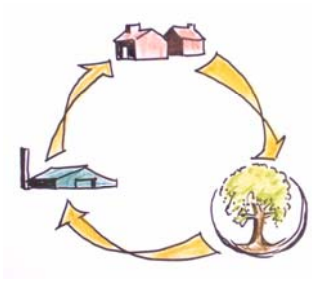
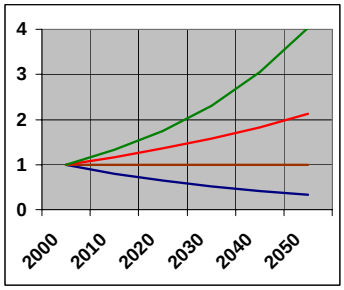


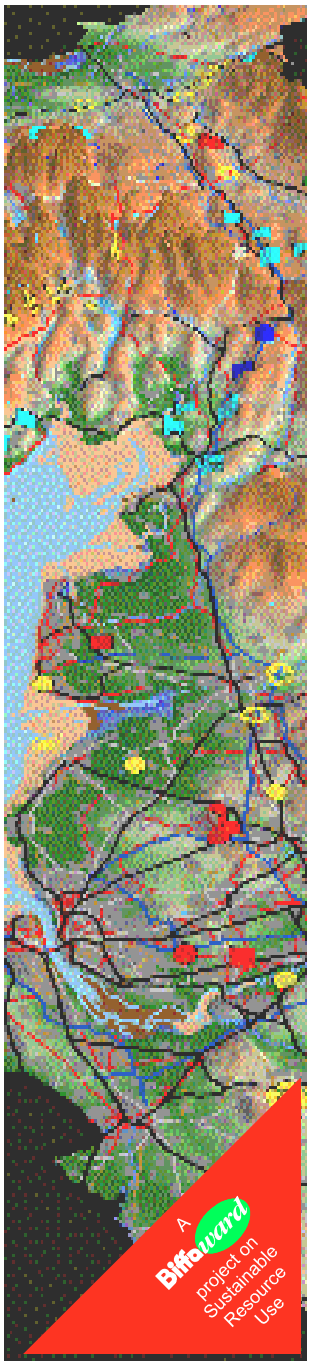


Eco^{nw}

towards a one planet region

May 2006

Centre for Urban
& Regional Ecology



cure SEI sustainability northwest

Eco-NW: towards a one planet region

main report
CURE
May 2006

CONTENTS

Note

In the spirit of the digital age, the main output from this project has gone on the website, as this is now thought to be a more permanent and accessible medium. Therefore this report is a deliberately low-tech interpretation of the website, available to download.

Acknowledgements

The project team would like to acknowledge the contributions of many individuals and organizations to this project:

- Biffaward and the other sponsors as listed below
- The project steering group, including representatives of NW Development Agency, NW Regional Assembly, Government Office NW, Environment Agency, Greater Manchester Waste Disposal Authority, Greater Manchester Geological Unit, White Young Green Environmental.
- The wider community of 'mass balance' and sustainable consumption & production policy makers, researchers and practitioners,.

Research team

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- Contributions: Alastair Moore, Nick Green: CURE:
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- Construction research: Nigel Lawson, Julian Ridal: Building Research Establishment:
- Communications: Steve Connor, Tim Brook: Creative Concern.

Project Partners

The project has been coordinated by CURE (Centre for Urban & Regional Ecology), in partnership with:

- Sustainability NW, www.snw.org.uk
- Stockholm Environment Institute at York www.seiy.se

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- Royal Society of Wildlife Trusts – www.rswt.org.uk
- Building Research Establishment (Scotland) www.bre.co.uk
- Environment Agency (NW region) www.environment-agency.gov.uk
- Merseyside Waste Disposal Authority www.merseysidewda.gov.uk

Further information

All project reports and materials, interactive tools, and workbooks for downloading are available on:

www.eco-region.org

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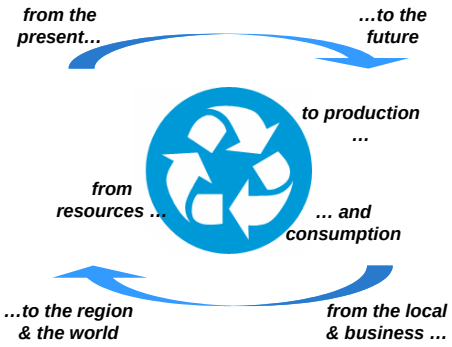


Summary

The Eco-region NW is all about a better future for us and our children. In other words, it concerns sustainable development and a **One Planet Economy**, in the Northwest of England.

The project

The **Eco-Region NW** project maps out the flows of energy, materials and the **ecological footprint**, of all activity in the NW region.

It looks both at what we produce, and at what we consume. It goes from the region to the local level and the household level.

It shows the measure of 'real' sustainability – for the region, for industrial sectors, for policy options, and lifestyle choices.

It looks from the present to the future, and sets a direction for the region which combines economic growth, social welfare and environmental sustainability.

Who is it for

The Eco-Region NW, mainly through its website aims to put technical information side by side with interactive communications, across many topics:

- Sustainable urban development
- Climate change & energy policy
- Waste & minerals management
- Business-environment issues
- Sustainable economic development
- School / college topics in geography, economics, environmental science and current affairs

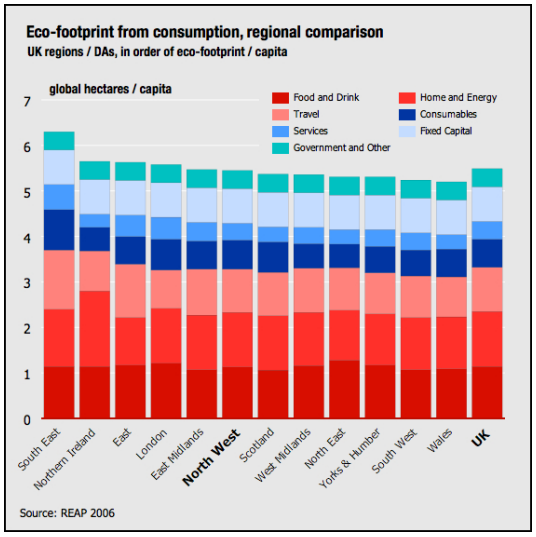
Although the Eco-Region NW is bounded to the North West, it is strongly linked to the national 'Ecological Budget UK', which covers all UK regions and devolved countries in a common method: further details on www.ecologicalbudget.org.uk

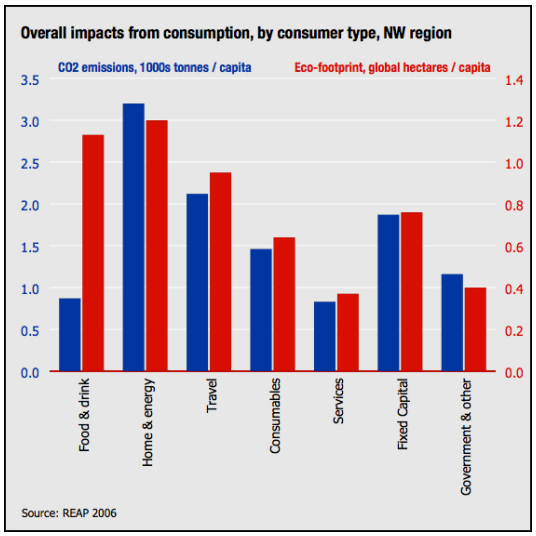
An interactive toolkit

The Eco-region NW is not only a report and data sheets – it provides a set of interactive working tools. The gateway to these is the site **www.eco-region.org**

The most important is the database / scenario model '**REAP**', which covers all UK regions as well as all local authorities in the NW. This is available (as of mid 2006) on **www.reap.sei.se**

For a more wide ranging exploration, the user can explore the possible future of the region with interactive tools:





- NW Life quiz– this asks topical questions about the future (i.e. what do people really want), and assesses the footprint.
- NW Visions this then shows a graphic vision & newspaper reports from the next 40 years.
- NW Quest – this asks for policy decisions (housing, transport etc) and then shows the results in detailed maps and charts of the region.

The NW & the world

The Eco-Region NW research has focused on 3 main indicators of environmental performance in production and consumption:

- CO2 emissions, as the largest cause of climate change.
- Material flow and mass balance, as the way to understand the 'metabolism' of production and consumption.
- Eco-footprint, as the overall measure of impact, local and global. This is put as 'global hectares per capita', i.e. the land area needed to provide all the resources and soak up emissions generated by the average person's consumption.

These are each calculated in the REAP system for the UK, and then allocated to regions by their profile of production and consumption.

Warming the world

- Total 'consumption' CO_2 emissions (i.e. generated from the supply chains involved in all types of personal consumption) are 11.5 tonnes/cap, slightly lower than the UK average.
- This is higher than the 'territorial' emissions of the NW of 10.8 tonnes/cap (i.e. emissions within the NW boundary, which includes production for exports).
- Notably, domestic energy consumption in the NW produces emission of 1.7 tonnes CO_2 per capita, the third highest of all UK regions. This is due to the relative inefficiency of the housing stock.

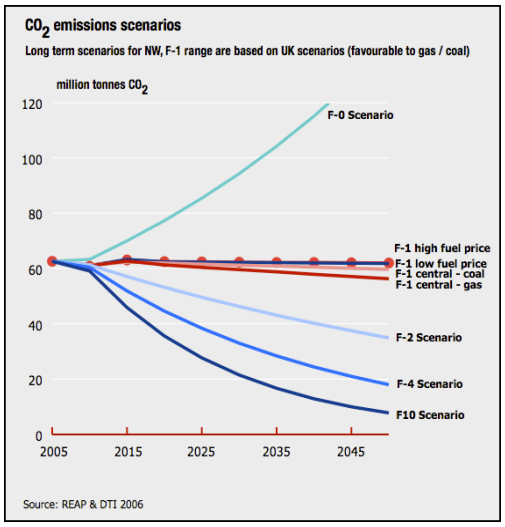
Eco-footprint

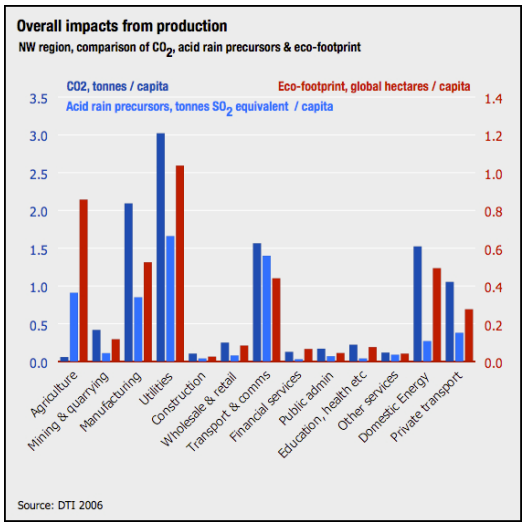
- The NW region's eco-footprint is just over the UK average at 5.45 global hectares per person.
- This is 3 times bigger than our fair 'earth share' of 1.8 global hectares, i.e. if the world's productive land area was equally shared with the world's population.
- The sectors with the largest eco-footprint are food / drink: and home / energy.
- The region's waste arisings from households, commerce and industry (13 million tonnes) contains enough embodied energy to power a large (2000MW) power station.
- The local areas with the highest eco-footprint per head are Macclesfield and Fylde: and with the lowest, Halton and Barrow.
- Liverpool, Manchester and Blackpool each have a eco-footprint of 200 times their actual area.

Balancing the books

Material flow analysis puts another light on the metabolism of the regional economy:

- Primary industries such as agriculture, fishing, forestry and mining bring 5.3 tonnes per person per year into the NW economy.
- Imports from overseas bring another 2.2 tonnes per





person, and half of that tonnage is then exported.
- All these materials are then circulated around in the economy from one sector to another, until they reach the point of sale or 'final demand'.
- Households purchase directly nearly 1.9 tonnes per person of food and other products, and capital investment is another 0.3 tonnes
- Waste accounts for over half the material flow at 4.2 tonnes per person

Where are we heading?

At the moment, there is much talk of sustainable development, but the current trend is still on the **"F-1"** 'business as usual' scenario.

- The **F-1** projections in the graph above show CO2 emissions within the UK as about level, but the overall eco-footprint from consumption shows 1% growth.
- In contrast the F-4 scenario aims at a ***factor of four*** increase in efficiency, and reduction in eco-footprint, by the year 2050. This is in line with scientific advice on climate change, and principle of convergence between rich and poor nations.
- The fastest growing impact is that of low cost flights from Manchester and Liverpool: at current growth rates, air travel would consume the regions's entire carbon budget by 2050. This is shown by the 'F-0' scenario curve in the graph.
- Overall, foreign holidays by NW residents cause about 10 times the impact of inward visitors to the region.

The role of policy

The Eco-region NW represents a whole new kind of thinking about responsibility in consumption and production. The UK government is promoting the idea, through policies on climate, waste, housing etc – but up to now it has been short of the evidence which links between consumption and production.

The NW Regional Economic Strategy's vision of a 'low carbon economy' should start with the UK target of a 60% cut in UK emissions by 2050. While the RES target to 'reduce CO_2 per £GVA' is a small step in this direction, a serious strategy in line with scientific advice, requires a continuous reduction in CO_2 per £GVA, i.e. increase in carbon efficiency, of around 5% per year.

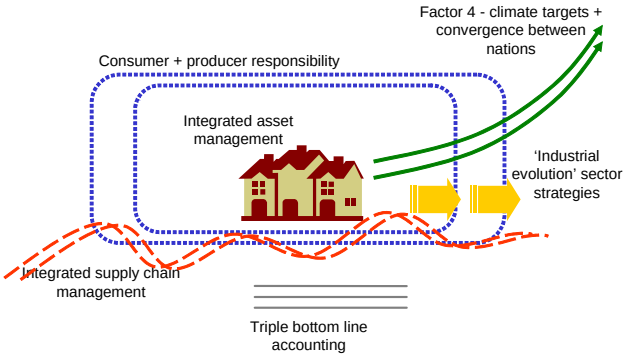
As the Regional Economic Strategy and Spatial Strategy recognize that investment in roads, airports and other infrastructure will have major impacts, they need to do more to find alternative ways of meeting demand.

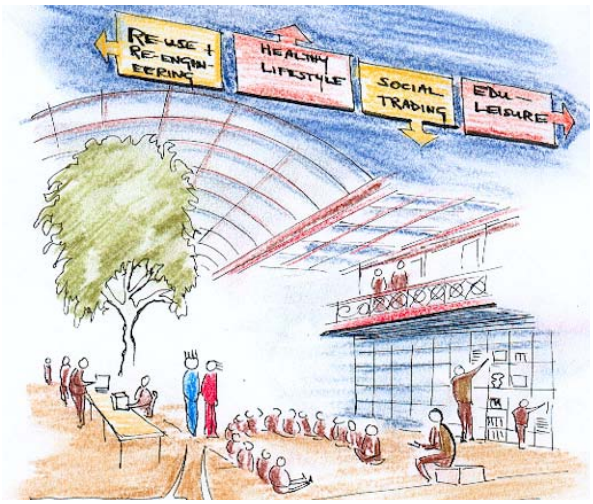
The role of business

The Eco-region NW provides a detailed benchmark for the performance of 123 business sectors, as summarized in the chart above. But this is not enough in itself. There is a wider realization that the necessary step change in resource efficiency can be both cause and effect of growth and competitiveness. All businesses are now somewhere on the 'responsibility' spectrum – and major oil companies and retailers are now queueing up to demonstrate their credentials.

One problem is 'spin' - as the presentation goes up, the credibility often goes down. This is then the contribution of the Eco-region NW, and its parent REAP model – to provide the best available solid data and analysis for benchmarking environmental sustainability. There is a prototype REAP benchmark tool, to be developed in phase 2 of the program.

One Planet Economy principles





One Planet Economy

Where is the destination in all this? What is the 'One Planet Economy', as talked about in the UK Sustainable Development Strategy (HMG 2005)? This can be defined as a system of production and consumption which respects environmental limits, local and global, which is also financially and socially sustainable.

Its foremost target is the fair 'earth share' footprint of 1.8 global hectares per person. This means a long term goal of 75% cut in resource use – i.e. **Factor Four** increase in resource efficiency. These are the main principles, as illustrated above:

- ***'Integrated asset management'***, covering economic, social and environmental capitals and risks – in other words, that the NW economy should manage itself as smartly as any other large organization.
- The accounts and budgeting systems in public and private sectors should take a ***'triple bottom line'*** approach, including for all forms of capital – economic, social & environmental.
- This follows an '***integrated supply chain'*** principle, i.e. by tracking material and energy resources from cradle to grave, and from supply sides to demand sides.
- This adds up to a full ***'industrial evolution'*** program in each sector, for low impact technologies and sustainable consumption.
- Such a programme should be ***financially viable***, aiming at net gains in both national and individual costs and benefits. It should also be ***socially responsible***, equalising the differences between social groups, between regions, and between nations.
- To implement this requires a practical ***'business case'*** to be developed for each economic sector: each policy level: each product type, and so on.

It is not too difficult to reduce the impacts of our lifestyles and consumption habits by up to 10-20% - using low energy light bulbs, changing driving styles etc. There is a lot of 'low hanging' fruit around. Beyond that, few people can really make major changes in their lifestyles and consumption habits. To make serious moves towards a One Planet Economy, the onus is on government and business – to invest in more sustainable technology and infrastructure.

One Planet Economy Network

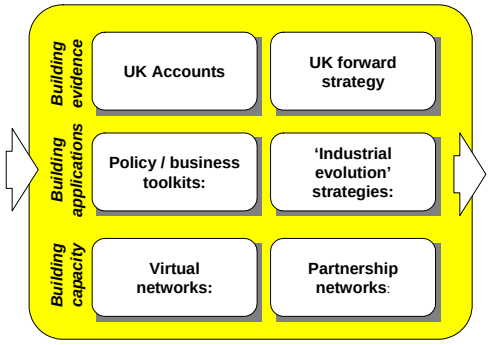
This challenge is now the theme of the One Planet Economy Network (OPEN), a national and regional program, with main sponsors WWF-UK. The OPEN works in parallel with the Sustainable Consumption and Production Network (SCP-net) on www.scpnet.org.uk.

The SCP-net aims to improve the evidence base for the sustainable consumption and production challenge, in partnership with the Environment Agency, Regional Development Agencies and Assemblies. It works on both the technical side, of databases and modelling, and also on the human side of advocacy, tools and training. There are two main technical models now being tested in the regions – the REAP system above, and the REEIO (details in the next section).

The OPEN starts from the long term goal of the One Planet Economy, and then works back to what is needed at the present time:

- ***Building the evidence base***: improved information for accounting, budgeting and analysis of all types

One Planet Economy Network - program



of consumption and production:

- ***Building the applications***: applying this evidence through benchmarking, appraisal, decision support etc, to the challenge of the One Planet Economy.
- ***Building the capacity***: promoting networks, training, partnerships, forums etc, to help mobilize the potential of public, private and civic sectors.

The Eco-Region NW forward program is one of the regional applications of the OPEN program from 2006-2010.

Conclusions

The Eco-region NW is the most significant step yet in the region, in understanding the bigger picture of how daily choices affect the planet we live on. It shows a direction to move from the current 'three planet economy' of the region, to a One Planet Economy for the future.

However it should be clear that the research is a continuing process, not a final product. There are many directions for it to travel – industry programs, product analysis, policy appraisal and so on. The tools and methods such as the REAP system and its extensions, are each in continuous development. We hope that users will bear with this!

For the next steps, the aim is to continue sharpening the tools, the data and the applications. This should help to underpin policy networks, industry programs, consumer lobbies, procurement schemes, integrated asset management and so on around the region.

2

Introduction

Sustainable consumption & production

The North West is changing fast from its former industrial base, to a more diverse and knowledge-based economy. How will this look in 20 or 40 years time, and will it increase or reduce its load on the rest of the world? The Regional Economic Strategy aims at a dynamic business environment, a high-skilled and IT-enabled workforce, and inclusive communities. Meanwhile the Regional Spatial Strategy aims at urban and rural renaissance with revitalized 'city-regions'. Both these strategies are inspired by the goals of sustainable development, as summed up by the UK government – social progress, economic growth and environmental protection.[1]

In reality, what happens if the regional targets are achieved? The results could easily be more consumer goods, more waste, bigger airports and motorways, and longer supply chains from the other side of the world. At present, while the North West continues its 'cleaning and greening', the global impacts of its production systems and consumption habits continue to rise.

The Eco-region NW provides detailed evidence on these impacts across the North West economy. In this report we look at production and exports from industries in the region: we also look at the material consumption of households, imports from around the world, and the total impacts caused. Finally we look at trends, future scenarios and policy options, to see how the region can best achieve the goals of a 'One Planet Economy' – living sustainably within a fair share of the earth's resources.

One Planet Economy & Factor 4

The eco-footprint in the North West is close to the UK average, at 5.45 global hectares per person. If the available land area was distributed evenly among the global population, the North West is overshooting that share by a factor of three. In other words, if the world lived like the average person in the North West, we would need at least three planets.

At present the NW footprint is rising at about 1% per year; while that of much larger populations such as China and India is growing at 5% or more per year. Meanwhile the bio-productive land area is rapidly reducing, as forests are burned, farmland is turned to desert, and fish stocks are run down to extinction.[2]

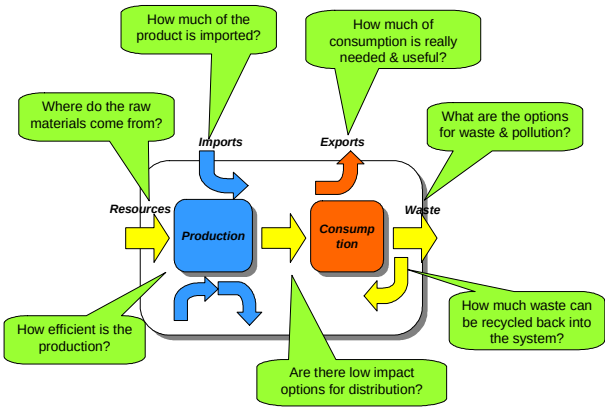
The UK government aims to follow the scientific advice for a 60% cut in climate change emissions by 2050. But is also needs to factor in the growth of developing nations, and convergence towards greater equity. This points towards a long term goal of a 75% cut in resource use – i.e. a ***Factor Four*** increase in resource efficiency.[3] Actions for achieving this are being

[1] HMG 2005: *Securing the future*

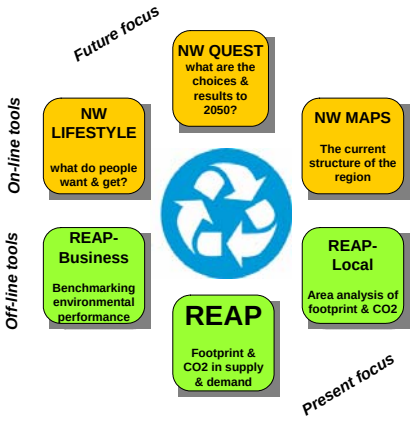
[2] WWF 2005: Living Planet Report

[3] von Weizsacker, Lovins & Lovins 1997

Eco-region NW & REAP tool – questions



Eco-region NW - TOOLKIT



explored in the ***One Planet Economy Network*** program, as in Section 1[4].

Such a step change in efficiency is achievable with known technologies and consumption patterns. It represents a 3% reduction in physical impact year on year, and over 5% increase in 'resource productivity' per unit of economic activity. In reality, in the face of growth trends in the opposite direction, it is a very challenging target.

