

The Carbon Footprint and Climate Footprint of Highlands and Islands Enterprise 2007/08



Research Report
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Centre for Sustainability Accounting

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Financial Year 2007-08

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Key Findings

This report provides a carbon footprint and climate footprint for Highlands and Islands Enterprise (HIE). Internal activities and external regional investment activities have been distinguished by assessing expenditure for the financial year 2007/08 as well as on-site emissions.

These are the key findings from the quantitative analysis:

1. This study enables Highlands and Islands Enterprise to understand the carbon footprint of its complete internal operations and regional investments, ensuring that both its direct impacts and the indirect impacts of every supply chain are taken into account.
2. Total direct plus indirect emissions of greenhouse gases caused by HIE activities add up to 16.2 kilotonnes (kt) of CO₂ equivalents. This can be separated into 1.7 kt CO₂-e for HIE's internal operations and 14.5 kt CO₂-e for HIE's regional investments, making the latter one by far the larger climate impact of HIE's activities.
3. By far the biggest contribution to HIE's internal carbon footprint comes from business travel. Flying and driving together make up almost half of HIE's internal carbon footprint (25% and 23% of all emissions, respectively). On third place are direct (on-site) emissions from natural gas use for heating (12%).
4. Compared to the previous financial year, the internal footprint has not changed while external support shows an increase from 12.1 to 14.5 kt CO₂-e.
5. Business travel by car has gone up from 303 to 381 t CO₂ while emissions from flights have gone down from 465 to 406 t CO₂. In total, emissions from business travel have increased by 3% from 2006/07 to 2007/08.
6. Through the purchasing of green electricity, HIE has already reduced its internal carbon footprint significantly. However, the higher upstream impacts of electricity supply from renewables still account for around 7% of HIE's total internal carbon footprint. Electricity consumption in total has increased by 17% from FY2006/07 levels, leading to an equivalent rise in associated emissions.
7. The purchasing of IT equipment, furniture and other (office) equipment make up another 10.5% of total impact. There is a decrease in expenditure in this category and an associated slight drop in carbon footprint from 191 to 170 t CO₂.
8. When compared to the UK sector of Public Administration and Defence, HIE is performing exceptionally well in terms of their relative impact per £ spent. This is a result of the nature of the organisation's business and the use of electricity from renewable sources.
9. The combined footprint of all greenhouse gases for HIE's regional investment activities is almost nine times higher than HIE's internal footprint and can mainly be attributed to miscellaneous manufacturing, fishing and agriculture. A careful allocation investment project spending to economic sectors is required for a correct allocation of impacts.

Introduction

Responsibility for change

The political momentum to address the adverse effects of climate change through both mitigation and adaptation is mounting. At a national level the Stern Review has focused attention on the issue with the clear message that we need to act now, or literally pay the price at a later stage stating that the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP per year, now and forever. More importantly, climate change potentially threatens the livelihoods of millions of vulnerable people.

In order to preserve a high probability of keeping global temperature increase below 2 degrees Centigrade, current climate science suggests that atmospheric CO₂ concentrations need to peak below 450ppm. This requires global emissions to peak in the next decade and decline to roughly 80% below 1990 levels by the year 2050. Such dramatic emissions reductions require a sharp move away from fossil fuel, significant improvements in energy efficiency, reduced consumption and substantial reorganisation of our current economic system. This transition can only be achieved by far-reaching national and international climate policies. Industry must improve the carbon efficiency of production by not less than a factor of two to four, while a change in consumption is also required.

There is clear acknowledgment that responsibility for mitigation lies with the developed countries as they all have disproportionately higher carbon emissions on a per capita basis and have emitted for a longer time period. The UK has a legally binding commitment under the Kyoto protocol to reduce greenhouse gas emissions (GHG) by 12.5% below base-year level (1990), over the first commitment period 2008-2012. The UK also has a domestic target to reduce carbon dioxide emissions by 20% below 1990 levels by 2010 and the Energy White Paper sets a longer term goal of reducing carbon dioxide emissions by 60% by 2050 with real progress to be achieved by 2020. As mentioned above, evidence from climate change science suggests the required reduction is nearer 80% to avoid some of the more extreme effects of climate change. There is also a case for moving early, i.e. achieving a reduction sooner rather than later.

Legislative requirement for industry to take on responsibility is growing. This will mainly be achieved through the introduction of a carbon market. In reality, this will mean that high carbon products will cost more in the future, ensuring there is a significant market advantage in producing a low carbon product. As well as the growing legislative commitments, the consumer is increasingly demanding to know the impacts of products. There is a significant market advantage for companies that can demonstrate the sustainability merits of their products.

Scope of this Report

This report provides a carbon footprint and climate footprint for Highlands and Islands Enterprise (HIE), the Scottish Government's economic and community development agency covering the north and western half of Scotland. Internal activities and external regional investment activities have been distinguished by assessing expenditure for the financial year 2007/08 as well as on-site

emissions. The study should be seen as a "Carbon Footprint" analysis and not a "Climate Change Action Plan".

Results

Results presentation

The business activities of Highlands and Islands Enterprise can be distinguished into two categories: internal or office activities for own business affairs and support activities for the support of other businesses.

Table 1: Overview of HIE activities in 2007/08

Highlands & Islands Enterprise	<p><u>INTERNAL ACTIVITIES</u></p> <p>Total expenditure £ 24.5 m</p> <p>This includes all expenditure on internal and office activities such as salaries, rent, travel, telecommunication, office and computer equipment, professional fees, building work & maintenance, utilities, etc. (HIE 'Block B' spending)</p>
	<p><u>REGIONAL INVESTMENT ACTIVITIES</u></p> <p>Total support £ 94.3 m</p> <p>This is the support that HIE offers to businesses in the Highlands and Islands, including the programmes Growing Businesses, Global Connections, Developing Skills & Learning and Strengthening Communities (HIE 'Block A' spending)</p>

The results are being presented by these two categories, Internal Activities and Support Activities. Note, that this is not the same distinction as 'direct' versus 'indirect'. The carbon footprint of HIE's internal activities includes both, direct (or on-site) emissions from heating and vehicles and indirect emissions that are embodied in the goods and services supplied to HIE. HIE's support activities, on the other hand, lead to a carbon footprint in those businesses that have been supported, giving rise to greenhouse gas emissions for which these businesses are (directly and indirectly) responsible for.

Total support in financial terms is about four times larger than expenditure on internal activities. The respective footprint results show an even larger disparity of 9 to 1, see Table 2 below. Whilst the footprint for internal activities has not changed from the year before, the support activities have created a larger climate footprint in the year 2007/08 (increase from 12.1 to 14.5 kt CO₂-e).

Table 2: Total climate footprint of HIE activities in 2007/08
 (direct + indirect emissions of greenhouse gases)
 (numbers in brackets are from FY 2006/07)

HIE's Activities	HIE's Climate Footprint (CO ₂ +CH ₄ +N ₂ O)	Unit	Percentage of Climate Footprint	Percentage of budget
Internal Activities	1.67 (1.66)	kt CO ₂ -e	10 (12)	21 (20)
Support Activities	14.5 (12.1)	kt CO ₂ -e	90 (88)	79 (80)
Total (internal + support activities)	16.2 (13.7)	kt CO ₂ -e		

The Internal Carbon Footprint of HIE

The climate footprint of HIE’s internal activities was calculated for the financial year 2007/08 (April 2007 to March 2008) and includes direct (on-site) as well as indirect (from suppliers and other sectors in the economy) emissions of three greenhouse gases: carbon dioxide, methane and nitrous oxide. The total climate footprint of 1.67 kt CO₂-e is clearly dominated by carbon dioxide which makes up 1.62 kt CO₂-e alone. When expressed in tonnes of CO₂ equivalents, methane and nitrous oxide make up only 1.6% and 1.3%, respectively (see figure below). The detailed results below show CO₂ emissions (carbon footprint) in most cases, the picture would look practically identical if all greenhouse gases were included (climate footprint). Where interesting and relevant, we show detailed results for methane and nitrous oxide.

