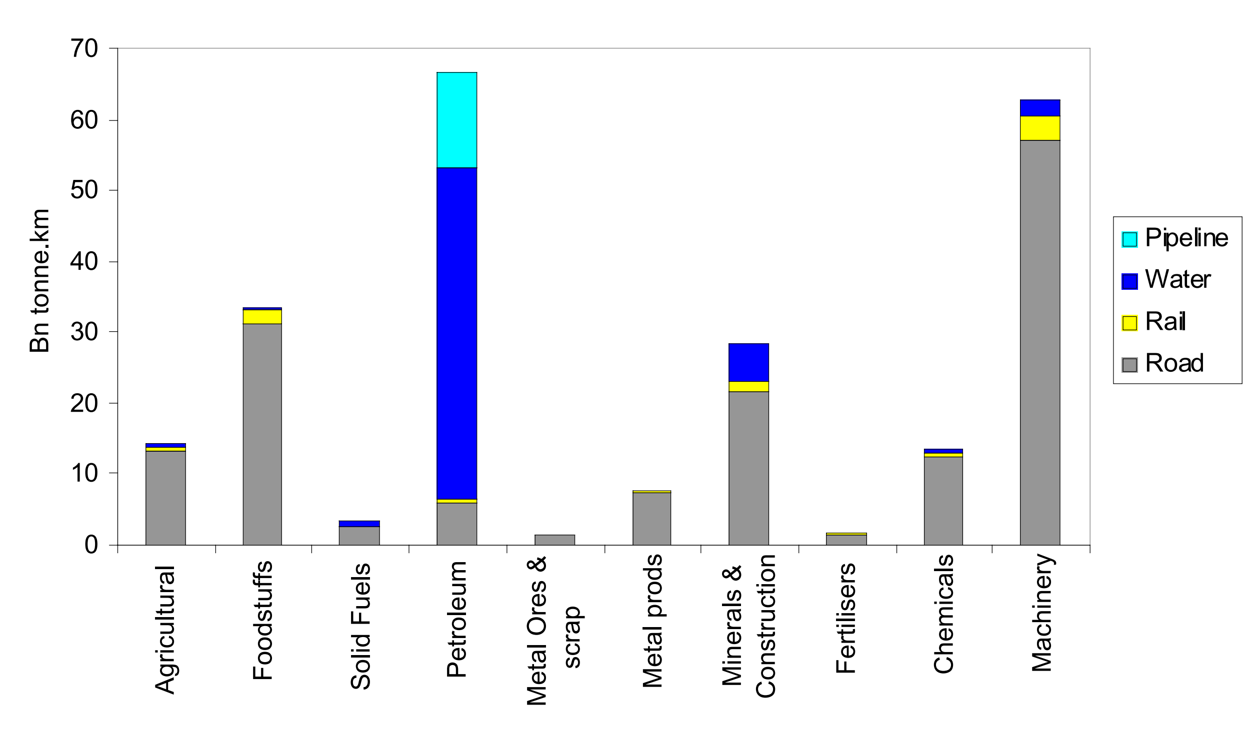
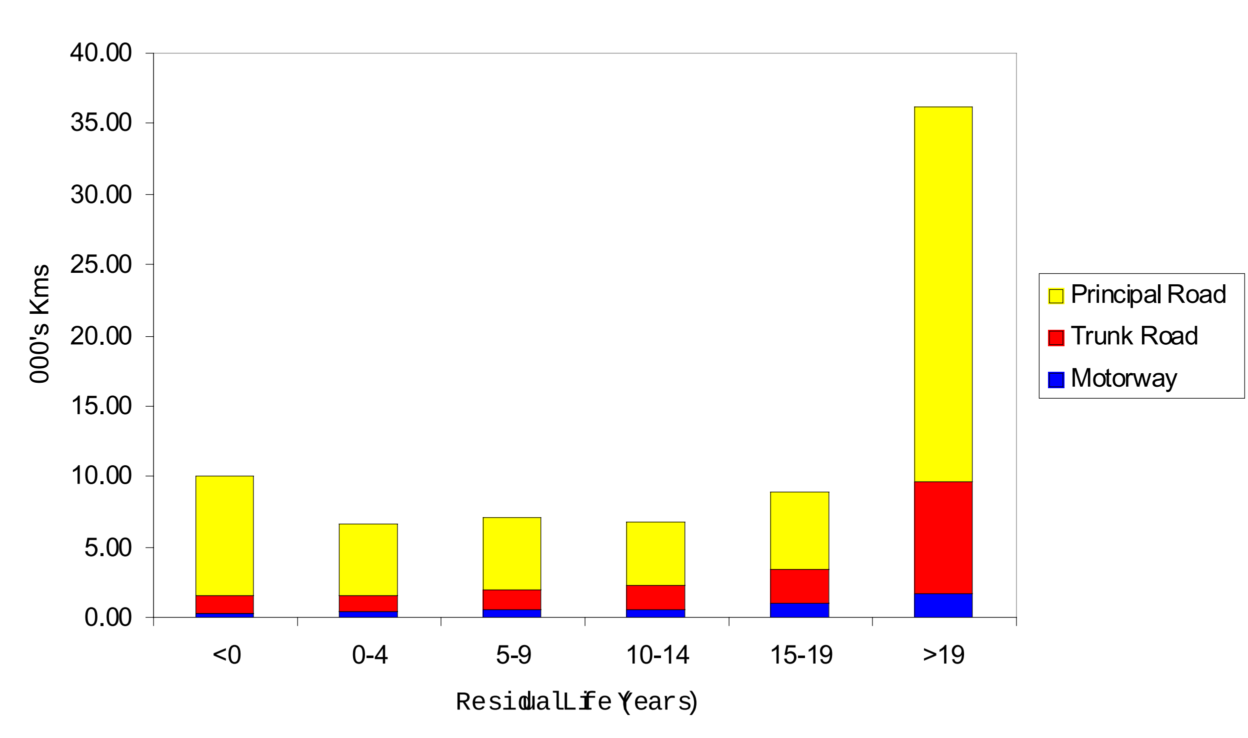


Figure 12 - Residual Life of Roads



Source: DETR (1997) - Table 1.1.3
Source: DETR (1998d) - Table B Note: England & Wales only

5.6 Recycling and Disposal

Approximately 40% of all construction and related wastes are believed to arise from the repair, maintenance and new build of domestic buildings, the remainder coming from other construction sectors.

5.6.1 Construction Waste

Table 13 shows the approximate quantities of waste predicted to arise from the construction process. The majority of this waste goes to landfill because of the way construction sites are operated. Much of this waste is avoidable and reduces the already small profits of construction companies. Some estimates indicate that this waste is a large proportion of those profits – typically 25%. If 10-20% reductions in waste could be achieved, 6 million tonnes of material might be diverted from landfill saving approximately £60m in premium rate disposal costs. The cost of construction waste includes the cost of materials, disposal, transport and labour to clear it up.

Construction waste comprises inert and active wastes which if mixed, will incur the higher landfill tax rate. Separated wastes can incur lower landfill tax rates, are much more suitable for recycling and reuse and can become an asset rather than a liability.

Table 13 - **Estimated Annual Construction Waste**

Construction Material	Quantity
concrete, bricks, blocks, aggregate	3.5 million tonnes
metals	2.8 million tonnes
excess mortar/concrete	1.2 million tonnes
timber & products	0.8 million tonnes
plastic packaging & plastic products	0.9 million tonnes
plasterboard & plaster	0.3 million tonnes
paper and cardboard	0.2 million tonnes
vegetation	0.1 million tonnes
other	0.2 million tonnes

Source – Various sources combined including: BRE (1999a), DoE (1991), Humphries (1991), CIOB (1995), BRE (1976), EC (1993), EC (1992), CIRIA (1996), BRE (1999b)

5.6.2 Excavation Waste

30 million tonnes per year of excavated soil/clay waste are estimated to arise from construction site preparation. This could be minimised by appropriate architectural, structural and landscape design. At present, this is not a serious consideration even for environmentally sensitive design teams. Landscaping often provides important opportunities to utilise this type of waste.

5.6.3 Demolition Waste

Demolition waste is taken to include waste from the demolition of structures and parts of structures and include recycled/reclaimed materials where appropriate. The breakdown of the estimated 30m tonnes of demolition waste arising each year is shown in *Table 14.*

Table 14 - Demolition Waste, Estimated Annually

Material	Quantity
concrete	12 million tonnes
masonry	7.2 million tonnes
paper, cardboard, plastic and other	5.1 million tonnes
asphalt	4.5 million tonnes
wood based	1.0 million tonnes
other	0.2 million tonnes

Source – Various sources combined including: BRE (1999a), DoE (1991), Humphries (1991), CIOB (1995), BRE (1976), EC (1993), EC (1992), CIRIA (1996), BRE (1999b)

5.6.4 Waste from Roads

Although most of the waste from road construction and maintenance is likely to be excavation waste, it is not possible to separate this from the other categories of excavation waste.

Approximately 7 million tonnes of asphalt road planing waste arises per year. Although most of this is reused as fill materials, only about 10% is recycled to benefit from the bituminous content (6%). This represents a bitumen recycling rate of 0.5-1%. Recycling is best done with recoating and reuse on site to avoid transporting materials. Highways agency limit the reuse of road planings to 30%. (pers comm TRRL).