Meanwhile in the North West and similar regions, the economic and spatial strategies are a one-off opportunity to steer development towards such a step change – this can then be both a cause and effect of economic growth and competitiveness. So, the overarching question for the Eco-region NW is –

> ***how can regional economic and spatial strategy help to meet the One Planet Economy goals?***

The Eco-region NW

The Eco-Region NW shows the state of the art in the analysis of resource and waste flows. It provides a 'joined up' information system to measure environmental performance, at both the regional level and the firm level.

This builds on the results of the national Eco-Budget UK project and the REAP material / footprint modelling system which covers all UK regions. The Eco-Region NW then applies this modelling system with a particular focus on:

- Urban & environmental policy
- Economic development policy
- Waste and resource management
- Business-environment benchmarking
- Construction and building materials

The Eco-Region NW links the flows of resources and wastes from cradle to grave, with their causes in economic production and household consumption. It also links the 'top-down' analysis at the regional level, with a 'bottom-up' environmental benchmark system at the sector and firm level.

The questions in the diagram above show the kind of issues which can be explored, using the REAP structure as a basis. They also show the kind of policy choices which are raised by the theme of 'sustainable consumption and production'.

Methods & tools

In order to help move this forward, the Eco-region NW provides a range of results:

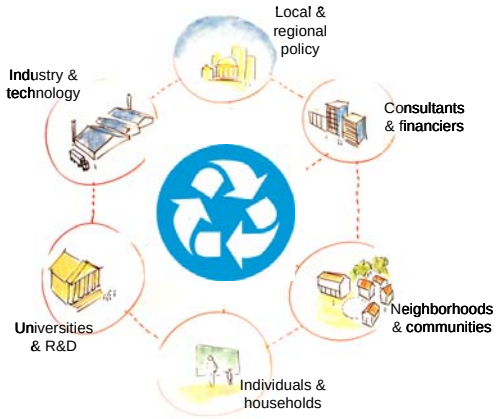
- Demo of 'how it can be done', of the REAP modelling system at the regional scale.
- Prototypes of interactive spatial modeling, scenario visioning, and 'aspiration survey'.
- An environment-business benchmark framework, for measuring and comparing business environment performance at the sector level.

Overall, the Eco-region NW provides a demonstration of 'what can be done' with the REAP toolkit. This new interactive model offers several kinds of function:

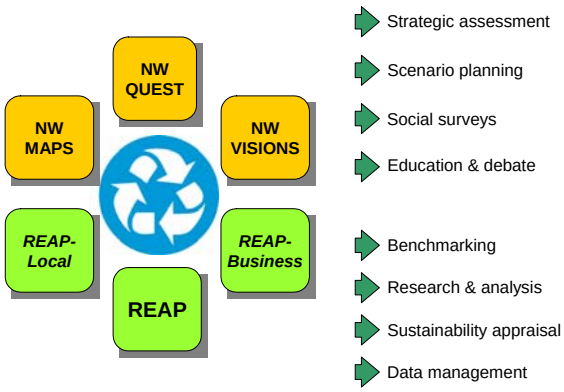
- ***Modelling***: application of the REAP model to analyse future trends and scenarios, in resource

[4] Details upcoming on www.ecologicalbudget.org.uk

Eco-region NW - USERS



Eco-region NW - APPLICATIONS



flows, strategic waste management, and assessment of BPEO.

- ***Databasing***: a comprehensive data system on regional resource and waste flows: including sources, destinations, balances and ecological footprints.
- ***Business toolkit***: a starting point for a benchmarking system for waste minimization and resource productivity in sectors, firms and products:
- ***Assessment and appraisal:*** demonstrate the applications to Strategic Environmental Assessment & Sustainability Appraisal.

Who is it for

The Eco-Region NW provides not only static information, but an interactive tool and communications platform. The main users include:

- ***Policy-makers*** in waste management, utilities, transport, planning and economic development, can get direct feedback on the environmental impacts of their decisions.
- ***Businesses*** can use the Eco-benchmark system to benchmark waste minimization performance against the sectoral and regional profile, within existing environmental management systems.
- ***Waste management*** and materials supply industries, can assess more accurately where their problems, risks and opportunities are coming from.
- ***Construction industries*** can see clearly the trends and opportunities in regional environmental strategy, tracking their performance and its environmental impact.
- ***Households*** can assess their consumption choices and work out the best way towards waste minimization and eco-efficient lifestyles.

Implications and next steps

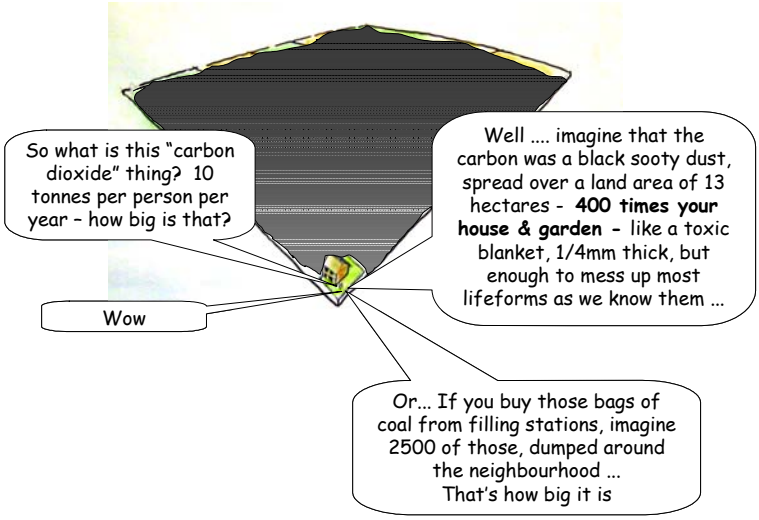
In summary, the Eco-Region NW project has provided a detailed evidence base to help the transformation of the region towards a 'factor four' reduction in overall footprint by 2050. This can be interpreted as reducing environmental throughput at -3% per year - while continuing economic growth at about 2.25% per year. This very challenging target can in principle be shared between supply sides (production + imports) and demand sides (consumption + exports).

To help this process, the Eco-Region NW and the One Planet Economy Network are aiming to work on three main fronts:

- **Building the evidence base**: improved information for accounting, budgeting and analysis of all types of consumption and production:
- **Building the applications**: applying this evidence through benchmarking, appraisal, decision support etc, to the challenge of the One Planet Economy.
- **Building the capacity**: promoting networks, training, partnerships, forums etc, to help mobilize the potential of public, private and civic sectors.

At present this is taking shape through a 4 year development programme at the UK level. This will be translated to the regional level in the NW as one of several regional strands in the program.

3



The state of the region

Resource flows

The Eco-Region NW results draw on the REAP model / database, with 3 main indicators of environmental performance in production and consumption:

- CO2 emissions, as the largest cause of climate change:
- Material flow and mass balance, which can show some of the underlying causes and effects.
- Eco-footprint, as the overall measure of global impact.

These are each calculated in the REAP system for the UK, and then allocated to regions by their profile of industrial production and housedhold consumption. Where better data exists at the regional level, then it has been inserted.

As in the next chapter, these three indicators are related, but each shows a different angle on the region. As the NW increases its service sector, its direct production impacts may reduce, even while its consumption impacts from imported goods increase.

Most of these indicators are shown as per person per year, e.g. CO2 / cap / yr. This enables easy comparison with other areas with different populations. To produce totals for the NW region, multiply the figures by the population of the NW, i.e. 6.77 million.

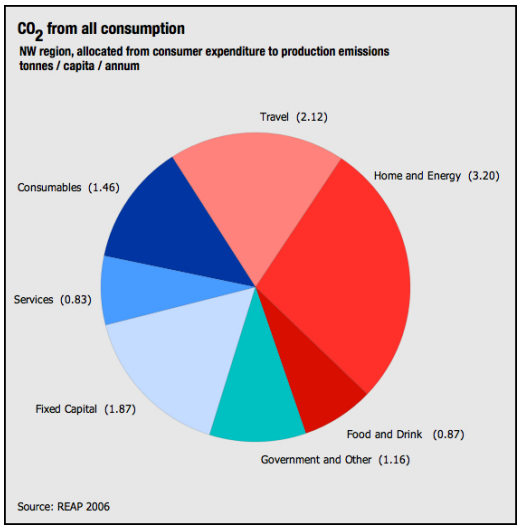
CO_2 emissions

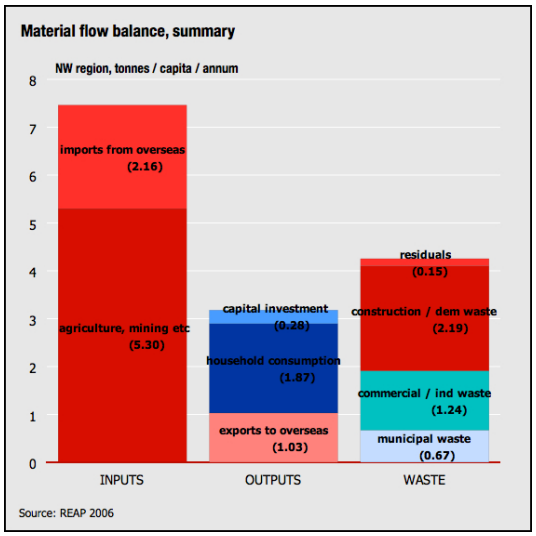
CO2 emissions are the largest single cause of climate change, and according to the government chief scientist, a larger threat than terrorism. The cartoon shows the scale of the average household emissions.

The chart above shows the relative scale of emissions on the consumption side (not including exports):

- Home and energy at 28% of the total is the largest category, of which the majority is for direct energy supplies. The emission of 1.7 tonnes CO_2 per capita, is the third highest of all UK regions, due to the relative inefficiency of the housing stock.
- Transport is 18% of the total, although this the fastest rising sector
- 'Consumables' of all kinds account for 13% of the total: food and drink at 8% of the total.
- Government (public services) and fixed capital (buildings and industrial investment) account for over 25%.
- Total 'consumption' CO_2 emissions for the average NW resident, (i.e. generated from the supply chains involved in all types of personal consumption) are 11.5 tonnes/cap, slightly lower than the UK average.
- This is higher than the production or 'territorial' emissions of the NW of 10.8 tonnes/cap (i.e. emissions within the NW boundary, which includes production for exports).

There are many trends and projections for the future of CO2 emissions, as in Chapter 6.





Material flows

The material flow measure starts with 'Regional Material Input' – the materials from primary industries such as agriculture and mining, together with all imports. The Regional Material Consumption is that which remains to be 'consumed' after exports. The rest of the material flows in the accounts are basically circulating around the economy from one sector to another.

The balance sheet diagram above shows graphically how more than half the input ends up as waste, and how imports are nearly twice the exports. The NW has a Regional Material Input at 17.5 t/cap, and Regional Material Consumption at 6.8 t/cap – the lowest of any UK region. 1.2 tonnes / cap of 'energy carriers' are used, and the total demand for mining materials is the third lowest in the UK at 4.9 tonnes/cap. Meanwhile, the region has the highest throughput of chemicals of all UK regions with 2.0 tonnes/cap, showing the dominance of the chemical and process industries.

In terms of physical trade, the NW shows a typical regional profile, with the bulk of flows in intra-UK trade and much less in material exchanges with the rest of the world. With a total of 133 million tonnes, this shows the second highest physical exchange with other UK regions, equally driven by imports (51%) and exports (49%).

While the NW mainly imports quarrying materials, as well as wood or wood products, its main exports by tonnage are food, chemicals, pulp and paper products. Taking into account all trade with other regions and countries and subtracting imports from exports, the NW turns out to be one of five net importing regions with an import surplus of 10.2m tons.

Waste flows

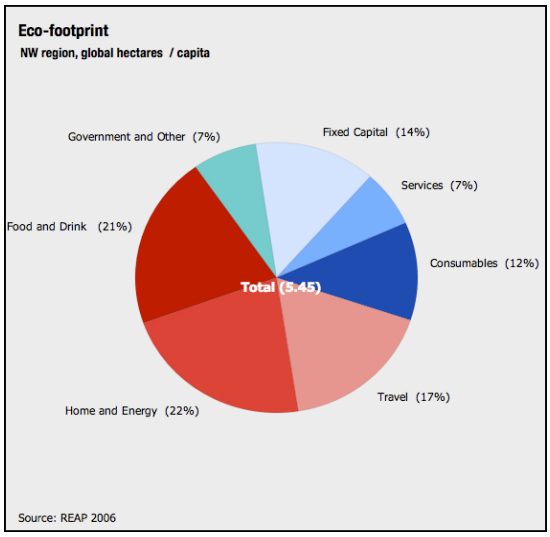
The other side of the material flow pipeline is of course the waste agenda, and its place on the mass balance sheet (details in Chapter 6). There are also cross-overs between CO2, waste and footprint – the loss of materials can be counted off the inputs needed to produce them, and the transport and disposal of waste also has large effects. Any serious attempt at sustainable consumption and production needs to consider waste, not only at the end of the pipeline, but where it comes from upstream, and what the opportunities are for improving resource efficiency.

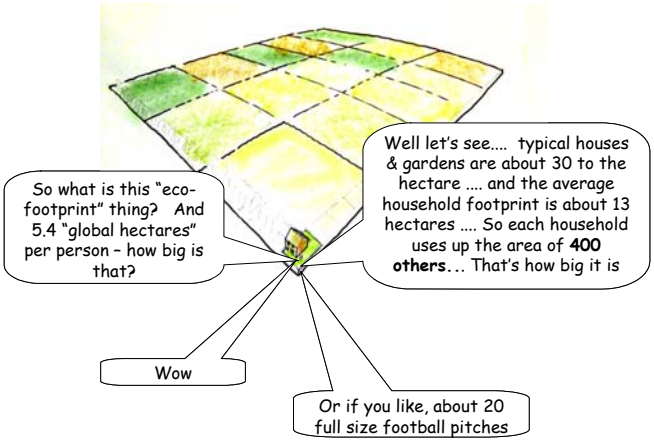
For municipal waste, the average waste stream of 11 kg per person per week, can be assessed at an eco-footprint of 0.9 gha / cap, (more than 15% of the total householder footprint). The current rate of recycling offsets this by less than 10%, due to the energy involved in transportation and recovery. For commercial & industrial waste, the 2003 national survey showed that arisings in the NW totalled 8.3 million tonnes in 2003 - 4.5 mt of industrial and 3.8 mt of commercial waste.

As a whole, the material – waste balance sheet can then be linked with the footprint:

- Primary inputs from domestic production: 35.5 mt
- Imports from overseas: 14.5 mt
- Exports to overseas 6.9 mt
- C&I production waste; 8.4 mt:
- Reused & recycled production waste: 3.3 mt
- Total waste incl mining, agriculture, C&D and municipal: 43 mt
- Municipal waste: 4.4 mt
- Municipal waste recycled / re-used: 0.6 mt or 14% of the total.

For construction and demolition waste, about half the





total of 10 million tonnes per year was put to 'beneficial re-use' including restoration, engineering, recycled aggregates and other inert materials. There are also larger volumes of agricultural and mining wastes – these do not pass through the production system in the same way, and so are counted separately.

Eco-footprint

The NW regional footprint can be summed up in relation to UK averages (details in the next chapter):

- The NW region's eco-footprint is just over the UK average at 5.45 global hectares per person.
- This is 3 times bigger than the fair 'earth share' of 1.8 global hectares, i.e. if the world's productive land area was equally shared with the world's population.

The components of the footprint are shown above – these are calculated on the 'consumption' principle, i.e. based on supply chains which end up at the door of the consumer, but also including for government and fixed capital items. There is an interesting contrast with the CO2 account:

- 'Home & energy' is the largest sector jointly with food and drink, which now includes the land-use and eco-systems impacts of agro-food production.
- Transport is the next largest at 17% of the total.

The local picture is detailed in chapter 5, but there are some interesting footprint results:

- The local areas with the highest eco-footprint per head are Macclesfield and Fylde: and with the lowest, Halton and Barrow.
- Liverpool, Manchester and Blackpool each have a eco-footprint of 200 times their actual area.
- Residents in the NW have the third lowest transport footprint in the UK at 0.62 gha/cap, due mainly to low car mileage and related expenditure for private transport.

Regional strategy

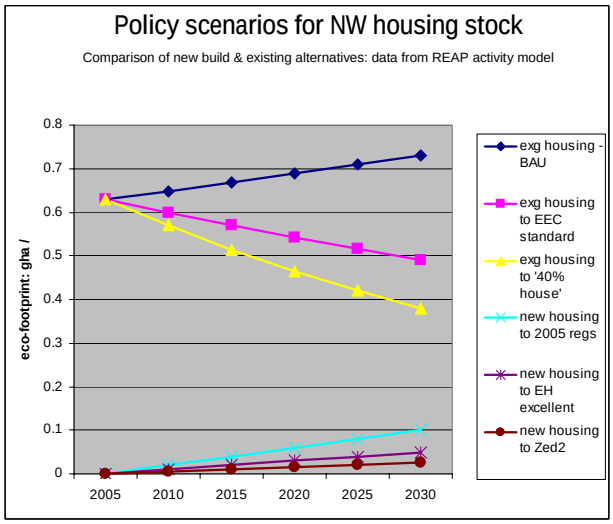
In a large complex region, these combined measures of CO2, material and footprint affect almost every type of activity in the public and private sectors. In order to home in on the issues most relevant at the regional level, we focus here on the implications for the two main regional strategies – spatial and economic.

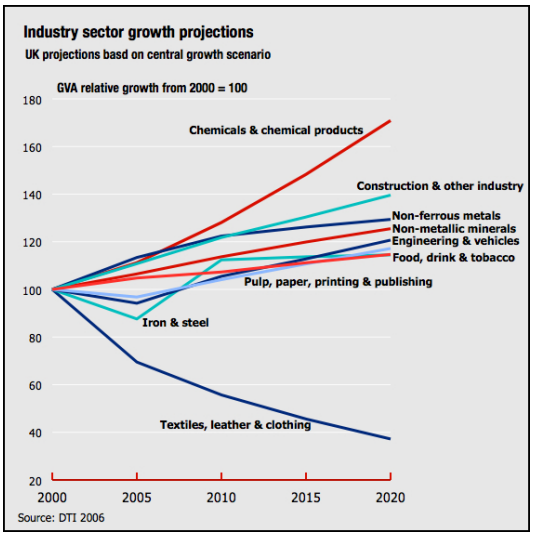
Regional Spatial Strategy

Firstly, the REAP tool was used to measure the materials and supply chains involved in the average NW house (more detail in the urban development chapter):

- Inhabited by 2.35 people, 0.4 cats and 0.3 dogs.
- Energy use of 9,127 KWh of energy, producing 5.18 tonnes of CO2: from natural gas (66%) and electricity (24%).
- Materials of about 150 tonnes with another 137 tonnes for the foundations
- Maintenance and repair require 0.50 tonnes of materials each year

The initial construction and materials for the average house produces 61 tonnes of CO_2: if depreciation (NPV) over 60 years is assumed at public discount rates, this CO_2 can be allocated at 1.9 tonnes a year, plus maintenance and repair at a further 0.2 tonnes of CO2.





This can be contrasted with the operational use, where by current standards, direct energy demand produces an average 5.38 tonnes CO_2 per year, or over 2.5 times the emissions from construction and maintenance.

Today, there are roughly 2.9 million dwellings in the NW: the Regional Spatial Strategy proposes that an increased rate of nearly 23,000 dwellings per year should be built. This amounts to 403,000 over the 18 year plan period, net of clearances (2003-2021). If the same rate continued to 2050, there would be an extra 965,000 dwellings, on top of the existing stock.

On purely environmental grounds, it appears almost impossible to meet the climate change targets for the whole building stock, without a much increased rate of demolition and replacement. The Oxford '40% house' project proposed this for the least efficient third of the housing stock, as the footprint cost of construction would be more than offset by the footprint gain from ultra-efficient houses.[5] However such a wholesale restructuring of urban areas would be quite radical by current standards.

Regional economic strategy

As birthplaces of the industrial revolution, Manchester and Liverpool suffered extreme levels of poverty and pollution, followed by 50 years of decline and restructuring. From the challenges of social exclusion, ill-health, obsolescence and dereliction, the 'metropolitan' core of the North West is now re-inventing itself as a globalized hub for creative and knowledge-based industries in the mode of the 'new urbanism'. The regional economy as a whole is diverse, and catching up with the UK, but in GVA / per capita lags behind by about 10%, and there are structural problems with skills, entrepreneurship and innovation.

The North West Development Agency aims to transform the region through 'sustainable economic development' into a competitive, high added value, knowledge based inclusive economy: by promoting productivity, clusters, skills, access to work, and reducing regional variations.

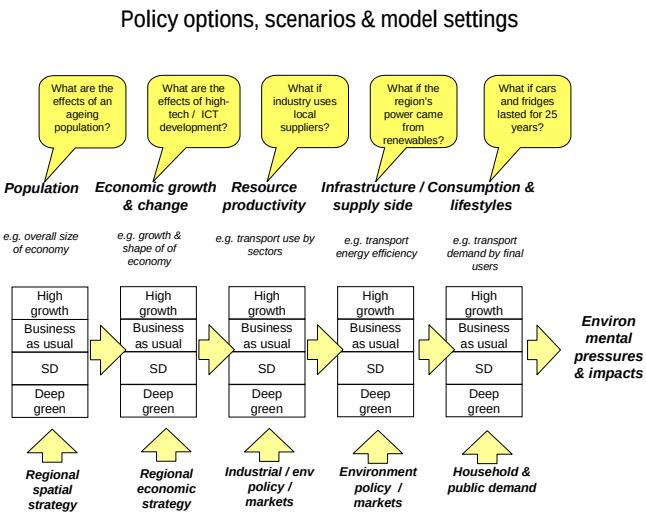
There is a strong environmental strand in all this, in areas such as renewable energy, environmental technology, community-based recycling, ethical finance and corporate responsibility. However this is not yet enough to turn the tide of material affluence and growth in impact – the prime example being the gateway to the region, Manchester Airport, which continues to double in size every 10-15 years.

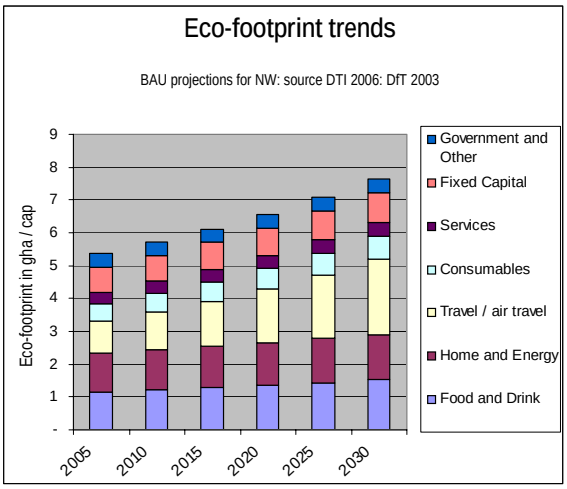
The Eco-region NW ongoing research looks at the NWDA target sectors for industrial clusters, in the light of the current sectoral projections above. For the average sector, a 10-20% reduction in footprint is feasible, just by improved management: 35% reduction is possible through best practice in sectors such as paper, printing, chemicals and pharmaceuticals: and 50% reduction is possible, through integrated supply chain management coupled with strategic procurement.

Regional policy options

The angle which is relevant here is that of developing and comparing ***policy options***. Policy options are needed in order to identify the possibilities, and compare the impacts of alternative choices. As far as the Eco-region NW and REAP tools are concerned, these can be described in 4 basic types:

[5] Boardman et al, 2005





- Economic growth and structural change in both production and consumption
- Environmental / resource efficiency in production by industrial sectors
- Supply-side / infrastructure options for housing, energy, transport, waste management etc
- Demand-side management for energy, transport, water etc

This underlying theme of resource efficiency or resource productivity has many angles – output per investment, per employee, or per tonne of waste or emissions. The policy options which influence these, will be a combination of the financial, regulatory power, market development, or technology innovation. It is fair to say that the regional bodies have only an indirect leverage on most of these factors, as yet.