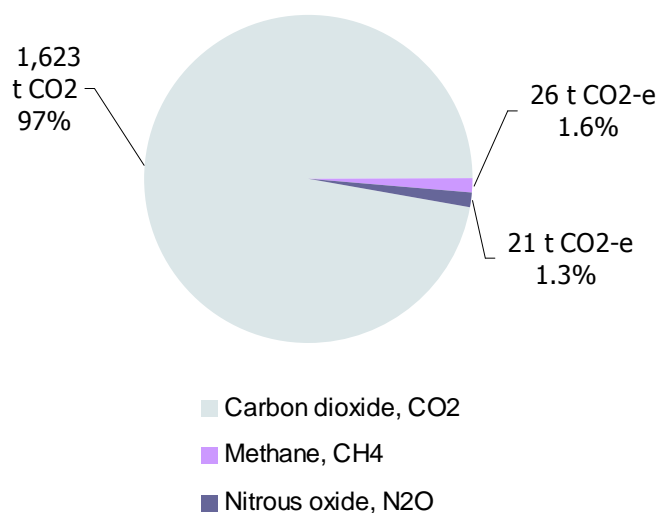


Figure 1: Composition of HIE’s total internal climate footprint by greenhouse gas.

The table and chart below provide a breakdown of HIE's internal carbon footprint (CO₂) by 'commodity group', i.e. by broad expenditure categories. The picture is clearly dominated by air transport (25%) and HIE's direct emissions from driving (23%) and heating (12%).

The most notable difference in carbon footprint between 2006/07 and 2007/08 is an increase of emissions from driving from 303 to 381 t CO₂ and a – not quite as large – fall in emissions from flying, from 465 to 406 t CO₂. In total, the carbon footprint from business travel has increased by 3% from 2006/07 to 2007/08.

The fifth largest carbon footprint contribution from furniture and equipment (105 t CO₂ or 6.5%) can be broken down into the purchase of new equipment (61.9 t CO₂) and maintenance and repair of existing equipment (42.9 t CO₂).

Table 3: Total internal carbon footprint (CO₂) broken down into commodities bought by HIE

Rank	Commodity	Carbon footprint in FY2007/08	Unit	% of total	Carbon footprint in FY2006/07
1	Air transport	406.0	t	25.0%	464.9
2	HIE on-site emissions from vehicle driving (Scope 1)	381.0	t	23.4%	302.8
3	HIE on-site emissions from heating (Scope 1)	194.0	t	12.0%	217.9
4	Electricity (Scope 2)	108.2	t	6.7%	92.7
5	Furniture and equipment	104.8	t	6.5%	115.3
6	Office machinery and computers	64.9	t	4.0%	76.1
7	Vehicle fuels (indirect impacts of petrol/diesel production)	51.2	t	3.2%	41.9
8	Education	36.9	t	2.3%	43.3
9	Food and drink	32.5	t	2.0%	33.5
10	Paper and paper products	28.4	t	1.8%	31.2
11	Plastic products	25.7	t	1.6%	28.2
12	Post and telecommunications	25.3	t	1.6%	14.4
13	Motor vehicle maintenance & repair	23.3	t	1.4%	<14.0
14	Real estate activities	21.4	t	1.3%	22.3
15	Water transport	16.7	t	1.0%	23.4
>15	All other commodities	102.4	t	6.3%	125.0
	Total	1,623	t	100.0%	1,647

The direct emissions from HIE belong to Scope 1 as defined by the GHG Protocol; electricity is Scope 2. All other commodities belong to the category Scope 3 upstream; this is also depicted in Figure 2. Note that the category vehicle fuels – which contributes 51t CO₂ or 3.2% - is *not* from the actual combustion of these fuels (this is included under on-site emissions), but is due to *indirect* emissions caused by the extraction of crude oil, refining and distributing the fuels.

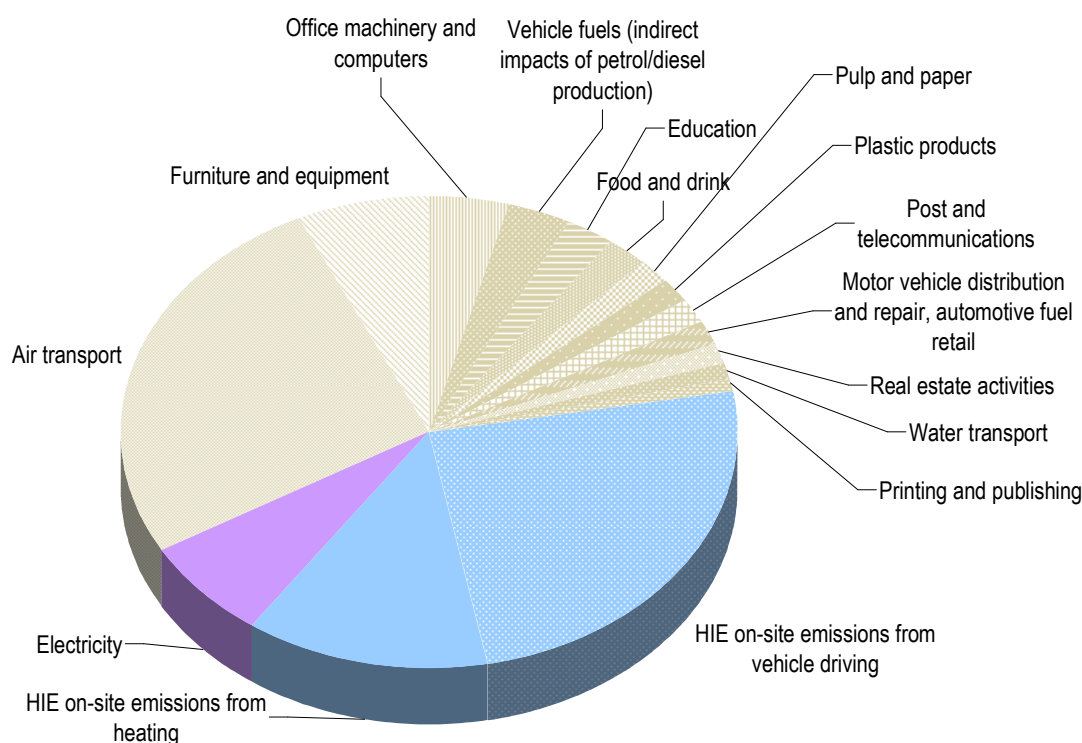


Figure 2: Composition of HIE's internal carbon footprint (CO₂) by commodity group and GHG Protocol Scope 1 (blue), Scope 2 (purple) and Scope 3 (brown).

Direct CO₂ emissions

There are two sources for direct (or on-site) emissions of HIE, heating and driving. The burning of 1.02 GWh of natural gas for heating purposes creates 194 tonnes of CO₂; this is a decrease of 24 t CO₂ from 218 t CO₂ in 2006/07. Car driving leads to around 381 tonnes of direct CO₂ emissions; as mentioned above, this is an increase in emissions from 303 t CO₂ in 2006/07.

Together, these two sources of direct emissions add up to 575 tonnes of CO₂ or 35% of HIE's total carbon footprint.

Indirect CO₂ emissions

The majority of HIE's internal carbon footprint consists of indirect or 'upstream' emissions. These are emitted by suppliers to HIE who manufacture a product or deliver a service that is bought by HIE. One important example of such a commodity is electricity which is generated by power plants supplying electricity to the national grid. Other examples are transport (business travel), consultancy or construction services or goods such as office equipment, furniture or machinery. Whenever HIE pays for a service that it requires or buys a product, it causes indirect emissions elsewhere in the economy and can thus be seen to be partly responsible for these emissions. The respective companies delivering the good or service can be located anywhere in the supply chain. The emissions can be caused by the direct supplier to HIE, for example a computer retailer, or somewhere higher up in the supply chain, for example by a mining company that extracts copper

ore which is turned into copper used in office computers. With the methodology employed in this study it is possible to capture and rank all these indirect emissions, whether they are embodied in a product or in a service.

The most important source for HIE's indirect CO₂ emissions is air transport. This is due to the many flights undertaken by HIE staff. The £386,000 spent on flights translate into 406 tonnes of CO₂ or 25% of the total carbon footprint. However, it is considerably less than in the previous year, when emissions from flying were 465 t CO₂. On the other hand, it is still more than the amount emitted by HIE's use of cars which is 381 t CO₂.