5.6.5 The Impact of Landfill

In 1996, landfill was estimated to contribute 1.7M tonnes of methane or 46% of the UK national total (DETR 1998b – Table 1.3). Landfill is the largest source of anthropogenic methane emissions identified in the UK Environment Statistics and hence a very significant contributor to climate change impacts.

Recent estimates of the maximum future methane emissions arising from waste landfilled every year stand at 3.3 million tonnes (*Table 15*). Although there is a relatively small biodegradable fraction in construction and demolition waste, the sheer volume of it compared to other wastes implies that it can be a very significant contributor to methane production from landfill over time.

Table 15 - Estimated long term methane emission/tonne of construction and demolition waste.

	Best estimate	Lower band estimate	Upper band estimate
% of all CH_4 produced by landfill (c)	*16*	*0.7*	*28*

Most construction waste is inert and non-toxic and leachate is not generally thought to be a significant problem. The exceptions are treated timbers, plastics and certain metals. Research into the toxicity of chemicals is most advanced for pesticides, cosmetics, drugs and food additives. Accordingly, there is not sufficient toxicity data for reliable risk analysis of construction materials. This is the subject of international research sponsored by the EC, OECD, WHO, UNEP, IARC and UN-FAO.

Greater reuse/recycling/incineration with energy recovery of biodegradable C&D waste would help to reduce these impacts. Nearly all of the putrescible waste from construction activity is wood, which is potentially reusable or recyclable. Equally, it can be used as fuel for heating or hot water production, ideally with the co-generation of electricity. Even incineration without heat recovery would be beneficial to reducing net greenhouse gas emissions because, whereas incineration releases CO_2 landfill can predominantly release methane which is 21 times more potent as a greenhouse gas (over 100 years). Finally, with appropriate engineering, large proportions of the gas generated in landfill can be recovered and put to productive use.

The full impact of landfilling C&D waste will only be quantifiable when information on the quantity and nature of the biodegradable component of construction and demolition waste going to landfill is available and the transport, noise, dust and other impacts have been evaluated.

5.6.6 The Recycling Industry

Approximately 24 million tonnes of inert C&D waste is recycled per annum. The average transport distance to the recycling site and back to the customer is 25km each way.

Further information on recycled aggregate is presented in 5.2.8. Recent work being carried out by the Environment Agency & minerals Planning department of the DETR will give a more accurate picture of the amount and type of inert waste recycling occurring throughout the UK.

Timber recycling is increasing with new markets being sought in horticulture and energy recovery. The chipboard manufacturers are all now replacing virgin feedstock with up to 25% recycled wood fibre. The main constraints to this market are the location and quality of the material arising.

Other materials such as plastics, cardboard and paper are not reaching the recycling sector from construction and demolition works. This would require greater segregation and the creation of collection systems that are currently not available.

Metals recycling involves traditional recycling routes such as scrap yards. Metal from construction and refurbishment is far less likely to be recycled than that arising from demolition.

5.6.7 The Reclamation Industry

Approximately 3 million tonnes of C&D waste is reclaimed as per *Table 16*. 30% of this material is reclaimed within 30km of its source, 60% within 150km and 10% beyond 150km distance (including import and export).

Greater reuse of materials in mainstream construction would further increase the amount of materials being reclaimed. Reclamation involves less processing, greater employment and is often a more efficient use of resources than recycling.

Table 16 - Size of reclamation industry and market

Sector	Sales £million	Employment	Tonnes 000's
Architectural antiques			
Stone	17	2100	71
Timber	4	1100	7
Iron & steel	4	800	7
Clay	1	800	2
Ornamental antiques			
Stone	16	1170	22
Timber	36	1740	22
Iron	9	1000	9
Clay	1	100	1
Reclaimed materials			
Timber beams	42	3600	137
Timber flooring	29	2960	105
Clay bricks	31	4300	457
Clay roof tiles	63	3600	316
Clay and stone paving	19	1300	694
Stone walling	29	2450	1118
Salvaged materials			
Iron and steel	11	2800	77
Timber	36	7800	383
Antique bathrooms			
Sinks, baths, taps, WCs	41	1900	1
TOTAL	**389**	**39520**	3430

Source – BRE (1999a)

5.6.8 Waste Disposal Impacts

The total landtake for waste disposal and recycling facilities is estimated at 800 hectares. This is dominated by landfill operations. The main implications of landfill concern noise, dust and landscape damage over the life of the landfill. At the end of their lives, landfill sites are renovated. Hence, the key issue for the sustainability of landfill sites concerns the impact on neighbours during the operating life of the facilities.

Dust emission factors from waste disposal and recycling facilities are similar to those for primary aggregate extraction, (~ 0.1 kg/tonne), but landfill sites are typically closer to populated areas. At recycling sites, noise impacts mainly from crushing and screening plant (110 to 120 dB) as well as vehicle movement (95 to 105 dB) are significant.

A balance has to be struck between locally sourced materials and effects of waste handling on the local population. Recycling sites need to invest in quieter plant, noise barriers and dust suppression systems to reduce effects locally.

5.7 Social Perspectives

The construction industry moulds the environment in which we live by creating the cities, towns, villages and buildings that constitute our communities. It also creates the infrastructure and communications networks that define the scope of our communities. Essential social requirements are the provision of decent and affordable housing for all, security of the built environment and mobility for all. The construction industry also contributes to our economy and provides employment. Equally, it has a large impact on the environment, especially locally, and also has significant social, community and spiritual implications (e.g. landscape damage and restoration).

In addition, construction activity itself constitutes a community which employs people, provides working conditions and educates its workforce. Many of these aspects are difficult to measure objectively and for this reason, it has proved difficult to assess the social implications of construction.

5.7.1 Decent and Affordable Housing

In 1996, 116,870 households (0.59% of the total), were accepted by local authorities as requiring re-housing. In addition to the thousands of people sleeping on the streets, about 42,500 households were in temporary accommodation. Of the total homeless households, 54% have dependent children, 11% have a pregnant member, 32% are vulnerable elderly, young, mentally ill or physically handicapped or victims of domestic violence or other emergencies and are classified as priority A for housing (Wilcox 1998).

Figure 13 shows the distribution of homeless families compared to the regional distribution of households. According to the English House Condition Survey (1996), about 1% of all homes are vacant at any point in time. The vacant homes could house the homeless 7 times over. Measures to streamline the process of moving home might be able to reduce the number of vacant homes at any time sufficiently to house many and perhaps all of the homeless (DETR 1998c).

Also, the English House Condition Survey identifies approximately 2 million families as living in 1.5million homes (7.6% of the stock) which were judged unfit for human habitation in 1991. This is similar to the situation in 1989. Although about a third of unfit homes had been renovated or demolished between these years, a further 500,000 homes had fallen unfit.

The main reasons for unfitness in 1991 and 1996 are shown in figure 14.