Demand-side management focuses on the consumer side, and highlights the goal of reducing demand while raising quality of life – either through technology, regulation, market signals, the social economy, or public awareness.. For instance, rather than plan for unlimited growth in road traffic, there may be a 'win-win' combination of more and better public transport, coupled with reducing overall travel demand through green travel plans. The Eco-region NW and the REAP tool can help to analyse a range of policy options:

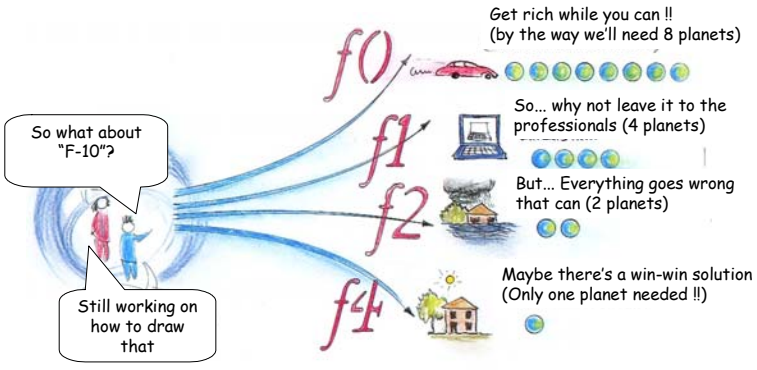
- Housing: further growth in construction and household energy use – or – more rehabilitation coupled with sustainable neighbourhoods?
- Transport: further growth in traffic – or – lower impact modes and better integration?
- Energy, water, waste etc: more power stations, dams and landfills – or – alternative ways of managing demand.
- Industry: further growth in high-impact industries and branch-plants – or – more ecologically sound and socially responsible industries, more compatible with 'one-planet living'.

Trends & scenarios

Which way is the region now heading? For some sectors there is much detail, while for others there are only outline estimates – generally based on climate emissions projections, with adjustments to eco-footprint. This is a small start on a much more detailed research program:

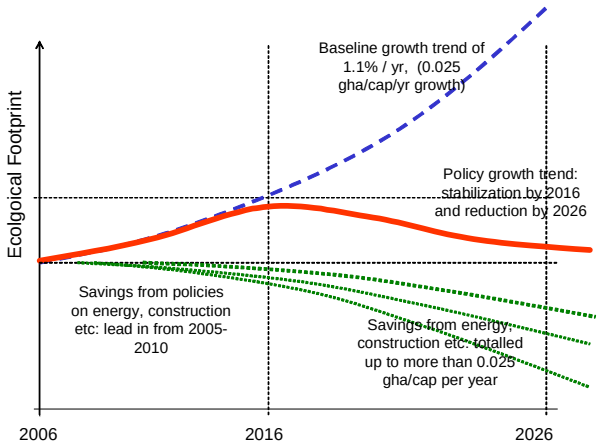
- Food and drink: 1.1% growth, based on growth in UK sector growth & energy use: proportion of imports: growth in international trade: growth in air freight: growth in land utilization and degradation.
- Home and energy: 0.65% growth: based on DTI estimates (2006)
- Travel / air travel: net 2.5% growth: based on 0.6% growth in surface transport, with 3.5% average growth in air travel to 2030
- Consumables: 1.1% growth, based on growth in UK sector growth & energy use: proportion of imports: growth in international trade: growth in air freight: growth in land utilization and degradation.
- Services: 0.65% growth, based on DTI estimates of services related construction, & energy demand.
- Fixed Capital: 0.65% growth, based on DTI estimates of infrastructure related activity.
- Government & other: 0.3% growth, based on DTI estimates

Total 'business as usual' trend: summing the above shows a default trend of 1.16% per year growth, or over



Stabilization of eco-footprint

Example of South East Plan: source: SEERA 2005



60% change from 2010 – 2050.

This contrasts with the Factor Four target. If this is taken for the period 2010 – 2050, i.e. allowing for policy lead in time, then the required rate of reduction is approx -3.4% year on year.

Footprint scenarios

In this study we take a deliberately simple approach to scenarios, and focus on 2 main variations out of 5 possibilities – the main ***trend*** and the main ***target***. Each one is expressed in terms of the main One Planet Economy targets. The 'F' word refers to the factor of reduction in eco-footprint by the horizon of 2050. The full range includes:

- F-0 - A ***'high-growth'*** scenario can be characterized generally as unrestricted economic growth, material consumption and environmental pressure.
- F-1 – existing trends, at about 1% per year as above.
- F-2 – eco-footprint reduced by 50% in a ***'dysfunction'*** scenario: a topical variation which assumes that most things which can go wrong do so, and that the eco-footprint is reduced for all the wrong reasons - environmental degradation and catastrophe: economic stagnation: political conflict: technological hazards: and social exclusion.
- F-4 – eco-footprint reduced by 75%. This ***'sustainable development'*** scenario sees quality of life and social welfare rising, while environmental pressure reduces. There could be several variations on this: one being a '***F-4 technology***' scenario where technological improvements reduce environmental pressures: another being a '***F-4 community***' scenario, the result of political, economic, social and cultural change.
- F-10 – eco-footprint reduced by 90%. Going even further, a ***'deep green'*** scenario would envision a future of ecological protection as a top priority. It is useful to establish an alternative option beyond that of the SD scenario, so that the SD may appear as moderate and sensible.

Regional stabilization

These and many more possible scenarios serve a particular purpose – to link long term goals and targets to action in the present day. For instance, the South East England Regional Assembly proposed for investigation:

> *POLICY CC3: RESOURCE USE*
> *Over the Plan period, per capita use of natural resources will stabilise and begin to reduce, supported by increased efficiency of resource use in new development, the adaption of existing development, the extensive use of sustainable construction techniques and corresponding changes in public behavior…with an aim to* ***stabilize the South East ecological footprint by 2010***.[6]

The graph shows the calculation of this stabilization target – a matter of bending curves with lead in times for different parts of the regional machine.

Generally, there is much active thinking on the meaning of sustainable regional development. The eco-footprint concept then raises both technical issues on how to measure this, and the broader goals and aspirations. It would be too optimistic to predict that regional bodies can lead the way single-handed towards a One Planet Economy, but there may be much more scope than seen yet.

[6] SEERA 2005

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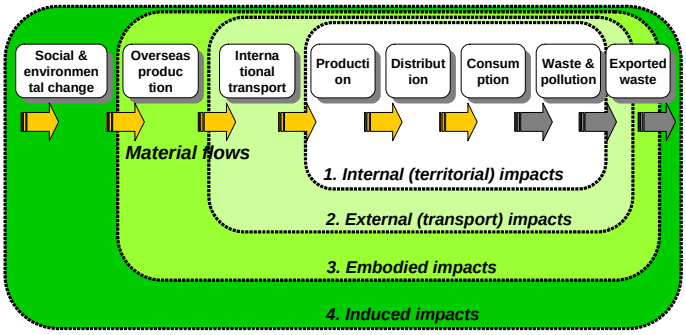


Methods & tools

The Eco-region NW results were produced with a view to developing new methods and tools, both technical and interactive. First among these is the REAP modeling tool: there are other technical tools in use around the UK, such as the REEIO model. There is also a wider set of interactive tools at various stages of development.

Methodology

Just the goals of the One Planet Economy are beyond conventional economic growth, conventional analysis and modelling can only go some of the way towards the solutions. The Eco-Region NW analysis involved 5 steps, some of which are ongoing:

- Development of the mass balance framework and its application to regional policy issues.
- Review of each key sector in terms of trends, projections and scenarios, for technology, markets, infrastructure etc.
- Development of the 'resource flow framework' and institutional agenda for the likely effects of a move towards a One Planet Economy.
- Development of the REAP toolkit, covering 69 types of consumption and 123 sectors of production.
- Development of further applications in construction appraisal: business benchmarking: and policy appraisal.

The Eco-Region NW is very much part of the mass balance 'family' of projects, mainly sponsored by Biffaward. In particular it aims to be a detailed demonstration of the Ecological Budget UK and the One Planet Economy Network program: it also has links with the other regional applications in the North East and West Midlands. The Eco-region NW also draws from the 'Rocks to Rubble' project on mineral resources: the Taking Stock project in the South East: and particularly the City-Region 2020 project and publication.[7]

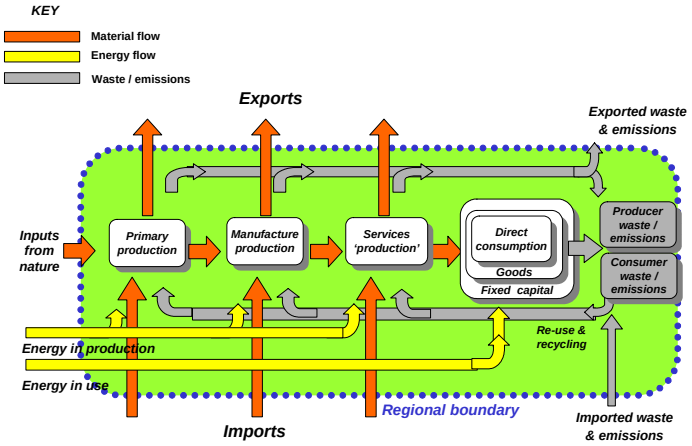
Integrated impact assessment

At present, UK / regional climate emissions (mainly CO_2) accounts are drawn up as per the Kyoto convention, in terms of direct emissions within that region, or directly allocated emissions such as grid electricity. The problem with this method is that it may hide more than it shows – for instance if our region shuts down its steel mills and imports its steel from overseas, this shows an improvement, while in reality it can be the opposite. Hence the logic in the 'consumer responsibility' approach as followed by the eco-footprint analysis (EFA) method.

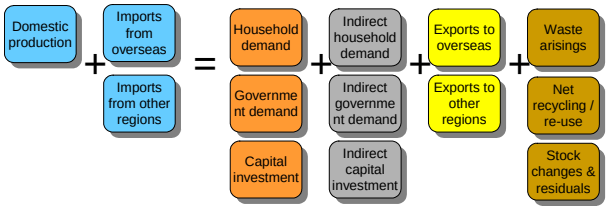
The REAP system of accounting opens up the possibility of a more meaningful and comprehensive analysis of global impacts from both production and consumption. The different layers of this can be seen in the diagram above:

[7] Ravetz 2000

Material flow analysis framework



Sectoral mass balance accounts



- The ***'internal'*** emissions accounts at present include only emissions from energy conversion within the regional borders.
- '***Indirect***' emissions are put through the input-output model in order to track upstream effects: for instance, office activity can be 10 times more carbon intensive than its direct effects would show.
- An ***'extended'*** account includes for aviation and international shipping, which are the fastest growing emissions sources.
- An ***'embodied'*** account tracks the goods and products, produced overseas and consumed in the region. This is the logic of the full 'consumption' based approach of the EFA.
- An ***'induced'*** account aims to measure the ultimate environmental and social damage, in terms of deforestation, desertification etc. These effects are often more uncertain and more indirect, but no less important. The EFA has the potential to reflect this more global view, even though its calculations are more complex.

Material flow analysis

A ***Material Flow Analysis*** (MFA) looks at the material inputs to a region, in terms of raw materials and products, and at outputs in terms of waste and emissions, plus any changes in stocks. It can also look at '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. The data can be arranged by types of consumer needs, or types of economic production sectors. It generates some key indicators:

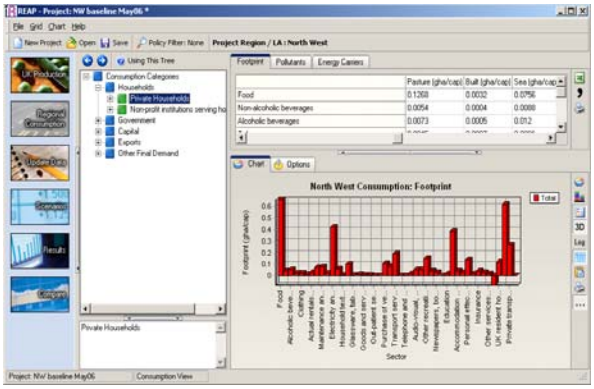
- ***Direct Material Consumption*** (DMC): the total amount of materials directly used in the regional economy and consumed, i.e. excluding exports.
- ***Total Material Consumption*** (TMC): the total material use associated with regional consumption, including DMC together with the indirect or 'hidden' material flows generated by that flow.

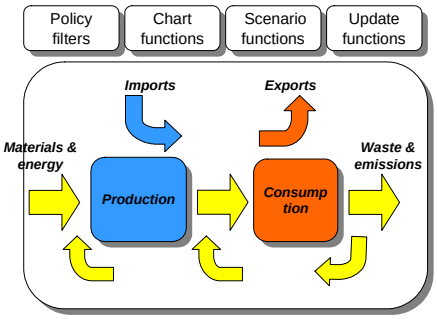
There is a risk of double counting when adding up all the material inputs to each industrial sector. The DMC can be calculated from the primary inputs from nature (i.e. from agriculture, forestry, fishing and mining), plus all imports from overseas. While the data has many gaps, there is enough to at least provide an outline model of the UK and regional economy in material flow terms, as shown above.

- The framework is organized in a 5 stage process, corresponding roughly to the primary, secondary, tertiary, demand and 'externalities' classification of economic sectors.
- Various kinds of waste streams are shown in green by the shaded boxes on the right hand side, coming off each of the stages.
- Various inputs of energy and transport are shown in yellow at each of the 5 stages.
- The 'products in use' circle shows the effect of infrastructure such as vehicles or buildings.
- ***Resource productivity,*** i.e the useful outputs per unit of input, can be measured at each stage of the production chain, in the context of the mapping above.

Sectoral mass balance

The MFA principle can then be used to generate mass balance equations for each sector or supply chain, on the basis that matter is neither created or destroyed. The full tables of mass balances by 123 sectors in the





NW economy are available on the website. These are organized on a supply-demand principle, as in the diagram above. This shows the regional production plus imports: which equals the direct demand, indirect demand, exports and waste components.

The REAP toolkit

The '**R**esource & **E**nergy **A**nalysis **P**rogram' is a database and modeling system which shows the total impacts of the throughput of materials and energy in the economy.

It calculates this for 123 sectors of production by industry, and 68 types of consumption by households and government, at local and regional level. It focuses on 3 main indicators of environmental performance in production and consumption:

- CO_2 emissions, as the largest cause of climate change, together with energy flows as the main cause of CO_2 emissions.
- Material flow and mass balance: although the heaviest materials are often the least damaging, this analysis underlies the regional 'metabolism' and helps to locate hidden impacts.
- Eco-footprint, as the overall measure of global impact.

These are each calculated in the REAP system for the UK, and then allocated to regions by their profile of production and consumption.

The REAP system provides several unique features over and above other available tools in the UK:[8]

- Analysis of inter-dependencies between sectors and supply chains, via physical input-output tables and database for the UK regions.
- Analysis of total impacts of consumption to meet final demand, through a detailed model of international trade and UK imports.
- Analysis of material flow at regional and local authority level; the local level is calculated through applying physical throughput to household expenditure data and then to the local area Acorn classification.

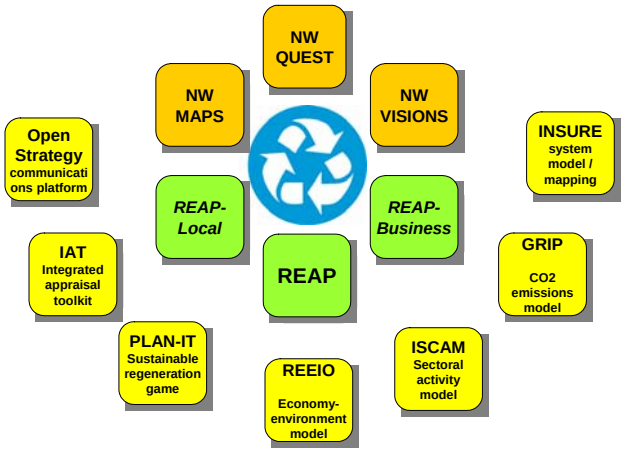
The REAP system was produced in a partnership led by SEI-York with CURE and WWF-UK. It is now available in Version 1.0, but development is continuing, on scenario modeling, sectoral applications, appraisal packages and business toolkits. For further details see www.reap.sei.se

The REEIO tool

The REEIO (Regional Environment-Economy Input-Output) model provides a detailed analysis of regional strategy, with links to other technical models and databases. The REEIO is based on a detailed econometric input-output model of each region, based on the 'Local Economy Forecasting Model' (Lewney 2001: Brettell 2003).

This uses a 50 sector economic classification aggregated up from the 123 national SIC classification, and the labour market is shown in six types of employment and 25 types of occupation. The REEIO then links economic

[8] Details on www.ecologicalbudget.org.uk



and employment changes with key environmental and resource pressures:

- Waste sector: household, industrial / commercial, construction, agriculture etc:
- Energy sector: demand from households, transport, industrial / commercial activity: supply is by 13 sectors and 6 fuels.
- Air emissions: including greenhouse gases, SO_x, $N0_x$, VOCs, PM etc:
- Water demand, etc

The user inputs are arranged in a series of 'what-if' scenario assumptions, from overall population trends to the details of waste or energy management. These are generally arranged as policy inputs or technological change, but short term interventions, projects and shocks can also be simulated.

One of the main components is the 'Linking-Up' study, which looks in detail at the policy applications of the model, in terms of future studies, strategic planning, evaluation / appraisal, and policy training.[9]

Other tools

The REAP toolkit itself is continuously under development, and is surrounded with a large set of R&D type workbooks and datasets. Some of these are from the ISCAM (Integrated sustainable cities assessment method) (Ravetz, 2000). There are many others with applications to sectors such as construction, education, waste management, transport and so on. A portfolio of datasets and workbooks is available on the www.eco-region.org

[9] CURE 2003

The INSURE model is a system dynamics approach under development by CURE and others, in a FP6 project funded by the European Commission, as on www.insure-project.net. It aims to combine two parallel strands:

- A 'system model' which uses Eurostat data on economy, population, infrastructure, sectoral change and spatial development, for any NUTS 4 region in the EU.
- A 'system mapping' method which involves users in a process of exploring the chains of cause and effect in policy issues, most of which cannot be modeled by numerical means.

The NW region version of the INSURE model is anticipated in late 2006.

Meanwhile the GRIP (Greenhouse gas Regional Inventory Project) is an initiative set up by the Tyndall Centre and the Environment Agency. The project has provided a clear, consistent and transparent methodology for calculating emissions on the sub-national scale. This GRIP approach is easily repeatable, timely in its approach and it utilises readily available data sets. The heart of the project is the scenario tool, which shows the relative impacts upon emissions of demand changes and fuel switches, regionally and nationally. http://www.grip.org.uk

Data sources & workbooks

It should be stressed that all the data shown in the Eco-region NW, and more generally in the REAP model, is derived by statistical calculation. Hence it is subject to the uncertainties of original surveys, classification

problems etc.
The REAP tool and its database is built almost entirely on government and industry standard datasets. These include the ONS blue book, Family Expenditure Survey, COICOP consumption data, ACORN social group analysis, and PRODCOM trade data. However it allows for users to insert more up to data local information where this is available.

The scenario and activity model data then extends this by drawing on government departments, industry bodies, European Environment Agency etc. It draws also on the ISCAM scenario model, the REEIO projections for regional growth, Environment Agency waste assessments etc.

It is intended to update the core datasets and national / regional accounts in the REAP model on a biennial basis. It is also intended to publish a Ecological Budget for the UK annually from 2007, and this will also contain a breakdown for regions including the NW.

One of the main outputs of the Eco-region NW is a series of technical datasets, available in Excel workbooks on the website. With more details in the Appendix, these include:

- Core MFA datasets for the NW region
- Local REAP data for 44 local authority areas
- Municipal waste & footprint calculation
- Commercial & industrial waste by 123 sectors
- Activity sector accounts for key supply chains
- Pilot resource productivity benchmark scheme

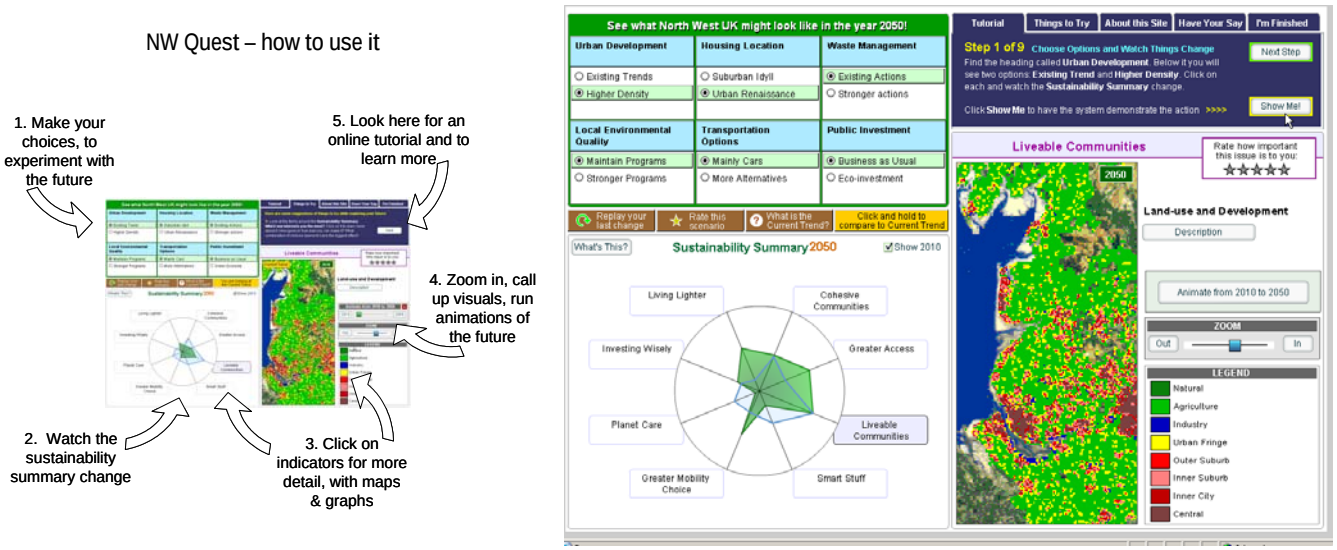
NW Quest

The theme of sustainable development needs us to look into the future, to see the longer term effects of present day actions. It also needs us to understand better the present, and the tangled web of causes and effects in a complex society which needs to live in harmony with its environment.

The NW Quest module helps to throw light on this. This is a kind of 'time traveller' or 'sim-region' package which helps users to design and create maps of the future of their region. It aims to show the effects of personal choices and policy decisions directly – whether for houses, cars, diets or lifestyles in general. The NW Quest concept works best at the regional level – not so large as a nation, yet large enough to show the support systems of energy, water and landuse. The current version is a prototype, to show what is possible for the next stage, for other regions, or for other sectors. It also aims to be a platform on which material can be accumulated as it becomes available.

It covers 6 key themes – cities, communications, economy, society, resources and environment. It covers a time period of about 40 years, from 'now' (roughly) to 2050. The software builds in the values and priorities of users, and offers a set of detailed choices for lifestyles or policies. It then provides the feedback and 'consequences' of these choices, on a series of maps of the NW region.

At the heart of the software is a detailed model of the urban development process, with its implications for environmental, social and economic issues. The concept also draws from other regional projects such as:



- 'Integrated Sustainable Cities Assessment Method', developed by CURE with funding from the ESRC:
- 'Visions NW' scenario project led by CURE for the EU:
- 'Timetracker' projects, as led by Sustainability North West.