The CO₂ emissions from electricity generation are not emitted on site but in power plants elsewhere and are therefore reported under the indirect part of the carbon footprint. Though HIE purchases all its electricity from renewable energy (100% green tariff), a detailed supply chain analysis of electricity generation in the UK using Bottomline³ shows that around 10% of the emissions associated with the production of one kilowatt-hour of electricity can be attributed to processes higher up in the supply chain and not related to the power generation process itself. These upstream production emissions are due to the provision of goods and services required by power plants, e.g. transport, materials, secondary electricity, maintenance etc. By purchasing 'green electricity' the consumer – in this case HIE – avoids the 90% of emissions that would otherwise come from the average energy mix used in power generation; but even renewable energy schemes will need higher upstream goods and services, unavoidably leading to 10% of emissions.

Through the decision to purchase green electricity, HIE has already reduced its emissions by almost 1000 tonnes of CO₂. If electricity had been bought from the average national grid instead, the carbon footprint would have been 60% higher.¹

Furniture and other equipment bought by HIE embody around 105 tonnes of CO₂ and contribute 6.5% to the total carbon footprint. Another 4% can be attributed to office machinery and computer hardware. As mentioned above, the category vehicle fuels – contributing 51t CO₂ or 3.2% – is *not* from the actual combustion of these fuels (this is included under on-site emissions), but is due to *indirect* emissions caused by the extraction of crude oil, refining and distributing the fuels.

Breakdown by production layer

Not all of the emissions that are embodied in the goods and services bought by HIE are created by HIE's direct suppliers. This is shown in the following chart where the whole economy is represented by 18 broad categories, ranging from 'Agriculture' through to 'Public/personal services'². HIE is shown separately. 'Layer 1' is HIE itself and we can see the 575 t CO₂ of direct

¹ The Bottomline³ supply chain analysis allows for a distinction between direct and indirect suppliers of electricity. The calculations are based on the assumption that the direct supplier of HIE produces indeed carbon free electricity. Higher upstream impacts are not (necessarily) carbon free and this is why there are still indirect emissions associated even with "green" electricity. Note however, that the UK's Carbon Reduction Commitment scheme requires companies to report 'renewable/green electricity' imported via the grid at the average grid emissions factor (<http://www.defra.gov.uk/environment/climatechange/uk/business/crc/action.htm>).

² We have summarised the following sectors under "Public/personal services": Public administration and defence, Education, Health and social work, Sewage and refuse services, Membership organisations, Recreational services, Other service activities and Private households with employed persons.

emissions from driving and heating on the left hand side (for details see previous section). This represents 35% of the total carbon footprint.

Direct suppliers to HIE ('Layer 2') add approximately 700 t of CO₂ to the carbon footprint. These suppliers come from various sectors, most notably are the contributions from (air) transport and equipment. Note that there is no contribution from electricity in Layer 2 as the direct supplier of electricity to HIE is assumed to use 100% renewable (and carbon free) energy sources. However, further up in the electricity supply chain, other companies still add to the carbon footprint.

The remainder of about 340 t of CO₂ emissions is caused by companies that supply HIE's suppliers or are located even further up in the supply chains. The diagram below shows that these higher upstream emissions are mainly due to electricity consumption as well as further equipment and transport requirements of these suppliers. They all contribute to HIE's total carbon footprint. However, these more remote agents are more difficult to identify and to influence.

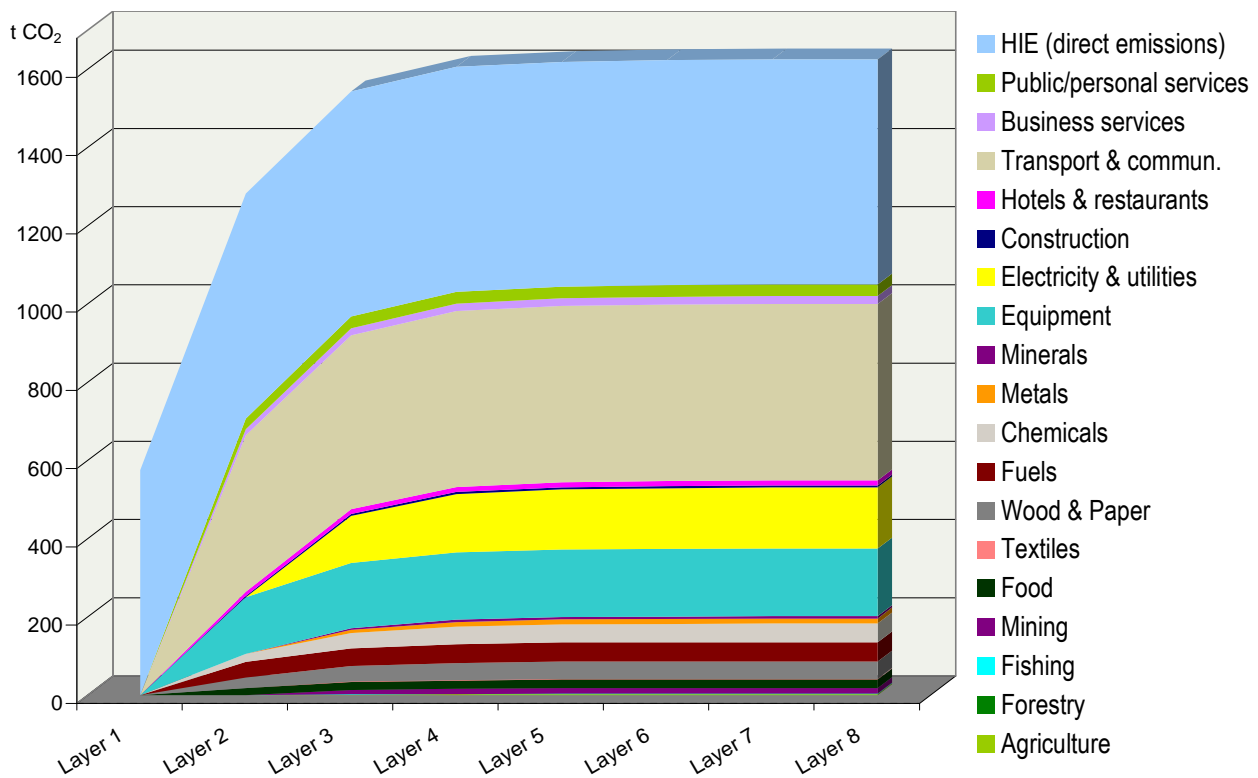


Figure 3 HIE's internal carbon footprint (CO₂) by production layer
 (Layer 1 represents the on-site emissions from HIE alone; Layer 2 and higher add the indirect emissions from suppliers to HIE's direct emissions)

Breakdown by HIE area offices

HIE's internal activities are managed through main offices and a number of area offices. The following table and graph provide a breakdown of the total greenhouse gas emissions by these offices.

Table 4: HIE's total climate footprint broken down by area office and individual GHG

HIE office	Carbon dioxide, CO ₂ [t]	Methane, CH ₄ [kg]	Nitrous oxide, N ₂ O [kg]	Greenhouse gases [t CO ₂ -e]	GHG per employee [t CO ₂ -e/person]
HIE main	914.9	712.9	42.0	942.8	3.9
AIE	150.9	64.0	4.12	153.5	3.2
CASE	73.7	61.0	2.71	75.8	2.6
IEH	163.0	130.3	5.63	167.4	2.2
Innse	72.5	54.5	3.66	74.8	1.9
Lochaber	30.0	40.4	1.87	31.4	1.7
Moray	85.0	58.1	2.77	87.1	2.1
Orkney	33.7	56.0	2.17	35.5	1.8
Shetland	41.5	34.0	2.34	43.0	2.3
SWR	57.4	27.9	2.01	58.6	2.8
Total	1,623	1,239	69.3	1,670	3.0

Table 4 highlights the constituents of HIE's climate footprint and how this breaks down for each area. With HIE beginning to implement a voluntary redundancy programme towards the end of 06/07, employee numbers and their location fluctuated during the year. It is therefore difficult to compare the climate footprint per employee with different periods.

The main office creates more emissions of all other offices together. The Lochaber office creates the lowest carbon footprint of all and together with Orkney, has the lowest footprint per employee. Argyll, with their dispersed area and clients, have the highest area footprint per employee.

