Footprint North West

A Preliminary Ecological Footprint of the North West Region

Contents

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Action for Sustainability
Action for Sustainability (AfS) is the regional sustainable development framework for the North West of England. It was adopted on behalf of the region by the North West Regional Assembly in 2000. AfS provides the framework for delivering regional priorities in a more integrated and sustainable way. The North West Development Agency, Government Office North West, and the Environment Agency (NW Region) have all signed concordats with the Assembly to take forward the principles and priorities identified in Action for Sustainability.

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For more information on this project please refer to:
www.actionforsustainability.org.uk

Foreword

We all strive to make a good impression on those around us, but what about the impression we leave on the planet?

As a region, our footprint on the world, the impression we create, is much greater than our average share of available land. We are quite simply living beyond our means. If everyone else in the world had consumption patterns like us in the North West, we would need more than three planets to sustain our lifestyles.

The industrial revolution left its toll on the North West. The pressure put on our natural resources is plain to see in the quality of our rivers and wild places, as well as our urban green space. However, we are making progress to improve the quality of life which the region enjoys, and this includes making good progress to improve the quality of our environment. Investment in waste water treatment, innovative methods of utilising waste products, and increasing use of renewable energy have contributed to these improvements.

The ecological footprint approach demonstrates the extent of land and sea resources which we will require to continue our current level of consumption. The footprint shows how our everyday activities contribute to the impression we leave on the planet. Our regional footprint is made up of things we can all relate to – energy, transport, food, shelter, household goods – things we all take for granted.

The regional sustainable development framework, Action for Sustainability, is a framework within which regional partners can work towards addressing these issues in a more integrated and mutually reinforcing way. We need to ensure that our environmental, social and economic policies work together to improve our quality of life, whilst ensuring that we lessen our impact on the world's resources.

In responding to this footprint as a region, we need to not only acknowledge our impact, but also ensure that regional policy supports us in striving to decrease this impact. Assessing how the region's footprint increases or decreases in future will be an important measure of whether the region is heading in a more sustainable direction. And it is a measure for which we must all take responsibility.

Cllr Derek Boden
Leader: North West Regional Assembly
Chair: Action for Sustainability Management Board

1 Introduction

1.1 What this project has set out to do – A contribution to 'Action for Sustainability'

This study has been carried out as part of 'Action for Sustainability' (AfS), the regional sustainable development framework for the North West of England. AfS was adopted on behalf of the region by North West Regional Assembly in 2000 (for more information please refer to: www.actionforsustainability.org.uk). The ecological footprint is an important part of this programme, and can fulfil a number of roles:

- to generate greater awareness of the issues around sustainable development;
- as a measure of progress against regional objectives; and
- to develop further regional priorities to be addressed in future action plans.

The project described in this report focused on measuring the environmental impact of the residents of the North West region. This was placed within the context of the UK and compared with data on the South East region for the baseline year of 2000. As a measure, a preliminary calculation of the impacts of consumption in the North West has been carried out and has been put in context of trends and targets, and related to the current policies and future opportunities for improvement. The study included the following steps:

- The entire throughput of materials and energy in the North West was analysed. This is known as a Material Flow Analysis (MFA). Using the results from the MFA, an ecological footprint (EF) was calculated, taking into account the total land area needed to sustain the consumption of the North West.
- The MFA and EF results were analysed and compared to national and other regional figures.
- Current trends were then scrutinised and scenarios were developed to explore alternative future pathways.
- The implications for policies and strategies on a regional level were presented and discussed, with the over-arching question – if the North West region is going to achieve its aspirations for environmental sustainability, as measured by the EF method, what measures would need to be taken?

The results of this study are presented in a manner that enables the identification of priorities and are intended to be used in a number of ways:

- as a key reference point for monitoring the progress within the region, especially within the Action for Sustainability framework;
- to provide data to inform policy decisions;
- to investigate ways to reduce the North West's global impact; and
- to act as an educational tool to inform individuals of the impact of their consumption and lifestyle choices.

All results from this study should be seen as a starting point or baseline for the AfS programme. A more detailed and sophisticated environmental analysis of the North West, involving a physical input-output method, is forthcoming with the ongoing research

projects "Eco-Region NW" and "Ecological Budget UK" due for publication in 2005. More information on these projects can be found in Chapter 11.

A similar study has recently been undertaken for the South East region ("Taking Stock – Managing Our Impact. An Ecological Footprint of the South East Region", Barrett et al, 2003). The same methodology has been employed in this study enabling a comparison of the results for the North West with those of the South East and the UK as a whole. In order to ensure direct comparability between NW, SE and UK results, the year 2000 was chosen as the base year for all data (the full technical report including all calculations, data sources and assumptions can be downloaded from the "Taking Stock" website: www.takingstock.org).

This report is structured as follows:

After a brief introduction into the methodologies employed in this study (chapter 1.2) the framework for trend and scenario analysis is described (chapter 2). The main findings of this study are presented in chapter 3 providing an overview of the current performance of the North West. Chapters 4 to 9 go into more detail: the results for each of the components that were studied are presented and analysed including prospects of sustainable development within each area. Chapter 10 draws the conclusions of this study and offers options on how to proceed. Chapter 11 includes more information on related research, a glossary and the references to this report.

The Appendix to this report includes all results in table format, a more detailed description of the MFA/EF methodology and further background information. However, the Appendix is not included in this brochure but has been made available as a separate document for downloading on the Action for Sustainability website (www.actionforsustainability.org.uk).

1.2 Concept of the ecological footprint and Material Flow Analysis

There is a limited amount of productive land on the planet to provide for all humanity's needs and wants. Sustainable development requires that we live within the carrying capacity of the earth, allowing our economies to develop while ensuring that basic human needs such as food, clean water, shelter and warmth are provided for everyone. This is becoming increasingly difficult due to population increases, and it is exacerbated by the inequalities that exist between rich and poor nations. The World Watch Institute have estimated that the 12% of the world's population living in North America and Western Europe consume over 60% of global resources (WWI, 2004).

The ecological footprint (EF) has been developed as a combined measure of total environmental impact (similar to Gross Domestic Product (GDP) in economic terms). The EF is based on the area of land needed to provide raw materials and crops and to absorb pollution and waste from consumption in a given area. The EF is measured in a standardised area unit equivalent to a world average productive hectare or 'global hectare' (gha), and is usually expressed as global hectares per person to permit comparisons between countries or regions (unit 'global hectares per capita' or gha/cap). The numbers always refer to one year. Often the ecological footprint is divided into 'land footprint' and 'energy footprint' (see Box).

Land footprint: The land footprint includes the area required to produce all the crops, the grazing land required to provide meat consumption, the forest land required to produce forest products and the fishing ground required to produce the fish and seafood products consumed by people living in a defined area.

Energy footprint: An energy footprint represents the area required to sustain energy consumption. This includes the energy used directly by households and services in the region and the indirect energy to produce goods imported and consumed within the region. The footprint is calculated as the area of forest that would be required to absorb the resulting carbon dioxide emissions, excluding the proportion that is absorbed by the oceans.

The benefit of the EF approach is that it assesses the impact of consumption from a consumer perspective, i.e. it takes into account the impact of the residents within a defined boundary rather than the industries located there.

Globally, the average ecological footprint per person was 2.3 gha/cap in 1999 (the most recent year for which data has been calculated) – as opposed to an available estimated capacity of 1.9 gha/cap (excluding biodiversity considerations) – suggesting that humanity is using more natural resources than can be sustained in the long term (WWF, 2002). If the world's total population was to live at the level of affluence of the UK, i.e. at about 6.2 gha/cap, we would need 3–4 planets to sustain our lifestyle.

A complementary approach to the EF method is an assessment of resource flows within a defined boundary, termed a Material Flow Analysis (MFA). This looks at the material inputs to a region in terms of raw materials and products and at the outputs in terms of waste and emissions. The analysis focuses on the consumption of goods and services by households and the commercial sector, including materials directly used and consumed, but also 'hidden' material flows including ores and wastes from extraction or harvesting, energy used for extracting, transporting and producing materials and greenhouse gas emissions from energy use.

As a result of the MFA and EF analysis a number of main physical indicators have been generated:

- **Ecological footprints** (EF), measured in 'global hectares per capita'.
- **Carbon dioxide** (CO_2) **emissions** as the largest single cause of climate change.
- **Direct Material Consumption** (DMC) which is the total amount of materials directly used in the regional economy and consumed in the region, including imports but excluding exports.
- **Total Material Consumption** (TMC) which is the total material use associated with the regional consumption activities, including DMC and the indirect or 'hidden' material flows associated with it.

These indicators help to understand and measure the environmental pressures caused by consumption. Collaboratively they provide a comprehensive indicator for ecological sustainability, enabling us to determine whether we are living within the capacity of the earth's biosphere to regenerate itself, or if we are depleting the stocks of natural capital on which we depend.

For a more detailed description of the methodologies employed in this project please refer to the Appendix which can be downloaded from the Action for Sustainability website (www.actionforsustainability.org.uk).

2 What does the future hold?

Calculation of the ecological footprint of the North West produces some interesting numerical data. However, the most significant application of EF data enables us to look at current trends and alternative future pathways, thereby raising vital questions. These include: Where are we heading? What targets should we aim at? And, what do we need to do to achieve them?

2.1 Status quo and current trends

Economic environment

The North West is vibrant and diverse. It is home to millions of people and many businesses, resulting in a region with a size and scale that makes it an important force in the UK. With over a quarter of a million businesses, the North West accounts for over 11% of the UK's total business base. In the last four years the gap in growth between the region and the UK has narrowed, and in 2001 the North West out-performed the UK economy as whole. This helped Gross Value Added per capita in the region to reach just short of 90% of the UK level in 2001. The region remains relatively dependent on more traditional manufacturing, such as chemicals and transport equipment, and is under-represented in some higher growth sectors such as business, financial services and electronics.