The software does not attempt to 'predict' or 'forecast' the future of the region – this is simply not feasible by computer or any other means. It does aim to provide useful feedback on the question of 'what if', and to explore the possibilities in conjunction with debates, discussions, stories, maps, images etc.

This is a much simplified version of the phase 1 model (available on CD by request to CURE). This enables a complete range of scenarios to be pre-calculated, and selected scenarios are then called up from the server by the unique combination of user choices.

At the heart of the NW Quest is an ***urban development*** model: this estimates the movement of population around, in and out of the region in response to user inputs. It works by assessing what will cause people to want to move from where they live at the moment (push factors) and where they would most like to be living in the future (pull factors). The environmental implications of these choices are then calculated in a simplified version of the REAP – ISCAM worksheets, for the scenario range.

The 'eco-investment' chart is based on the One Planet Economy Network research from the Ecological Budget UK. The key theme for the economic transformation is eco-taxation and eco-investment in clean technology, sustainable infrastructure etc. However the implication is that there is not necessarily a 'free lunch' – while the economic win-win case can be argued about, there are knock on effects on social change, on disruption of organizations, and vulnerability to outside threats or internal tensions. Details of the data sources, calculation methods and software compilation are in the documents on the website

Applications

These are interesting times for interactive sustainability tools. On the political side, there is the new city-regional agenda, public participation and interactive techniques for planning, surveys, visioning etc. On the research side, there are new concepts of integrated assessment and systems modelling. On the technical side, the advances in web technology and digital databasing over the last decade now open up new possibilities. In response to this the NW Quest has been designed for a variety of users:

- Public users: open access to themes, priorities and possibilities
- Policy users: generating a broad picture of the future of the region.
- Technical users: focusing on the analysis of urban development.

Educational users may access any of these, depending on skills and interests. The system also works with user inputs on different levels:

- Values & priorities: underlying social and cultural factors
- Lifestyle choices: where personal and social preferences are highlighted
- Policy issues such as land-use planning: either as what ***should*** happen, or what is ***likely*** to happen

One of the most interesting features is that different user inputs can be contradictory – many people will

input ***wants, needs, hopes, and fears,*** which all appear to be in conflict. This is simply a reflection of the complexity of society and the human psyche. A portion of such complexity can be represented by the software, which deliberately contains different levels of input and feedback. The best application is therefore in an interactive workshop forum setting, where users can debate and bounce off each other. Such workshops can be focused either -

- visioning mode, i.e. exploring future possibilities
- action mode, i.e. working backwards from desired or undesirable futures to present day actions.

Where an interactive workshop is not possible, the individual user on the web can explore, contemplate, dig out further information, follow the links, and so on. For web users, an interactive feedback system is in preparation. This will enable automatic logging of user choices for further analysis.

Lifestyle NW

This prototype tool, came up in response to the carbon or footprint calculators now available, such as – www.earthday.org/Footprint

These calculators are fine as a measure of what goes on now. However, the Eco-region NW was also interested in the question of where lifestyles and their footprints might be heading in the future. So the **Lifestyle NW** module takes a more psycho-cultural angle. It uses simple visualizations to try to get under the skin, to explore the underlying values in what people want, and the implications of what they might get.

Background: what do people want

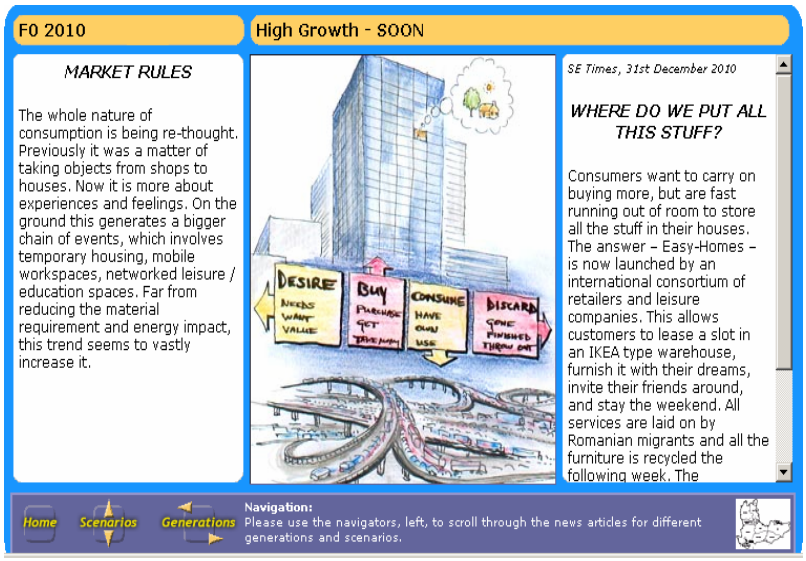
The question of 'what people want' is of course not so simple – there are issues of psychology, cultures, education, work, families, communities etc. In a contrast to the economic view, the recent focus on 'happiness' shows that despite more and more 'stuff' we are no better off than 30 years ago. This depends in turn on how you measure happiness.[10]

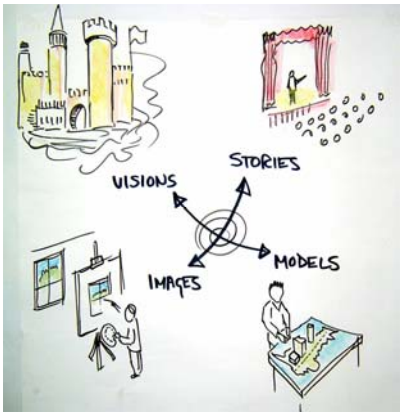
In this case we took the very simplistic approach of the footprint scenario series. In reality people see the footprint issue in different ways, for different reasons:

- A small minority of people actively change their lives for environmental goals. These are the 'inner-directed'.
- A majority of people say they would like to protect the planet, but are unsure what to do, or feel it makes little difference, or unwilling to look stupid, or just have other things on the mind.

The implication is that lifestyle change, for anyone but the small minority, is likely to come through identity-forming, brand making, celebrity endorsement, reality media, and other cultural wave making. If for instance people are moved by the idea that 'their' city is going to be the coolest, greenest city, then they might do things which otherwise stay in the background. This is the approach of **www.manchesterismyplanet.com**

[10] Layard, 2005





So the agenda for interactive tools like this, is to link the footprint analysis with a more personal kind of angle. At this stage the NW Life Quiz is an early crude prototype. It may develop into a more sophisticated 'semantic web' system, combining the best of e-bay, sim-city, genealogy sites, ebo and other virtual communities.

Scenario methods

A 'scenario' is a structured description of possible future conditions and trends. The development of scenarios in 'sets' is a way of mapping out future trends, risks, opportunities and alternatives. Scenarios can show either what appears to be ***probable***, what might be ***preferable***, or other possibilities which might just be ***plausible.***

Often the ***process*** of scenario development can be a catalyst for enhancing strategic intelligence and organizational capacity, and can be at least as important as the scenario ***product*** itself. This process can work best if it goes beyond the 'technocrat' world, i.e. if it looks at underlying trends, subliminal signals, hidden causes etc. The 2nd cartoon above shows how scenarios can play different roles at the same time –

- Stories about the future
- Models, which look at the technical side
- Images, which can tell more than stories
- Visions, which can illuminate hopes and fears.

NW Visions futures software does not attempt to 'predict' or 'forecast' the future of the region – this is simply not feasible by computer or any other means. It does aim to show 'what if', in conjunction with debates, discussions, stories, maps, images etc. The interactive scenario material on the website is based on the NW regional experiences of the EU project 'Visions for a Sustainable Europe' - www.sed.manchester.ac.uk/research/cure/projects/completed/visionsNW

They are also drawn from the UK 'Environmental Futures' Foresight scenarios: www.foresight.gov.uk

These scenarios might appear quite extreme, and some of them are. But the scale of the gap between the F-1 business as usual, and the F-4 One Planet Economy goals is too large for conventional thinking. Such scenarios are not to be taken literally, but rather as devices for stimulating thinking and debate.

5

Local agendas

In contrast to the big-picture view of the region, here we look at the local perspective and the lifestyle choices of local people.

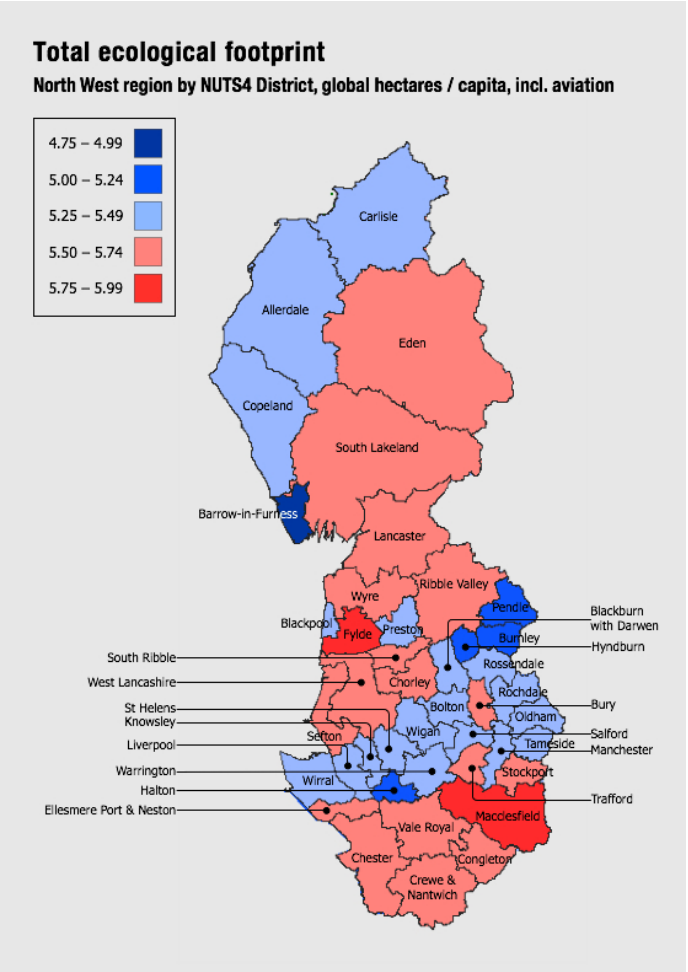
Users can download a spreadsheet file with the REAP footprint / carbon data on any one of the 44 local authority areas in the NW, at
http://www.sei.se/reap/local

This section shows an overview of the NW counties and districts within them, and the consumption items which make up the footprint.

Mapping the footprint

The REAP model has produced for the first time the eco-footprint and CO_2 due to consumption of residents, of every local authority area in the NW region and the UK.

As in other regions, there are distinct variations across the North West. The map here shows this quite clearly, as quite similar to the map of wealth and poverty across the region (shown in the NW Quest module). The local areas with the largest eco-footprint (Macclesfield and Fylde) have a footprint 14% larger than the areas with the smallest (Halton and Barrow). We can see pockets in East Lancashire and a more remote area of relative poverty in the north part of Cumbria.

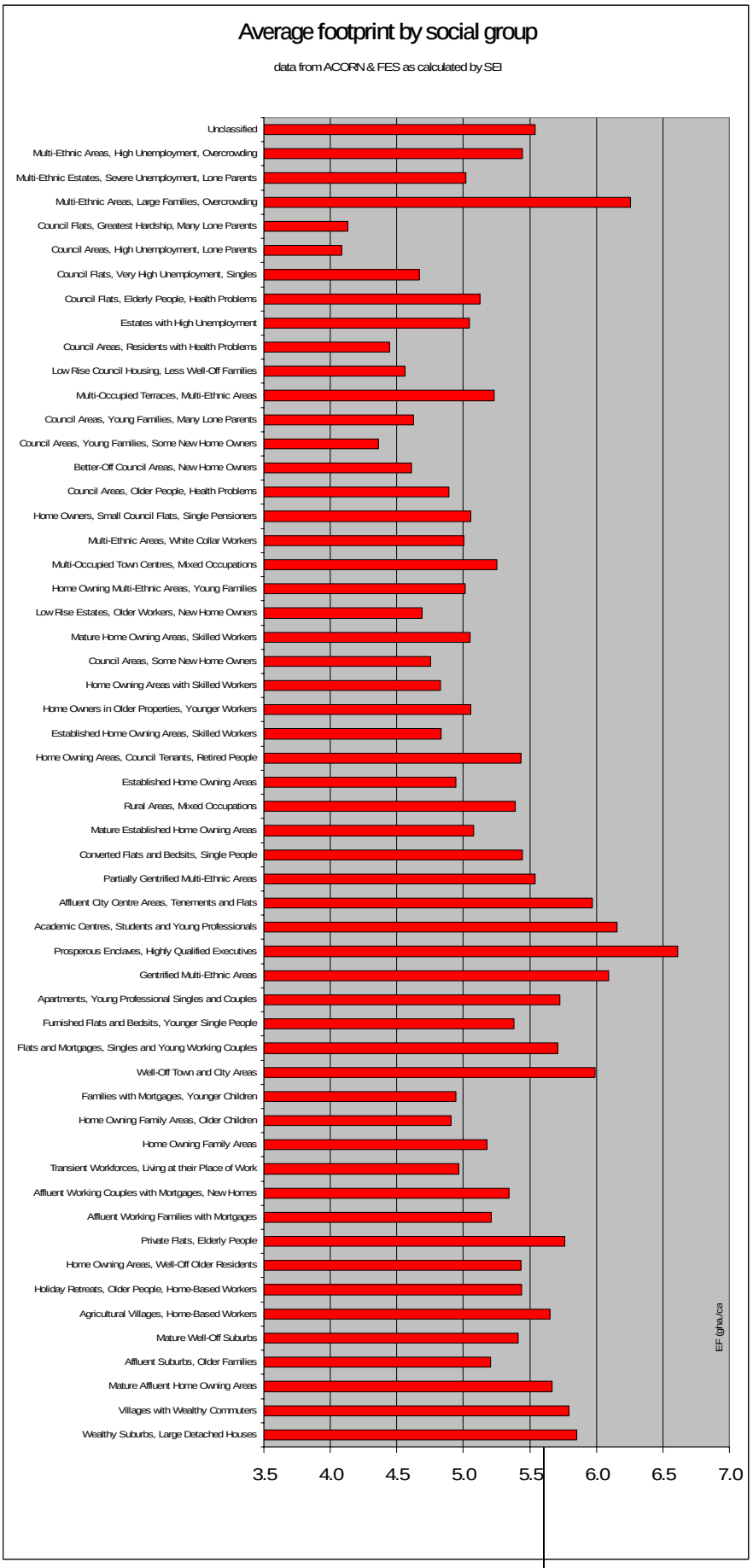


This data is generated from the REAP modelling method. This uses the ACORN consumer classification system, as shown overleaf, to profile the consumption patterns of different groups in each local area. This is then matched to the population profile of each area, to produce a first base estimate of the footprint. As and where there are better data at the local level these can be inserted into the calculation.

Affluence & footprint

There are, however, interesting differences between the footprint and the income levels: the chart over the page shows how many local areas are not on the trend line. This is a result of different types of consumption from different social groups.

For instance, the same £ unit of expenditure may be used for overseas holidays with a high footprint, or for more value added services which have a much lower footprint. The Factor Four scenarios as in the previous chapter show how more extreme combinations of lifestyle choices can add up, but for an average population of an area the differences are smaller.



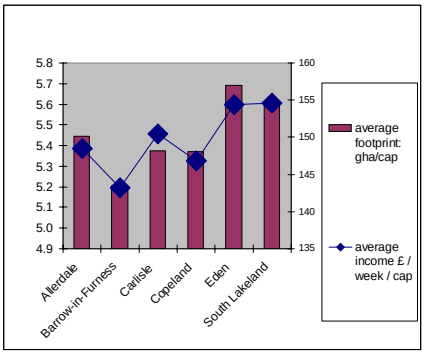
The chart here is a very topical analysis of social groups in the ACORN system, and their eco-footprints. It is calculated by the application of family expenditure data by social groups, to the consumption impact factors in the REAP modeling system.

This could be at the start of a whole research program on the components of lifestyle footprint, on the theme of sustainable consumption. In terms of the Eco-region NW, such components would include:

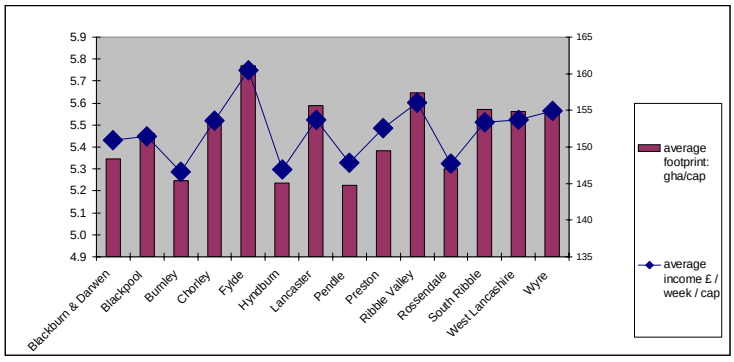
- Family / household size
- Dwelling size and energy efficiency
- Transport and holiday choices
- Food and drink choices
- Disposable income and purchases of consumables.

Some of these components are more fixed and a matter for public policy: some are more volatile and subject to fashion, new technology.

Local eco-footprint: Cumbria



Local eco-footprint: Lancashire



Counties & districts

Here we look briefly at the sub-regions of the NW – Cumbria, Lancashire, Merseyside, Greater Manchester and Cheshire.

These 'county' structures are now being reconsidered, in the light of the current 'city-region' agenda. For the eco-efficiency agenda, the city-region has great potential for integrating many supply systems – transport, energy, local food and so on.[11] In reality, there are many layers to the definition of a city-region, and as yet there is no single solution emerging.

Cumbria

Cumbria is relatively remote to the rest of the NW. It has experienced massive change in its industrial areas: many rural areas are also undergoing a hollowing out of the agricultural economy, and an influx of more urbanist type employment. Much of this is tied to the tourist activity, where the accounts produced here do not show adequately the effects of visitor flows.

The districts of Eden and South Lakeland are relatively high, while Barrow has the dubious honour of having the 2nd lowest footprint in the region.

The eco-efficiency priorities for Cumbria include:

- 'green tourism', particularly with access by public transport:
- revitalizing the agricultural economy

[11] Ravetz 2000

Lancashire

Lancashire is a large and diverse county. There are pockets of concentrated expertise and high-tech activity, and larger areas of comfortable commuter homes: agriculture ranges from intensive horticulture to upland sheep farming.

Fylde is the district with the highest footprint, followed by Ribble Valley. The lowest are in the East Lancashire corridor of Hyndburn, Burnley and Pendle.

The topical 'city-region' theme is needed as much here as anywhere. For the eco-efficiency theme, the city-region would focus on:

- Public transport systems for low-impact links between the 5 towns
- Upgrading or replacement of much sub-standard housing, with some of the worst conditions in the region.

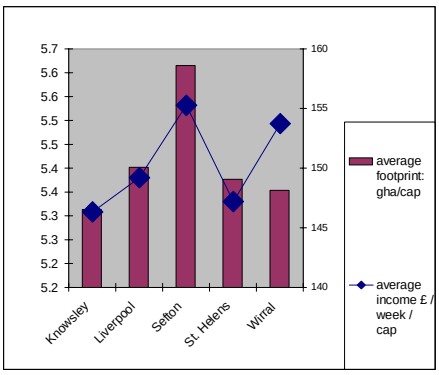
Merseyside

The historic problems and potential of Merseyside are well known. The de-industrialization, the loss of international shipping, and the rivalry with Manchester for core functions have compounded with low entrepreneurship and low quality housing.

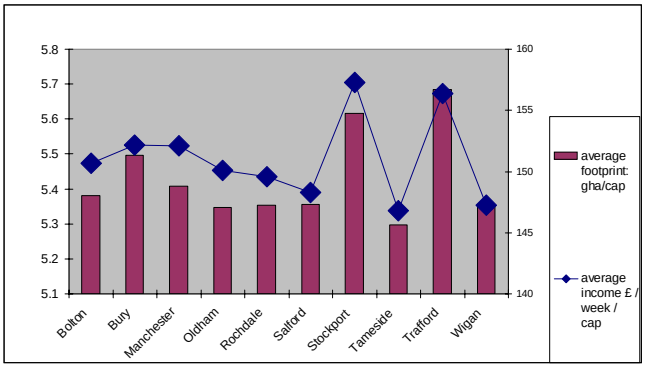
Again this county shows massive contrasts, between the relative wealth of Sefton and the relative poverty of Knowsley and the Wirral.

The eco-efficiency agenda for Merseyside would focus

Local eco-footprint: Merseyside



Local eco-footprint: Greater Manchester



on the urbanized city-region:

- Offshore renewable generation, now forthcoming
- Public transport
- Urban food systems
- Revitalization of urban services in order to stem the outward migration for better education, housing etc.
- Revitalization of urban communities, as a counterpart to private consumption of goods and mobility.

Greater Manchester

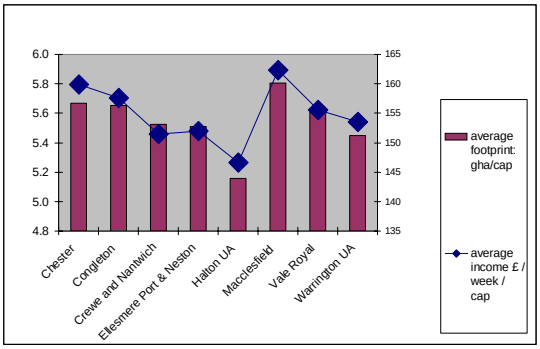
In the larger conurbation of Greater Manchester, there is a complex arrangement of international functions overlaid on local neighborhoods. As with Merseyside there has been rapid economic restructuring, particularly in the more traditional industrial parts of the city-region, but the economy and physical fabric has on the whole survived better.

The chart shows the division between the relative affluence of Stockport and Trafford, and the relative downbeat of the northern and eastern districts. Manchester itself shows up as middle of the road, containing affluence and deprivation side by side.

Again, the eco-efficiency agenda would show a more urban and peri-urban agenda:

- Upgrading of large areas of inefficient housing
- Shift from car travel (often very slow) to faster bicycle and public transport modes.
- Again, the revitalization of urban communities, as a counterpart to private consumption of goods and mobility.