A detailed commodity analysis as shown above was undertaken for all areas. The results very much reflect the picture shown in Figure 2 on page 10, i.e. direct (on-site) emissions from heating and driving as well as air transport are clearly the main contributors to the carbon footprint. Indirect emissions from other goods and services are mostly in the region of 20-30% of the total with the exception of HIE's main office where the 'All other commodities' category accounts for 44% of the total carbon footprint.

Emissions from electricity plays a minor role, because HIE has already switched to green electricity supply. Some of the offices are not heated with natural gas but with electricity instead which, according to Figure 4, does not seem to lead to increase emissions due to electricity consumption. It could therefore be argued that a switch from gas heating to electrical heating could further reduce carbon emissions. However, this is only true if the electricity supply is truly carbon free and also does not induce significant emissions in the whole supply chain.¹ Site- and technology-specific considerations and analyses are therefore absolutely essential to establish whether real carbon reductions could be achieved by such a step.

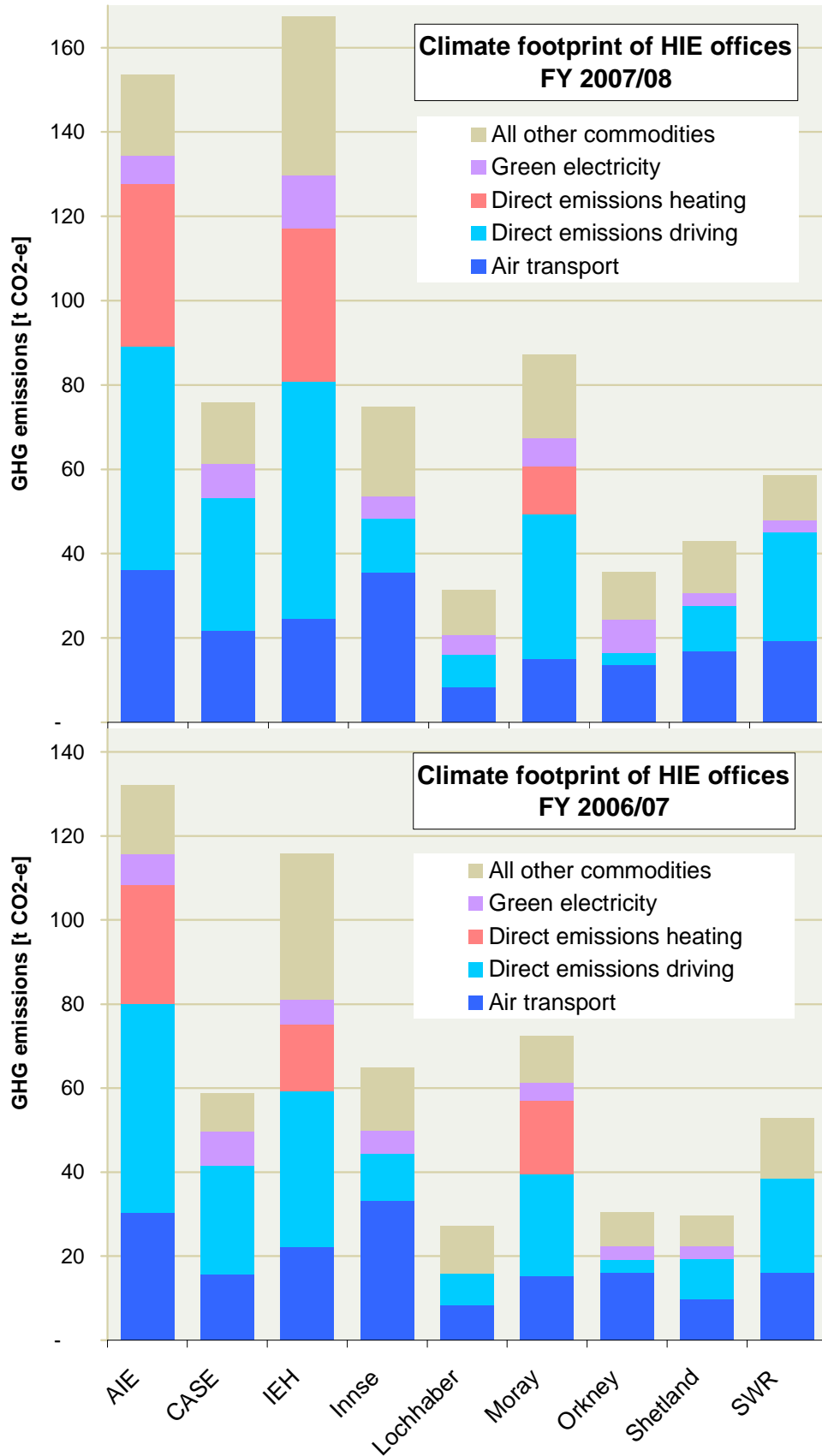


Figure 4: HIE’s total climate footprint (GHG) broken down by area office and main source (top: FY2007/08, bottom: FY2006/07)

Figure 4 shows a graphical comparison of the GHG footprints of area offices between 2006/07 and 2007/08 (leaving out the two main offices in Inverness and Dingwall). The underlying data are shown in Table 5. IEH is the office with the largest increase in direct emissions and electricity use.

Table 5: HIE's total climate footprint (GHG) broken down by area office and financial year

Office ↓	Air transport		Driving		Heating		Electricity		Commodities	
	07/08	06/07	07/08	06/07	07/08	06/07	07/08	06/07	07/08	06/07
Financial Year →	07/08	06/07	07/08	06/07	07/08	06/07	07/08	06/07	07/08	06/07
HIE main	219.3	298.3	145.9	111.8	107.5	156.2	54.7	58.8	415.4	454.9
AIE	36.3	30.3	52.8	49.7	38.8	28.4	6.6	7.2	19.1	16.3
CASE	21.7	15.7	31.6	25.9	-	-	7.9	7.9	14.6	9.2
IEH	24.7	22.1	56.1	37.2	36.5	15.8	12.4	6.1	37.7	34.6
Innse	35.6	33.2	12.7	11.1	-	-	5.2	5.6	21.3	14.9
Lochhabar	8.4	8.3	7.6	7.6	-	-	4.8	-	10.6	11.3
Moray	15.0	15.2	34.4	24.3	11.3	17.5	6.7	4.4	19.8	11.0
Orkney	13.7	16.1	2.8	3.1	-	-	7.8	3.3	11.2	8.1
Shetland	16.8	9.7	10.9	9.7	-	-	3.1	3.0	12.2	7.3
SWR	19.2	16.1	26.0	22.4	-	-	2.9	-	10.5	14.4
Total	410.7	464.9	380.8	302.8	194.0	217.9	112.1	96.4	572.4	582.0

Benchmarking

How does HIE's internal carbon footprint compare with similar organisations in the UK? This question is not an easy one to answer. Different businesses, even those with similar activities, have different sizes and provide different services, leading to different impacts on the environment. As a boundary for the analysis we have chosen the total expenditure of HIE to derive the indirect GHG emissions as well as the on-site emissions from premises owned and operated by HIE. The same boundary can be applied to the economic sector to which HIE belongs. HIE is officially classified under code 75.X of the Standard Industrial Classification (SIC 2003): "Administration of the state and the economic and social policy of the community; foreign affairs". This sub-sector in turn is part of sector 75: "Public administration and defence".

Data on total expenditure and on-site emissions from the UK sector "Public administration and defence" (PAD) is available from the Office for National Statistics.³ When expressing 'the footprint performance' as total emissions per £ spent, a comparison between the different entities becomes possible. Figure 5 below show the results of this comparison.

³ Similar benchmark data should be available for a comparable sector in Scotland. This would allow a more regionally specific comparison of performance. However, it was beyond the scope of this project to investigate this question further.