The Key North West Economic Forecasts expect to see the regional economy growing at, or close to, 2% a year from 2003 to 2006. This is better by a clear margin of 0.3 percentage points than the average achieved by the North West through the 1990s, however, structural differences explain why this will not be enough to keep up with the UK as a whole. With house price inflation slowing, and weaker commercial property markets, the North West construction sector is set for much slower growth by 2005. Despite this, construction and the public sector are expected to be key drivers of regional growth in 2004 and 2005. Longer term trends are difficult to define, but might be expected as somewhere between 2.25–3.00% per year growth in GDP. The shift to services is likely to continue in the region as elsewhere, with a reduction of primary and manufacturing employment towards 15% of the total.

The North West is home to 6.9 million people, making up 2.8 million households. It has the second largest population of the UK's regions as well as being three times more densely populated than the European average. Despite this, the population of the region has reduced since the 1970s which can be linked to the out-migration of residents to more prosperous regions in the South. It is presently bottoming-out, with current projections of a slight rise over the next 20 years. Over that period the proportion of the population who are children aged 5–15 may reduce from 15% to 12%, and the proportion aged over 65 (males) or 60 (females) may increase from 19% to 22% – significant, but not quite the demographic time-bomb of the headlines.

Urban and rural environment

The North West region covers an area of over 1.4 million hectares and includes 5 sub-regions and 46 local authorities. Although the majority of the population live in the large

and highly urbanized metropolitan core (Merseyside and Greater Manchester), 80% of the land area is defined as rural. The region possesses 1000 km of coastline and almost 11,000 hectares of lakes and open water. The North West contains 11% of the UK's land area of which 26% is national park and 15% is green belt making it second only to the South East. There are 454 Sites of Special Scientific Interest (SSSI) covering 14.1% of the region compared to the national average of 7.58%.

The Regional Planning Guidance projects a house building rate of 12,790 new houses per year (net of clearances), which if continued over 20 years would total 257,800 dwellings, slightly higher than the projected household increases. Commercial building continues at approximately 1–2% of the building stock per year. About 63% of new development is on recycled land, short of the regional target of 70%. Derelict land is set to remain at its current level of 4.3% of the total, while the current vacant housing total will remain consistent at about 130,000 dwellings.

Greenhouse gas emissions are increasing mainly due to transport growth and energy for commercial and public services. Road traffic is roughly in line with national projections, i.e. air travel continues its exponential growth, with Manchester airport continuing to double in size every decade. Waste arising from households continues to grow at about 3% per year, while commercial and industrial waste is almost static in volume.

2.2 Scenarios for the ecological footprint

Scenario outline

Scenarios are 'what if' explorations of future possibilities. They do not aim to be forecasts. They generally combine numbers and words (narratives), and often pictures or other media. There are different types of scenarios, depending on their applications, whether visioning, strategic planning, risk assessment or target setting. The three most common forms of scenarios consider:

- What is **probable** – generally, the 'business as usual' or default projections.
- What is **plausible** – this can take the form of a worst case, high risk scenario.
- What is **preferable** – the desired vision of 'success' or 'sustainability', as far as this can be defined.

This range of scenarios can then be framed in terms of higher or lower economic growth, technological advance, climate change or any other factor.

A range of footprint scenarios

In this project we have arranged the scenarios around different rates of change in the ecological footprint, rather than any other economic or social factor. Each scenario assumes changes in the world outside the region which cannot be explored here. It also puts together a whole range of factors: social, technological, environmental, economic, political, and values (the 'STEEPV' system used in foresight activities (PIU, 2001)).

The 'F' in the following scenarios refers to the factor of ecological efficiency. For example, Factor Four (F–4) refers to the concept of doubling resource efficiency, while halving

resource use (von Weizsäcker et al., 1997). The titles in brackets are those of similar scenarios from the UK Environmental Foresight programme (SPRU, 2002).

- ***F–0: HI-GROWTH (Market rules):*** 'American model' with an economic growth dynamic, deregulation and liberalization, corporate globalization, big government, cultural rigidity, wealth-poverty divisions, technological and environmental change and hazard as generators of market opportunities, in a business-led framework.
- ***F–1: 'BUSINESS AS USUAL' (Global governance):*** 'European model' with a governance and institutional dynamic, networks for social and economic organization, rational management of technological/environmental opportunities and risks for social responsibility, within a strong state framework.
- ***F–2: LOW GROWTH (Regional autonomy):*** 'Environmentalist model' of vulnerability and hazard, environmental and technological change and risk as the generator for social and economic change, in a context of dysfunctional and divisive problems, insecurity, paranoia and competition.
- ***F–4: FACTOR FOUR (Local communities):*** 'Communitarian model' of social cohesion, self-determination, local economy, cultural diversity, moderate technological and environmental change as the generator for social solutions ('local stewardship').

In this preliminary study we have focused on two scenarios in particular: the F–1 'business as usual' and the F–4 Factor Four efficiency scenario. The first shows what is probable, in terms of expectations and projections of current trends and the second shows the aspirations and goals, centred on a single target.

For the Factor Four scenario the time horizon is crucial. We suggest here that the IPCC[1] recommendations on reduction of greenhouse gas emissions be taken as the benchmark, i.e. 60% reductions by 2050. If we take into account global equalization between rich and poor nations, then the benchmark, or Factor Four improvement, is in the region of 75% reductions. Working to a time horizon of 2020, equivalent to many regional strategies, this equates to a reduction of 35%, which appears more achievable.

The implications of each of these scenarios for each sector, as measured by the total ecological footprint, are explored in the sections to follow.

1 Inter-governmental Panel on the Scientific Assessment of Climate Change (2001).

3 Summary of results

The overall results and a broad analysis have been presented in this section, however the following chapters focus on specific policy areas, including food, energy, household consumption, construction, transport and public services. From the economic perspective, the separation into sectors is in a sense artificial, as each sector is inter-dependent on others. This is, however, useful in terms of organizing and reporting the findings and in terms of informing regional policy. From the social perspective, the use of footprinting is perhaps most useful as an input to a wider discussion on quality of life and the social processes which may enhance it. The footprint results help raise awareness and provide a useful conceptual tool to explore consumption choices.

This study has been based on 'consumption' rather than 'production' in order to capture the resource use and impacts on the environment that the residents of the North West generate via their direct consumption. This consumption may include goods produced in the region, or goods produced outside the region and then imported. Their environmental impacts may be anywhere in the world. Meanwhile there are many industries in the region which export some or most of their production; for these industries, only the part which is consumed in the region is accounted for in this study.

Key results

- The ecological footprint (EF) of the North West region in 2000 totals 43 million global hectares (gha). This equates to 6.2 gha per resident.
- The highest single footprint component is food consumption in households with 1.4 gha/cap.
- The carbon dioxide emissions add up to 125 million tonnes for the North West in total or 18 tonnes per capita (the volume of which is equivalent to 1,800,000 balloons per person per year).
- The direct material consumption (DMC) adds up to 66 million tonnes or 9.5 tonnes per capita. If hidden flows are taken into account as well, the total material consumption (TMC) is 160 million tonnes which equates to more than 23 tonnes per capita.

3.1 Results

The overall ecological footprint of the North West region is 43 million global hectares (gha). This is 30 times greater than the actual land area of the North West (1.4 million hectares). Although these two numbers are not directly comparable their magnitude shows clearly that much more land area is required to satisfy the demands of consumption in the North West than is available within the boundaries of the region. On a per capita basis the ecological footprint is 6.2 gha/cap which is the same as the total footprint for the UK but significantly lower than the South East (6.8 gha/cap). Despite this, when compared to the available global capacity of 1.9 gha per person, we can see that if all the world's population were to live like the average North West resident we would need more than three planets to sustain this level of resource consumption (see also Figure 3.1).

Household food production, supply and consumption is the highest single component of the total ecological footprint at 1.4 gha per person and accounts for the second highest CO_2 emissions per capita. Other components with high ecological footprints are construction (1.0 gha/cap), commercial services (0.85 gha/cap) and freight transport (0.71 gha/cap) followed by energy consumption in households (0.62 gha/cap).

The Direct Material Consumption (DMC) for the North West region in 2000 was 66 million tonnes, which equates to 9.5 tonnes per person. The Total Material Consumption

was 160 million tonnes, or 23 tonnes per person. The North West DMC and TMC is 10% lower than that of the South East. The largest single component of DMC is the construction sector, with 35 million tonnes per year of bulk materials.

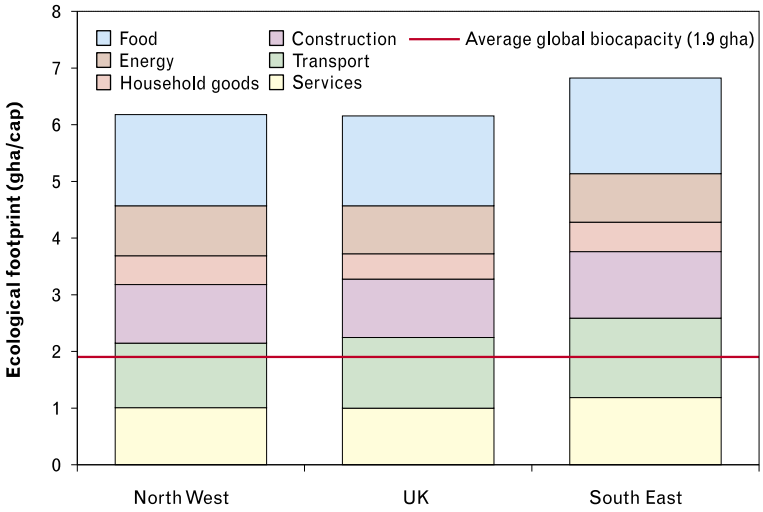


Figure 3.1 Total ecological footprint in the North West, UK and South East

Total carbon dioxide emissions due to consumption by the region are 125 million tonnes per year. These are the emissions involved in delivering the level of affluence of the North West region. Each person in the North West is responsible for 18 tonnes of CO_2 through their consumption of materials and fossil fuels. When released into the atmosphere, these 18 tonnes take up more than 9,000 cubic metres, which is approximately equivalent to the volume of 1.8 million balloons. Not all of these emissions occur in the North West, however, as this number also includes 'embodied' emissions of products that are imported to the North West region but may have occurred in other parts of the world.