Local eco-footprint: Cheshire

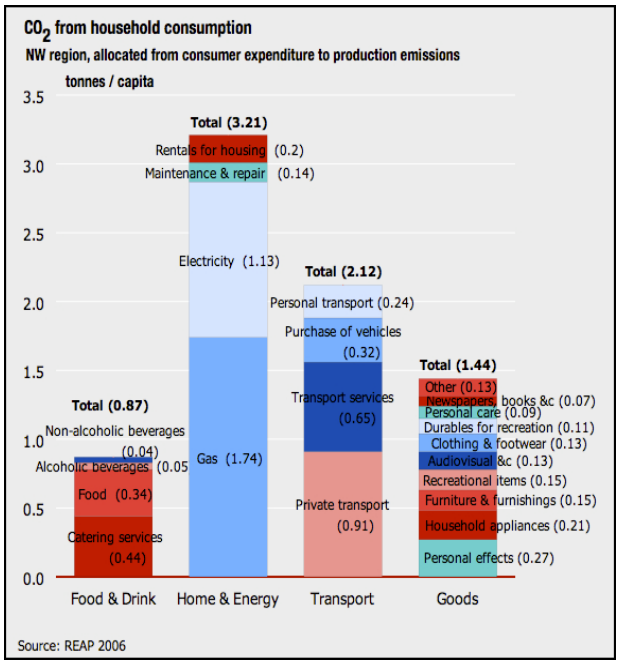


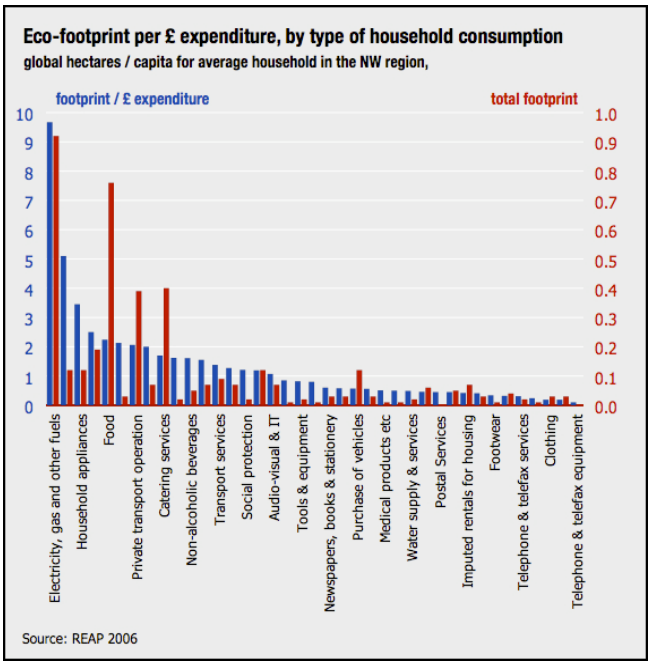
Cheshire

The 'home county' of the NW is noted for its fine agricultural landscapes and historic towns. It also contains some of the largest industrial complexes in the country. (The districts shown here include the county plus the Unitary Authorities of Halton and Warrington). Cheshire has a special significance for the region, being the most attractive for high-tech and knowledge based industries, although this does not necessarily fit with planning objectives.

Half of Cheshire contains the districts with the highest income and highest eco-footprint in the region (Macclesfield being the highest). It also contains one of the most deprived with the lowest footprint – Halton.

The eco-efficiency agenda has a serious challenge here, in a county with high affluence, large commuting flows, two motorways and two major airports on its doorstep. Possibly the most significant way to go, would be in advanced ICT to replace some of the large volumes of car travel with teleworking and virtual offices wherever possible.





Lifestyle choices

Possibly the most topical question in all this is where to find 'win-win' solutions – combining quality of life, a strong regional economy and a reduced eco-footprint. For instance, to reduce fuel poverty but improve energy efficiency: to improve access to services but reduce the need to travel: and to minimise the creation of waste in economy but increase competitiveness, are some of these.

At another level, sustainable consumption policies need to be closely targeted on the needs and desires of social groups, cultures and households (SDC, 2004). Components of a modern lifestyle which are potential targets include food and drink, consumables and appliances, domestic energy, holidays and personal travel. Some, such as food demonstrate a lower variation in consumption levels than others: the differences between high cost and low cost diets are not as simple as high or low footprint. However the links between consumption and impact are significant on the regional and national scale. For instance the average North West household consumes 10% more meat and 20% less fresh fruit than the UK average, and has the highest rate of smoking in the UK. There could be some causal link with health impacts, where the North West average life expectancy is 5 years less than the UK average.

The item with the most variation, and the most rapid growth trend, is air travel and foreign holidays. As with many other consumption items, any restrictions on air travel demand or supply are not really on the agenda of local or regional policy.

Ultimately, no single ACORN social type as yet demonstrates all the components of a sustainable lifestyle. This reflects the general picture at national, regional and local levels. It is possible to construct an ideal model, but the changes that are required to make the 'model sustainable consumer' a reality are significant. For the moment particular components of a sustainable lifestyle can be encouraged, and some initiatives already exist in the North West to encourage this.

Future developments of the REAP system aim to provide more evidence, with details of product LCA (life cycle analysis), and with details of the supply chain paths by which they reach the consumer. This should then provide insight on whether, for instance, to buy fruit from Sefton or from Spain.

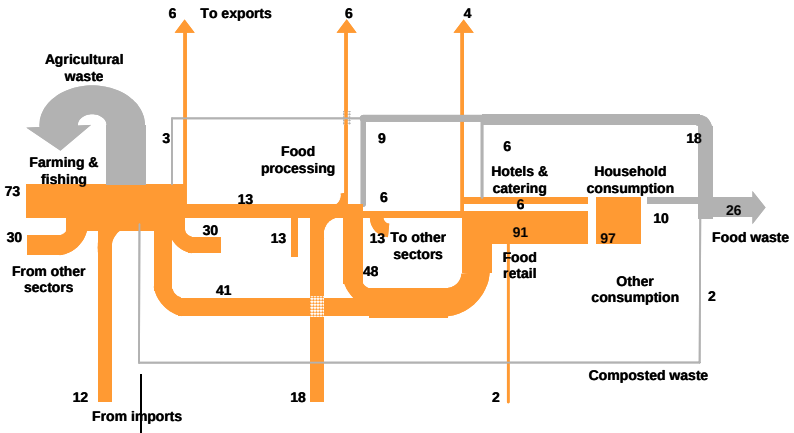
For now, the first chart above shows the relative components of types of spending, as a guide to what is a policy issue or a personal issue. The second chart shows the relative scale of priorities in spending, from the most footprint intensive (electricity & gas: household appliances) – to the least intensive, (clothing, leisure services etc).

6

Goods & services

Agro-food chain resource flows

Summary of 2002 MFA data generated from REAP system for the UK:
all figures shown to nearest million tonnes, approximate for illustration



In this chapter we look briefly at each of the key 'activity sectors' – food, transport, products, commercial services and public services. Following on from there, we look at environmental services, built environment and the business agenda, in the next chapters.

In each sector we draw on the REAP data, with examples of the many different ways to present resource flow and resource productivity indicators. We look at current trends, possible scenarios, and how the F-4 targets might be achieved. The issue then is what, if any, is the role of the region in this? There are many questions, some of which are followed up in the One Planet Economy Network papers.

Food & farming

In the food sector there is generally a direct path from production to consumption to waste, i.e. there are small levels of stocks or effects from products in use. The UK is generally more self sufficient than would appear, i.e. 60% overall by raw food weight. However the imports are generally of much higher impact, particularly with the growth of air freight for fresh produce.

The MFA data shows that most economic value-added and energy inputs are concentrated in the manufacturing & distribution sectors. The bulk of material flow in farming is returned to the land: most imports are entering at the food processing stage. The impacts of agriculture also include many non-CO_2 climate effects (CH_4, N_2O, etc: and also the non-climate impacts include land-use, biodiversity and many others. In particular there are questions on the international trade and development agenda, as in the OPEN report.

There is also competition / substitution between agriculture and other sectors for scarce resources such as land / water etc. In particular the energy transformation puts pressure on land for bio-fuels, with clearance of rainforest etc, and industrialized farming of bio-fuels can be as damaging as any other. Generally, the food chain with its global logistics is clearly based on cheap fossil fuels, and rising energy prices and/or taxes will change the nature of this system. In terms of UK policy, there is a disconnection between mainstream national and regional / local development. There are linkages to the rural diversification / healthy eating agendas, but these are as yet on the margins.

Towards Factor 4 food & farming

As in the scenario box above, there are possible changes to the food system at each stage of the supply chain. NW food production could shift towards more IT-enabled 'precision farming', niche products with networked logistics for distribution. Household consumption is likely to follow the trend of growth in healthy low-additive fresh foods, and this could also go in the direction of low impact, given a package of fiscal

Scenario Box –

FOOD & FARMING IN 2050

When the world food 'crunch' came in the 2030's some tough decisions had to be made, very fast. World population was still growing by 60 million per year, while the effects of climate change had reduced mighty rivers to mud, and once fertile paddies and orchards to dust. Many of the poorer half of the world, both rural and urban, were close to the threshold, even while their fields were being converted by trans-nationals to feed cattle for American beefburgers, and now ethanol for Chinese cars.

Meanwhile in the UK, the increasing appetites of health and beauty conscious consumers seemed to demand the best of all worlds – high quality speciality foods, grown locally by niche farmers, with the best health and animal standards, at minimal cost. Meanwhile the UK energy transformation required rapid shift away from fossil fuels. How could this be done?

Overseas, the long-argued reformation of international trade proceeded in parallel with a global energy transition. The effect was to shift the order of natural 'advantage', towards one where transport and energy mattered, local production for local economies mattered, as did food quality.

In the UK the Common Agricultural Policy shifted its incentives from large industrial to small organic producers. With other changes in planning laws and neighbourhood services, for the first time in 150 years the advantage was with smaller producers. This is not to say that all food was local, but rather that food was grown and prepared with respect to ecology alongside health and community issues. New ICT techniques emerged rapidly to enable precision farming and low impact logistics, to match supply with demand in the most sustainable way.

incentives and market transformation measures. This could result in much import replacement with local glass house cultivation, using wholly renewable energy sources, with advanced control and logistics systems.

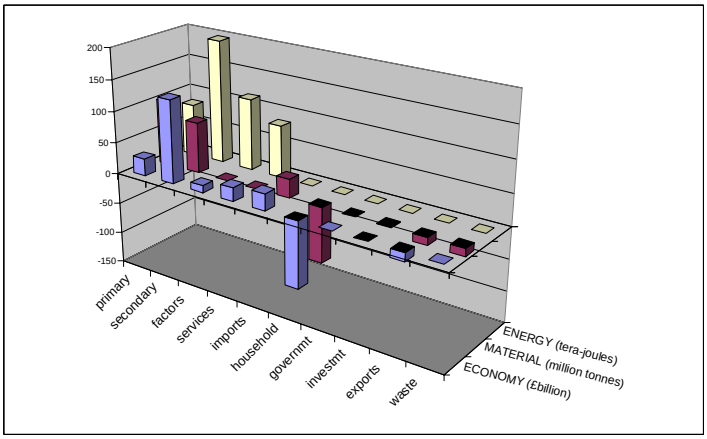
Role of regional & local policy:

Regional policy has had very little engagement with food issues since World War II, when basic production was an overriding priority. This is now changing, and further developments are likely:

- ***Regional image and marketing*** and the role of food and drink: The Countryside Agency programme 'Eat the view' is a forerunner of more regional based food activity, already well established in many EU countries.
- ***Regional countryside policy:*** this may prioritize farm or land-related employment and intermediate labour market activity.
- ***Regional housing policy***: this 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 maintenance (in both image and reality) of a populated agricultural landscape; therefore there is a strong case for encouraging the diversification and continuing production from the regional landscape.
- ***Regional climate change policy***: the extra pressures put on the landscape and habitats by climate change and extreme events (storms, floods, droughts, soil erosion, stress on species) may be ameliorated and adapted by a diversified and productive countryside.
- ***Food and drink production*** as a priority sector for economic development for the NWDA and others. Much of the industry is low skill, with high environmental impact, but open to innovation and small business enterprise.

Food supply chain in the NW: energy, economic & material flows

Data from REAP / activity model



The supply chain flow charts above show extracts from the data which is listed as 'resource productivity' indices in the table overleaf. Each of these represents a possible way in to such questions. They should be used as benchmarks to help identify best practices, resource exchanges, and potential added value.

Food sector productivity indices	domestic material intensity: MFA / £GVA domestic production	imported / domestic material input: %	waste / material input: waste as % of DMI	fossil fuel intensity: tonnes oil equiv / £million domestic production	electricity intensity: tonnes oil equiv / £million domestic production	eco-footprint intensity: gha / £million total demand	CO2 intensity: tC02 / £million domestic production	embedded CO2 import intensity: tC02 / £million domestic production	IMPORT INTENSITY: import as % of domestic by tonnes	EXPORT INTENSITY: export as % of total demand by tonnes
Agriculture	4.95	17%	77%	57	17	50	0.16	0.19	29%	10%
Forestry	14.51	6%	29%	46	30	439	0.13	0.15	16%	14%
Fishing	0.99	41%	323%	166	40	381	0.48	0.15	18%	73%
Meat processing	0.54	32%	8%	228	43	2	0.56	0.47	29%	6%
Fish, fruit processing	0.86	74%	8%	263	49	2	0.65	0.55	47%	8%
Oils and fats	1.23	256%	8%	139	26	2	0.34	0.29	60%	17%
Dairy products	1.49	9%	8%	249	47	2	0.61	0.52	23%	7%
Grain milling, starch	2.83	17%	8%	131	24	2	0.32	0.27	18%	21%
Animal feed	8.28	5%	8%	116	22	2	0.29	0.24	10%	13%
Bread, biscuits etc	0.35	14%	8%	133	25	2	0.33	0.28	9%	7%
Sugar	0.08	2401%	6%	78	15	2	0.19	0.16	41%	27%
Confectionery	0.32	32%	7%	323	60	2	0.80	0.67	22%	9%
Other food products	0.43	36%	7%	174	33	2	0.43	0.36	23%	14%
Alcoholic beverages	1.58	22%	7%	435	81	2	1.07	0.90	85%	20%
Soft drinks	2.73	11%	8%	263	49	2	0.65	0.55	18%	4%
Tobacco products	0.05	36%	47%	21	12	0	0.05	0.14	66%	7%
Retail distribution				357	324	296	0.92	0.01	0%	5%
Hotels, catering, pubs				288	121	4	0.65	0.10	15%	0%

Summary & questions

Overall, the resource flow effects of the F-4 food scenario are quite challenging to envisage:

- Rapid reduction in energy and material inputs to agriculture.
- More sustainable land management

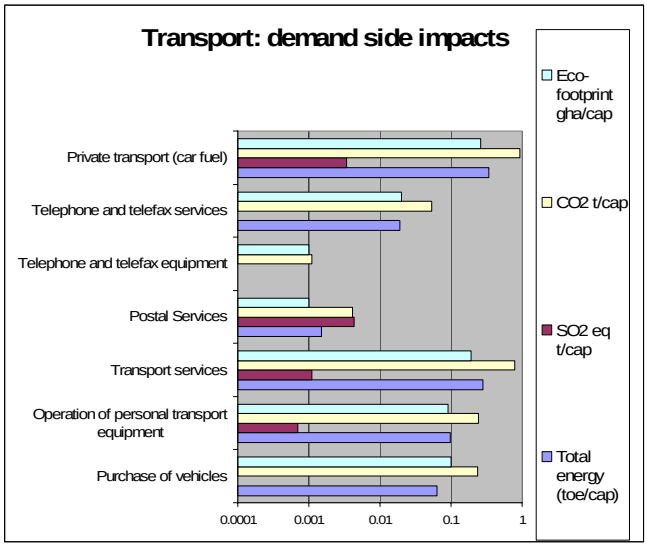
- This is likely to mean a shift away from chemical and land-intensive meat, towards more vegetarian and organic foods.

Likewise the main economic drivers and effects of such a change, are hardly on the policy radar as yet:

- Phase out regressive farm subsidies & export subsidies.
- Phase in healthy food / stewardship subsidies
- Premium on compostable recycleate material
- Fuel levies on transport, both UK & international
- Increase in farm employment & rural diversification.
- Projected fiscal effect on the average household aims at "better food, lower taxes"

Key questions for research and debate:

- Will mainstream consumer preferences go local?
- How much does low-impact food imply localized or organic production?
- Is there a need or role for genetically modified foods, either as specialities or on the open market? (purely on resource flow terms there may be advantages).



Transport & communications

Transport is seen as the maker and breaker of modern economies and globalizing lifestyles, and is also the most directly damaging of all sectors. The issues can be divided as:

- Demand factors, which involve behaviour, regulation, micro-finance, spatial planning, business practices, etc.
- Supply of transport services, which focuses on fuel supply chain in public and private modes
- Infrastructure & vehicle production / maintenance. For this the stock question is crucial, ie generally the renewal of the stock of vehicles will increase efficiency but at the cost of extra production. Stock turnover in UK for most vehicles is approaching saturation at about 7-10% per year.

Transport in the region

- The average distance travelled on all forms of surface transport was 13,300 km per person per year, or 36 km per day per person: 85% of the distance was by car, 6% by rail, and 3% by bus. This figure divides into social types with very localized lives – the old and the young – and others who travel much more.
- Half of all journeys are for leisure/personal business, and two thirds if shopping is included. Commuting and business are 23% for males and 15% for females.
- 83% of households have at least one car or other vehicle, and 37% have two.
- The average person in the NW travelled 7,600 km by air per year: 97% of this was international travel, and 18% of this was within the EU.

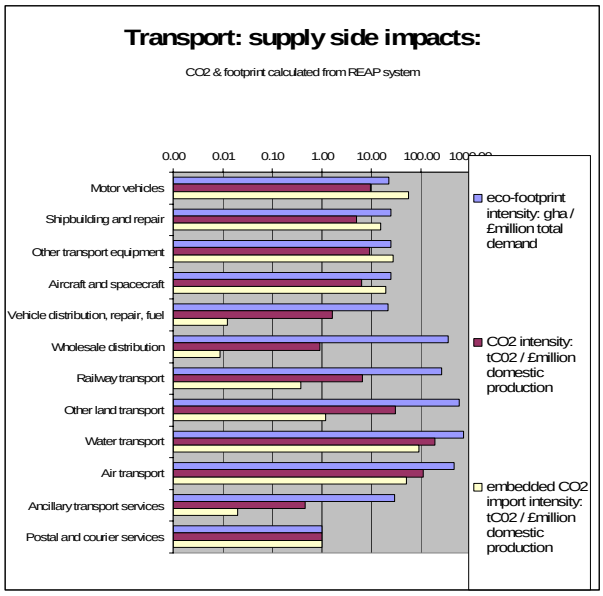
For walking the reported figure is 310 km per person – less than half a mile per day . Cycling, the most energy efficient mode of all transport, is an average one mile per week per person. Given these trends it is not surprising that obesity is a growing problem.

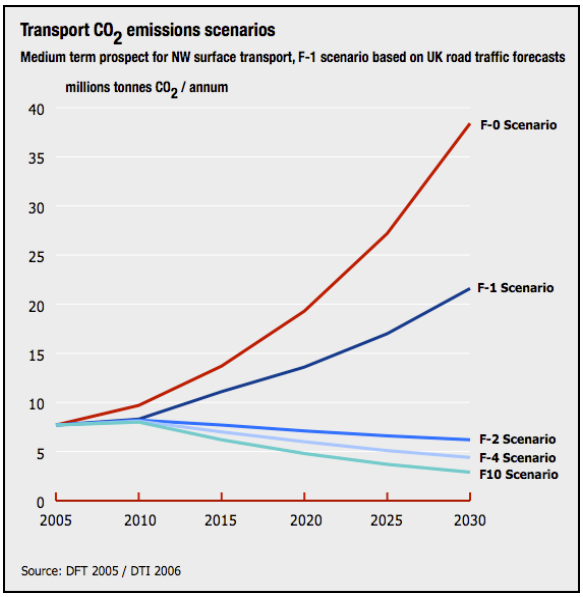
The environmental impact of transport includes; fossil fuels and climate emissions: other air emissions, noise, dust etc: the fuel production and disposal life-cycle: and the vehicle manufacture & usage life cycle. There are topical questions on the potential for alternative vehicle fuels and technologies:

- Liquid gas is only marginally more clean and efficient than oil:
- Bio-fuels may be very environmentally damaging on a global scale.
- Hydrogen fuel systems are attractive but untested on a larger scale.
- The electric power needed for hydrogen and various hybrid technologies may be in short supply in the coming decades.

Air travel

The current expansion plans from airports at Manchester, Liverpool and Blackpool are for 67 million passengers per year by 2030 – as many as currently use Heathrow. Current projections of UK air travel growth show that by 2050, the high altitude climate emissions will overtake the whole of the UK emissions targets. Any possible substitution by hydrogen fuels would also have large and uncertain climate effects.





On the demand side, growth is driven not only by consumer affluence but by inbuilt pressures for globalization and networking of businesses and lifestyles. Constraints on demand may come through limits on airport growth, but as in Hong Kong, off-shoring airports is quite feasible in the longer term.

Meanwhile, international marine shipping is a large sector, at present invisible in the UK accounts, but surfacing in the REAP accounts as in the business chapter. For shipping the scope for energy efficiency seems limited, but there may be potential in reverse logistics.

Towards Factor 4 in transport

There is potential for substitution of fossil fuels by renewable energy: the main choice is between bio-fuels or hydrogen as the common energy currency between electricity and other forms. This does not in itself address the larger life cycle of vehicle manufacture and maintenance, road infrastructure, and other environmental effects of transport. The foremost question is that of fuel prices vs fuel taxes, as against other incentives or pressures for change.

It is clear that there is at least as much potential in demand side management as on the supply side. For passenger travel this is a familiar list – increasing vehicle efficiency, increasing occupancy, reducing unnecessary trips, shifting modes, encouraging walking and cycling through urban planning etc. For freight transport, ICT may be the catalyst for integrated supply chains and low-impact logistics, coupled with a new generation of infrastructure – low energy vehicles and modes coupled with inter-modal logistics systems.

For air travel, it is fair to say there are no easy win-win solutions in sight, beyond those of pricing or taxing out growth, which are politically less plausible at present. A Factor 4 approach might aim at a socially progressive system of quotas, to enable basic travel for lower income people, while higher incomes pay increasing surcharges: all this coupled with vastly improved ICT networks to enable 'virtual travel'.

Issues for regional policy

As in other sectors, 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 spin-off or win-win case. The regional transport strategy is a kind of bridge head between national level policy/taxation, and sub-regional/local transport investment. In that sense it shows a good range of aspirational policies, with no targets by which it could be measured.

Any transport strategy will naturally be focused on social and economic objectives, and the footprint results are at best an added spin-off. For instance the eco-footprint of a typical car/light van through its life cycle can be summarized:

- Fuel combustion: 70%, of which $C0_2$ emissions are 99.75% of the total
- Manufacture and maintenance: 30%
- Road/parking area: negligible

This is very revealing, in the sense that improvements to occupancy (usage) and fuel efficiency, will on aggregate have twice the effect of any changes to ownership and manufacturing of the physical item. In other words, the government advice that ownership is

preferable to useage, still stands. It is also revealing that comparison with other modes shows that, passenger mile for mile, air travel, motorcycles and local bus travel are comparable with the EF ratios for private cars. However this calculation is on a global scale; on a regional and local scale, the physical presence of roads and parking is very much an issue.

Vehicle emissions controls relate mainly to NO_x, particulates and other pollutants, which have very little influence on the EF. Current EU targets are to increase the carbon/fuel efficiency of cars by 30% from 1996/2010. This is being partly undermined by the recent trend for more powerful SUV type vehicles. There are no practical known technologies which can increase significantly the efficiency of air travel, assuming that current speeds are predominant (which rules out helium balloons).

The effect of the current trend forecasts (business as usual), on the relative EF factors of the dominant modes, car travel and air travel shows, that while long distance air at present is relatively 30% more efficient, and car travel is 50% greater in volume, its much higher rate of growth increases to outweigh car travel soon after 2021. The continuation of this trend line after 2031 is a matter for speculation.

Summary & questions

Moving transport towards an F-4 scenario is plausible, but will require rapid step changes in both demand and supply sides. Major actions are possible, as shown by the example of the London congestion charge: however the overall impacts of transport will be dominated by air travel, still growing at 3-5% per year.