Figure 13 - Homeless Families and Homes by Region

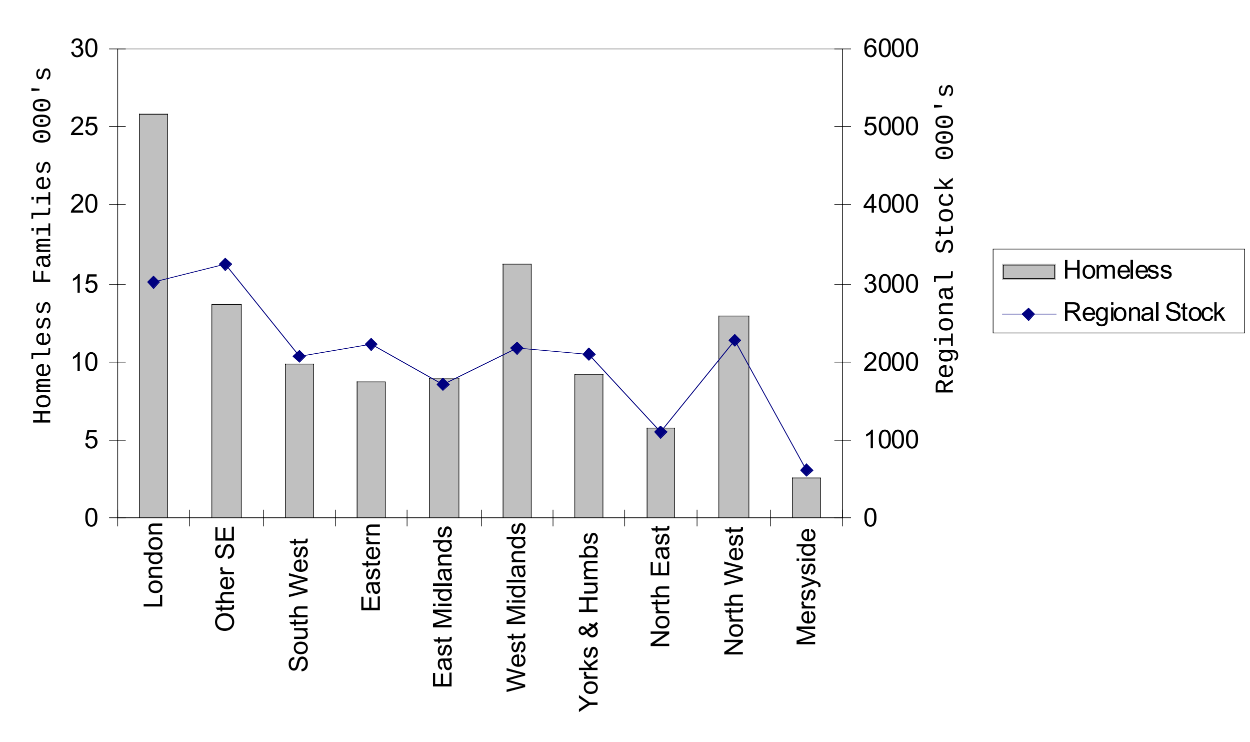
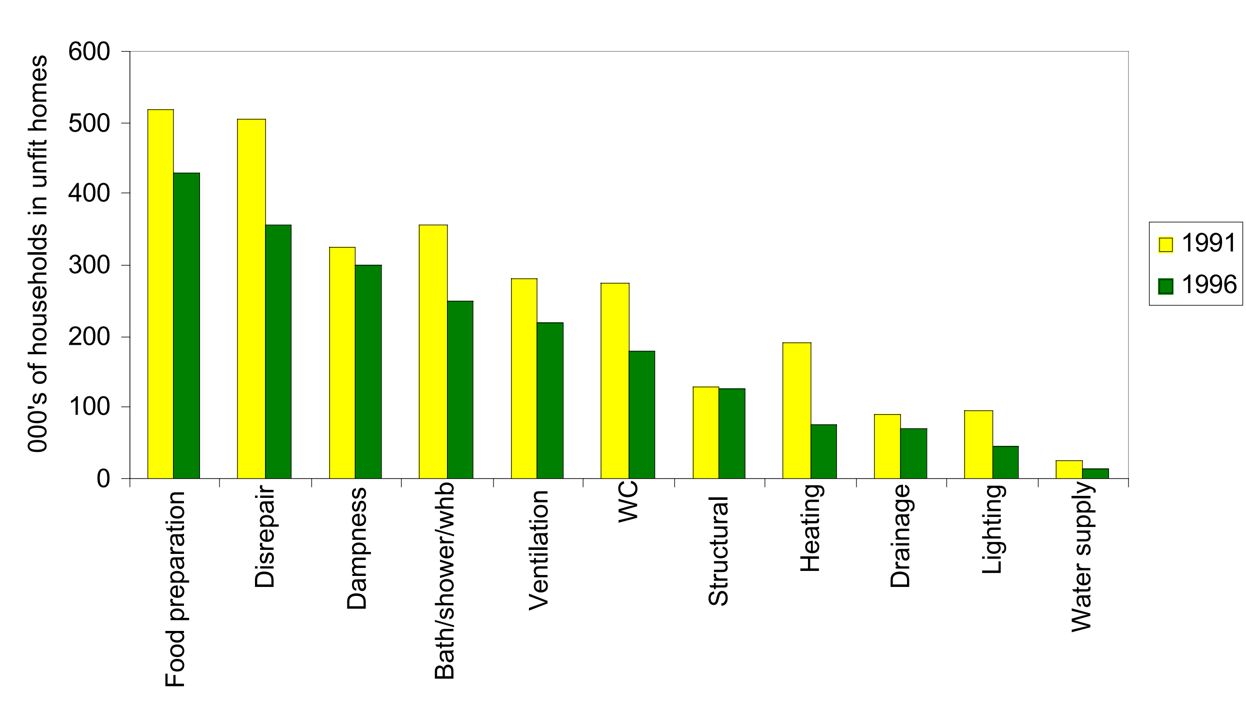


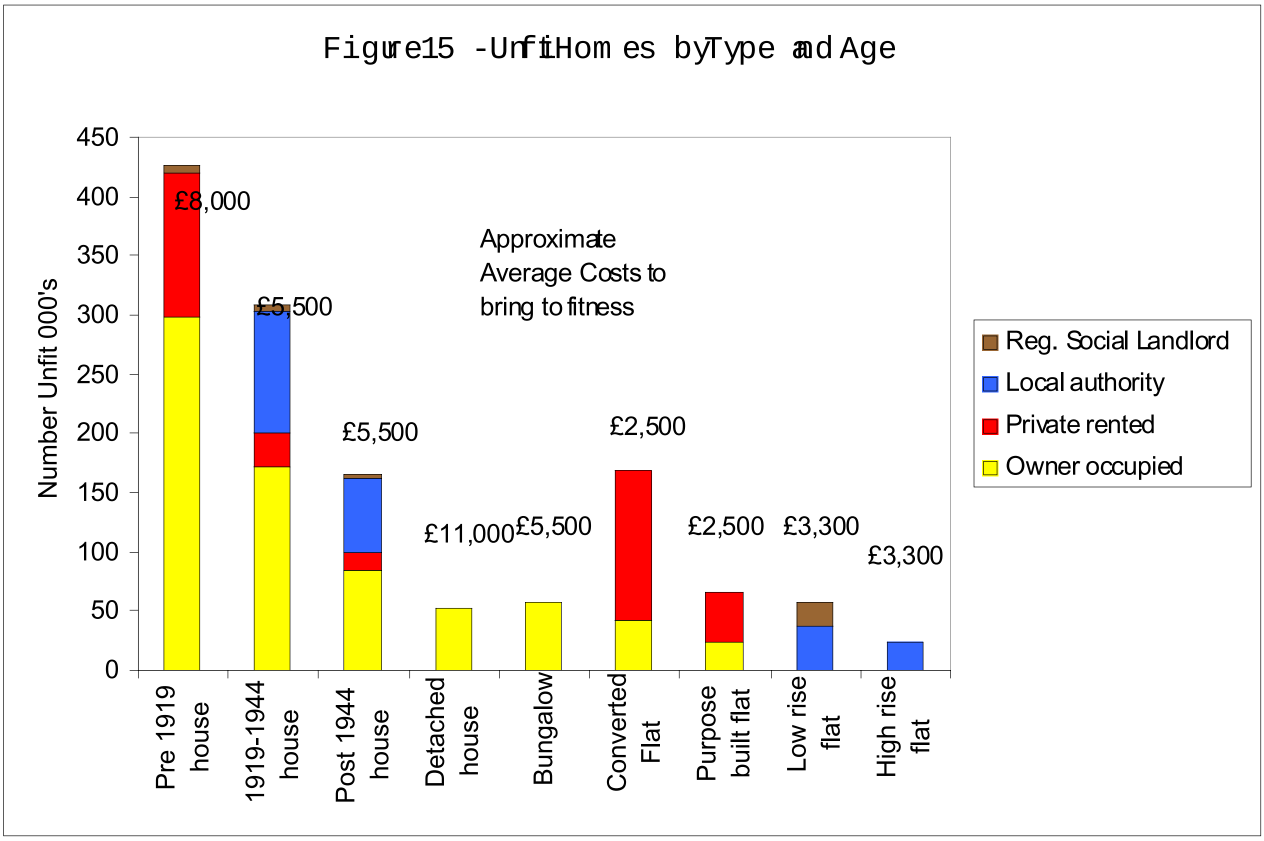
Figure 14 - Reasons for Unfit Housing



Source: Wilcox S (1998) - Table 90, DETR (1998a) - Table 9.1
Source: DETR (1998c) - Table 6.2

Figure 15 shows that the majority of unfit homes were built before 1944 – both owner occupied, privately rented and local authority rented. Privately rented flats, especially conversions are also prominent. The costs of bringing these homes to a fit standard are also shown. These costs are at the level of small contract works. The total costs to make all housing fit are estimated at £8 bn – 16% of construction industry turnover.