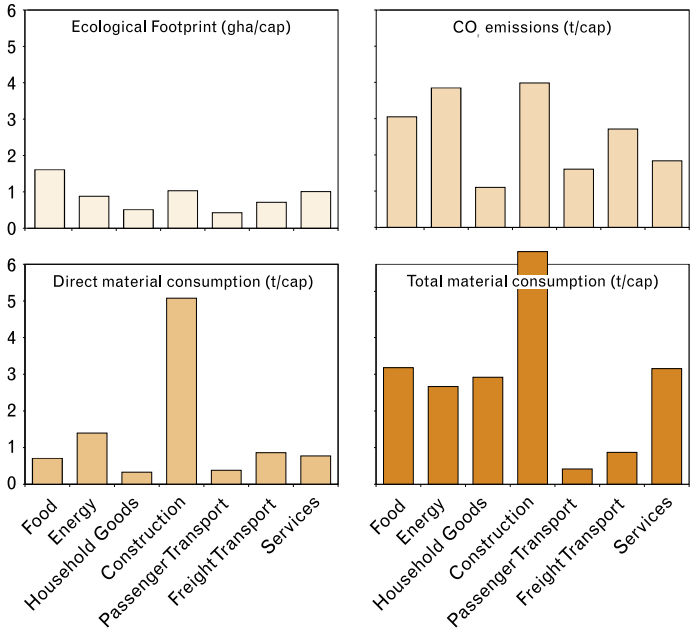
The biggest contributions to climate relevant emissions come from transport and construction. If passenger and freight transport are taken together, they account for the highest CO_2 emissions of 4.3 tonnes per person and a footprint of 1.1 gha/cap. Nearly 30 million tonnes of CO_2 were released by all transport in the North West in 2000, however the material flows (DMC, TMC) of transport are relatively low with 1.2 and 1.3 tonnes per person, respectively. Construction activities account for 27 million tonnes of CO_2 emissions, or 4 tonnes per resident. Household food, energy consumption and freight transportation are other sources for CO_2 with around 2.7 tonnes per capita each.

In contrast to the CO_2 from consumption, the CO_2 from production (i.e. from direct fossil fuels use and industrial production in the region) is less than half that figure, at 53.6 million tonnes per year, (6.7 tonnes per person). This shows that the global impacts of consumption are more than twice the direct impacts of production in the region. The implication is that the UK and regional climate emissions targets and policies are falling a long way short if they do not address the global impacts of consumption.

Although great efforts have been undertaken to avoid the double counting of material flows, this has not always been possible. The food that is eaten out in restaurants, for example, also appears in the services component under 'hotel and catering'. In order to show a complete picture of both components this was not subtracted from the overall results. However, double counting is below 3% of the total.

Figure 3.2 shows a comparison of the total results by components (activity categories). The biggest impact in terms of DMC, TMC and CO_2 emissions comes from the construction sector. The total material requirements of this sector are significant, at 70 million tonnes (10t/cap), out of a total 160 million tonnes TMC.

Figure 3.2
Comparison of indicators by components



More detailed results for each component of the analysis are described in the subsequent chapters and can also be viewed in the Appendix to this report which is downloadable from the AfS website (www.actionforsustainability.org.uk).

4 Food

4.1 What has eating to do with sustainability?

The UK food system has changed significantly during the last fifty years, on the assumption that people want cheaper food, greater variety and non-seasonal food all year round. Farms have become larger and more mechanized and specialized, and the distance between food producer and consumer has increased. Food retailing has become concentrated within a small number of multiple retailers, with many stores located away from the traditional high street now accounting for over three-quarters of UK food sales. Take-away food and ready-to-eat meals have been introduced and are extremely successful. These changes have combined to greatly increase the resource consumption and environmental impacts of food supply.

For this study, the ecological footprints for over 50 food items were calculated. The embodied energy of food packaging was also determined and, for paper/card packaging, the forest land area required to grow the trees for pulping.

4.2 Analysis of food consumption in the North West

The ecological footprint (EF) of household food and drink consumption is 1.4 gha per resident, catering consumption 0.17 gha and packaging 0.07 gha, corresponding to over a quarter of the total EF from all activities. In contrast to other sectors the 'energy footprint' is of a very similar size to the 'land footprint', with values of 0.72 and 0.71 gha/cap respectively. In terms of the breakdown of food types, animal product consumption accounted for two thirds (67%) of the total EF from food and drink. Vegetable products account for 23% and drinks and packaging are responsible for 5% each.

Key results

- The EF of food and drink consumption in the North West totalled 1.6 gha, the single biggest footprint component.
- 20 million tonnes of raw materials were required to produce the 4.2 million tonnes of food consumed in the North West.
- Food consumption required over half a million tonnes of packaging.
- Almost one million tonnes of food and drink were never eaten and sent directly to landfill.

More than four million tonnes of food was consumed in North West households in 2000, equivalent to around 620 kg per person. The associated packaging weighed two thirds of a million tonnes, or 76 kg per person. Nearly a quarter of food and drink, 960,000 tonnes or 140 kg per person, goes directly to waste. The Total Material Consumption requirement (TMC) takes into account all the food that is lost during the process of getting a item from the field to the plate ('hidden' flows) and is much larger, with a value reaching almost 20 million tonnes in 2000, equating to 2.9 tonnes per person or 8 kg per day. The TMC for commercial and public catering is 2 million tonnes, or 330 kg per person.

The carbon dioxide emissions associated with food production and consumption totalled 21 million tonnes, this is more than 17% of the total carbon dioxide emissions that the region is responsible for.

When compared to the UK as a whole the patterns of food consumption in the North West are very similar, but when compared to the South East, the North West has a 8%

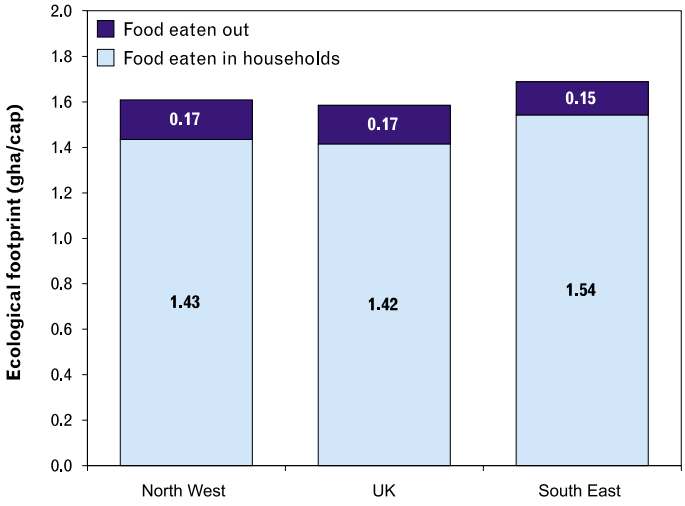


Figure 4.1 Comparison of the ecological footprint for food consumption

lower impact for food eaten at home (see Figure 4.1). In contrast, the impact of food eaten out of the house, such as in restaurants, is 13% higher in the North West.

4.3 Prospects for sustainable food systems

Current trends

Food production systems are in rapid flux at present, particularly with the reform of the Common Agricultural Policy (CAP) system of the EU. Factors that influence this study include:

- Consolidation into larger units of production, where these are competitive with EU and world markets.
- New forms of agri-industrial products, including pharmaceuticals and specialist chemicals.
- New forms of niche food/drink products and markets, such as local cheeses, fruits or wines. This is of particular interest to this project, because it would tend to localize the combined production/consumption of food and directly influence the EF of the food chain.

The great majority of residents of the North West region have sufficient food. Future trends are therefore more concerned with food quality, sources, supply chains, risks and health factors. For these there are few forecasting methods apart from the projection of current trends.

Key indicators of change

Key indicators of trends and prospects for the EF of the food system include:

- ***Imported %:*** the trend towards greater imported foodstuffs (from overseas) is set to continue, and the impact of CAP reforms on UK agriculture may well accelerate this process.
- ***Vegetarian %:*** this affects the balance between meat-based food (generally energy and land intensive) and others (less intensive).
- ***Organic production %:*** at present this covers 0.6% of food volumes by weight, but has been increasing by 15% per year over the last decade. There are different opinions on whether this trend will continue or level off.
- ***Chemical intensity:*** the inputs by weight of chemical fertilizers and pesticides have increased dramatically in the last 50 years. However it is likely that chemicals inputs by weight are likely to decrease as a result of precision agriculture and increased organic production.
- ***Packaging %*** (by weight): food packaging by weight has increased slowly, but more rapid is the shift from brown paper packaging to materials that are more energy intensive and less easy to recycle (plastics based on fossil fuels).

- ***Composting of food waste %*** (by weight): there is limited re-use of food for animal feed from institutional catering. The current levels of composting of food waste are a fraction of 1%. However the draft Regional Waste Strategy contains objectives to increase this.

Future scenarios

The main alternatives lie between a projection of current trends, and a rapid transition to a more low-impact food system:

- **'Business as usual' scenario (F–1)**: Based on a continuation of current trends, i.e. a rise in packaging, processing and imports, alongside a rise in vegetarian and organic production and food waste composting. The total food and drink EF would rise by 1% per year, equivalent to 18% by 2020 and 64% by 2050.
- **Factor Four scenario (F–4)**: This scenario represents a gradual adjustment towards a more sustainable, low-impact food system. Imports decrease, with more regional and organic production and greater diversity. Plant-based diets increase, accelerated by further food scares. Packaging becomes re-usable and recyclable and composting increases rapidly. EF for food and drink reduces by 40% by 2020 and 75% by 2050.

Policy implications

Regional policy has had little engagement with food issues since World War II, when the volume of production was the overriding priority. This is now changing and there are many more possibilities coming up for the Regional Economic Strategy and Regional Planning Guidance:

- ***Regional image and marketing*** – The Countryside Agency programme 'Eat the view' is a forerunner of more regional based food activity, already established in many EU countries.
- ***Food and drink production*** – as a priority sector for economic development. The industry is often low skill with high environmental impact, and the forthcoming CAP subsidies will tend to polarize between intensive and extensive production.
- ***Regional countryside policy*** – this may prioritize farm or land-related employment and intermediate labour market activity.
- ***Regional housing policy*** – may seek to encourage new forms of low-impact rural housing, in order to maintain populations and landscape quality, while avoiding the spread of commuter settlements.
- ***Regional landscape policy*** – in most areas the social or visual amenity is closely linked to the maintenance of a populated and diverse agricultural landscape.
- ***Regional climate change policy*** – the extra pressures put on the landscape and habitats by climate change may be ameliorated by a diversified and productive countryside.
- ***Regional health strategy*** – this is possibly a key to a more sustainable consumption of food, putting priority on organic, low fat and native foodstuffs.