Overall, the main resource effects of the F-4 scenario:

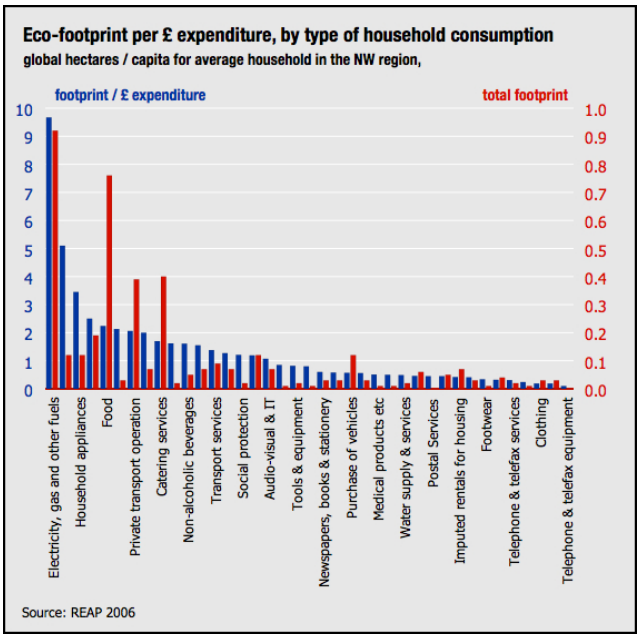
- Total travel growth stabilized.
- Phase in renewable energy vehicle fleet
- Shift to responsive integrated transport modes
- Air travel growth slowed.

And the likely types of economic measures to achieve this:

- Domestic / commercial fuel levy, recycled to investment in integrated transport
- Levy / subsidy incentives for low energy / cleaner vehicles
- Tradable quotas for low income & essential travellers
- Budget effect on the average household: No change in household travel bill: increased vehicle efficiency balances rise in fuel duty: reduced cost of public transport.

Wider issues and questions:

- International fuel price rises or carbon tax?
- What if most vehicles switch to hydrogen?
- Public & business reaction to fuel levy – how to increase efficiency at the same time?
- How will the UK live with limits to air travel?



Products

Material inputs

The largest single item of household consumption is the car, and the trend towards larger SUVs is accelerating 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).

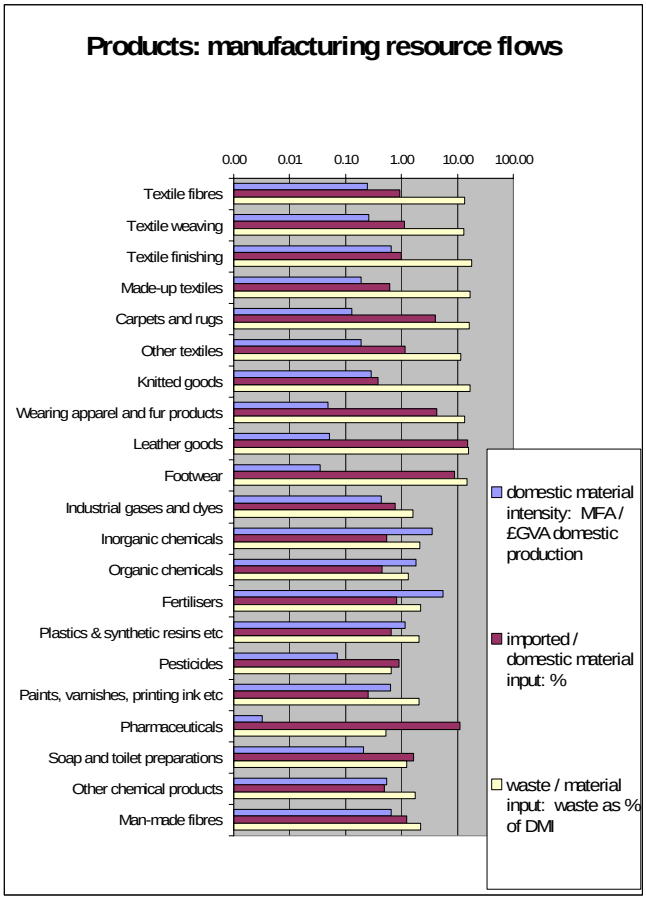
- The tonnage of furniture is not far behind, although this contains a larger proportion of renewable materials. Householders consume on average 30 kg of furniture, a total of 200,000 tonnes in 2000.
- A total of 80,000 tonnes of electrical appliances, including washing machines, computers, television, hi-fis and so on 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, TVs 9,000 tonnes per year, and personal computers at 5,000 tonnes per year.
- Overall, the household durables TMC (total material consumption) is 6% (9.9 million tonnes) of all consumption in the region.
- Half of this is from purchases of cars, which include by weight, over 50% steel, 11% in plastics and 11% in aluminium products.
- Rubber for tyres is only 5% of the total. In household furniture, paper/pulp-based products including chipboard are a third of the total materials: wood, steel and plastics are each 8–10%. In household appliances, steel comprises 40% by weight, with over 26% in miscellaneous materials.

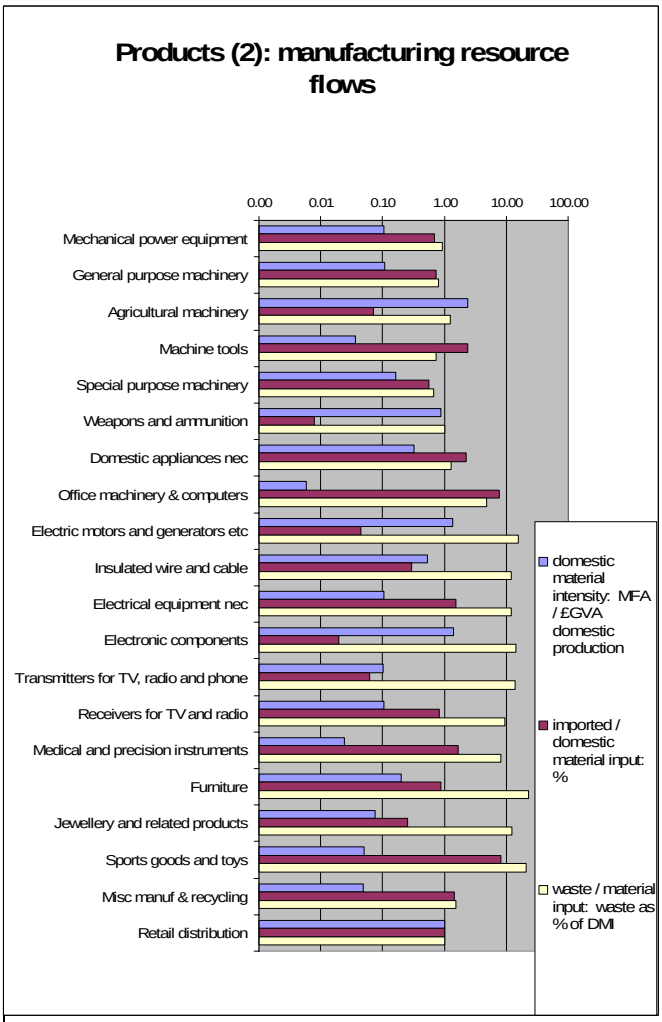
Profile of the sector

This sector covers a huge variety of material goods and products to meet final demand by households and government: i.e. any material items not included in food, shelter or transport. For this variety there is a wide range of disparate information, and in practice the majority of material flows comprise intermediate products used in other industries. We can divide the agenda by life cycle profiles and material intensities:

- Consumables: generally items with a short life, of between zero and 1 year.
- Peripherals: generally, items which are part of a larger system, e.g. ink for printers
- Durables: generally items with more than 1 year lifetime: this latter includes appliances and media items which are significant energy users. There are saturation effects for some of these.
- For each of these there are different balances of material intensity, economic added value, life cycle impact and so on.

For all these there are supply side issues, in technology, logistics, business practice etc. Technological innovation tends to drive obsolescence and hence turnover, i.e. products are increasingly outmoded before they are physically worn out. Such innovation involves a combination of performance, processes, logistics, cost advantage, brand name and market creation. For most manufactured product types a globalized market and logistics system now applies, where the manufacturing process is in reality more like assembly of components from around the world: and for many such products the material content is





reducing in relation to economic added value. In other words, manufacturing is in many ways approaching the pattern of the service sectors.

On the demand side there are equally challenging issues. Demand by consumers is highly dependent on culture, psychology, fashion, advertising, consumer affluence etc. It is also technologically driven in terms of functions and symbols, e.g. so that demand increases for clothes which are 'streetwise' or cars with 'attitude'. Products also operate their own infrastructure systems with peripherals, spares,

Towards Factor 4

Despite the complexity of supply chains, products and impacts, there are some clear directions towards a Factor 4 approach to goods and products.

The average product would be longer life, shared and adaptable: designed for re-use, reconditioning and recycling: composed of non-toxic and lower-impact materials, and more energy efficient in use.

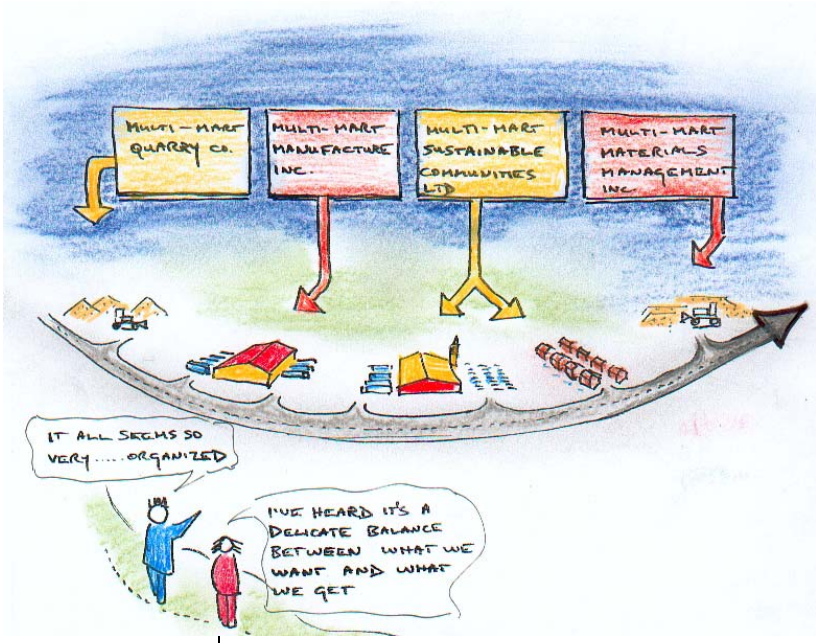
Wherever possible it would be locally sourced or distributed on low-impact logistics. Consumer demand would favour ecological and social responsibility through ethical trading, and financial investment would encourage sustainable enterprises and trading markets. These last points are possibly the most challenging of all.

Summary

For the shift towards a Factor 4 / One Planet Economy, there are some overall resource effects:

- Reduced energy & resource demands in manufacturing
- All manufactured products designed for re-use & recycling
- Longer product life & higher energy efficiency
- All packaging designed for re-use and recycling
- Increased secondary owners' markets, with real-time distribution logistics

The economic strategy to encourage this is based on a series of producer / consumer responsibility measures: the government taking a role as environmental stewardship: and re-investing any proceeds into



industrial innovation:

- Fuel levies on manufacturing & distribution: re-invested in innovation strategy.
- Public procurement incentives for market transformation
- Subsidy / levy differentials for energy efficient goods: e.g. so that low-energy bulbs are cheaper than standard bulbs.
- 'End-fate levies' on products with toxic content e.g. batteries
- Economic structural shift from resource added to value added activity.
- Likely fiscal effect on the average household: saving on household expenditure on longer life & more efficient goods: balanced by higher unit prices.

Key issues & questions to be addressed:

- Public acceptability of lifestyle constraints:
- Willingness to buy lower impact
- Willingness to share, re-use and recycle

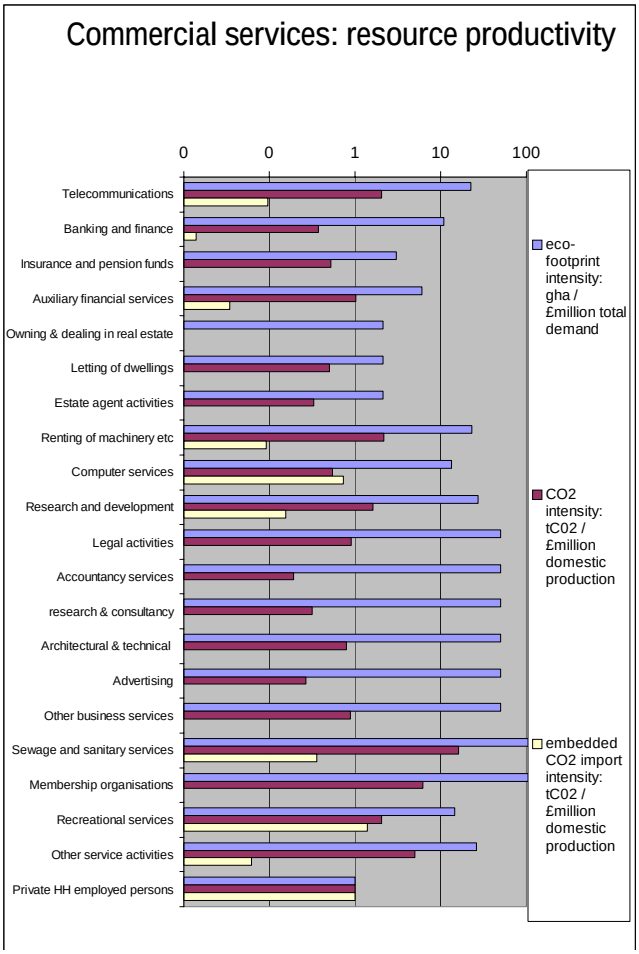
Role of regional policy

Up to now there has been little or no interest in the consumption agenda from regional policy. At the national level, the government published in 2003 its strategy for 'Sustainable Production and Consumption' (SCP). This is more a review of possibilities than a fixed plan of action, but the main themes include:

- "Taking a holistic approach that considers whole life-cycles of products and services, intervening to deal with problems as early as practicable in the resource/waste flow.
- 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.
- Stimulating innovation in all its facets."

The question here is how much this is a regional agenda, and something that the regional organizations can promote. It has to be said that the obvious starting point – consuming less 'stuff' – is apparently opposite to mainstream economic policy and its goal of GDP growth. So the agenda here focuses on potential win-win opportunities:

- Promoting innovation in manufacturing technology, to increase productivity with less impact.
- Encouraging industrial clusters with integrated materials management systems.
- Innovation in materials and waste 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.



Commercial services

The resource flow metabolism of commercial services is different from the previous sectors above. It is apparently more indirect and further down the supply chain: however the total indirect effects are as great as upstream secondary sectors. There is lower direct material intensity, with greater added value from labour & information.

The services sector categories also include economic 'factors' i.e. transport, buildings and utility supplies, and these generate the largest direct impact sources in the service sectors. However by looking at the supply chains upstream, we can the indirect effects of sectors such as banking and finance are more than 10 times the direct effects. Otherwise the material flow in the service sectors is more difficult to track, as the public accounts are limited to primary and manufacturing: clearly some sectors such as catering have large material flows and waste arisings, which need to be estimated.

There are various special and unique cases to consider. Retail and distribution are instrumental for the flow of other products and goods. Real estate and letting sectors are instrumental to the construction industry. Tourism is a special case, in both accounting and modelling terms: following the consumer responsibility principle, the Ecological Budget UK accounts include for the travel and consumption by UK tourists abroad: and domestic tourism is allocated by residence.

In policy terms, commercial services are more embedded in a free market approach to individual choice: In some areas there is direct overlap or competition with with the public services economy; e.g. in health, care, education etc. There is an interesting area of overlap with the social / household economy, for instance in the balance of catering vs home cooking, where a similar mix of food could be either in economic production or in private consumption. Arguably, the first priority is on financial services for their instrumental role in providing incentives for other sectors.

Towards Factor 4

Given the mainly indirect resource flows in the service sectors, there is naturally more focus on Corporate Social Responsibility (CSR), environmental management systems, ethical trading, ethical finance and consumer protection. In various sectors there would be versions of green tourism, low impact logistics, responsible retailing and so on. In this way the greening of the service sectors can provide incentives and structures, as an instrumental force in the Factor 4 programme for other more material-intensive sectors.

Summary of actions

Main resource effects

- Stabilize demand for energy & transport

- Accelerate material recycling & recovery
- Shift in local labour markets etc.

Main economic effects;

- Tradable quotas on commercial energy use
- Accessibility incentives for new commercial development
- Packaging deposit levies for retail & distribution
- Tourism & leisure constrained by transport levies
- Shift to recycling & recovery economy with rising waste costs.
- Shift to knowledge-added for resource / energy intensive sectors
- Budget effect on the average family: no net change: increased material efficiency, increased intermediate / social labour market.

Key issues & questions:

- How far can CSR activity be realistically transferred to the service sector?
- Will the mainstream economy suffer from a shift towards intermediate labour market / social economy activity?

Public services

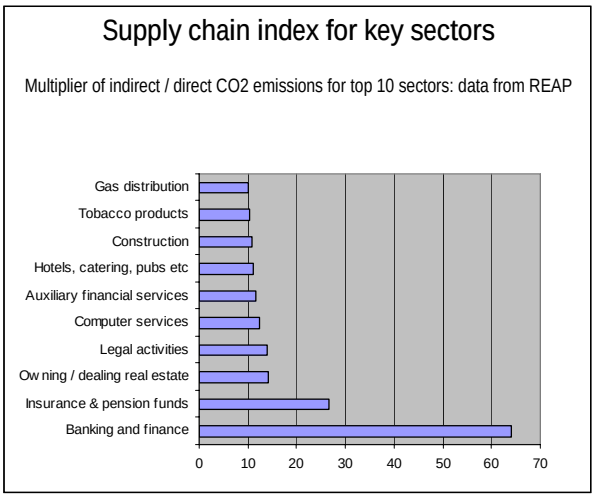
The resource metabolism of public services is similar but distinct from that of commercial services. Such activities are generally more indirect and further down the supply chain, with greater added value from labour, capital & information. As above, the factors of production are the largest direct impact source – buildings, energy and transport. However, some services – health, defence and so on – are also major material and capital consumers, as well as large scale occupiers of land and buildings.

However the policy context and political economy for public services is quite different to that of commercial services. Health, education, defence and so on are generally structured in large organizations/ consortiums, so that forward planning, integrated asset management and green chain management are more feasible. Therefore public services are the first priority for advancing the programme of public procurement for market transformation.

However all services are subject to financial efficiency criteria, which does not necessarily coincide with environmental policy. There are major questions on the privatization, franchising, devolving and otherwise marketizing of health, education and many other services: this brings up the role of public / private partnerships (PPP, PFI, DBFO etc) in adding value on both sides. Apart from the many social and economic issues, there are environmental issues involved.

Towards Factor 4

The Factor 4 program for public services would range from direct to indirect effects. Firstly there is scope in



environmental policy for direct impacts: transport, buildings, energy, waste. The health and education sectors are becoming aware of the greening agenda, although as yet it is secondary to service and management issues. The Building Schools for the Future investment programme has the potential to produce ultra low impact buildings with enhanced educational value. A recent analysis of a Manchester school showed that building construction, energy use, staff travel, and school dinners each had roughly similar portions of the total ecological footprint.

There is also an agenda for indirect and induced impacts: i.e. where provision of services may increase or substitute for material consumption. For instance, health professionals have realized that providing some types of patient with a room with a view may have more effect than prescribing drugs. Each of the service agendas above then applies, i.e. ethical trade, finance, CSR, environmental management systems etc.

The difference is the huge potential of public procurement, which in public services should be coordinated and strategic like nowhere else. This represents the leading edge of the OPEN strategy.

Summary

Main resource effects: in the shifting of public services:

- Stabilize demand for energy & transport
- Accelerate material recycling & recovery
- Shift towards local labour markets etc.

Main economic effects:

- Tradable quotas on public energy use
- Accessibility criteria for public services
- Shift towards recycling & recovery economy.
- Budget effect on the average family: no net change in public taxation: increased material efficiency, increased intermediate / social labour market.

Key issues & questions:

- Consumer convenience vs system efficiency / cost reduction
- Allocation of CSR to public service functions
- Shift towards intermediate labour market / social economy.

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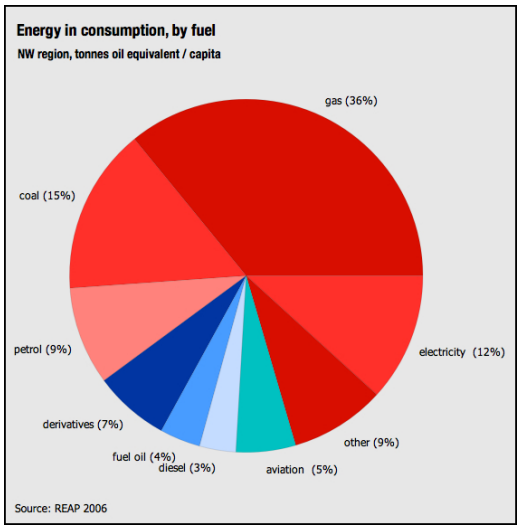


Environment agenda

Energy supply

Energy is very topical at the time of writing – the DTI Energy Review, the Stern Review on the economics of climate change, and the DEFRA review of the Climate Change Program, are all in progress – even while more urgent estimates arrive daily, of more extreme events and risks from climate change.

This sector focuses on the supply side to meet energy demand, as generated from each of the other sectors, i.e. food, shelter, transport, products, services and public. In many ways the energy question is at the heart of the Eco-region NW agenda. If current energy supply systems can be ***de-carbonized,*** and then the options ***de-materialized***: and if other land-use and environmental impacts can be greatly reduced, then effectively the level in energy demand is not an issue – the Factor Four goals could be achieved even with rising energy demand. However in practice, changes are more likely across the board, at each stage from supply to demand:

- Fuel sources, resource depletion, and the impacts of each fuel option.
- Energy conversion and distribution technology, i.e. for electricity or other medium
- Direct emissions and waste, and energy system life cycle impacts

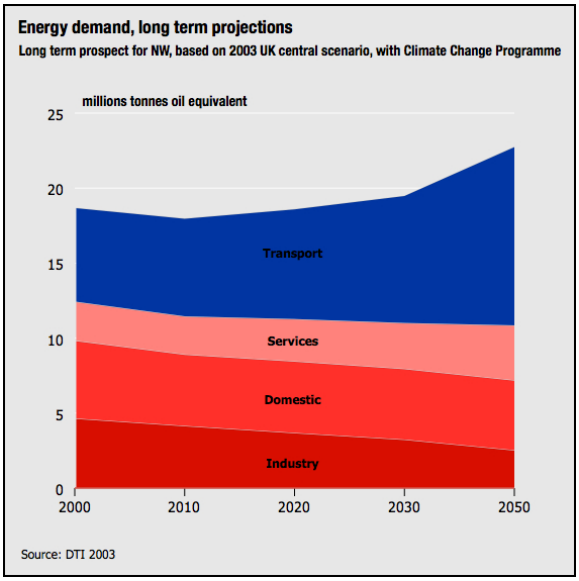
In terms of technological options for supply, several kinds of packages can be considered (pending the various policy reviews above):

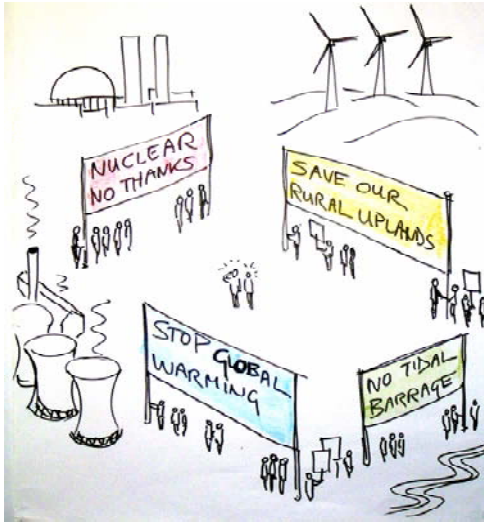
- Conventional fossil fuels – phasing out due to likely resource depletion & price rises
- Alternative fossil / new coal technology – possible rapid development, with a changing impact profile, i.e. cleaner burn, but strip mining overseas.
- Diverse combinations for various UK and local renewable sources.
- Potential for bio-fuels for transport – possible greater environmental impact.
- Potential for shift to new technological platform – i.e. hydrogen
- Replacement nuclear plants to maintain the current fraction of UK electricity: albeit life-cycle costs and risks.