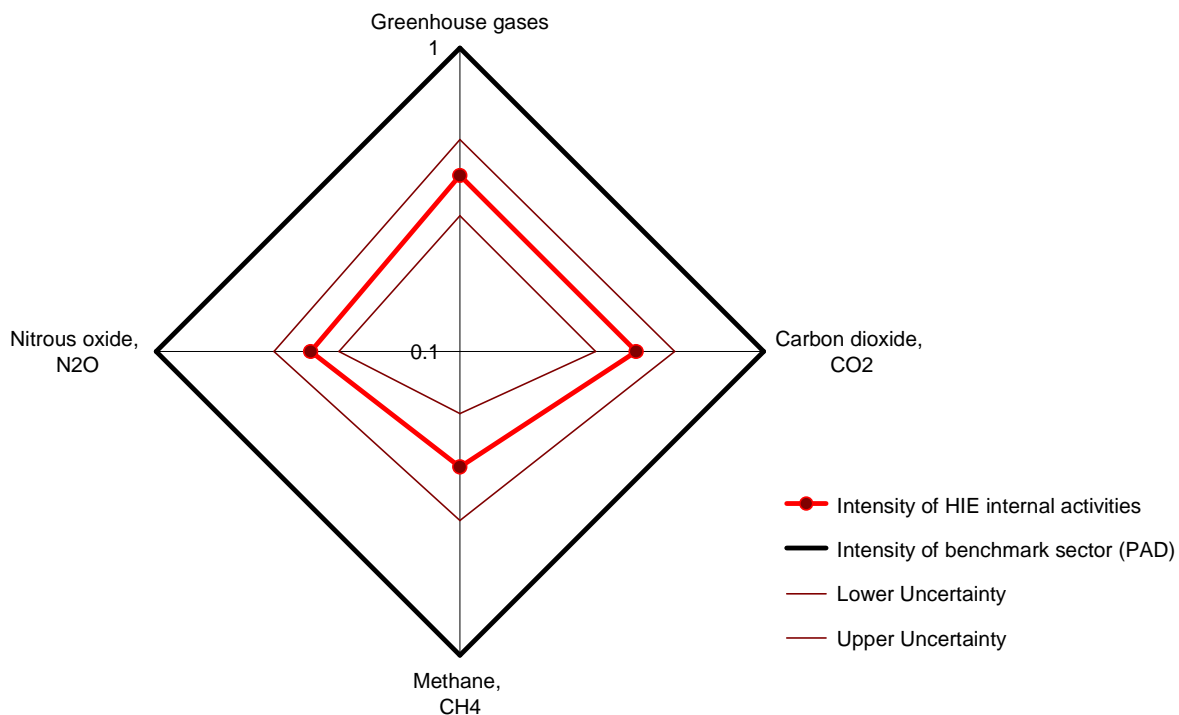


Figure 5: A spider diagram presentation of total (direct + indirect) greenhouse gas emission intensities of HIE. The thick red line shows HIE's performance for each gas. The regular polygon forming the outside borders of the diagram (thick black line) shows the average performance of 'Public Administration and Defence' (PAD), normalised to 1, allowing a benchmark comparison between HIE and the economic sector under which its business is classified. A performance better than average is closer to the centre ("the smaller the area encircled by the red line, the smaller the footprint").

According to this comparison, HIE is performing exceptionally well. Overall emissions of GHGs per £ are 38% of PAD's intensity; methane and nitrous oxide intensities are even lower with 24% and 31%, respectively. Partly, this can be explained with HIE's purchasing of green electricity. The model data assume that the PAD sector purchases average mix electricity from the national grid and therefore has a more carbon intensive electricity supply. Also, PAD obviously includes defence activities which are relatively energy and carbon intensive, due to an above-average dependency on technical and transport equipment. Generally, the breadth of the sector PAD poses a limitation to the comparison of per £ emissions. A more accurate comparison would be obtained if the same analysis could be undertaken for a similar business or a more appropriate sub-sector, ideally with data specific for Scotland.

The Carbon Footprint of HIE's Regional Investment

In its function as the Scottish Government's economic and community development agency for the Highlands and Islands of Scotland, HIE support individuals, businesses, organisations and communities across the region. HIE's activities include: provision of business support services,

delivery of training and learning programmes, assistance for community and cultural projects and measures for environmental renewal.

In the financial year 2007/08 HIE spent £ 94.3m on regional investment projects. A breakdown of this expenditure into economic sectors used in Bottomline³ is provided in the graph below. The largest SIC Tier 1 expenditure category, where 19% of the money is spent, is 'Misc. service activities' which includes community, development, social and personal service activities. This is followed by spending in Public Administration, Recreational Services, Real Estate Activities and Construction.

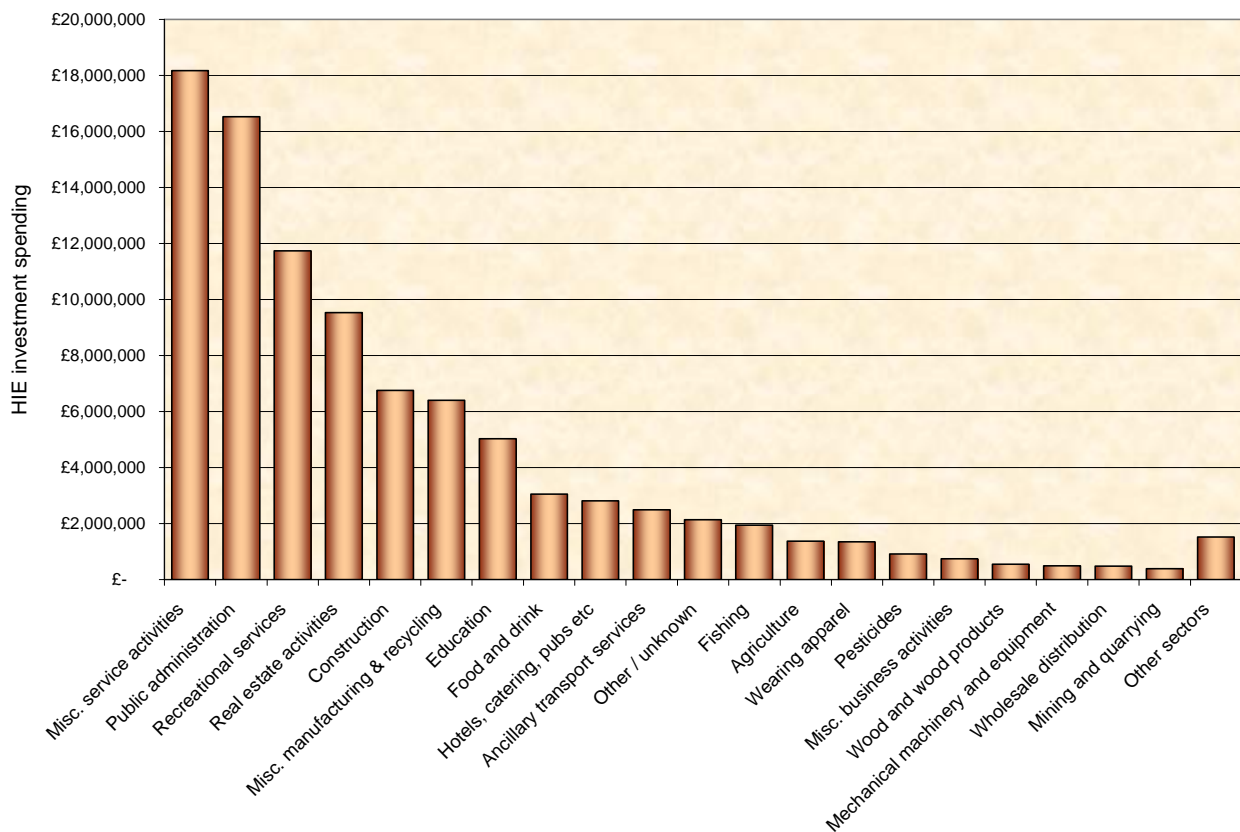


Figure 6: HIE's external regional investment in 2007/08

By spending money on other businesses or organisations, be it for the purpose of purchasing a good or service or for supporting the business financially, HIE indirectly creates a carbon footprint impact. This is because it can be assumed that the money is spent (sooner or later) by the recipient on an internal activity, such as capacity building, staff training or construction projects. These activities in turn are associated with greenhouse gas emissions which would not occur if the support had not been received in the first place.

Translating HIE's support expenditure into a carbon/climate footprint by using the Bottomline³ approach results in total impacts of 14,495 t CO₂-e, consisting of 12,662 t CO₂, 35.9 t CH₄ and 3.5 t

N₂O. A further breakdown of the total climate footprint into supported sectors is shown in the following table and layer graph.