5 Energy and water

5.1 Energy consumption and the environment

Energy is fundamental to the life of every region, but the current energy system is disrupting the global climate. This is possibly the greatest single threat to the global environment, a problem for which every nation and every region has to accept some responsibility and work together in a new kind of global order. The ecological footprint approach has much to offer to this agenda:

- It provides a common platform for comparing energy and infrastructure to other sectors.
- It provides a direct assessment of the impact of different energy futures and energy strategies on the global environment. The wider scope of a regional energy-climate strategy can only be sketched here.
- It includes 'supply-side' actions on energy fuels and markets as well as 'demand-side' actions on housing, transport and production.

Renewable energy sources and combined heat-and-power (CHP) are the long term energy sources of choice in the transformation of the regional energy metabolism. Success depends on linking a 'joined up' energy-climate strategy into housing, transport, regeneration and economic development

In this study, direct energy use by households and the commercial sector has been accounted for. This includes the analysis of the consumption of gas, electricity and other fuels. The CO_2 emissions and ecological footprints have been calculated for domestic lighting, cooking, heating, hot water and other electrical equipment power consumption by the residents of the North West. The energy required to supply all of the domestic mains water has also been considered. Transport energy is considered separately, as is the energy used during the production of goods consumed in the North West, termed 'embodied energy'.

Key results

- The total ecological footprint of energy and water consumption is 0.88 gha/cap.
- 93 billion kilowatt-hours (kWh) are consumed by residents and services within the region.
- Supplying energy to the region produces 3.8 tonnes CO_2 per year per person, 21% of the total CO_2 emissions.
- NW residents consume on average 139 litres of drinking water per day, one third being flushed down the toilet.

5.2 Analysis of energy and water consumption in the North West

The total ecological footprint of household energy is 4.3 million global hectares, or 0.62 gha per person. This equates to 10% of the total footprint per person. Total energy consumed in North West households per year is 69 billion kilowatt-hours (kWh), three quarters of which is gas. This energy supply produces 2.7 tonnes of CO_2 per year per person. Over half of the energy consumed in homes is for space heating, 18% is for cooking, lighting and appliances, and most of the remaining 24% for heating water. This consumption requires a DMC of 6.8 million tonnes and TMC of 12 million tonnes, or 1.7 tonnes per person. The 'hidden' flows of electricity consumption are high because hard coal is one of main energy carriers used to produce electricity in the UK and with every tonne of hard coal about 3.9 tonnes of overburden material is produced.

The total energy consumed in commercial services is 24 billion kWh. Half of this is in gas, a third in electricity, and the rest mainly in oil. The total footprint of this energy is 1.8 million hectares (0.26 gha/cap), or about 4% of the total.

Nationally, about half of all water use is for cooling power stations. Public water supply for households and for services accounts for 30% of the consumption. Household water consumption in the North West amounts to 139 litres per person per day, or about 50,000 litres per person each year. One third of this goes in the flushing of toilets. The energy used in the North West water supply system is 589 million kWh. Supply to households, and the drainage/sewage system, are responsible for 30% and 50% of the total respectively. Most of the rest is leakages. The ecological footprint of the water supply system is about a thirteenth of 1% of the total EF per person.

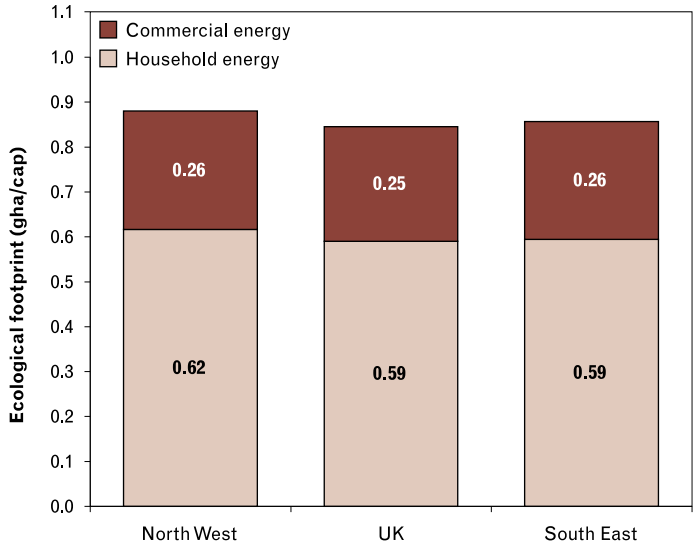


Figure 5.1 Comparison of the ecological footprint for energy consumption

The footprints for energy consumption are on similar levels for the North West (0.88 gha/cap), the UK as a whole (0.85 gha/cap) and the South East (0.86 gha/cap) (see Figure 5.1).

5.3 Prospects for sustainable energy

Current trends

The long-term target is for the UK and the North West region to move towards the scientific target of 60% reduction in CO_2 emissions by the year 2050. The key question in achieving a Factor Four reduction is whether this is going to be achieved by greatly expanded renewable energy, greatly improved efficiency, or a new set of nuclear power plants. The net effect of policy and market trends is expected to be quite rapid changes in the structure of energy production in the UK.

The DTI Energy White Paper sketches out an ambitious scenario for the energy system in 2020, which it maintains is on the path towards the recommended 60% reduction by 2050: "We envisage the energy system in 2020 being much more diverse than today. At its heart will be a much greater mix of energy, especially electricity sources and technologies, affecting both the means of supply and the control and management of demand" (DTI, 2003).

Indicators of change

Key energy systems indicators include:

- The CO_2 emission factors for fossil fuels.
- Energy demand per unit of floorspace, from household and service building stock.

- Renewable energy supply from the region.
- Heat supplied directly, e.g. from passive solar sources.
- Combined heat-and-power, generally co-generation with district heating.
- Energy recovery from waste, through incineration and other technologies.

Future scenarios

Energy infrastructure planning demands long-term thinking and there is no shortage of projections and scenarios. Below are two very simple alternatives.

- **'Business as usual' scenario (F–1)**: Current trends continue, combining the government's aspirations in the Energy White Paper, with the realities of a globalized industry. Offshore carbon sequestration appears to be the ultimate technical fix, enabling fossil fuel production to continue while stocks last. The result is an EF which changes little between now, 2020 and 2050.
- **Factor Four scenario (F–4)**: The Factor Four scenario represents an aspirational mix of best practices, including those on demand, infrastructure and supply sides. An integrated energy-climate strategy will seek opportunities to combine employment, environmental gains and social objectives, and emphasis will be given to energy from renewables and more efficient use of water. Combined heat-and-power (CHP) will be a major provider in urban areas and ultra low energy building designs will be used. Energy services companies will mediate between suppliers, distributors and users. The result is a reduction in carbon dioxide emissions and EF of 35–40% by 2020, and 75% by 2050.

Policy implications

Regional policy has had very little engagement with energy issues since the initial installation of the national grids for electricity and gas. There is now a resurgence of regional thinking in the light of aspirations for renewable energy sources. While this is currently focused on spatial planning, this is only part of a bigger picture which includes investment and market signals for utilities, co-generation and energy efficiency in buildings.

To achieve a reduction approaching the Factor Four scenario above, a more proactive regional energy strategy is needed than currently exists, and it will need to operate at sub-regional and urban level. It will achieve best practice in new development and conversions on the 'energy services' model. This brings together institutions and financial mechanisms to steer developers, utility managers and contractors into a low-energy mode of practice, offering warmth and light rather than units of power or gas. Key factors will include:

- ***Supply side*** – combined heat-and-power in all urban areas and building complexes plus rapid expansion of renewable sources.
- ***Demand side*** – accelerated energy efficiency policies for new and existing buildings, plus proactive partnership arrangements on the 'energy services' model, at an urban or sub-regional scale.

6 Household goods

6.1 Consuming household goods – pivotal to sustainable consumption

Household consumables include papers, clothes, books, shoes, cosmetics, chemicals, toys, and a plethora of miscellaneous bits and pieces. Each of these product types is either small and diverse, or has an average lifetime in the household of less than one year. Behind this definition lies a very topical question, what is 'consumption' anyway? In the case of food or clothes it is fairly clear. In the case of a visit to the theatre or the purchase of shares, it is less tangible and often more difficult to pin down in material terms. The analysis in this section considers the material metabolism of an affluent society.

On a longer term basis, household durables are a key 'life aspiration', having got a larger house than last year, the consumers of the North West will need to fit it out with the latest furnishings, appliances, electronics and one or two cars in the drive. Durables are described here as cars, furniture and electrical goods, or anything of material weight in the household with an average lifetime in use of more than one year.

6.2 Results for the North West

The total ecological footprint (EF) from all consumables is 2.6 million gha (global hectares) constituting 6% of the total EF from all activity, or 0.37 gha per person. The product with the largest single footprint is pet food, with 26% of the total EF. Split evenly between the energy footprint and land footprint, pet food has a higher than average footprint due to the highly intensive meat content. Stationery, newspapers and books together comprise 39% of the total. The footprint of wood and pulp-based products such as paper, card and toilet tissue are two thirds 'land footprint' based.

Key results

- The total ecological footprint of household goods consumption is 3.5 million gha or 0.51 gha per resident.
- Pet food has a 26% share of the total footprint of household consumables.
- Consumables have a total material consumption (TMC) 6.5 times larger than the direct consumption of materials (DMC).
- For durables TMC is 12 times higher than DMC.
- Half of the material consumption for durables is from cars.

The total EF from durable items is almost one million global hectares. Due to their highly manufactured state, individual durable items have high EF values. Although the largest single footprint item is cars and other vehicles, only 10% of the ecological footprint of car use is due to manufacture and maintenance, the rest coming from fuel use and its associated emissions. The 'land footprint' component of furniture is half the total, mainly due to the use of wood. By contrast, in electrical goods, the 'land footprint' component is only 1% of the 'energy footprint' component.