There is also a national / regional policy and economic agenda, with added social dimensions. Energy is increasingly a globalized industry, with larger UK / EU inter-connectors planned for gas and electric. The majority of UK distribution is now foreign-owned, and UK fuel self sufficiency is declining. However there are new opportunities for renewable and embedded generation at the local / regional level. Energy security is a key concern, in the light of international tension.

Towards Factor 4

The over-riding question can be framed as – peak oil vs emissions controls – i.e. will the oil (and later on the gas) start to run dry, or whether climate emissions should be contained by policy. If the latter case, then there are further questions at national and international level, i.e. targets vs trading: taxes vs quotas: and offsets vs emissions. Demonstrating an alternative to direct





regulation, the European Trading Scheme (ETS) is so far more or less successful. The major drawback as of mid 2006 is that a tonne of carbon is currently trading at €20, a small fraction of its 'assumed' social cost of damage of about €100.[12]

Role of regional policy

The national power generation strategy is of course crucial to the North West economy, which employs 20,000 in the nuclear industry, half the national workforce. Otherwise, regional policy has had little engagement with energy issues since the setting up of the CEGB and the national grid. There are now many aspirations for renewable energy sources, micro-generation and co-generation (combined heat and power). While the utility company companies are mainly foreign owned, local and regional planning has a big role to play in enabling development. Public procurement has an even bigger role in stimulating new forms of low-impact energy.

To achieve anything like the Factor 4 scenario above, a much more pro-active regional energy strategy is needed than at present. This is likely to operate at urban and sub-regional level. It will achieve best practice in new development and conversions by bringing together institutions and financial mechanisms needed to steer developers, financiers, utilities, designers, contractors and building managers into a low-energy mode of practice. At the same time it will seek win-win economic and social opportunities from this agenda.

- Supply side – combined heat and power
- Supply side – renewables
- Demand side – households: aggressive energy efficiency policies for new development, also for regeneration and rehabilitation.
- Demand side – commercial: pro-active partnership arrangements on the energy services model, at an urban or sub regional scale

Summary & issues

Main resource effects on the supply side:

- Shift to renewable sources with low impact storage technology
- Energy diversity and flexibility maintained
- Embedded sources and generation with spin-off benefits.

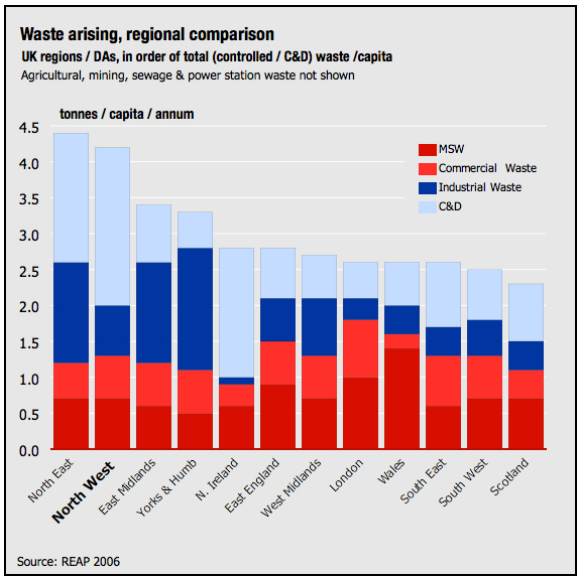
Main economic policies and economic implications:

- Expansion of EU emissions trading scheme.
- International levies on carbon in transport fuel.
- Tradeable quotas on commercial and domestic energy use.
- Fiscal effect on the average household: no net change, where generally rising energy efficiency balances rises in unit costs, across all sectors.

Key issues & questions – many strategic options:

- The big energy supply questions: low impact fossil fuel, nuclear or renewables?
- Large scale globalized / small scale decentralized grids?
- Political economy of utility privatization – reliable energy security, flexibility, diversity vs lowest cost?

[12] Defra 2005



Waste & resources

Waste management policy is in a state of flux – as well as the UK waste strategy review, there are new waves of EU directives, and a new generation of resource-conscious local and regional strategies. But while there is much aspiration towards the goals of sustainable waste / resource use, the practice is lacking, and most waste management is still at the end of the pipe.

Historically, municipal solid waste (MSW) has been a public policy issue, while other the other 90% of total waste are left to organize themselves. This is likely to change in the context of a 'wider waste' strategy which looks at the potential for critical mass in putting these streams together.[13]

The sector as defined here, covers the economic activities of waste recovery and disposal, material re-manufacturing and recycling, sewage and other sanitary services, other material flows in agriculture, power generation and so on. The agenda for 'sustainable' waste management also raises more general questions on the role of resource flows in the regional economy:

- Waste management & recycling is a small sector in economic terms, but clearly very significant in terms of resource flow;
- One key issue in resource flow terms is not only the ***quantity*** of re-use / recycling, as the ***quality*** of end-uses – in other words, not only a matter for waste management but for businesses in many areas.
- Moving towards a Factor 4 economy would see the majority of flows in secondary materials – recycled, re-manufactured, re-used materials and products would become the default choice for most forms of production and value added.

In UK policy terms the main reference point is the landfill levy 'escalator', which increases to £21 per tonne in 2006 for controlled wastes. At the point when it reaches £35 per tonne, then other waste recovery technologies start to become comparable in terms of pure cost.[14] However as with other infrastructure issues, there are strong lock-in effects to capital investments and supply contracts. Experience shows that economic incentives need to be combined with behavioural incentives, which are otherwise hard to shift.

Regional waste strategy

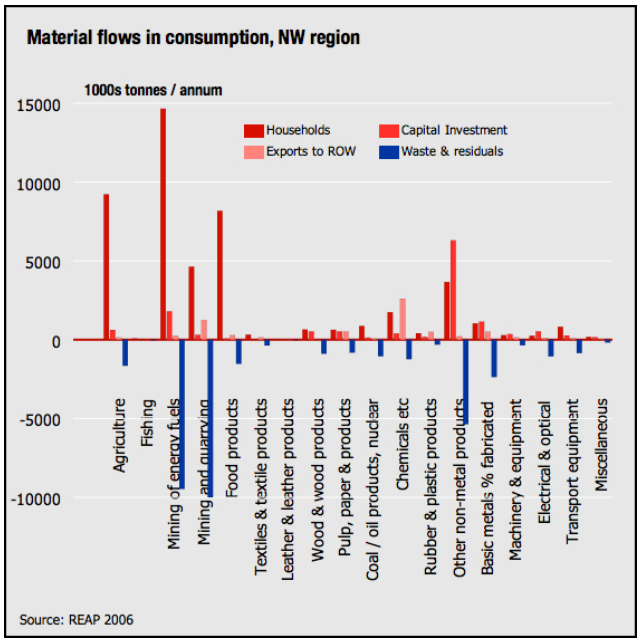
In 2001/02, North West households, businesses and industry produced over 20 million tonnes of waste : the majority was disposed of to landfill, with only a small volume being recycled. Landfill capacity is a finite resource, and at current rates of waste production there is only sufficient capacity to the end of this decade. In addition, mixed trade and domestic waste arisings are increasing at around 3% per annum and recycling rates, although improving, are falling short of national targets.

The North West was the second largest producer in the UK of commercial and industrial waste: in 1998/99 the region produced:

- 9.6 million tonnes of industrial and commercial waste

[13] NWDA, 2006

[14] Mitchell, 2005



- 6.5 million tonnes came from industry and included over 1 million tonnes of chemical waste
- around 50% of industrial and commercial waste went to landfill sites for disposal
- the composition of both industrial and commercial waste was dominated by "general waste" with very little separation.

The Strategy sets an initial target for reducing growth in municipal waste across the North West to 2% by the end of 2006, in line with the recommendation of the Strategy Unit, with the ongoing targets of a further reduction in growth to 1% before 2010 and 0% before 2014, across the region. The Strategy also sets a series of recycling/composting targets for household waste across the North West, up to recycle and/or compost 55% of household waste by 2020. For commercial and industrial waste streams the Strategy is to:

- achieve 0% growth in wastes through the life of the Strategy, without compromising economic growth in the region.
- recycle 35% of all commercial and industrial wastes by 2020: and recover value from at least 70% of all commercial and industrial wastes by 2020.
- provide sufficient treatment and landfill capacity for these waste streams up to 2020 – approximately 4 million cubic metres per annum.

The backdrop to this is the national Waste Strategy review, with its goals of waste prevention in the context of Sustainable Consumption and Production (SCP); seeing waste as a resource; linking municipal with other sectors: investment in new technology – where previous relatively cheap landfill 'solutions' are not an option.[15]

Contribution of Eco-region NW

There is a full portfolio of databases, models and toolkits on waste management, so what is the added value from the Eco-region NW? There are several approaches, with datasets available for download:

- Technical agenda: analysis of supply chains, indirect effects, footprint. This starts with the basic 'mass balance account' and the waste fraction for each of the 123 sectors. This takes the most recent Commercial & Industrial Survey data (2003) and allocates to detailed sectors on a material flow basis with composition breakdowns – not perfect data, but better than otherwise.
- Such data can then be worked back through the supply chain using the structural path analysis as in Section 3. The indirect waste effects due to consumption can also be calculated back through the supply chain. The net effect of all this is to enable a more 'joined up' information system for resource exchanges between sectors, supply chains etc.
- There is also a policy agenda: each of the above can be used for a more comprehensive and details appraisal of waste policy options and waste strategy, as in Strategic Environmental Assessment and Sustainability Appraisal
- On the communications and behavioural agenda: there is scope for further development of the Eco-region NW interactive tools for scenario modelling and impact feedback.

[15] DEFRA 2006

MSW waste analysis

The footprint calculation for MSW is based on a detailed composition analysis of the average household waste bin.

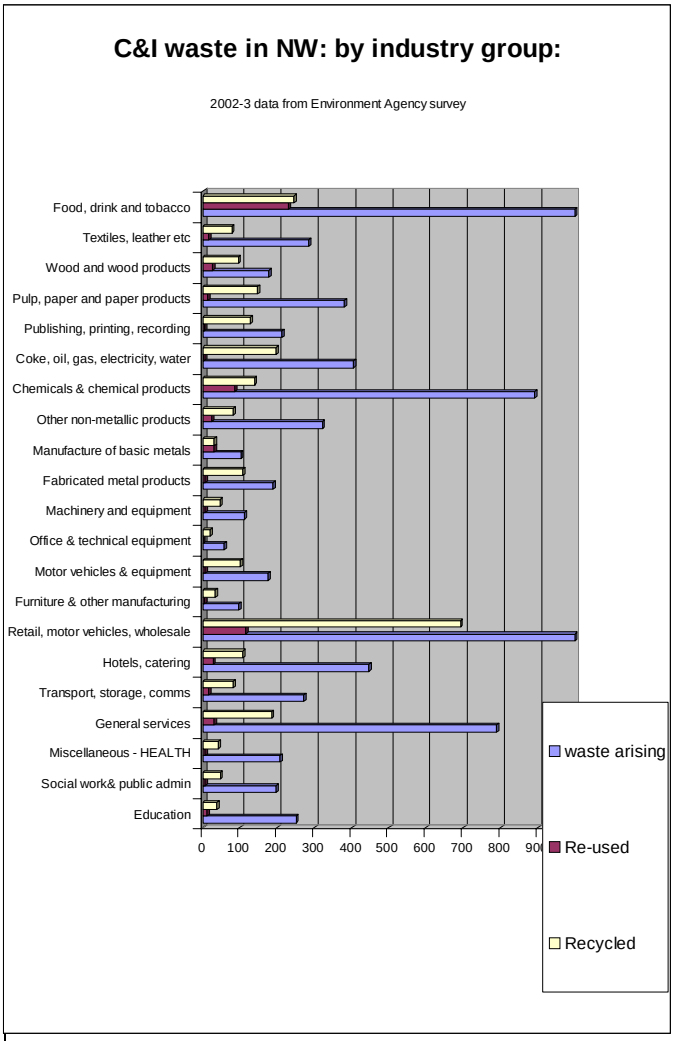
- Materials 'lost' to landfill in terms of opportunity cost and typical effects in the waste stream
- Less the energy involved in recycling
- Plus, transport & energy used on site
- Plus, methane emissions and other climate effects

The results of the area by area analysis is shown in the workbook on the website <<*EcoNW – MSW waste footprint.xls*>>. This shows that the average household waste stream of 11 kg per person per week, results in an 'opportunity cost' eco-footprint of 0.9 gha / cap, which is more than 15% of the total householder footprint. On this calculation the most footprint-intensive waste types by weight are in fact textiles, shoes and nappies. The current rate of recycling offsets this by nearly 10%, less than the proportion by volume, due to the energy in transport and recovery.

C&I waste analysis

The key contribution of the Eco-Region NW and the REAP data has been to put waste flows in their context of material flows and balances, sector by sector. The results show some interesting features.

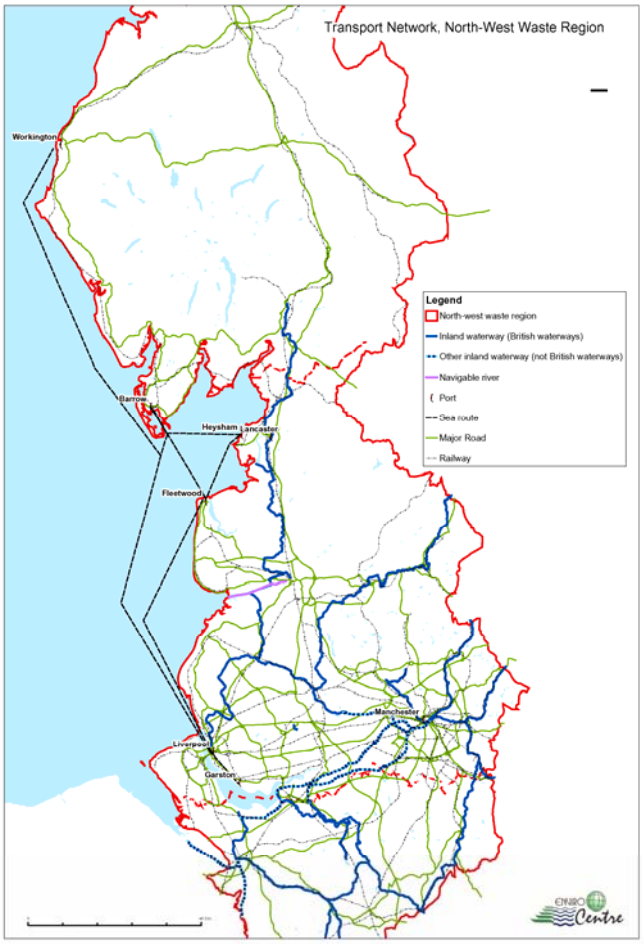
- Minerals and ores are estimated at 22 million tonnes input, of which 56% becomes waste.
- Food processing industries have a combined input of 6 million tonnes, of which the waste fraction is 12-25%.
- Textiles have waste fractions of up to 30%, but higher recycling rates of up to 40%.
- Printing and other paper-based industries have recycling rates of up to 60%.
- Bricks and other building materials often have very low recorded waste fractions, as the process includes for re-use of raw materials on site.
- Metal based industries have high waste fractions of up to 30%, of which nearly two thirds is recycled.



For construction and demolition waste, about half the total of 10 million tonnes was in 'beneficial re-use' including restoration, engineering: soil used for these: recycled aggregates and other inert materials.

As a whole, the material – waste balance sheet can then be linked with the footprint:

- Primary inputs to domestic production: 35.5 mt
- Imports from overseas: 14.5 mt
- Exports to overseas 6.9 mt
- C&I production waste; 8.4 mt:
- Reused & recycled production waste: 3.3 mt
- Total waste incl mining, agriculture, C&D and municipal: 43 mt
- Municipal waste: 4.4 mt



- Municipal waste recycled / re-used: 0.6 mt or 14% of the total.

The implication is that the overall 'resource efficiency' of the economy – i.e. the proportion of material throughput to final consumption - is less than 25%.

Waste transport agenda

Transport and logistics is one of the largest impacts in waste management. It is also crucial in determining the 'value boundary' between waste and resources – i.e. if waste can be got to potential users easily and cheaply on low impact modes, then it becomes a resource for recycling.

The Sustainable Transport of Resources and Waste (STRAW) project investigated these issues in detail (www.straw.org.uk) . The NW potential for inter-modal transport was mapped out as above, with a focus on the areas of search which combine inland waterways, coastal shipping and access to rail freight terminals. Such locations would be ideally suited for the kind of inter-modal technology which will be needed for the shift towards an integrated resource management economy.

Towards Factor 4

A Factor 4 resource / waste system would aim towards an integrated 'market transformation' approach. Here, product design, material sources, logistics systems, consumer services, and fiscal incentives are all to be integrated with the available resources coming through the waste stream. The example of the Irish tax on plastic bags, shows how a small economic measure can link with public attitude change, for large improvements in the waste stream.

The regional waste strategy has set out its stall – but with some risk of failure, relying on new technologies and commercial schemes. There is also a risk that the environmental targets will be missed, as the question of waste sources and streams is mainly outside the powers of the public sector.

In this larger frame, success could be achieved by coordination of 'public' MSW, with private sector waste management of C&I and special waste streams. It also depends on coordination between retailers, packagers, producers, and many others. Possibly the most effective way forward is through an accelerated 'greening' of public sector purchasing and procurement, within a regional strategy for 'integrated resource management'.

Summary

Main resource effects:

- All manufactured products designed for re-use & recycling
- All packaging designed for re-use & recycling
- Industrial clusters & networks designed around material cascades
- Increased secondary owners' markets for waste minimization

Scenario Box –

WASTE vs RESOURCES in 2050

It seems remarkable now that the UK used to put so much stuff in holes in the ground, as recently as 2006 – one calculation showed that £1 in every £15 profit in industry was binned.

Actually, we had to go through several decades of confusion and controversy. There were protest riots on incinerator projects, chemical attacks on sewage plants, and huge lawsuits against landfill sites claiming loss of property values.

Who could bring together manufacturers and packagers together with distributors and housing managers? Surprisingly, local schools turned out to be the catalyst. When it came to creative re-use of packaging, re-manufacturing of products, recycling of oddments and so on, no-one could beat the kids. In fact, working out how to deal with all that stuff seemed to have very high educational value, in an otherwise overheated service sector world. So when the energy crunch came in the 2030's, and raw material prices shot through the roof, schools and the neighbourhood social enterprises which grew around them did very well indeed.

The result – rather than use the bin bags which are now about £15 a time to empty, people walk down to the re-manufacturing shed with all their old bits and bats, and come back with furniture, audio stuff or whatever. Of course the big retailers didn't like it, and some went under rapidly. Then finally they realized they could actually shift their operations to higher value added lines…. But that's another story.

Main economic effects:

- Material / waste levies on international trade to raise prices of raw materials,
- All packaging on deposit-return / trading schemes
- Climate levies on manufacturing & distribution: re-invested to industrial innovation.
- Public procurement incentives for market transformation
- Economic structural shift from resource added to value added activity.
- Budget effect on the average family: overall saving on household expenditure, due to lower council tax & lower material prices: balanced by higher waste disposal unit costs.

Key issues & questions:

- Given the acceleration in many technological innovations, is increased recycling and re-manufacturing of products realistic?
- How much more expensive should materials become in order to encourage more material recovery and recycling?
- Will the price rises damage the NW and UK economy, or will they encourage innovation and total quality management?
- Could the UK waste disposal shortfall be solved by sending waste to China in return load containers?

8

Urban development

The urban development agenda is the combined set of activities which links between the Regional Economic Strategy and the Regional Spatial Strategy. For the economic side, the Eco-Region NW aimed to demonstrate the REAP 'business benchmarking' concept for the construction sector. This is a major challenge, as construction involves a huge diversity of activities and materials, with many supply chains upstream, and many impacts downstream. This was based on a sector study carried out by the Building Research Establishment.

On the spatial strategy side, a large part of the potential for a One Planet Economy region depends on the urban matrix – the stocks and patterns of housing, property and other infrastructure.

Sustainable construction agenda

Clearly more housing is needed on a large scale across the UK, and this housing has the potential to be vastly more sustainable and environmentally efficient.

- Construction is the largest resource using sector, both in direct materials and in the energy demand of its products. With rising energy and waste disposal costs, and the new Building Regulations and EU Directives, there is increasing pressure on construction to improve. Many contracts will be let on environmental as well as financial performance.
- We also know that as performance requirements go up, as urban density goes up, and design quality goes up, the material demands and the energy intensity of the construction supply chain are likely to increase.

So, the over-arching question is very challenging –

how to achieve a Factor Four increase in efficiency for urban development and the construction sector?

Key questions

Following this are more specific questions such as;

- Which is better for sustainable regeneration – rebuilding or rehabilitation?
- Is timber frame more eco-efficient than concrete or traditional masonry?
- What is the cheapest way to save a tonne of carbon?
- What is the total impact of the Regional Spatial Strategy, and the scope for improvement?

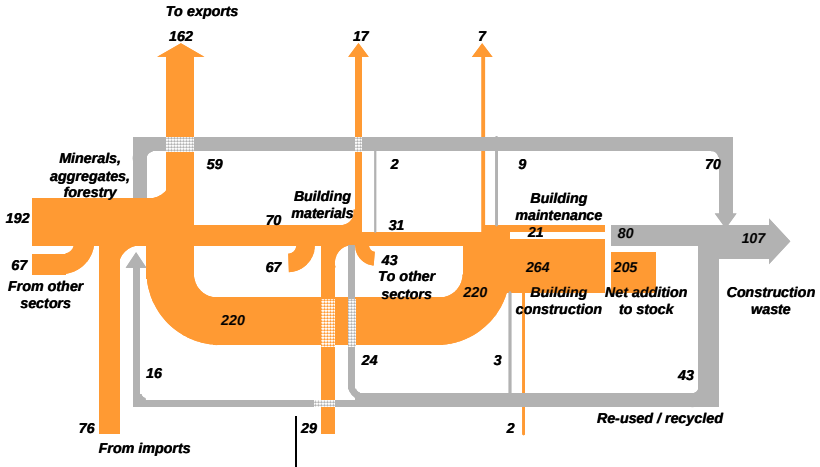
For these and others there are often few simple answers. To help developers, designers, builders, planners and others, the Eco-Region NW has mapped out the components of a prototype ***'REAP-building'*** system. This is based on extensions of systems which are already in use around the industry, including:

- BREEAM / Eco-homes assessment method
- BRE Eco-profiles / Eco-points
- Construction Products Association KPIs
- BRE 'Envest' package

The notes below are in order to outline the concept of this scheme, illustrated with some samples from the calculation database.

Built environment resource flows

Summary of 2002 MFA data generated from REAP system:
all figures shown to nearest million tonnes, approximate for illustration



Construction flows

The summary charts for the environmental impacts from the construction and operation of a typical dwelling, are quite revealing.

These are all calculated where the construction cost is spread over 33 years, equivalent to a net present value calculation (NPV) of 6%. The analysis of lifetime costs in the next section also bears out this approach, rather than a simple assumption of 60 year life or any other.

In terms of material flow, there is near equality between the operating energy and the construction costs, with maintenance at only 4%. The picture is even more equally balanced for the eco-footprint allocation.

The CO2 impacts however are skewed heavily towards the direct energy side, which is fossil fuel intensive. This of course depends on the power generation fuel mix, but at a national level this is unlikely to shift rapidly.