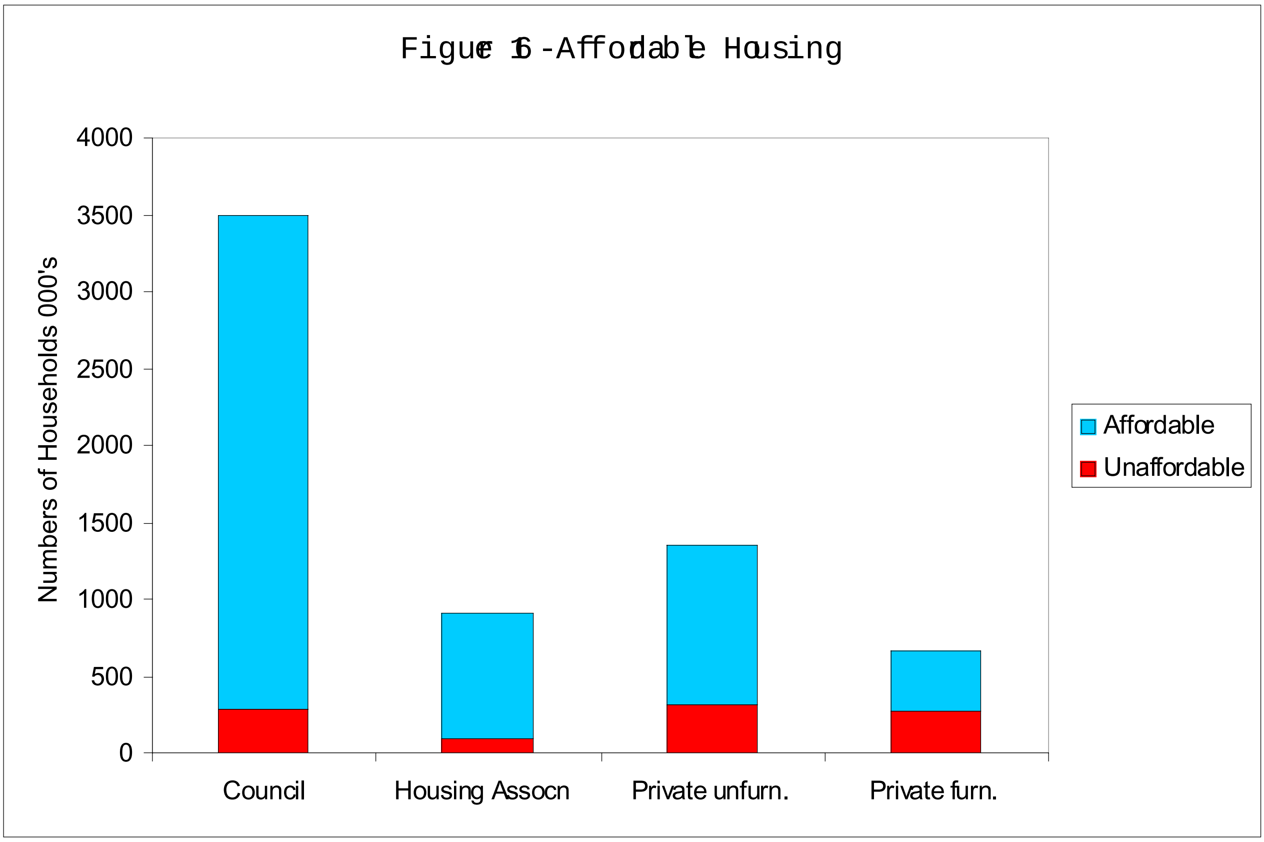
The English House Condition Survey reveals that poor housing is predominantly occupied by lone parents, young adult households and lone persons. The significant number of lone persons over 60 in poor housing in 1991 has been reduced over recent years. The unemployed, full-time students, the economically inactive and part-time employed predominate as do young households (age 16-24), black, Pakistani and Bangladeshi households.



Source: DETR (1998c) - Table 6.2

If we take affordable housing to mean housing that costs less than 25% of a household's net income, then about a million households – 5% of all households - are not living in affordable housing. This is most prominent in the private rented sector – Figure 16. (DoE 1997 – Table 12.3)

In addition, for housing to be affordable, the householders must be able to afford to heat their homes in winter. Data from the family expenditure survey for 1996/7 show that about 10% of households spend more than 10% of their weekly expenditure on fuel. Moreover, according to the Energy Supplement of the English House Condition Survey, almost 30% of households should be spending more than 10% on fuel to achieve reasonable conditions. This group are also least able to invest in measures that enable them to save on their heating bills.



Source: DoE (1997) - Table 12.3. Note for 1994/5

5.7.2 Security

In local consultations, fear of crime and security are seen as the biggest issues for local citizens. 10.2% fear that they will be burgled within the coming year. In practice, the likelihood of them being burgled is 2.4% on average and 4.8% in city centres. The chances of being a victim of crime are significantly greater in city centres (ONS 1997a – Table 9.8).

Figure 17 shows the regional variation in different types of crime. Figure 18 examines convictions and cautions for burglaries and thefts committed by over 18 year olds and compares this with unemployment rates in different regions. There appears to be some correlation, but it is imperfect. If criminal damage data could also be taken into account, a better correlation would probably be obtained, but the data available were not in a suitable form to enable this.

Figure 19 examines convictions and cautions for burglaries and thefts committed by 10-17 year olds and compares this with estimates of the numbers of 16 year olds not attending full time education. There appears to be a good correlation, except for the North Eastern region where particularly high rates of burglary and robbery are perpetrated by this age group. Hence, finding ways to foster full employment and developing appealing educational courses for less academic youngsters could contribute to reduced crime and an improved sense of security.

Figure 17 - Regional Variation in Crime

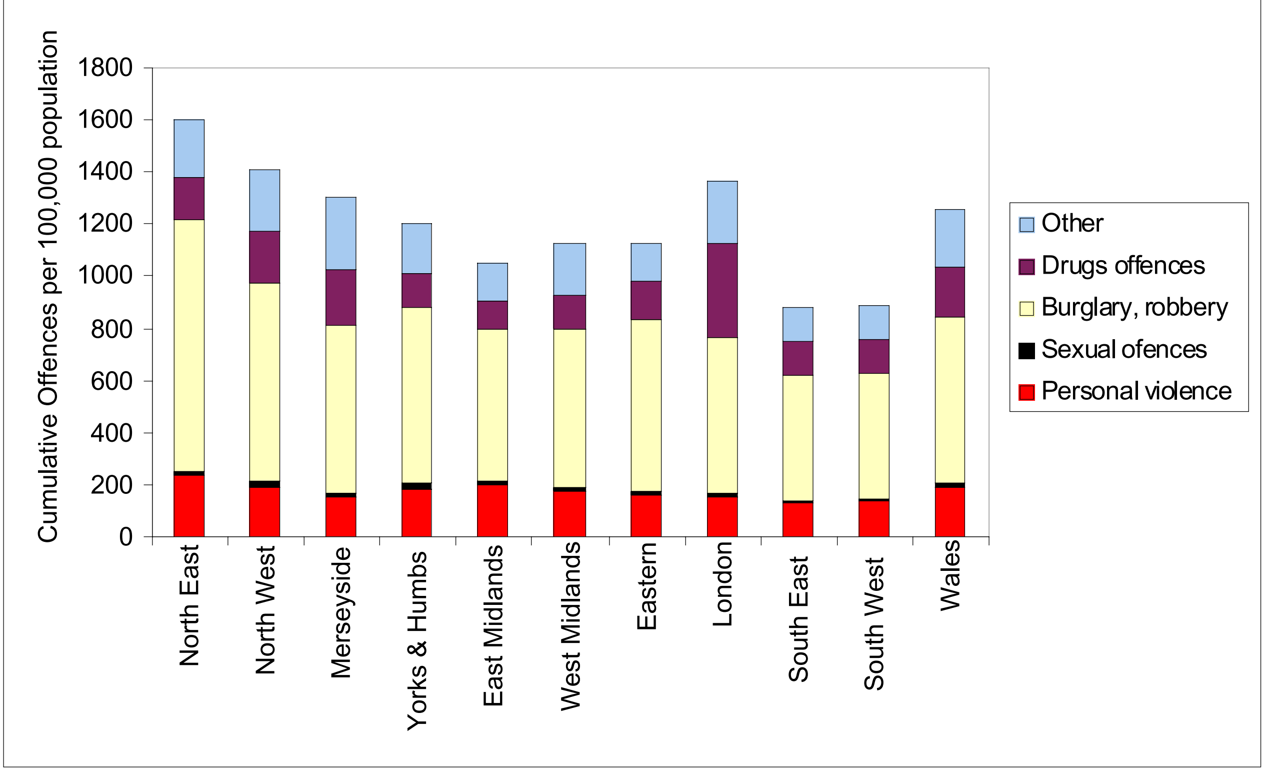
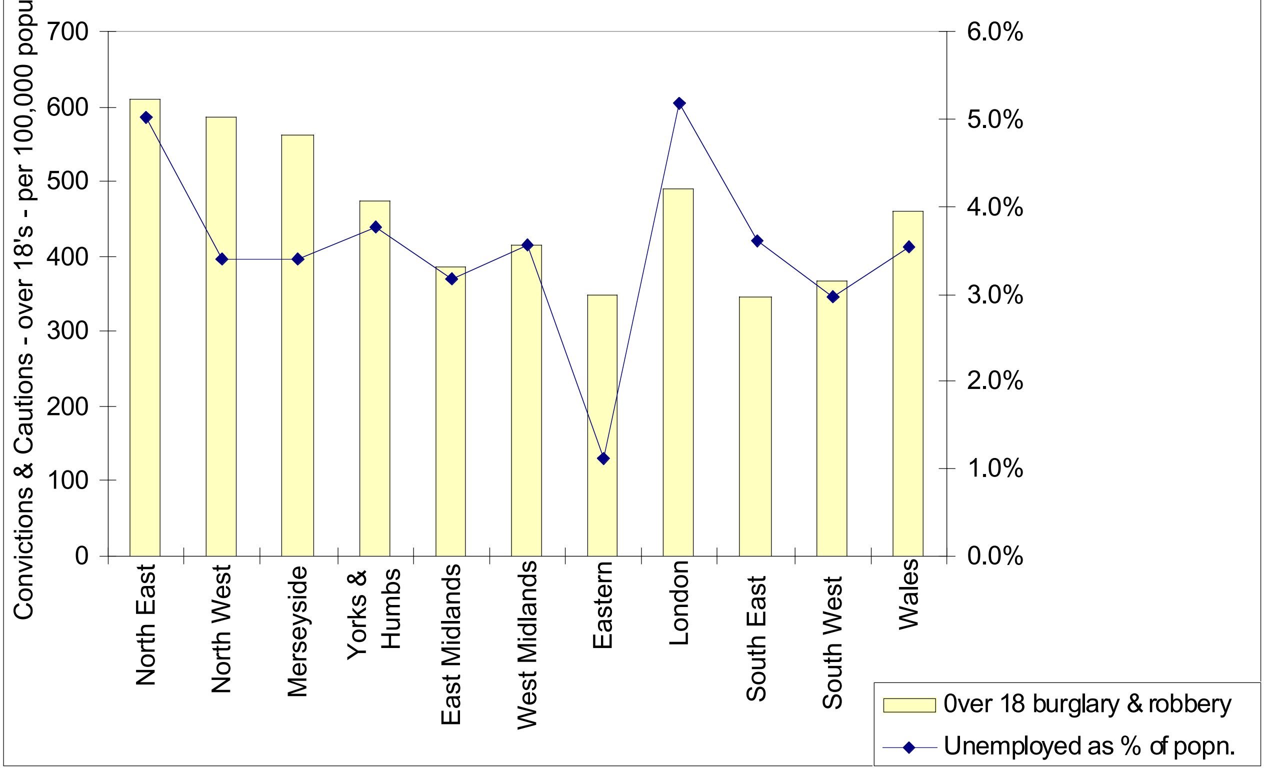
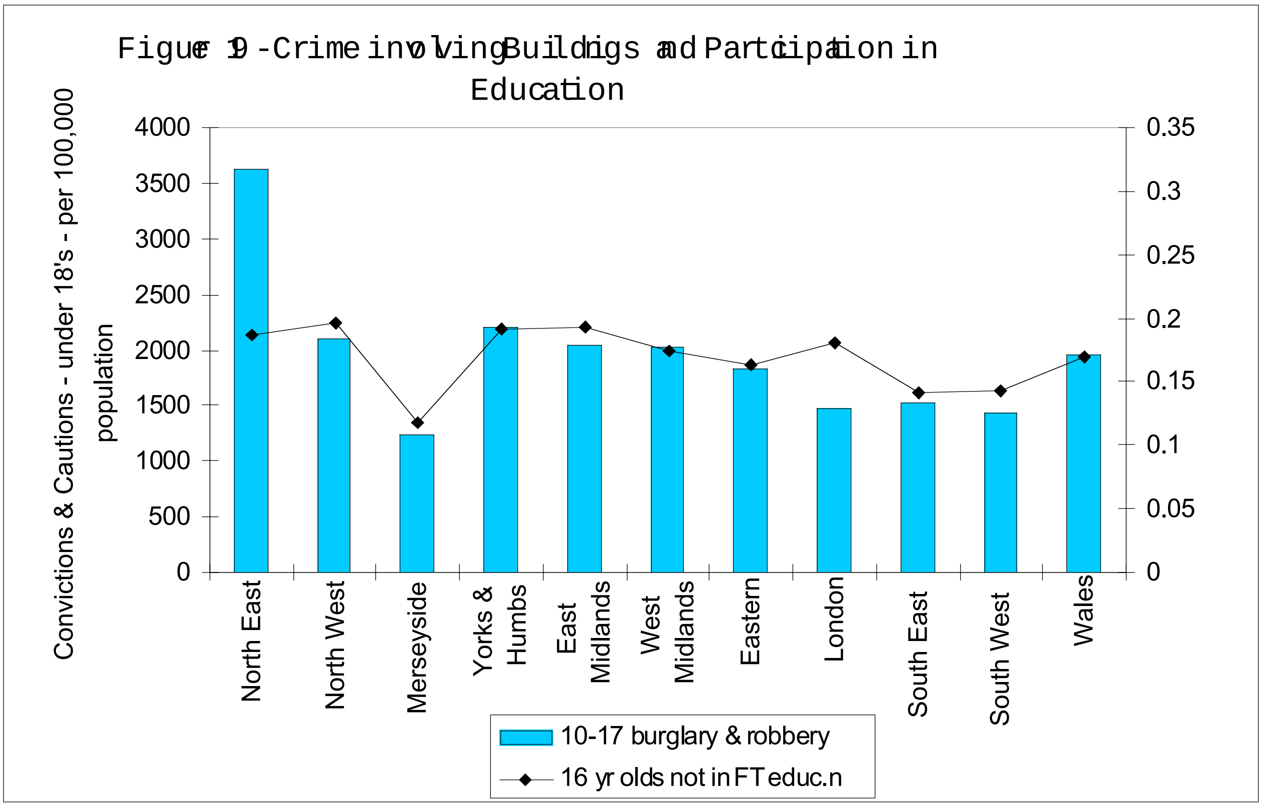