A preliminary comparison shows that the total EF for the consumption of household goods in the North West (0.51 gha/cap) is similar to the South East (0.52 gha/cap), whereas the UK average is slightly lower (0.45 gha/cap) (see Figure 6.1).

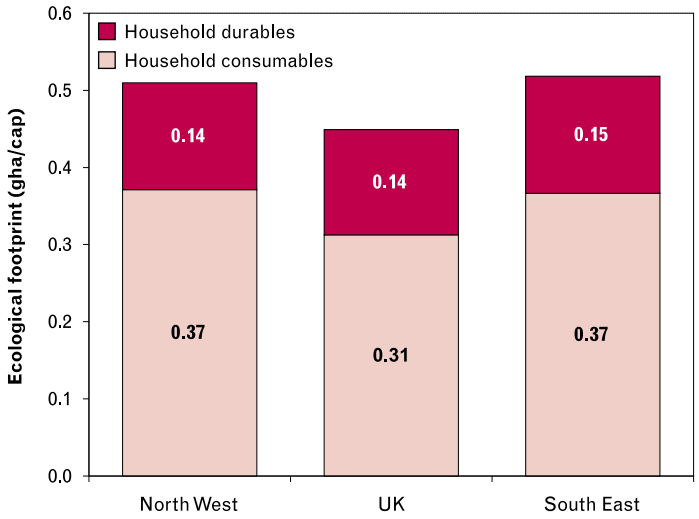


Figure 6.1 Comparison of the ecological footprint for household consumption

The direct material consumption (DMC) of household consumables is over one and a half million tonnes per year or nearly a quarter of a tonne per person. The total material consumption (TMC), including indirect material flows, is six and a half times greater at nearly 10 million tonnes per year. This comprises 6% of the TMC from all activity in the region. There are a few larger product types by weight: newspapers are a quarter of the total, and other paper products almost 20%. Pet food consumed in the North West weighed over a quarter million tonnes. Although household consumables are a small proportion of the TMC, they form a major part of the household waste stream, at over 30%.

Durable items have large indirect material and energy requirements: for every tonne of DMC there are over twelve tonnes of TMC. However the data available is only a sketch of a very complex set of supply chains. Overall, the total material consumption of household durables is 6% (9.9 million tonnes) of all consumption in the North West region. The largest single item of household consumption is the private car or other motorised vehicle, making up more than 50% of the total DMC and TMC. The trend towards larger 4x4 vehicles is accelerating the growth in material impact. New cars are bought by 1 in 20 people on average every year; the result is the annual consumption of 60 kg of new car per person (400,000 tonnes per year in the North West). By weight this includes over 50% steel, 11% plastics and 11% aluminium products. Rubber for tyres is only 5% of the total. However the tonnage of furniture is not far behind, although this contains a larger proportion of renewable materials. Householders consume on average 30 kg of furniture, a total of 200,000 tonnes in 2000, paper/pulp-based products including chipboard are a third of the total materials, wood, steel and plastics are each 8–10%. A total of 80,000 tonnes of electrical appliances, including washing machines, computers, televisions and hi-fis were consumed in the North West, an average of 12 kg per resident. Almost a quarter of all appliances by weight are washing machines at 19,500 tonnes per year, with fridges and freezers at 14,000 tonnes per year, televisions at 9,000 tonnes per year and personal computers at 5,000 tonnes per year.

6.3 Prospects for more sustainable consumables and durables

Current trends

Trends in consumer durables depend on 'saturation' and 'turnover', i.e. whether consumption slows down once all households have enough of an item. This is difficult to predict as lifestyle and fashion becomes as strong an influence as functionality, and technological improvement is the main driver of new purchases. So, for instance, demand for televisions has moved from one per household towards one per room, and rapid improvements in computers make regular replacement mandatory.

Past trends show growth in consumption from 1–3% per year in various items. 93% of households in the North West have a freezer, but only 31% have a dishwasher, and ownership trends are likely to reach saturation at 100%, unlike televisions. Nearly half of households have one vehicle, and over a third have two, while only 1 in 6 have no car at all. Saturation effects may slow down the growth of the total market and put greater emphasis on the turnover and replacement trends for the acquisition of new goods. These various factors can be seen in the recent trends in appliance ownership (only UK figures are available). These appear to point towards a moment at about 2020 when 100% of households will possess "all that they need", but we should bear in mind the 'television effect' for some products.

For consumables, the factors of change are often less predictable and apparently more volatile than with durable goods, making forecasting difficult. There is less of a 'saturation' effect, i.e. there is no particular limit to the number of shoes or clothes people will buy. Important factors include the pace of change of technology, relative costs, cultural pressures, income levels, re-use and recycling proportions, and perceived satisfaction from consumption.

Future scenarios

In contrast to energy or transport, there are very few long term studies of the future of household consumables, generally seen as a balance of supply, demand and technological innovation.

- **'Business as usual' scenario (F–1):** Current trends continue with steady growth in purchases of durable and consumable products from increasingly global supply chains. There is some measure of corporate responsibility, but the continuing spread of affluence puts unremitting pressure on natural resources, which technological improvements can hardly stem.
- **Factor Four scenario (F–4):** This win-win scenario sees the quality and efficiency of household durables and consumables rising rapidly. The fixation of consumers on acquisition of new products begins to dwindle, as more people find satisfaction in non-material experiences. The social economy grows, with sharing, networking, re-use and recycling of goods becoming a major economic sector, using sophisticated databasing to match supply and demand.

Policy implications

There has been almost no involvement of regional policy in any issues relating to consumption, beyond the basic goals of economic growth, to date. At the national level, the UK Government published in 2003 their "Framework for Sustainable Consumption and Production" (SCP) ("Changing Patterns" DEFRA/DTI, 2003). The key themes include:

- Taking a holistic approach that considers whole life-cycles of products and services.
- Working with the grain of markets, and identifying and tackling market failures.
- Integrating SCP thinking and objectives in all policy development and implementation.

- Using a well-designed package of policy measures and following the principles of better regulation.

The question here is to what degree is this a regional agenda, and something that the regional organizations can promote? The challenge is to demonstrate to a wide range of players the potential benefits in sustainable production and consumption. These might include economic benefits such as more competitive operations; environmental benefits at the local, regional and global scale; and social benefits through better distribution of resources, more social economy activity and training and job opportunities. In practical terms, and against the mainstream in regional policy, there may be potential win-win opportunities in:

- Promoting innovation in manufacturing technology, to increase productivity with less impact.
- Encouraging integrated industrial clusters to increase recycling and remanufacturing.
- Innovation in materials and waste management, to create markets for re-use, recycling and recovery.
- A regional 'green' investment bank promoting environmentally efficient production and distribution.
- Setting up public sector sustainable purchasing consortia to coordinate public spending on environmentally friendly/ethical goods and to build up supply chains and enable new markets.
- Promoting retail clusters and networks which encourage service economies, i.e. leasing and hiring.
- Promoting social economy groups and networks for sharing, re-use and recycling.

7 Construction

7.1 Why is construction crucial for sustainability?

The construction sector – buildings, infrastructure and the built environment generally – is the largest single material user, waste generator and energy user. It also has a massive inertia, as only 1–2% of the total built stock is renewed in any one year.

This section looks at the practical issues in steering the construction of the built environment towards a reduced ecological footprint and greater sustainability. The built environment is complex. With many environmental, economic and social angles to explore, we can sketch here only the key features at different scales. The starting point is the 'micro-scale' – the design, materials and material sources for the building fabric. This fits into the context at the 'macro-scale' – the location, density and form of urban development and building types. The time element is also crucial and the comparison between building construction and buildings in use – for example, whether it is better to replace older buildings by newer ones with improved energy efficiency.

7.2 Analysis of construction impacts in the North West

Key results

- With an ecological footprint of 1.0 gha per capita the construction industry is the second largest footprint component.
- The footprint of quarry material transportation is 7 times higher than the footprint for the production and use of the material.
- With 27 million tonnes of CO_2, or 4 tonnes per person, construction activities are the second biggest contributor (22%) to the total emissions of this greenhouse gas, topped only by the total of all transport emissions.
- The equivalent of 10 tonnes per capita of construction materials are required in the North West.

The total EF of the construction industry is 7.1 million gha, the second largest footprint component after the food sector. Most of the EF is taken up with the energy footprint, reflecting the high energy intensity of key construction materials (including cement, bricks and glass), and the small proportion of renewable materials. The largest material EF is minerals, bitumen and other mineral products which make up 47% of the total footprint; these are heavy and energy intensive materials. Only 24% of the construction EF is taken by quarry products even though they contribute to more than half the total material requirements for the sector.

With 1.0 gha/cap the EF of construction in the North West is comparable with the UK average and lower than the South East EF (1.2 gha/cap), where significantly more construction activities take place.

There are 2.8 million dwellings in the North West region, and new house building has recently been at a rate of 20,000 per year. Construction as a whole uses 35 million tonnes of materials directly (DMC), and 70 million tonnes in total (TMC) equating to over 10 tonnes for every person in the North West region. The construction industry is by far the most mass-intensive of any sector: the direct material consumption is 53% of the regional total DMC from all activity, and the TMC is 43% of the total from all activity. However, the bulk of this mass is not so energy and emissions intensive; construction activity produced 22% of the total CO_2 emissions, and 17% of the total ecological footprint from all activity in the region.

Quarry products are by far the largest type of material flow, constituting over 50% of the TMC. Cement-based products are the next largest, at 15 million tonnes TMC and slate, bitumen, stone and other non-metallic minerals are at six million tonnes TMC. Metal and metal products of all kinds are one million tonnes and wood/wood-based products are 2.5 million tonnes.

New construction versus buildings in use and recycling of materials

A topical issue for the North West region is the effect of the rate of new building on the total EF, both currently and in the future. The most effective way to determine whether new construction or re-use and recycling is more ecologically sound is to compare construction EF to total lifetime EF for buildings.

If we assume that material use is proportional to construction expenditure, then there is 25% in housing, 33% in commercial, 11% in public services, 12% in industry and 19% in infrastructure. For housing, the average EF for the use of each dwelling is about 2% of the EF for construction, i.e. embodied energy will balance energy in use after 50 years. For services buildings the EF in construction is over twice that of housing for the same floorspace, but the energy in use is half that of housing for the same floorspace.