Table 6: Climate footprint (GHG) of HIE support activities by industrial sector to which support is provided (the last column shows the impact intensity in g CO₂-e per £ of support).

Rank	Commodity	Climate Footprint (GHG) t CO ₂ -e	% of total	Spend £	Impact per £ g CO ₂ -e / £
1	Misc. manufacturing & recycling	4,961	34.2%	£6,400,637	775
2	Fishing	2,444	16.9%	£1,947,408	1,255
3	Agriculture	1,596	11.0%	£1,376,871	1,159
4	Public administration	1,490	10.3%	£16,521,356	90
5	Misc. service activities	739	5.1%	£18,169,189	41
6	Food and drink	668	4.6%	£3,052,306	219
7	Construction	473	3.3%	£6,747,000	70
8	Education	356	2.5%	£5,028,398	71
9	Recreational services	331	2.3%	£11,733,746	28
10	Wood and wood products	212	1.5%	£5,028,398	389
11	Pesticides	163	1.1%	£913,123	179
12	Mechanical machinery and equipment	145	1.0%	£491,812	295
13	Wholesale distribution	138	1.0%	£472,344	293
14	Real estate activities	110	0.8%	£9,529,991	12
15	Paints, varnishes, printing ink etc	102	0.7%	£129,609	790
>15	All other commodities	567	3.9%	£6,843,688	
	Total	14,495	100%	£94,385,876	

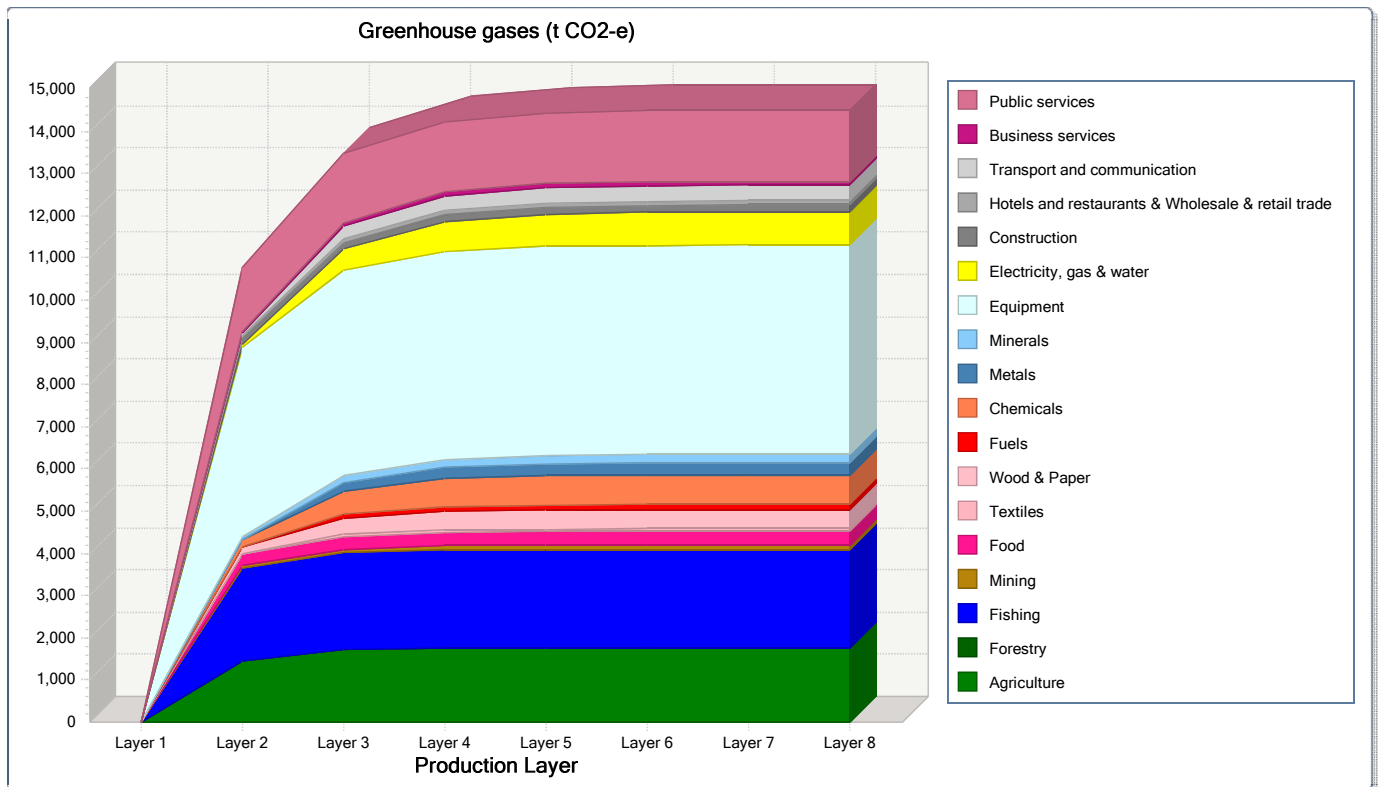


Figure 7: Climate footprint (GHG) of HIE support activities by production layer
 (The category 'Equipment' includes a range of manufacturing industries. Note that the impact from Layer 1 is zero because HIE's support activities do not create on-site emissions)

The largest indirect emissions (5.0 kt CO₂-e or 34%) are created by miscellaneous manufacturing activities (classified as 'Manufacturing not elsewhere classified'). This is followed by Fishing (17%), Agriculture (11%) and Public administration (10%). Table 6 shows that the first three sectors have, on average, a relatively high footprint intensity per £: 1,255 g CO₂-e/£ for Fishing, 1,159 g CO₂-e/£ for Agriculture 775 g CO₂-e/£ for Misc. manufacturing.

These average emission intensities are only representative for a whole industry sector but not necessarily for a particular project. It is therefore important that the actual activity that was supported is taken into account rather than the sector to which support was provided. For this reason, the project spend table for the financial year 2007/08 was scrutinised and all major support activities, i.e. those over £150,000 or just over 50% of total project spend, were reclassified according to actual activity, if necessary. That way, a more accurate emissions profile can be attributed to the activity. The other half of project spend could not be reviewed in that way, leaving some room for uncertainty of allocation. However, this second half consists of a large number of projects in different sectors and therefore an averaging effect can be expected. As an example, Table 7 shows project spending recorded under the broad heading of the Fishing sector. Some of the activities clearly belong to other sectors and have therefore been reclassified to represent an appropriate emissions profile before the Bottomline³ analysis was undertaken. For

example the "ongrowing of halibut juveniles" will involve animal husbandry which has an emissions profile more closely associated with agriculture than fishing.

Table 7: Sector classification of HIE support projects related to the fishing industry
(Only projects with costs of more than £100,000 have been included. Client names and actual project costs are not disclosed.)

Project Description	Emissions Profile / SIC Tier1 Name
Construction of Net Stores	Emissions profile of Construction
Relocation of business	Emissions profile of Construction
Ongrowing of halibut juveniles	Emissions profile of Agriculture
Factory modernisation and upgrade	Emissions profile of Construction
Purchase Fishing Vessel & Gear	Emissions profile of Fishing
Purchase Fishing Vessel & Gear	Emissions profile of Fishing
Purchase of Catamaran	Emissions profile of Fishing
Contribution to Scottish Aquaculture Research Forum	Emissions profile of Fishing
Expansion of Migdale Smolt Ltd	Emissions profile of Construction
Sea-urchins and Seaweed Cultivation	Emissions profile of Fishing
Expand Organic Salmon Fish Hatchery	Emissions profile of Construction
Purchase Fishing Vessel & Gear	Emissions profile of Fishing
Purchase Fishing Vessel & Gear	Emissions profile of Fishing
Purchase of workboat	Emissions profile of Fishing
BSU - Fisherman	Emissions profile of Fishing

Similarly, HIE investments in the Electricity sector in 2007/08 were mostly in renewable energy technologies (e.g. geothermal power) and were therefore treated in the analysis as if they were expenditure on green electricity supply.

Benchmarking

The impacts per £ spent on support can be compared with those from the national (UK) sector "Public administration and defence" (PAD). The result of this comparison is shown in the spider diagram below.