Figure 18 - Crime involving Buildings and Unemployment



Source: ONS (1997b) - Table 9.7
Source: ONS (1997b) - Tables 9.7& 5.21



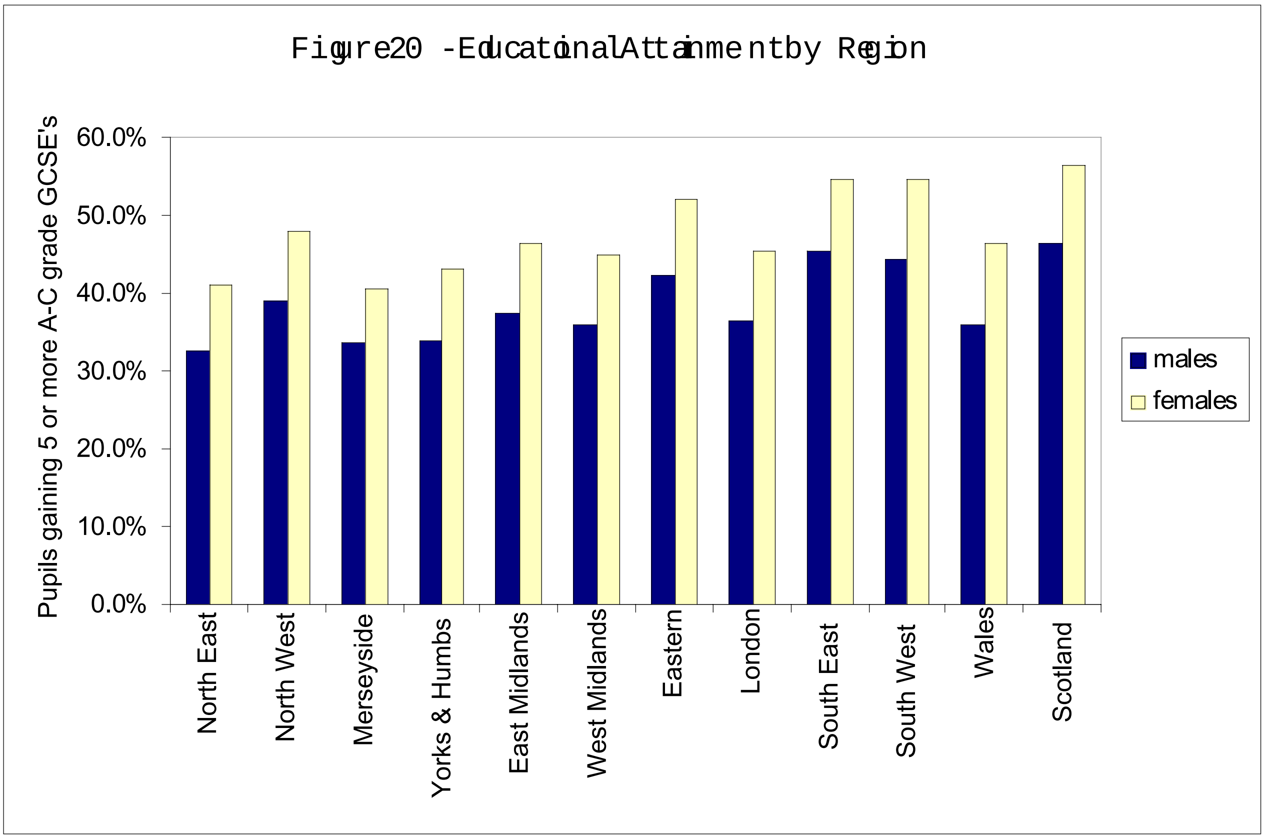
Source: ONS (1997b) - Tables 9.7& Calculated from 4.5

5.7.3 Education

The birth rate in the UK is stable or slightly declining, and about 740,000 people per year enter school. This amounts to a total of about 10 million school places. There should be an almost stable demand for school places.

Competition in the workplace and the decline of traditional industries in favour of high tech industry has created greater demand for higher levels of qualifications. In addition, employment has become less secure in recent years, and there has been a growth in the demand and requirement for retraining and vocational training. Full time places in further and higher education have grown nearly 3 fold since 1970 and by 1.5 times for part time places. This has an impact on the requirements for educational buildings and their adaptation.

Figure 20 shows that there is significant variation in the levels of educational attainment at GCSE level between girls and boys and between regions. There are also indications of inverse correlation between this educational attainment and both employment and crime levels.