This data enables analysis of the effects of changing the rate of new housing, the EF in construction or the EF of direct energy in use and should therefore inform regional strategy. Ecological building techniques can achieve massive reductions in energy and water use. There is also potential for the re-use and recycling of a significant portion of the 13.5 million tones of construction and demolition waste. This arises both from construction practices on site, and from larger scale demolition of older buildings. However the analysis shows that transport is the largest component of the EF, implying that the benefits of re-use or recycling will depend on how far the material has to travel to be sorted and re-distributed.

7.3 Prospects for more sustainable construction

Current trends

The factors in construction, its environmental impacts and its future trends combine politics, markets, technology and lifestyles at various scales:

- Spatial strategy: the location, density and form of buildings.
- Built environment activity in the urban system: the provision of new buildings for housing, commercial and public services, and the balance of stock/turnover/demolition.
- Construction design and materials: the materials and their required energy intensity per unit of floorspace.
- Energy and other demands over the life cycle of buildings: the length of that life cycle and the eventual fate of the buildings.

Each consideration above is influenced by property market, finance, legal and professional issues, for instance where landlord/tenant split responsibility is a constraint

to energy efficiency. They are also influenced by lifestyles and cultural shifts, for instance the move towards urban living or away from timber frame housing.

Indicators of change

Built environment construction activity is closely related to population changes and to economic activity, although there are counter-cyclical effects from public sector construction. Construction/demolition waste arisings from the system are very sensitive to policy on regeneration, recycling, building design and use of secondary wastes. Given these complex factors, a simplified set of indicators can be structured as follows:

- Household floorspace per head of population, for both existing and new housing.
- The turnover in the stock itself, as a proportion of existing stock and the demolition of older dwellings.
- Household energy efficiency per unit of floorspace, for new and existing dwellings.
- Household material efficiency per floorspace and the EF intensity of those materials.
- Waste arising and material life cycle.

Commercial and public services buildings require a similar range of indicators. The difference is that they are not closely related to population, but rather to economic growth and the structure of the economy.

Future scenarios

Strategic planning for the built environment and infrastructure is well established. However, the insights from EF analysis should have some influence.

- **'Business as usual' scenario (F–1):** Continuation of current trends, with strict controls on land use and larger, multi-storey and higher density buildings. Construction planning becomes more integrated and there is more strategic management of the balance of housing demand and supply.
- **Factor Four scenario (F–4):** This 'win-win' scenario sees the quality and overall efficiency of construction increase rapidly. Brownfield sites are redeveloped, affordable housing provided and there are moves towards more integrated community living. In housing, quality of space and proximity to services are at a premium, while more commercial activity is organised locally. Many city centre offices are converted to housing.

Policy implications

The North West region is polarized. Areas such as the green fringes of the conurbations are under increasing pressure for new housing, while many urban areas suffer from low demand, falling values and abandonment. While the total population is almost static, demographic ageing and reducing household size suggest accelerated house-building and EF from construction. Such issues will benefit from application of a footprint method to policy making.

The Regional Planning Guidance (RPG), and its successor Regional Spatial Strategy, are the main strategic influences on construction density and location. Local planning and building regulations have limited influence on building form and energy efficiency. To go further than this, particularly for the existing building stock, would require a new raft of regional powers and resources. There may be a need for some level of trade-off between the construction sector, where F–4 levels of reductions are difficult to attain, and the energy sector, where large reductions in the direct energy use of buildings are technically feasible. Positive measures might include:

- Integrated resource management enterprises, which achieve changes in material efficiency and material impact, by coordination between designers, contractors, material suppliers and demolition companies.
- Integrated energy services consortiums which achieve changes in energy efficiency by coordination with utilities, financiers, developers, designers, contractors, owners and tenants.

8 Transport – passenger and freight

8.1 Transport in context

Mobility is the basis for modern lifestyles, and transport is the 'maker or breaker' of cities and regions. It seems imperative that people need to be increasingly mobile to go to work, to go shopping or to escape their urban environment. With ever decreasing air travel fares, even more incentives are created to travel farther and more often. Air traffic at UK airports is expected to grow by at least 4% per annum, thus endangering the Government's target of achieving a 60% cut in Britain's carbon dioxide emissions by 2050.

The situation is similar for freight: more and more goods are moved within the UK and imported from abroad. Since the 1950s, road freight distribution has increased five-fold, whereas rail freight movements have almost halved.

To date, it has not been possible to 'decouple' the growth in transport from adverse environmental impacts. Whereas some air pollutants were reduced through the introduction of catalytic converters, transport related CO_2 emissions still increased by 9% between 1991 and 2001. Other problems like land use and congestion remain.

The ecological footprint method is a very powerful means of comparison between different modes and alternative scenarios of transport.

8.2 Analysis of transport in the North West

This study calculated the ecological footprints, CO_2 emissions and material flows for different modes of personal travel (air, bicycle, bus, car, train etc.) as well as freight transport to and within the North West.

On average, residents in the North West travelled 10,916 kilometres in 2000, or 30 km per day (see also Table 8.1). A significant proportion of this was travel undertaken in a car (7,908 km) followed by air travel (1,286 km). There is a relatively low propensity to fly when compared with the UK and the South East. Private expenditure on air travel is a quarter of the UK average and hence average distances flown are much shorter for NW residents. Ten percent of the total distance was travelled by public surface transport, with bus accounting for 5%, trains 4% and taxis 1%.

Key results

- The ecological footprint for passenger and freight transport in the North West is 0.43 and 0.71 gha/cap, respectively.
- The EF for passenger transport is significantly lower than those of the UK and the South East, whereas the freight transport footprint is highest for the North West.
- Carbon dioxide emissions of transport are high: passenger transport in the North West produces a total of 1.6 tonnes of CO_2 per capita (9% of all CO_2 emissions). Freight transport is responsible for 2.7 t CO_2/cap (15%).
- A total of 8.6 million tonnes of fuels are used for transport in the North West of which 31% or 380 kg per person are consumed in passenger transport.

The total ecological footprint for passenger transport in the North West is 0.43 gha/cap. It is clearly dominated by car use which accounts for 0.35 gha/cap or 81%. The air travel footprint is the second largest with 0.04 gha/cap but this is low compared to the UK and the SE, which have an individual air travel footprint of 0.14 and 0.25 gha/cap, respectively. This is also the reason why the total transport footprint for the North West is considerably lower than the UK's (see Figure 8.1).

Passenger transport in the North West used a total of over 2.6 million tonnes of fossil fuels, 2 million tonnes of this by cars and nearly 300,000 tonnes by planes. This equates

Table 8.1 Detailed data for passenger transport in the North West in 2000

Transport mode	Average distance travelled (km)	Ecological footprint per capita (gha/cap)
Air travel - all services	1,286	0.036
… of which total international	1,059	0.025
… of which within Europe *	195	0.009
… of which total domestic	32	0.002
Walking (including short walks)	277	< 0.00001
Bicycle	43	< 0.00001
Private hire bus	101	0.003
Car	7,908	0.346
… of which as car driver	5,049	0.313
… of which as car passenger	2,859	0.033
Motorcycle/moped	28	0.001
Van/lorry	203	0.009
Other private	25	0.001
Local bus	409	0.014
Non-local bus	93	0.002
Surface Rail	383	0.007
Taxi/minicab	119	0.007
Other public (including ferries, light rail, etc.)	42	0.001
All modes	**10,917**	**0.427**

* EU–15 (1999)

to 380 kg of petrol, diesel and kerosene for each person in the North West. Hidden flows of mineral oil are relatively low. Therefore the total material consumption of 2.8 million tonnes is only slightly higher than the direct consumption of transport fuels.

The extensive use of fossil fuels for transport results in high CO_2 emissions. Passenger and freight transport account for 30 million tonnes of CO_2 or 4.3 tonnes per capita. This is the highest proportion for all the components analysed in this study. 63% of these emissions come from freight transport, the remaining 37% are due to personal travel of North West residents.

In contrast to passenger transport, the footprint of freight transport within and to the North West region (0.71 gha/cap) is higher than for the UK (0.66 gha/cap) and the South East (0.61 gha/cap) (see also Figure 8.1). This reflects economic activities in the North West that are connected with a high level of freight transport, most of which is transported on the road (97% of the ecological footprint for freight transport is due to CO_2 emissions from lorries). More tonnage – 189 million tonnes of road freight, representing 15% of the total for England – was destined for the North West than any other region in 2000. 197 million tonnes of road freight originated in the North West with 141 million tonnes remaining in the region.

The direct consumption (DMC) of fossil fuels for freight transport allocated to the NW is 5.9 million tonnes or 860 kg per person.

8.3 Prospects for more sustainable transport

Current trends

Trends and projections in transport are the subject of many policy or engineering models and studies. The current forecasts in traffic growth are consistent with recent evidence, despite the government's goals in the 10 Year Strategy for transport (DETR, 2000).

- In recent decades the overall demand for surface transport has been closely linked to economic growth at 2–2.5% growth per year (i.e. a 30–40 year doubling time). Most 'business as usual' projections continue these trends.
- Light commercial transport is growing at a faster rate than passenger, at 3–3.5% per year.
- Air travel in the region is growing at the unprecedented rate of 5–6% per year, with a doubling time of 10–15 years at Manchester Airport.

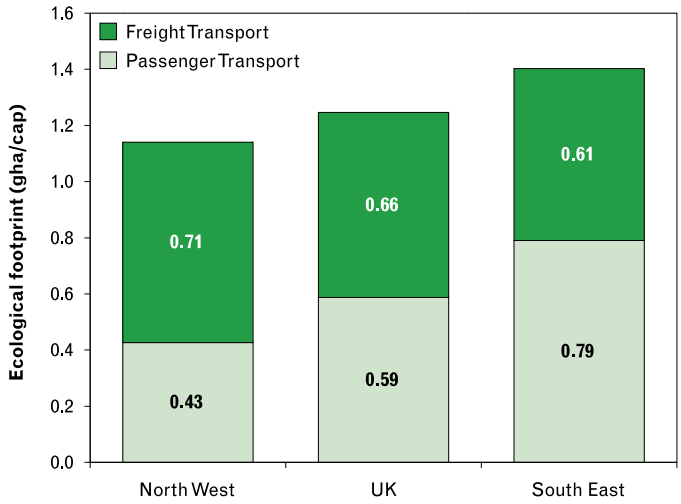


Figure 8.1 Comparison of ecological footprints for passenger and freight transport

Increasing the rate of growth are market innovations such as the low-cost airlines, affluence/lifestyle factors, technology improvements, the falling price of fuel or induced demand, for instance from internet-enabled business activities and social networks.