Data on total expenditure and on-site emissions from the UK sector PAD is available from the Office for National Statistics.⁴ When expressing 'the footprint performance' of HIE's investment activities as total emissions per £ spent, a comparison with the sector benchmark becomes possible. Figure 8 below show the results of this comparison.

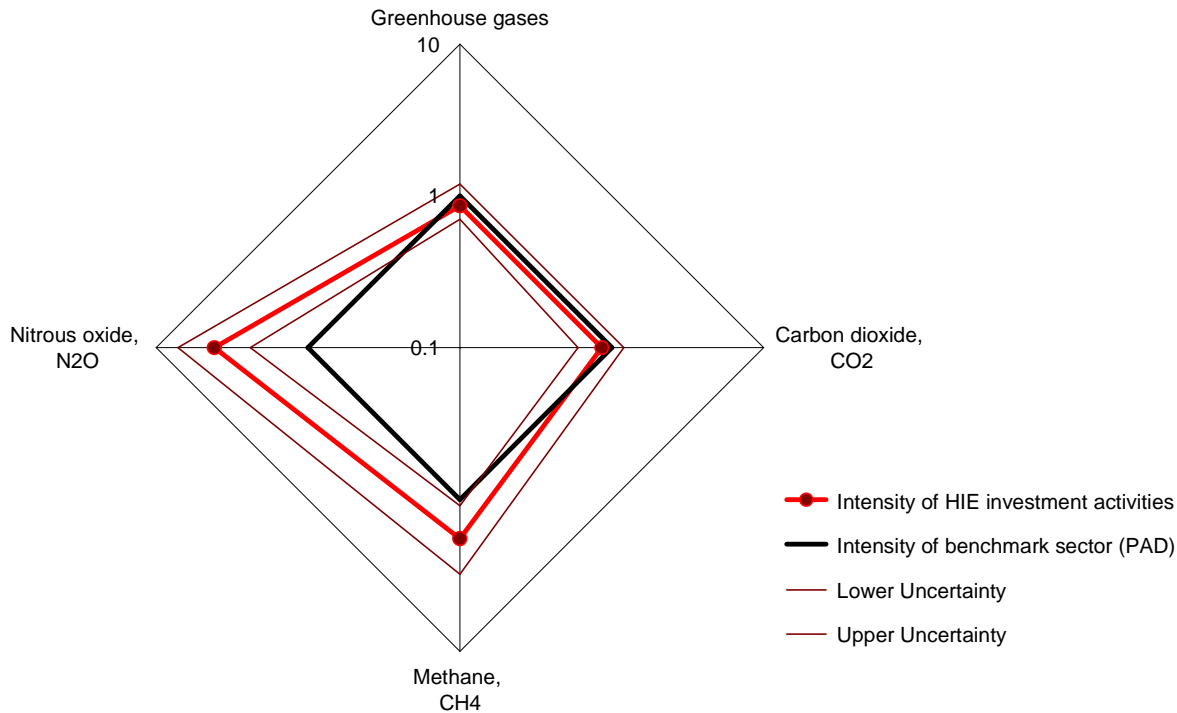


Figure 8: A spider diagram presentation of total (direct + indirect) greenhouse gas emission intensities of HIE's regional investment activities. The thick red line shows the relative impacts of investment for each greenhouse gas. The regular polygon in the centre of the diagram (thick black line) shows the average performance of 'Public Administration and Defence' in the UK. A performance better than average is closer to the centre ("the smaller the area encircled by the red line, the smaller the footprint").

For most carbon dioxide and total greenhouse gases, the relative impact per £ is the same as the national average for PAD (within the range of uncertainty). Relative impacts are higher for methane and nitrous oxide, for which the emissions per £ figures are significantly higher than average. This is mainly due to HIE's support of agriculture where most CH₄ and N₂O emissions occur.

The meaningfulness of such a comparison is debatable. As mentioned above, all impacts assigned to regional investment occur in the supported companies and organisations and are not in any way

⁴ Similar benchmark data should be available for a comparable sector in Scotland. This would allow a more regionally specific comparison of performance. However, it was beyond the scope of this project to investigate this question any further.

related to HIE's internal activities. A reduction of impacts and impacts per £ spent can only be achieved through the redirection of grants to sectors with low relative (per £) impacts.

The analysis above is however useful to provide evidence for the potential of emissions that can occur through HIE's support activities. In combination with other indicators this information could be used to optimise funding for wider economic, social and environmental benefits.

Recommendations

- There is one clear impact area that stands out from HIE's internal carbon footprint: business travel. Flying and driving together make up almost half (48%) of HIE's internal carbon footprint and total travel emissions have gone up by 3% from the previous year. Measures taken to reduce business travel have the potential to reduce the overall footprint significantly.
- Compared to the previous financial year, there is a shift in emissions from flying towards driving. An apparent decrease in flights seems to have been counteracted by more car travel. It is therefore recommended that HIE considers telephone and video conferencing wherever reasonably possible as an alternative to travelling. HIE should also investigate how it can encourage staff car travel in lower emission vehicles.
- Another significant component is the direct use of natural gas for heating and options how to decrease this demand should be investigated further.
- Further research could be undertaken in the area of HIE's regional investment footprint. As the example of the fishing sector shows, it is important to classify the financial support by actual activity and it might be worthwhile to measure the actual emission profile of specific activities.

Appendix A: Methodology

Background

Recently the calculation of embodied GHG emissions has prominently featured in the public debate and on the policy level. For example, Tesco, the biggest retailer in the UK, has announced to put carbon labels on every one of its 70,000 products and has put money towards the development of a methodology, which enables the determination of the embodied carbon emissions of its goods and services. At the same time the Carbon Trust has started developing a carbon labeling approach for products in cooperation with various stakeholder groups and put efforts into the development of a standard methodology for the estimation of the carbon footprints of goods and services in the UK (PAS 2050)⁵. Similar efforts to calculate the life-cycle climate change impacts of products have mushroomed in other countries and the wider international life-cycle assessment (LCA) community.

However, there is confusion as to how exactly the carbon footprint should include and how it can reliably be quantified. The Stockholm Environment Institute and the University of Minnesota have recently carried out a thorough review of methodologies for the PAS 2050 on behalf of Defra. The report⁶ is a review of methodological options to estimate product life-cycle GHG emissions ("product carbon footprints"). The main conclusion is, that in order to enable embedded emissions measurement to be used for applications requiring a high level of robustness and comparability, e.g. product labelling, an ISO-compliant Hybrid LCA was deemed the most suitable method. A key reason for this was that this includes the supply chain flows picked up in input-output analysis but which is cut off in Process-LCA due to system boundary limits.

Introduction to Carbon Footprinting and Terminology

The **carbon footprint** takes a 'consumption perspective'. This means that it does not just measure the carbon dioxide emissions generated 'on-site' from the burning of fossil fuels but it takes a more holistic view and also accounts for emissions that are generated somewhere else in the country or even somewhere else in the world when goods or services are consumed. In this respect the term 'footprint' can be seen as a synonym for 'life cycle', meaning that all indirect emissions occurring during the life cycle of a product or service are taken into account. Such a comprehensive perspective allows identifying the 'carbon hotspots' in an organisation's operations and prioritising actions for an effective climate change strategy.

⁵ <http://www.bsi-global.com/en/Standards-and-Publications/How-we-can-help-you/Professional-Standards-Service/PAS-2050/?id=89725>

⁶ Links to the report: <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=15520#RelatedDocuments> and <http://www.bsi-global.com/en/Standards-and-Publications/How-we-can-help-you/Professional-Standards-Service/PAS-2050/PAS-Current-Status---regular-updates-to-be-provided-by-BSIDefraCT/>.

We define the '**carbon footprint**' as a measure of the exclusive total amount of carbon dioxide emissions that is **directly and indirectly** caused by a human activity or is accumulated over the life stages of a product (Wiedmann and Minx 2008). This includes activities of individuals, populations, governments, companies, organisations, processes, industry sectors etc. Products include goods and services. In any case, all direct (on-site, internal) and indirect emissions (off-site, external, embodied, upstream, downstream) have to be taken into account. If other greenhouse gases (GHG), such as methane or nitrous oxide, are added to the carbon footprint we call the resulting measure a '**climate footprint**' in order to express its purpose: to indicate the combined global warming impact of various emissions.