Source: ONS (1997b) - Table 4.7

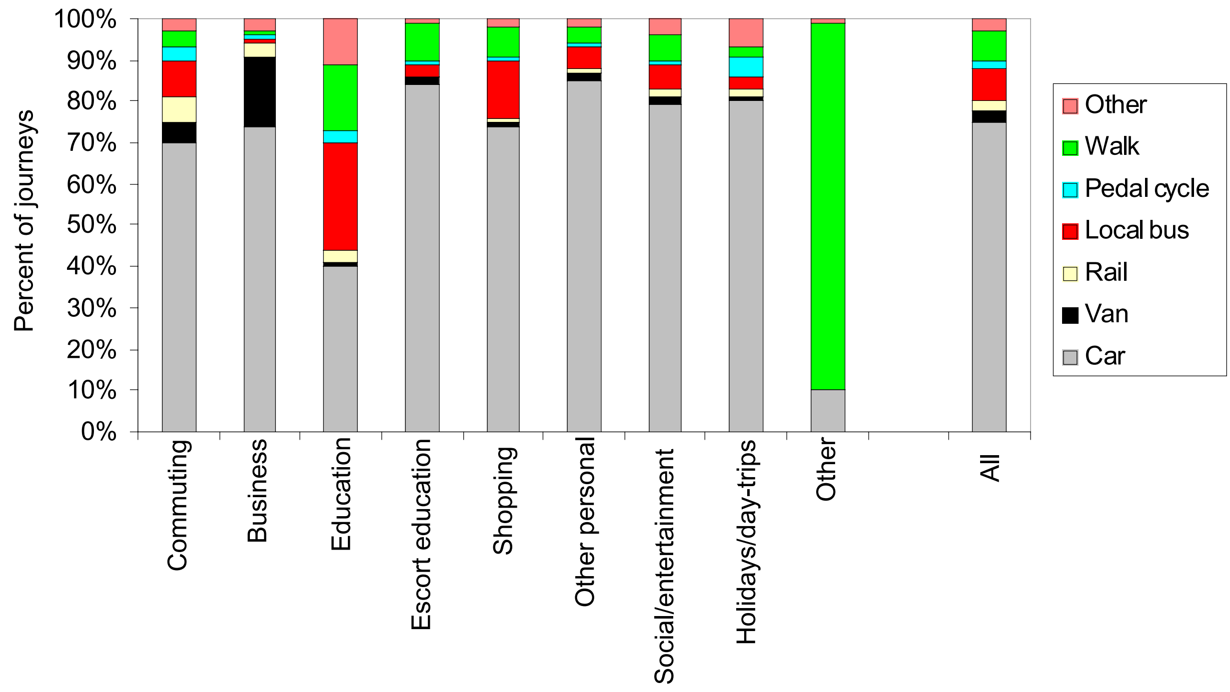
Promoting initiatives that increase construction activity could give productive educational opportunities to less academically inclined youngsters and build the skills and trades necessary to support a programme of rejuvenation of the building stock for fitness and energy efficiency. This could also bring the level of construction activity more in line with other parts of Northern Europe as a contributor to the economy.

5.7.4 Access to Transport

Figure 21 shows the modes of transport used to make different journeys. Car travel predominates in most. 45% of households regularly use a car, and a further 23% have the use of two or more cars. About 32% of households have no regular use of a car (ONS 1997a -12.8 & 12.9).

In 1993-1995, the average level of car occupancy was 1.7 persons per car with commuter traffic occupancies at 1.17 and day-trips at 2.71. In terms of most pollution emissions, car occupancy rates of 2 are equivalent to bus services, but occupancies of 3 or more are needed to beat rail transport (ONS 1997a -12.10).

Figure 21 - Journeys and Mode of Transport

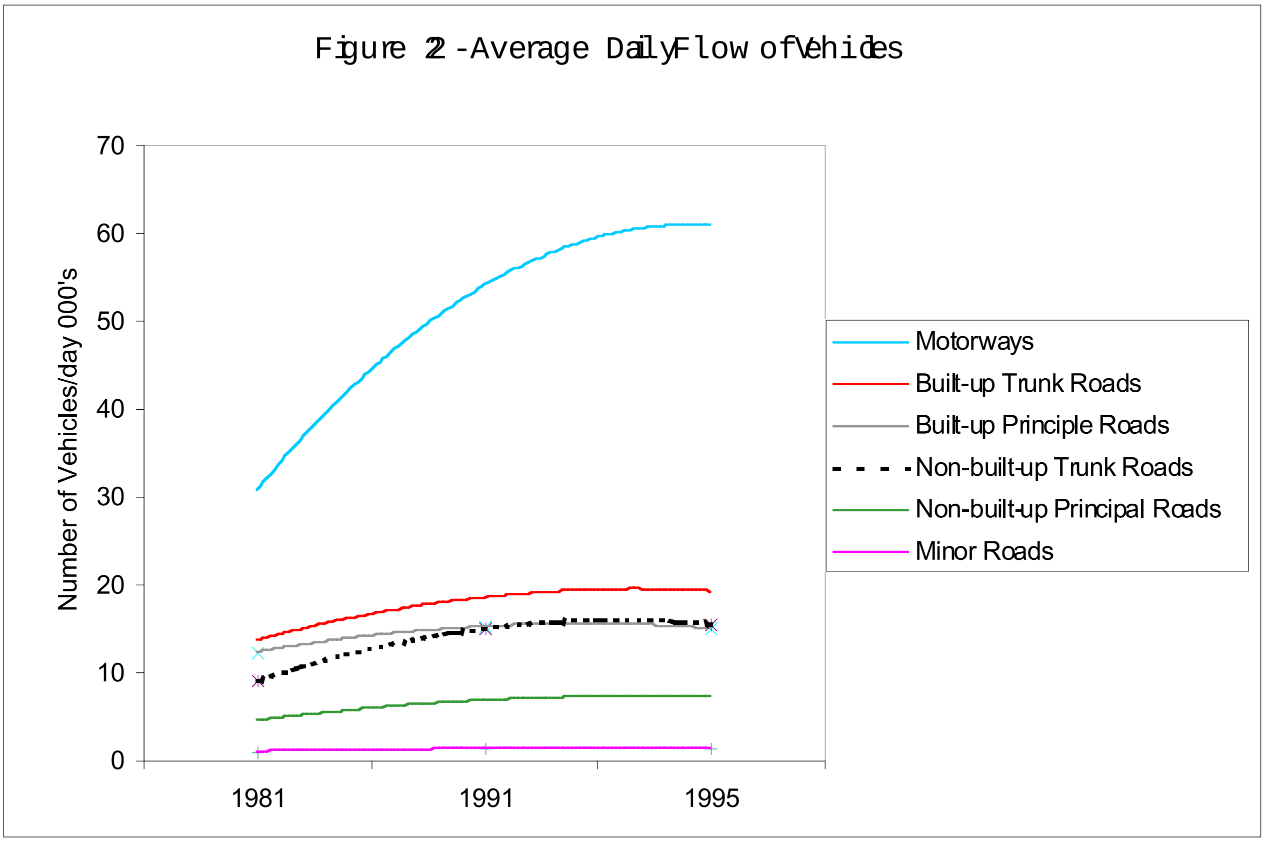


Source: DETR (1997) - 1.3

Car traffic has increased eight-fold since 1951, amounting to 427 bn vehicle kilometres in 1995. Road traffic is forecast to continue growing at about 4% p.a. to between 660 and 800 bn vehicle kilometres by 2025. Traffic flow has increased by about 50% between 1981 and 1995, especially on motorways with flows doubling (Figure 22) (ONS 1997a -12.12).

Bus travel is the second largest mode of transport and the numbers of vehicle kilometres have increased by about 26% over the last 10 years with more frequent services provided by smaller buses. Despite this, the numbers of passenger journeys made by bus has fallen by a similar degree (ONS 1997a -12.11), meanwhile the average distance walked has fallen by 20% over the last 20 years, especially for school aged children (ONS 1997a -12.5)

Since the construction industry provides the transport infrastructure, then any action taken to improve the sustainability of transport through planning, design or management change affecting individuals use of transport modes will have implications for the construction industry.