The rate of growth is being restricted by physical limits of infrastructure; congestion; government pricing and fiscal policies; and not least, environmental objectives which may encourage regulation and market measures.

Indicators of change

In terms of projecting these trends, a very simplified set of transport indicators are as follows:

- Passenger travel demand intensity (economic): this is an overall measure of the linkage or 'decoupling' of economic growth from travel demand.
- Vehicle occupancy: the higher the occupancy, the less the vehicle movements and the greater the efficiency. This factor will be influenced by technology, information systems, demand management and green travel plans.
- Public transport proportion of all transport: a modal shift is more difficult in the diffused economy and social networks of the North West.
- Vehicle energy efficiency: subject to fuel and engine regulations and fiscal measures at UK and EU levels.
- New vehicles versus existing stock: i.e. the turnover effect, size of the stock and any effects on vehicle efficiency which may be higher in new vehicles.
- Alternative fuels proportions: combinations and transformations from one medium to another: gas, renewable oil, hydrogen and other forms of electric power.

Future scenarios

The scenario approach is well established in transport studies, which combines the engineering approach with a more volatile 'lifestyle' approach. Transport volumes and emissions can be projected as linked or delinked to economic growth, with apparently great precision.

- **'Business as usual' scenario (F–1):** Continuing current trends, with an uneasy conflict between economic, social and environmental objectives. Road traffic doubles in 50 years, while air travel increases five-fold. Technological improvements for propulsion systems and also demand management avoid the worst case in air emissions, but roads are frequently grid-locked and climate emissions targets are abandoned.
- **Factor Four scenario (F–4):** A 'win-win' scenario based on integration of networks, coordination of supply and demand, accelerated technology improvements, and demand side management. The result is a reduction in EF from the transport system of 50% by 2050, which allows for the technological constraints on air travel in particular.

Policy implications

The 'predict and provide' philosophy is over in the UK, at least in principle, and there is a new generation of local transport plans and partnerships for an 'integrated' transport system. But will this be enough to contain the inexorable demand and desire for mobility? We cannot provide all the answers but we do aim to build bridges between the 'no-win' trends of 'business as usual', and the 'win-win' possibilities of a 'Factor Four' future.

Transport policy has inbuilt contradictions which national governments appear powerless to solve, and it would be difficult for the North West region to provide meaningful solutions in isolation. There are, however, various enabling measures which may combine to ameliorate current pressures and conflicts, for example:

- A multi-sectoral regional and sub-regional integrated transport strategy.
- Incentives for clean technology to reduce emissions.
- Diversification of vehicle ownership and access, to facilitate integration between modes.
- Coordination of supply and infrastructure with journey demand and cultural mobility.
- Use of information and communication technologies as the catalyst for integration, diversification and coordination.
- Demand management including social economy networks for car and lift sharing, green travel plans and coordination of public transport.

It is clear that the main agenda for transport strategy will be constructed on a range of social and economic objectives, and it is to be hoped that environmental and resource objectives can be combined as a 'win-win' case. Regional transport policy aims to do this by bridging national level policy and taxation and sub-regional/local investment, but it is mainly aspirational. The implication is that some level of trade-off may be necessary between the transport sector, where Factor Four type reductions appear very difficult, and other sectors where F–4 reductions are much easier.

9 Commercial and public services

9.1 Services in context

So far in this study we have looked at the impacts of those material flows that meet the consumption levels of private consumers directly, or 'final demand to households' in economic terms. This section looks at the more complex agenda of services, both public and commercial. These sectors in total are now approaching 75% of economic activity; they are less material intensive and more labour intensive, but they are becoming responsible for increasing amounts of material inputs and outputs.

How can the environmental impact of a service be measured? Some impacts are more obvious than others. For example, every vehicle causes direct emissions to the environment – but what happens if someone surfs the Internet or gets a mortgage from their bank? As soon as we 'consume' a service, this will stimulate an activity by someone somewhere, and most certainly this activity will require energy and will consume materials.

Key results

- The total ecological footprint for services in the North West is 1.0 gha/cap of which 84% is due to the consumption of commercial services.
- Land footprints are higher than energy footprints because of the high level of paper consumption that requires a considerable forest area.
- 1 million tonnes of food products were supplied to hotels and restaurants in the North West in 2000 but only 62% of these were eaten, the rest was thrown away.

In this study we have allocated the flow of materials and embodied energy for different types of services in the North West, including retailing, hotel and catering, communications, banking and finance, insurance, recreation and public services (including only basic infrastructure and not education, health, defence, security etc.). The methodology involves, firstly, the use of economic input-output tables for the UK, which were used to allocate the material consumption by the various sectors. Secondly, these material flows were allocated to the North West region based on expenditure on each of the commercial sectors as a proxy. On average, expenditure in the North West per person was higher than in the UK, except for 'banking and finance' where expenditure was 81% of the UK average. Finally, environmental impacts have been assessed by using the ecological footprint methodology.

It is important to note that there are different interpretations of 'material flows in services' – should 'food eaten out' for instance be in the food account or the services account? There is an infinite numbers of ways to 'slice up the same cake'. Within this study it should therefore be recognised that this section is only an initial insight and not a complete analysis. To ensure a fully comprehensive analysis, the use of Physical Input-Output Tables (PIOT) would be required. These provide a detailed understanding of the demand of services on all other sectors. Such an analysis will be undertaken in the future as part of the larger project in the North West ("Eco-Region NW", see also Chapter 11).

9.2 Analysis of the service sector in the North West

The total ecological footprint for services in the North West is 0.85 gha/cap for commercial and 0.16 gha/cap for public services. For the commercial services the highest impact comes from 'hotel and catering' (0.31 gha/cap) followed by 'recreation' (0.15 gha/cap).

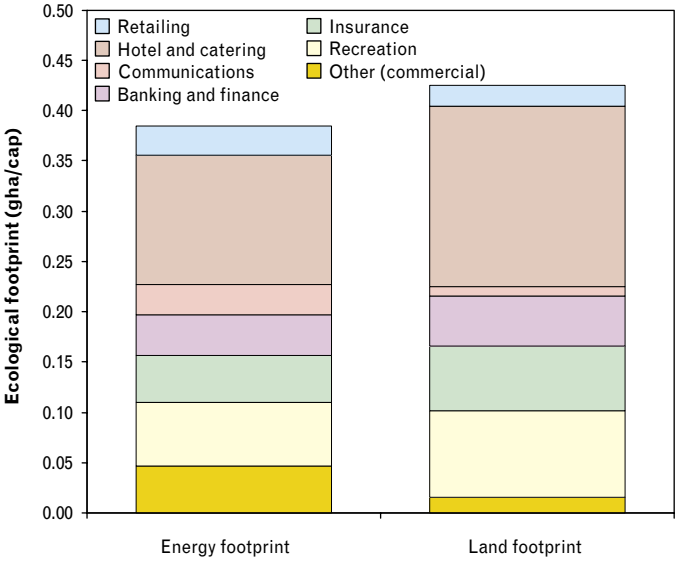


Figure 9.1 Composition of energy and land footprints for commercial services in the North West

A further analysis shows that on average, and for most of the services, the requirements for real land are higher than for carbon storage land. As Figure 9.1 shows, the land footprint is higher (55% of the total) than the energy footprint (45%). This is mainly due to the consumption of paper that requires forest area as a source for timber. In total, 2.6 million tonnes of paper have been consumed by services in the North West in the year 2000. Services with a high consumption of paper are 'banking and finance', 'insurance' and the public services. 'Communications' have the lowest paper consumption and hence a relatively low proportion of the land footprint.

In the 'hotel and catering' sector the consumption of food contributes to both a high number for the energy and land footprint. Food consumption by commercial services is also responsible for the emission of three million tonnes of carbon dioxide, which puts it in second place after paper consumption (4 million tonnes CO_2). The use of electrical equipment also contributes to the budget of embodied CO_2 emissions; with nearly 900,000 tonnes it comes in at third place. On a per capita basis, every resident in the North West is responsible for 1.6 tonnes of CO_2 emissions by using commercial services, compared to 0.28 t/cap for public services.

When compared with the UK, services in the North West are not significantly different from the UK in terms of their ecological footprint. The impact is lower than in the South East region though, where on average roughly 30% more is spent on commercial services.

9.3 Prospects for public and commercial services

Current trends

Material flow trends in service sectors are difficult to gauge as most of the activities are less material intensive and more labour intensive than in other sectors. However, it is clear that many service sectors use a great diversity of materials such as paper, food or chemicals, and that reducing such impacts is a high priority.

At present there are few clear trends beyond those which are easily measurable, i.e. transport, construction, energy and water which are directly supplied to the service sector:

- Commercial and public service building construction: for the current UK public sector investment programme, there is a new build rate of approx 3% of the stock per year, and a net addition to the stock of approx 2% per year. If continued this would see a doubling of the stock in 35 years.

- Transport: private light goods vehicles have the fastest projected growth of any surface transport modes, expected to increase by 1.6% per year or 60% by 2030 (DfT, 2004). Much of this is based on the expected pattern of customer-oriented just-in-time delivery systems.
- Energy in buildings: projected growth at 1.3% per year (DTI, 2003), for the 'business as usual' case.

Indicators of change

Each of the above is easily measurable and can be translated to indicators:

- Floorspace intensity, i.e. floorspace per gross value added or per employee.
- Efficiency in energy and construction materials of that floorspace.
- Business travel distance per employee or per tonne of material.
- Commuter travel distance per employee or per customer.
- Transport occupancy/load factor, efficiency and emissions factors.

A more specific range of indicators from the Material Flow Analysis would include:

- Paper intensity: amount of paper consumed, and proportion recycled.
- Food waste: especially relevant in commercial and public catering.