Carbon footprint accounting is still a young area of research and only very few organisations have ventured into measuring their total carbon footprint from a life-cycle perspective. Most studies have so far focussed on the direct (on-site) emissions only. This work is a novel and ground-breaking attempt of a truly comprehensive assessment of the total carbon and climate footprint of an organisation such as Highlands and Islands Enterprise.

Requirements

An organisation such as HIE is embedded in a complex web of suppliers and clients, each of which contribute their own GHG emissions to the total impact. Calculating the total resource use impacts (the "footprint" in short) of HIE has therefore to fulfil certain requirements. It must take into account the '**on-site**' impacts such as **direct emissions** from heating premises or driving vehicles, equivalent to 'Scope 1' of the Greenhouse Gas Protocol (WRI and WBCSD 2004). It must also take account of **indirect emissions** that are embodied in all the products and services purchased by HIE, for example electricity ('Scope 2') or office equipment etc ('Scope 3'). The approach that we have applied in this project has proved to fulfil both requirements in numerous studies and covers all three scopes in a consistent, comprehensive and comparable manner.

It is a relatively easy to calculate direct emissions. A set of standard coefficients have been published by DEFRA that are taken from the International Panel on Climate Change (IPCC). We have used these coefficients to convert the total use of natural gas and petrol/diesel by HIE into the associated GHG emissions.

A crucial characteristic of the carbon footprint, however, is the inclusion of all **indirect emissions** embodied in supplies on top of direct, on-site emissions of HIE. There are considerably more methodological difficulties when estimating indirect emissions. This aspect gains a particular importance and precariousness when it comes to carbon offsetting. It is obvious that a clear definition of scope and boundaries is essential when projects to reduce or sequester CO₂ emissions are sponsored. When accounting for indirect emissions, methodologies need to be applied that avoid under-counting as well as double-counting of emissions.

Why is it important to include these indirect emissions? An ideal accounting system must trace all the interactions that took place to produce a product or service. In the case of HIE, it is the support and regional investment that is of service to the regional economy. HIE is merely part of an "integral chain" in this economy. No company works in isolation and to account for its direct impacts only will always provide an underestimate of the costs and benefits associated with its wider actions.

The methodology used in this study does exactly that; it takes into account all the indirect emissions of HIE. The methodological approach used is an Environmental Input-Output Analysis (EIOA).

Our approach: Environmental Input-Output Analysis

The calculation model used in this project is based on an environmentally extended input-output life-cycle analysis (EIO-LCA) on the national (UK) level, using official data from the ONS National (economic) Accounts and ONS Environmental Accounts. This means that all results are fully consistent with standard accounting and fully comparable amongst each other. The sophisticated methodology is based on year-long scientific research, has been field-tested over five years, has been published in numerous journal articles, and has recently been incorporated into a software tool named Bottomline³ (www.bottomline3.co.uk).

The comprehensive nature of EIO-LCA means that the whole (UK) economy, including imports and exports, are the system boundary, which is a major advantage to a life-cycle analysis based on Process Analysis (PA) where only on-site, most first-order, and some second-order impacts are considered (Minx et al. 2008). This truncation of the system boundary in PA-based LCA can lead to a significant underestimation of the true impact (boundary problem). Using input-output analysis, the error caused by this truncation can be avoided. Process analysis on the other hand is more specific to individual products or services, a level of detail which is not easily achievable with the top-down approach of input-output analysis.

The software tool Bottomline³ was developed at the University of Sydney and has been adapted to the UK economy by ISA^{UK} Research and Consulting. This tool is based on a static, single-region, open, basic-price, 76-sector industry-by-industry input-output model of the UK economy, augmented with a database of environmental, social and economic indicators. Bottomline³ provides total (**direct + indirect**) impact quantification, sector benchmarking, supply chain analysis, production layer decomposition and quantification of 'shared responsibility' for over 100 economic, social and environmental indicators.⁷ Most importantly, a direct and valid comparison is possible between company/organisation, sector and national economy performance.

Whatever method is used to calculate carbon footprints, it is important to be aware of double-counting along supply chains or life cycles. Direct emissions of one agent are indirect emissions of another and vice versa. For example, if a power plant operator reports its emissions as direct (on-site) emissions and purchasers of electricity (such as HIE) report them as indirect emissions, then they are double counted. In this report, the full direct and indirect emissions are presented in order to show the full scale of climate impacts. However, one has to bear in mind that HIE cannot be held responsible for all of these emissions alone and that some of the indirect emission might be reported by other businesses.

The correct way of dealing with this issue is to apply the concept of shared responsibility and split the emissions between agents of a supply chain (Lenzen et al. 2007; Wiedmann and Lenzen 2006). This is not least because there are significant implications on carbon trading and carbon offsetting.

⁷ The model framework is described in (Foran et al. 2005a) with a summary available in (Foran et al. 2005b). A short summary of the methodology can also be found in (Wiedmann and Lenzen 2006a) and further details are available from <http://www.isa.org.usyd.edu.au/publications/index.shtml> and from <http://www.isa.org.usyd.edu.au/research/tbltwo.shtml>.

If carbon emissions were to be traded or offset, a shared responsibility approach needs to be applied.

Appendix B: Data Preparation

Data requirements

Two types of input data are required for our carbon footprint approach, **financial accounts** and **on-site fuel use data**.

Financial accounts include all expenditure (and revenue) data from one financial year, e.g. spending on (purchasing of) equipment, materials, furniture, computers, food, etc but also services like transport, insurance, banking & financing, legal advice, research etc. We match the data from HIE's financial accounts to the standard 82 sector categories in Bottomline³.

Data for direct (on-site) energy consumption include fossil fuels needed for heating and vehicles and are most useful in physical units (e.g. kWh of gas).

HIE's financial data

Detailed expenditure data for the financial year 2007/08 (April 2007 to March 2008) was provided by HIE. The breakdown into about 60 categories of expenditure and about 10 categories of revenue was well suited for the analysis.

The expenditure data were manually allocated to one of the 82 sectors in the Bottomline³ tool.⁸ HIE was consulted on the allocation, as for some categories (e.g. 'travel and subsistence') an allocation to several sectors is appropriate. One peculiarity of HIE operations is that 80% of its expenditure is on external regional investment, such as business support, business advice, developing skills, strengthening communities, etc. Only 20% of HIE's expenditure is on goods and services used for internal activities, including salaries. It was therefore decided that the carbon footprint analysis should distinguish two cases:

- **HIE's internal activities:** analysis of expenditure that HIE allocates to running the organisation.
- **HIE's external regional investment:** analysis of HIE's financial engagement with customers.

HIE's fuel consumption data

Energy use data for natural gas and electricity for 2007/08 was provided by HIE, broken down by office building (only four offices use gas for heating, the rest uses electricity; no heating oil is used). No temperature (weather) correction was carried out in order to reflect the actual amount of carbon emitted. Natural gas consumption in kWh was converted into direct CO₂ emissions by

⁸ As Bottomline³ uses economic transaction data from the year 2000, prices were corrected for inflation by using consumer price indices by commodity group. As physical data on electricity consumption in kWh (deemed superior to financial information) was available, expenditure on electricity was also adjusted accordingly (see <http://www.berr.gov.uk/energy/statistics/publications/prices/tables/page18125.html>).

using conversion factors from Defra (DEFRA 2007). The total of 1,021,214 kWh of natural gas thus equate to 194 tonnes of direct (on-site) CO₂ emissions.

Fuel consumption by vehicles (petrol and diesel) was estimated from detailed mileage data provided by HIE. Both, private car use and hire car use was included in the analysis.

Total private car business miles claimed by HIE network staff was 842,899 miles (1,356,224 km); trips in hire cars added up to 235,030 miles (378,163 km). The total of 1,734,388 km is equivalent to around 381 tonnes of direct CO₂ emissions, if an average emission factor of 220 g CO₂ / km is assumed (see <http://www.vcacarfueldata.org.uk>).

In the analysis, all direct emissions were allocated to HIE's operations, not to the services HIE provides, i.e. they appear under 'Internal Activities' not under 'Support Activities'.

Appendix C: References

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