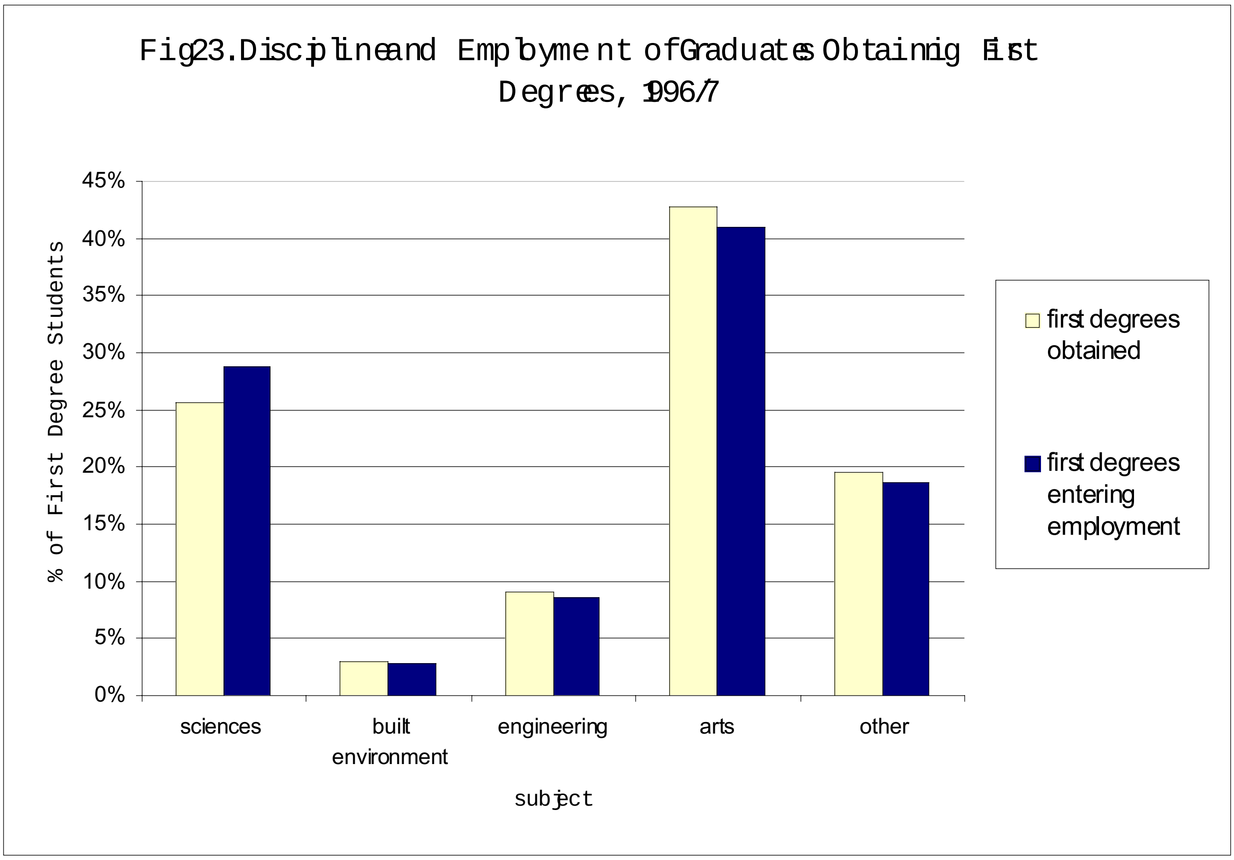
Source: ONS (1999) - Table 12.12

5.7.5 Education and Training for Construction

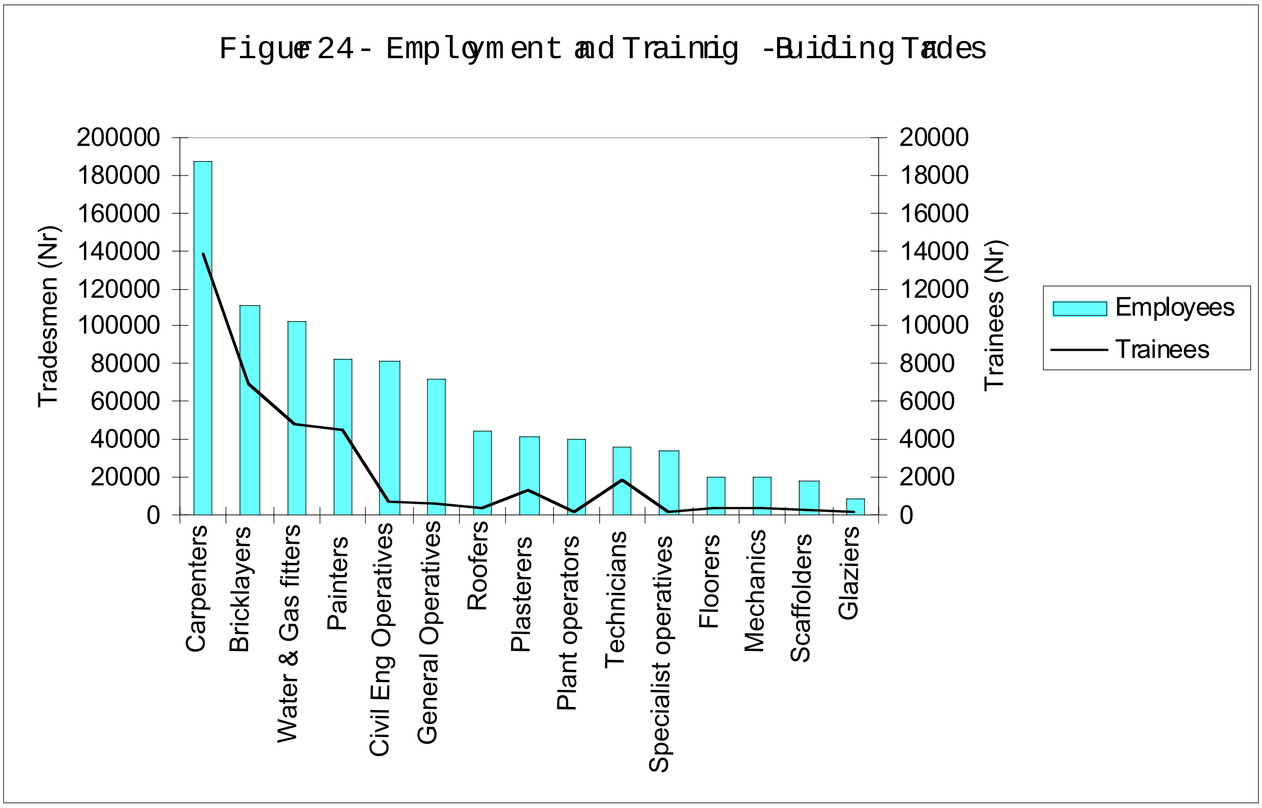
Perceptions of the construction industry are that it is a low tech, low skill industry. However, as figure 23 shows the numbers of students entering higher education to study construction related topics (architecture, building and planning) is about 3% of the total (1996). This is lower than one might expect given the size of construction as an economic sector at about 10% of GDP, but the industry is likely to recruit from other disciplines, such as engineering which makes up 9% of the total. Furthermore, an equivalent proportion of graduates go on to employment in the industry at the start of their careers (HESA 1996/97)

Figure 24 shows the numbers employed in each construction trade in 1997 and the numbers of trainees in 1989/99. The CITB predict that around 70,000 trainees a year are needed to maintain the integrity of the construction work force (CITB 1999a)

According to the CITB, the UK are only training sufficient tradesmen to meet the industry's skills needs in carpentry and bricklaying. In the remainder of the trade skills, fewer tradesmen are completing training than are required to maintain the skills base. The short-fall is most severe for plant operators and maintainers, and a number of specialist trades e.g. roofers, floorers, scaffolders and glaziers.



Source: HESA (1996/97)



Source: CITB (1999a) - Tabe A1, CITB (1999b) - Trainee numbers survey 1998

Figure 25 shows the regional distribution of training for construction trades by type of student. In the Northern and Southern areas, a significant proportion (25-35%) of trainees are adults whereas there are very few adult trainees in Scotland. This shows the extent of retraining of adults with new skills, and it is generally accepted that a flexible workforce should be more sustainable. A large proportion of trainees (30-70%) are employer sponsored (CITB 1999b).

Figure 26 compares trainee numbers to construction output in different regions. It is apparent that in Scotland and the Midlands, trainee numbers are high compared to construction output, whereas in the South East especially, but also in the South West and Northern areas the numbers of trainees are too low. To find work therefore, construction workers need to be mobile, with a net movement of construction workers to the south [CITB (1999b), DETR (1998a)].

Hence, the skills base is rapidly eroding, there is moderate engagement of employers sponsoring training, the workforce appears less flexible in Scotland and there are regional discrepancies in the training provision and work opportunities for the construction workforce.

5.7.6 Image of Construction

There are a number of industry sponsored schemes which promote better practice and image, the Considerate Constructors scheme and the Streetworks scheme for utilities providers.

The “Considerate Constructors scheme “seeks to minimise the disturbance to neighbours and passers-by caused by dirt, noise and litter, as well as abusive language and offensive behaviour”. The scheme is administered by the CIB which keep a register of sites applying their Code of Considerate Practice. At present, 264 contractors are registered at 683 sites on behalf of 349 clients. The clients are from both public (33%) and private sector (66%) organisations.

The BRE Environmental Assessment Method (BREEAM) provides a label through which owners and occupiers can publicise the environmental performance of their buildings. In a Deloitte & Touche market survey, 65-68% of users of BREEAM reported improvements in public relations and marketing benefits in describing the benefits of BREEAM (D&T 1996).

To the end of 1998, the following numbers of official BREEAM assessments have been completed:

for new Offices	376
for Superstores	15
for Industrial units	44
for homes	5 blocks

Many more unofficial assessments are known to have taken place. New versions of BREEAM are being developed for homes, retail units, property portfolios and estates. A new BREEAM module for construction sites is being considered with the Construction Industry Council to complement the Considerate Constructors Scheme.