Policy implications

For the North West 'Regional Economic Strategy' which seeks to develop a knowledge based region, the sustainability of the service sector is a key issue. However as yet this has not fully surfaced. For public services, there is already mounting pressure for greening both physical and in service delivery:

- Eco-schools initiative, and related programmes.
- Greening of higher education.
- Greening the NHS: the largest employer in the UK, in highly specialized buildings and equipment, and consequently the largest consumer of energy and materials.
- Other public administration: a gradual spread of environmental management systems and reporting, and the upgrading of buildings' energy efficiency.

For commercial services there are a range of initiatives reflecting the diversity of activity:

- Greening of property: as with the Environmental Assessment Method of the Building Research Establishment (BREEAM) for example.
- Green travel plans and demand management for larger employers and organizations.
- Green tourism programmes which promote low-impact travel and diversified rural economies.

Generally the practice of environmental management is widely spread in larger service firms and organizations. There are several approaches to this:

- The first approach concerns what can be directly measured, transport by employees and deliveries, construction and running of buildings and consumption of key

materials such as paper. For each of these, targets can be set and operational systems can be developed.

- A second approach is to focus on general environmental reporting, auditing and management systems. This will gradually move the operation towards better practice, and encourage investment and consumer confidence.
- A third approach is to develop a 'green agenda' for the service itself, which takes into account its wider impacts and focuses on the demand side in the hope that consumers will help to steer the operation towards better practice. A good example is that of 'green tourism'.

10 Conclusions and ways forward

This section provides some signposts towards actions by various stakeholders. It does not attempt the detail of a full scale action programme; that is the job of the AfS programme and similar ventures. It does aim to summarize the key responsibilities and opportunities for moving the region towards greater environmental sustainability. For this the ecological footprint is a primary point of reference.

10.1 Summary of ecological footprint targets

The analysis of production and consumption and direct/indirect material flows should provide some evidence on how to achieve Factor Four reductions, although clearly not all sectors are equal to this challenge. As change in each sector involves a combination of social, economic, political, technological and infrastructural factors, we can only suggest where the barriers and opportunities might lie:

- The food sector produces the largest single impact at 23% of the ecological footprint (EF) and 15% of CO_2 emissions. There is great scope for localizing food production, reducing energy intensive processing and meat content. This could produce an EF reduction target of Factor Four or 75% reduction.
- The utilities sector (household and commercial energy and water) is responsible for 21% of total CO_2 emissions and 14% of total EF. Here, while the technological potential for almost zero energy buildings exists, achieving it depends on lifestyles and institutions (for instance, the problem of split responsibilities between landlord, utilities and tenants). In this sector an EF reduction target of 'Factor 8' or 87% reduction is suggested.
- Manufactured durables and consumables each show opportunities for demand management, supply chain management, process efficiency and localized production. In combination these could produce an EF reduction target of Factor Four or 75% reduction.
- Construction activity is materials and land intensive, but again there is potential for demand management, supply chain management, process efficiency and localized production, with an EF reduction target of Factor Four or 75% reduction.
- Commercial and public services show somewhat greater potential for integrated resource management than households. In these sectors an EF reduction target of 'Factor 8' or 87% reduction is suggested.
- The transport sector is responsible for 18% of total EF and 24% of total CO_2 emissions (including freight transport). Growth is partly due to social equity and cohesion, at the local and global scale, and where there are few alternatives to energy intensive technologies. This is particularly the case for air travel. Consequently, there is a case for less stringent targets, combining social equity with technological innovation. In this sector a EF reduction target of Factor 2 or 50% reduction is suggested.

10.2 Integrated resource management

There is considerable detail to explore in each of the sectors above, and a complex story of the opportunities and constraints in markets, technologies, public policy and consumer

lifestyles. However there are also common principles which run through each of the sectors. These can be used as directions for regional and local policy-makers, producers, distributors, consumers and communities.

There are certain 'models' based on fundamental principles, which help to coordinate Material Flow Analysis and ecological footprint programmes. Four of the five models below also descibe an example to be found in the North West region:

- ***Strong environmental management model:*** this principle puts environmental issues to the forefront, as a driver for economic competitiveness and resource productivity. Where there are 'externalities' of pollution and waste, the business or organization will aim to account for these. The example comes from the Co-op bank which has put environmental and ethical goals at the top of its agenda, with the result of faster growth than any other bank in the UK.
- ***Evolutionary model:*** the Factor Four approach to 'dematerialization' and 'decarbonization' of the economy will be a shift on a massive scale. It relies on businesses and organizations anticipating such shifts in their own terms over years or decades, and steering their own evolution to turn potential problems into opportunities. One example comes from the eco-industrial park scheme in East Manchester.
- ***Service model:*** this works on the producer/procurement side, where products are leased, taken back, re-manufactured or recycled, with huge savings in raw materials, processing energy and waste impacts; plus the consumers' facility is continuously updated. The example comes from Milliken Carpets, one of the new generation of floor covering firms which lease their products rather than selling them.
- ***Social economy model:*** this works on the consumer demand side. In many cases there are opportunities to reduce material consumption while increasing human satisfaction, by social trading schemes, equipment banks, lift sharing and social cohesion in general. The example comes from the Homes for Change development in Hulme, Manchester.
- ***Integrated resource management model:*** this brings each of the above together, and aims to provide the infrastructure to make it work. Such infrastructure can be 'hard' pipes and wires, and/or 'soft' organizations and networks. The example comes from Copenhagen, where over 90% of the construction waste is recycled within the city.

10.3 Implications for the region

The North West is widely recognized as one of the furthest ahead in regional strategy – embodying mobilization of different bodies in a partnership mode, effective use of external funding, enhancement of infrastructure and recognition of environmental assets. It is also ahead in terms of regional sustainable development. The existence of the 'Action for Sustainability' framework and many other programmes and projects, is demonstration of this commitment.

Conversely, the region still suffers from its position relative to England, with the worst health, most derelict land, heaviest acid rain, poorest air quality, worst racial tension and lowest success rates for new businesses.

There are also particular issues which are seen as economic benefits, whilst also being environmental pressure points. The runaway growth rate of Manchester airport and its contribution to global climate change is a prime example.

In terms of scope for action, it is clear that the current structure of governance in the English regions is often partial and compromised. The Regional Assemblies and Regional Development Agencies between them manage a small percentage of the total public sector expenditure.

The question for each of the sectors above is how much of the agenda is regional, i.e. where the regional level organizations can be effective and relevant. It has to be said that the obvious starting point for reducing the North West's ecological footprint – consuming less – is apparently at odds with mainstream economic policy and its foremost goal of competitiveness as measured through economic growth. The regional agenda set out here focuses on potential 'win-win' opportunities:

- Promoting innovation in manufacturing technology, to increase productivity with less impact.
- Encouraging industrial clusters with integrated resource management systems.
- Innovation in materials management, to create markets for re-use, recycling and other forms of recovery.
- Promoting retail clusters and networks which encourage service economies, i.e. leasing and hiring for a service level, rather than one-off material purchases.
- Promoting social economy groups and networks for sharing, re-use and recycling, where this is relevant.

However to achieve Factor Four targets in each of these sectors will be very difficult unless new forms of networks, partnerships and consortiums can be developed. Change on such a scale will require political leadership, strong market signals, rapid advances in technology and commitment by consumers.

These new forms of networks and partnerships are in formation at present, generally on the boundaries between public, private and community/NGO sectors. Actions to take this agenda forward should focus on these 'breeding grounds' for environmental entrepreneurs.

The UK government has set an agenda and a direction in 2003 with the 'Framework for Sustainable Consumption and Production'. At this point it is very general and deserves to be followed through in every sector and at every level. The North West region will need to play its part along with others. This preliminary study is a step in that direction.

11 Related research, glossary and references

Related research

The project for this report was a preliminary trial for two larger projects which are ongoing for the next 18–24 months:

The "Eco-Region NW" sets a new standard for analysis of waste and material flows at the regional scale. It provides a 'joined up' information system which measures environmental performance at both the regional level and the business level. The result is an interactive information system for benchmarking waste minimization and resource productivity. This system helps to make the links between the region, industrial sectors, businesses, households and key products. It also connects a 'top-down' analysis at the regional level, with a 'bottom-up' environmental report template at the business level.

The "Ecological Budget UK" is a national research programme which is bringing together each of the regional material flow and footprint projects into a common format and software tool. This is being developed as the Resource and Energy Analysis Programme (REAP) – an integrated resource-environment modelling tool designed for policy scenarios. Material Flow Analysis as the basic methodology provides a comprehensive picture of apparent and hidden flows of materials and energy carriers through the economy, thus providing a complete physical account of the UK with a regional breakdown. The associated key environmental impacts can be expressed by calculating the corresponding greenhouse gas emissions and ecological footprints.

Both these projects are parallel and complementary to the REWARD ('Regional & Welsh Appraisal for Resource Productivity and Development') programme. This aims to promote the links between economic development and environmental protection at the regional level. Further information is included in the Appendix to this report (available from the website www.actionforsustainability.org.uk).

Glossary

Direct material consumption (DMC): The total amount of materials directly used in the regional economy and consumed in the region, including imports but excluding exports.

Ecological footprint (EF): A measure of how much productive land and water an individual, a city, a country or humanity requires to produce the resources it consumes and to absorb the waste it generates, using prevailing technology. The land could be anywhere in the world, is measured in global hectares (gha) and always refers to one year. If the footprint refers to one person the unit is given in global hectares per capita (gha/cap).

Embodied energy: The total amount of energy used in the production of goods.

Energy footprint: The amount of land needed to sequester the carbon dioxide emissions produced by a defined population.

Global hectare (gha): One hectare of biologically productive space with the world average productivity. Global hectares allow the meaningful comparison of the ecological footprints

of different countries, which use different qualities of cropland, grazing land and forest. Footprints of individuals are measured in global hectares per capita (gha/cap).

Land footprint: The amount of arable land and sea to provide raw materials and crops and the amount of built land to support the infrastructure of a defined population.

Material Flow Analysis (MFA): The analysis of all material inputs and outputs to an area or activity within a defined boundary.

Total material consumption (TMC): The total materials used in regional consumptive activities, including DMC and associated 'hidden' flows.

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