Figure 25 - Trainee Numbers by Area

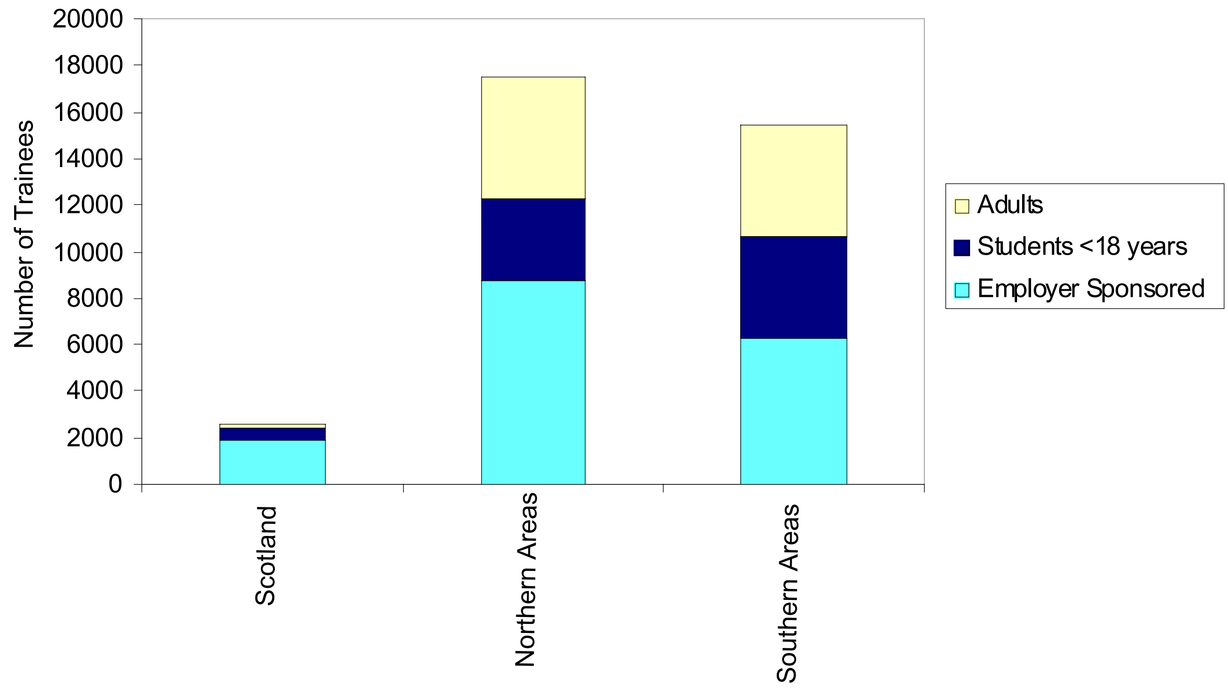
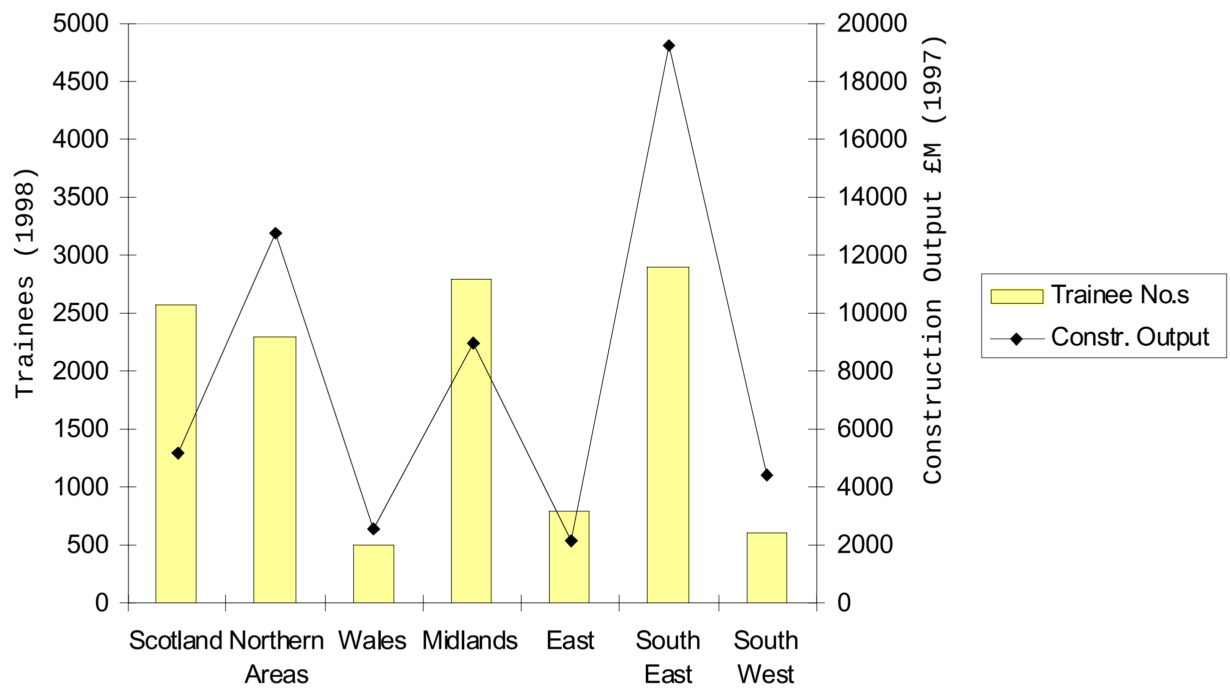


Figure 26 - Trainees vs Construction Output



Source: CITB (1999b) - Trainee numbers survey 1998
Source: CITB (1999b) - Trainee numbers survey 1998, DETR (1998a) - Table 1.9
Notes: Areas combined for consistency between sources - inconsistent dates

5.7.7 Working conditions in Construction

The construction industry is a male dominated industry (84% of employees are male) (ONS 1997b Table 5.8). Employees in the industry work 45.7 hours per week on average, slightly longer than the average for all industries of 44 hours. Men in the industry work significantly longer (by 16%) than women (ONS 1997b, Table 5.17).

The industry is moderately unionised (15% are members of a union) compared to the average for UK industry (22%) (ONS 1997a, Table 4.21). There is a high degree of self-employment (47%) in the construction industry compared to most other sectors (average 13%), but this is predominantly in very small firms (96% have less than 8 employees) (DETR 1998a – Table 2.1)

Hourly earnings in the industry are slightly higher than the average for all industries, but span a broad range from labourers to high skill trades and managerial and professional staff (DETR 1998a – Table 2.7).

Table 17 - Accident Incidents (per 100,000) Employees

	Construction	Agriculture, fishing, hunting and forestry	Extractive & utility supply Industries	Manufacturing Industries	Service Industries	All Industries
1993/94	8.9	5.3	6.1	1.6	0.5	1.2
1994/95	6.9	4.8	1.6	1.2	0.4	0.9
1995/96	7.7	7.8	8.0	1.1	0.4	1.0
1996/97	8.2	7.6	4.2	1.3	0.4	0.9
1997/98	5.8	7.8	7.8	1.3	0.4	0.9

Source – HSE (1999)

Table 18 - Accident Incidents (per 100,000) Self-Employed

	Construction	Agriculture, fishing, hunting and forestry	Extractive & utility supply Industries	Manufacturing Industries	Service Industries	All Industries
1993/94	2.1	9.9	-	3.1	0.5	1.6
1994/95	3.2	12.9	-	3.2	0.9	2.5
1995/96	2.2	8.3	-	0.4	0.6	1.5
1996/97	3.0	14.3	-	2.3	0.7	2.3
1997/98	2.9	7.4	-	2.7	0.4	1.6

Source – HSE (1999)

Tables 17 and 18 show that the accident levels for construction personnel are higher than in most other industrial sectors, except work on the land and in the extractive industries. The self-employed appear to have much lower accident rates than employees, but still significantly above the average for all industries.

5.7.8 Workforce Transport

The extensive use of labour only sub-contractors probably leads to high levels of workforce transport and reduce the use of local labour. However, no comprehensive statistics could be found to substantiate this assumption. On-site monitoring using Calibre (a construction project management toolkit developed by BRE) is starting to show that for projects of around £7M value, up to 10,000 road miles per week are travelled mainly by the workforce, but also to transport the materials used.

6 Conclusions

This study has collated the key data on Sustainable Construction into a single publication. From this data the impacts from the construction industry on society can be viewed holistically and in comparison to one another.

It is clear that our understanding of Sustainable Construction is incomplete. However, better information about sustainable construction is emerging all the time as sustainability is given an increasingly high priority, both amongst society as a whole and within the construction and materials industries.

In order to implement sustainability, the construction industry needs the best possible data with which to guide and assess its actions. For this purpose it would be beneficial to the industry for this study to be repeated on a regular basis (e.g. every 2 years).

The data in this report was the best available at the time the research was undertaken, but is obviously superseded by new information on a regular basis.

Further sources of information on Sustainable Construction can be gained from the Centre for Sustainable Construction – email contact CSC@bre.co.uk, telephone 01923 664118, or visit our web site at http://www.bre.co.uk/sustainable/index.html.

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