Resource flows in housing

The average house in the North West has a distinct profile:

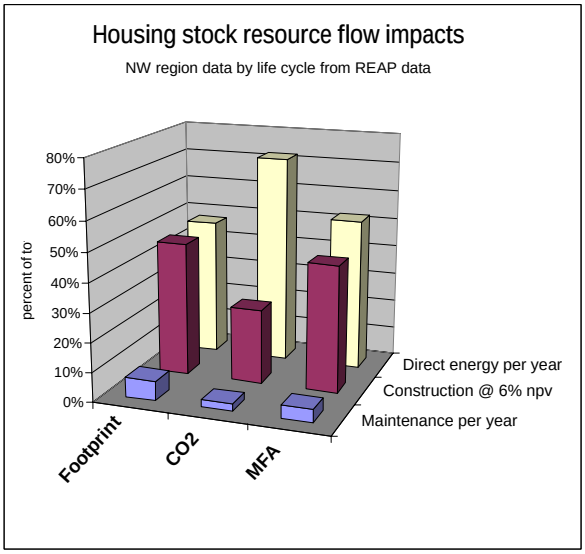
- 2.35 people living in it, 0.4 cats and 0.3 dogs.
- It consumes 9,127 KWh of energy, producing 5.18 tonnes of CO_2 per year.
- It weighs about 150 tonnes, with another 140 tonnes for the foundations
- It requires 0.50 tonnes of materials each year for maintenance and repair
- Most of the energy is derived from natural gas (66%) and electricity (24%)

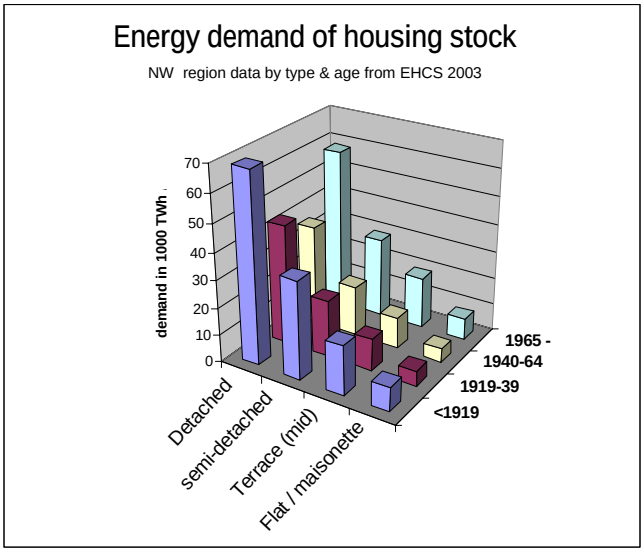
The charts show the flow of materials into a house required for maintenance and maintenance as well the energy required on a yearly basis to provide space heating, hot water, lighting and energy for appliances and cooking.

Of the 150 tonnes required to build the average house, the majority is made up of concrete and stone. Over the 60 year lifetime of the building, theoretically, 4.8 tonnes of materials are consumed each year. An extra 0.50 tonnes is required on an annual basis to maintain the condition of the house and build extensions etc. Therefore, in total the average house requires 5.3 tonnes of products per year.

Construction and manufacture of all the building materials for a typical dwelling produces an average 61 tonnes of CO2. When disaggregated over the lifetime of the buildings, the CO2 impact is approximately 1-2 tonnes per year, depending on the assumed life and whether a depreciation calculation is used. The yearly emissions of CO2 emissions from maintenance and repair add another 0.19 tonnes of CO2, or 10-20%. However, the most significant emissions come from the operational use of the house. The direct energy (gas, electricity and other fuels) produces an average of 5.38 tonnes per year, a total of 6.57 tonnes CO2 per house, per annum.

The chart here shows the effect of spreading the construction impact over a shorter or longer building lifetime. At the same time, energy and maintenance impacts also rise gradually with building age. The





optimum point is about 30 -40 years, similar to that using a NPV calculation at 6% discount.

Resource flows in construction

As a proportion of construction spending, material flow is approximately 25% of the total in housing, 33% in commercial, 11% in public services, 12% in industry and 19% in infrastructure.

- Construction as a whole in the WM region uses 35 million tonnes of materials directly (DMC), and used 70 million tonnes in total material consumption (TMC). This equates to over 10 tonnes for every person in the region.
- 50% of TMC is used on quarry products, including aggregates, sand, crushed rock and limestone
- Cement, concrete and plaster products are the next largest, at 15 million tonnes
- Slate, bitumen, stone and other non-metallic minerals are also at 6 million tonnes
- Metal and metal products of all kinds, were 1 million tonnes
- Wood/wood-based products are 2.5 million tonnes.
- Raw materials make up roughly 90% of material inputs for the construction sector, while only 10% are recycled or secondary.
- The footprint of quarry material transportation is 7 times higher than the footprint for the production and use of the material.

The REAP results suggest that an average dwelling in the North West requires 151 tonnes of materials to construct; whereas the BRE data suggests this figure is closer to 121 tonnes: the difference is mainly from the allocation of foundations and fill material.

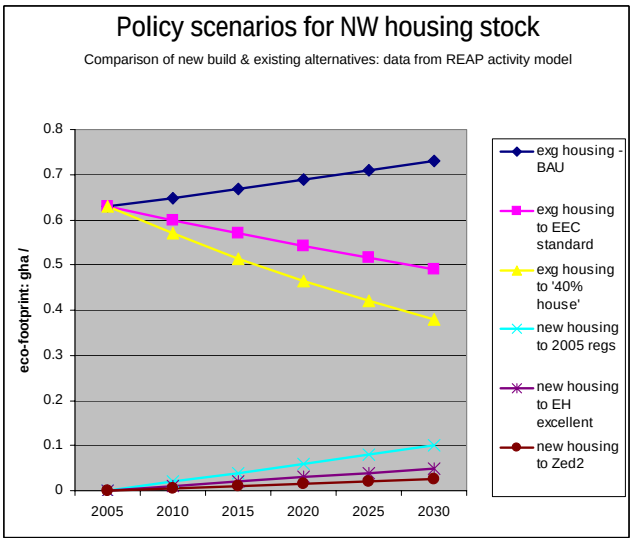
Eco-footprint in construction

The construction sector in the region can be assessed in terms of eco-footprint (EF) metric as follows:

- The total eco-footprint of the construction sector is 7.1 million gha, second only to the footprint of the food sector. The energy content of common construction materials and the reliance on virgin materials drives the majority of the footprint.
- Most of the EF is taken up with 'energy land', reflecting the high energy intensity of key construction materials (cement, bricks, glass and so on), and the small proportion of renewable materials.
- The largest material EF type was 47% with minerals, bitumen and other mineral products: these are both heavy and energy intensive.
- 24% of the construction EF is taken by quarry products, where energy/emissions are involved with transportation.
- 14% of the construction EF is taken by cement and plaster manufacture, which are particularly energy intensive.
- A Factor Four improvement in resource efficiency is the general target for sustainable construction, equating to a 75% reduction in resource use.

The next steps focus on the housing stock and take an integrated asset management over the life cycle. (details in the BRE construction report available on the website).

- apply these averages to the actual housing stock in the region.
- Investigate the opportunities and priorities for upgrading of individual dwellings
- Explore the possibilities for greater critical mass at



the block and neighbourhood level

- Assess the regional spatial strategy, LDFs and local regeneration programmes for potential in upgrading.
- Bring together different organizations such as finance & mortgage companies, social landlords, utilities, contractors, neighbourhood groups and so on.

Towards a sustainable built environment

Today, there are roughly 2.9 million dwellings in the NW: the Regional Spatial Strategy proposes that an increased rate of nearly 23,000 dwellings per year should be built. This amounts to 403,000 over the 18 year plan period, net of clearances (2003-2021). If the same rate continued to 2050, there would be an extra 965,000 dwellings, on top of the existing stock.

On purely environmental grounds, it appears almost impossible to meet the climate change targets for the whole building stock, without a much increased rate of demolition and replacement. The Oxford '40% house' project proposed this for the least efficient third of the housing stock, as the footprint cost of construction would be more than offset by the footprint gain from ultra-efficient houses.[16] However such a wholesale restructuring of urban areas would be quite radical by current standards.

This highlights the balance between old and new housing: and between the costs / impacts of construction versus energy in use.

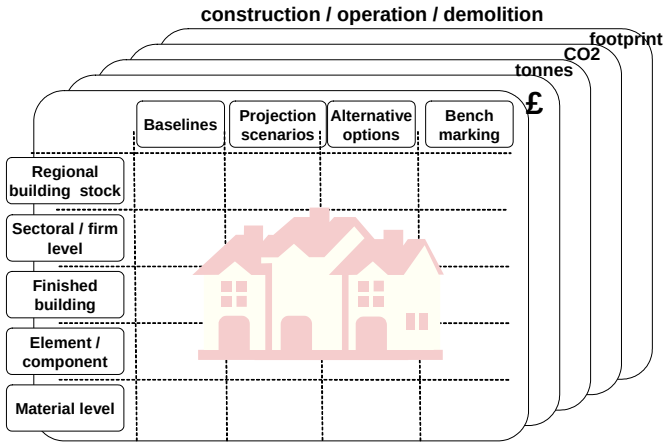
- for new housing, it is quite feasible to improve on current building regulation standards by at least 50%, by building beyond the Eco-Homes 'excellent' standard. This would cut the CO2 emissions to about 1.1 - 1.4 tonnes per year, a fraction of the current average, at a very small increase in cost and material use.
- However, over the next 20-40 years, a much greater problem is with the existing housing stock. This is complicated by a great diversity of types, constructions, conditions, tenures, and household situations. For this housing stock, achieving the current mandatory standard of 'Decent Homes' is a very small step forward, but nowhere near the targets above.
- For 'unimproved' housing, a coordinated package of efficiency measures can generally deliver a 60% cut in CO_2 emissions down to about 3 – 4 tonnes per year, at a cost of £2-3000 per tonne saved. For housing which is already at the decent homes standard, many of the easier and cheaper efficiency measures are already taken, and so costs can be greater for the same reduction.

Neighbourhood regeneration

There are many opportunities for increasing the effectiveness and viability of rehabilitation, through coordinated action at the block, street or neighbourhood scale.

- Housing efficiency improvements: the viability of the above retrofit case is much improved by rehabilitation at the block scale, which might include roofs and walls, passive solar heating, and redesigning internal and external spaces.
- Local energy supply improvements: a combined

[16] Boardman et al, 2005



heat & power with distributed heat network becomes viable at the block or area scale: this can reduce the CO2 from energy use by up to 80%, depending on the fuel source.
- Local transport: planning neighbourhoods for walking, cycling, and public transport can reduce the impacts of car use and transport emissions by 25%.

Summary

Main resource effects of a shift towards a Factor 4 built environment:

- Phased demolition & rebuilding
- Reducing building external energy demand.
- Phase in on site renewable sources.
- Rapid shift to renewable / low energy materials.

Main economic policies and implications:

- Domestic carbon levy recycled into efficiency programme
- Quota protection for lower income & energy poor
- Full life costing for all public building & procurement
- Budget effect on the average family: no change in total bill: higher efficiency balances higher unit prices. (However, distributional & transitional effects are crucial)

Key public messages and survey questions:
- "Higher efficiency = lower bills
- "Rapid improvement for energy poor households
- "Phase out national park quarries
- Would you let your house be rebuilt / upgraded to ultra efficiency standard?

Key questions to be addressed:
- What is the acceptability of rebuilding large parts of the housing stock?
- How far can natural resistance be shifted in the construction & property industry?
- What is the trend for new types of energy use, e.g. patio heaters, air conditioning?

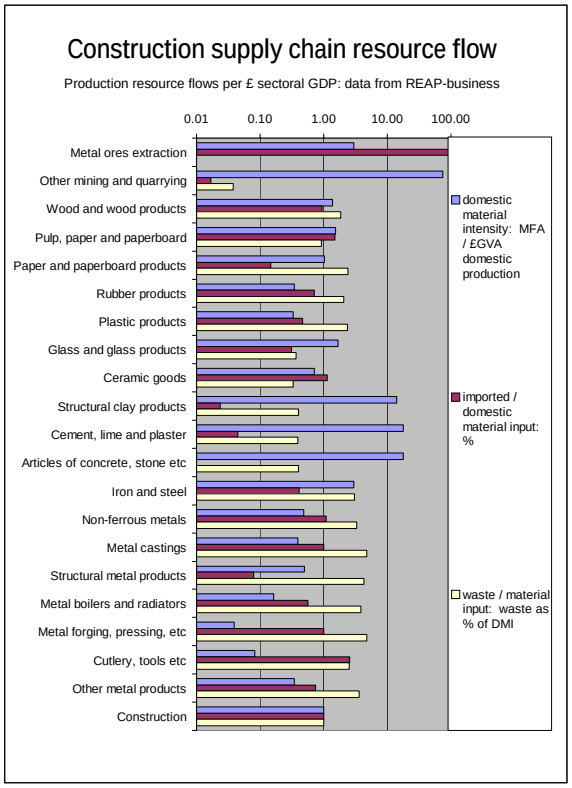
Assessment framework

The construction assessment framework is under development - shown above as a kind of Rubik's cube:

- Element / material breakdown: covers common building materials grouped by common elements and specifications
- Impacts – environmental / economic: the environmental impacts of material flow, eco-footprint and CO2 production are generated from the REAP modelling system, which includes for both direct and indirect impacts. The economic data are to be supplied by the industry.
- Level: the same underlying database informs each of the main levels, i.e. element / material level: building level: firm / sector level: regional level. Each of these levels has its own index point: e.g. the building level is indexed against finished floorspace: the firm level is indexed against output: the regional level is indexed against household / dwelling numbers.

Element / material assessment

The added value of the REAP-building system is:

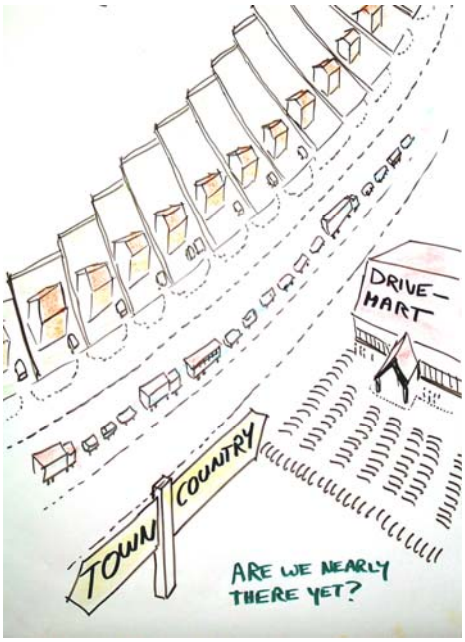


- Material flow analysis (MFA) eco-footprint analysis (EFA) and CO2 emissions are reported in one common format, including for both direct and indirect impacts
- This enables direct comparison of building design specification and procurement options.
- This is most closely related to the BRE Eco-profiles / Eco-points and Construction Products Association systems.
- The indexing is geared to the function of the element, i.e. m2 of walling or roof area: or for materials, indexed to tonnes.

Firm / sector assessment

The firm level assessment is geared towards the industry i.e. construction as an economic sector, in relation to other industries which buy from or sell to construction. Examples of sectoral productivity indicators are shown above:

- This uses the range of outputs from the REAP and REEIO modelling systems, in particular to identify the material flow from other sectors which is consumed by the construction sector.
- It can then index that consumption in terms of dwellings or floorspace produced, GDP or GVA utilized, capital investment etc
- The sector level indices are then a reference point and template for more detailed firm level



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essments, to be targeted towards particular kinds of outputs, e.g. proportions of housing, industrial, civil engineering etc

Regional policy assessment

This is focused on the agenda for urban / regional planners, environmental managers, economic development agencies and so on. It will help with policy issues such as:

- Environmental impacts of the Regional Spatial Strategy: with policy options on housing stock management, urban regeneration, urban form & density, building types and so on.
- Direct implications for regional supply and demand strategies in minerals & construction waste.
- Other implications for regional supply and demand strategies in energy & water.
- Setting of achievable regional targets for overall environmental sustainability.

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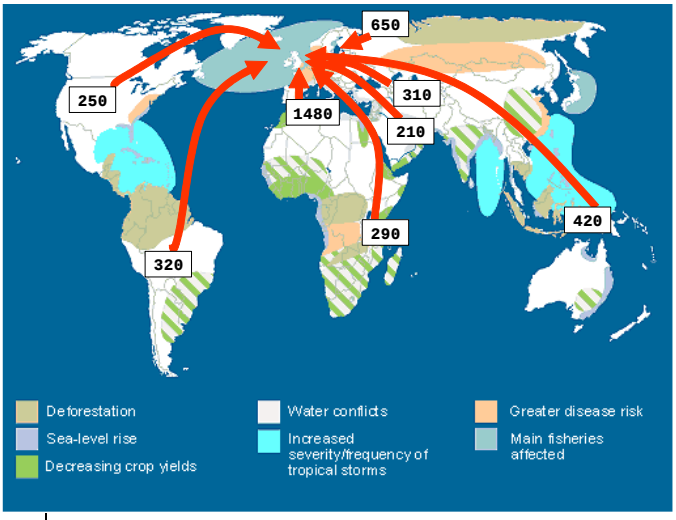


Business agenda

This chapter focuses on producers and business sectors.

- It looks at the business perspective on the resource flows of the region.
- It reviews the business-environment benchmarking agenda, and experiences from other systems.
- It sets out a prototype benchmarking system for further development.

Again the data is based on the REAP tool, which provides a technical information on 76 business sectors, at www.sei.se/reap

The prototype REAP-Business system, covering all 123 business sectors, is available on the website.

Sustainable production

Businesses may be on the threshold of a new kind of game – as well as financial viability and competitiveness, there is a bigger agenda of CSR (corporate social / environmental responsibility). Why should businesses care about this? Because their customers, supply chains, regulators, media image, lenders and investors, all care increasingly about this, in an increasingly inter-connected world.

However, as yet there are few measures for CSR which really get to grips with the key issue of environmental sustainability. Without rapid progress it is clear that the global environment and resource base is rapidly deteriorating.

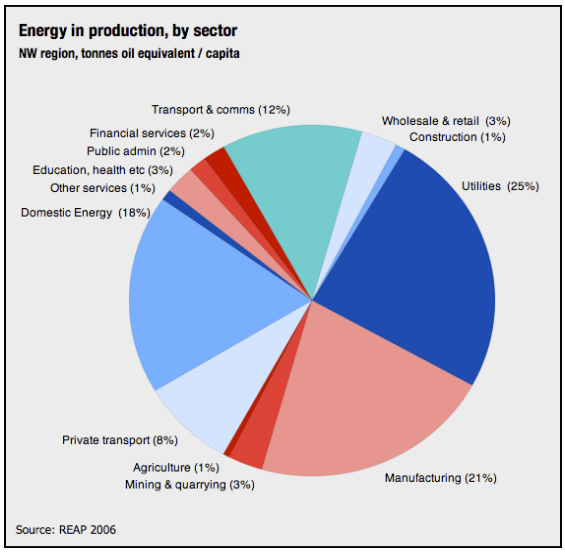
The Eco-region NW provides a detailed benchmark for the performance of 123 business sectors, as summarized in the chart above. But this is not enough in itself. There is a wider realization that the necessary step change in resource efficiency can be both cause and effect of growth and competitiveness.

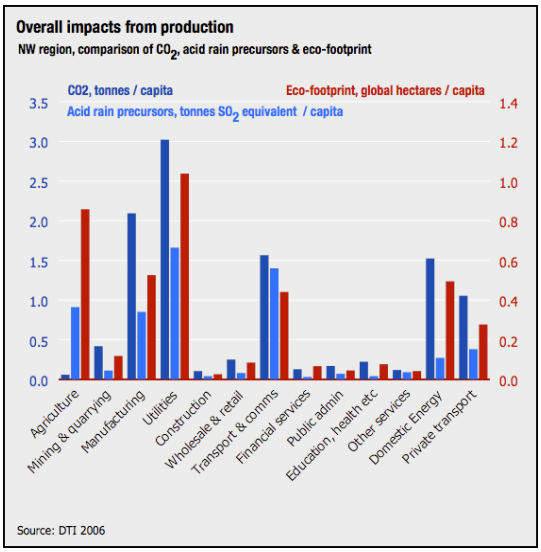
All businesses are now somewhere on the 'responsibility' spectrum, with major oil companies and retailers now showing the way. One problem is that as the amount of presentation goes up, the credibility often goes down.

This is then the contribution of the Eco-region NW, and its parent REAP model – to provide a benchmarking scheme for environmental sustainability, based on the best available solid data and analysis. The prototype REAP-benchmark shows some starting points, to be developed in future phases of the program.

Energy in production

This section is a brief overview of the metabolism of the NW regional economy, in terms of energy, materials and emissions. This is a brief summary of the much more detailed information in the REAP system and the REAP-Benchmark scheme.





The first questions are on what provides the energy for business: what are the proportions of the total consumed by each sector: and what are the vulnerabilities of each sector, in the context of rising energy prices and insecurity of supply.

The pie chart here shows the broad distribution of energy around the NW economy. This shows power generation as taking the largest slice, followed by manufacturing, and by domestic energy. Commercial and public transport (including aviation) is larger than private transport, at about the same volume as the rest of the service sector.

Material balance

The pattern of material production and trade balance can be seen clearly in the chart. This summarizes the much more detailed information available in the REAP system and the REAP-benchmark package.

The largest production volumes are seen in the mining and quarrying industries, but exports from here are relatively small. Large volumes are also seen in the non-metallic sectors, i.e. building materials and other mineral products. The largest exports are seen in the chemicals industry: and the largest imports with chemicals and energy fuels.

The same material inputs eventually find their way to the consumer (the exports to rest of world is shown here twice for reference). This list of sectors covers only the primary and secondary industries, as there is no regular data recorded for service sectors.

It does show clearly the very large volumes going to households, coming from agriculture and food, and from energy fuels. It also shows the large volumes going into capital investment (mainly buildings) from the non-metallic products sectors, i.e. building materials and so on, which pass through the construction sector itself (classified as a service industry). Major volumes of solid waste also arise from these three sectors.

International trade

Each region has a different international trade balance of imports and exports. This is usually shown as financial flows, so it is quite unique here to show material flows, as drawn from the REAP system.

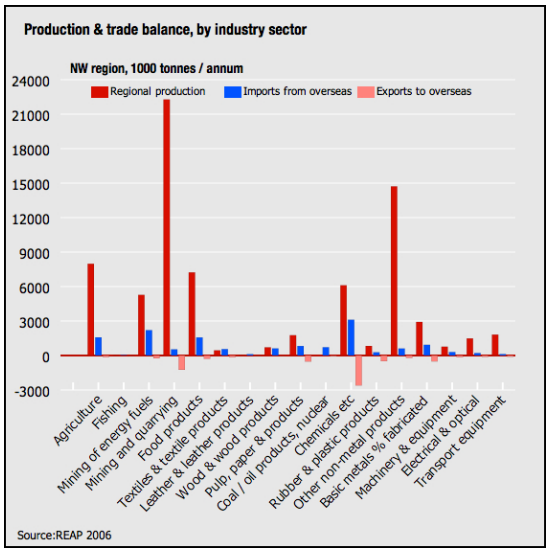
This shows interestingly the net balance of exports to the EU as the largest market, and also to North America, both in mining and quarrying materials, and in chemicals and other manufactures.

The world map overleaf shows these imports in terms of continents of origin, overlaid on a map of future global problems –deforestation, tropical storms etc. The message is very clear – that businesses cannot expect the current pattern of freely available low cost commodities to continue without limits.

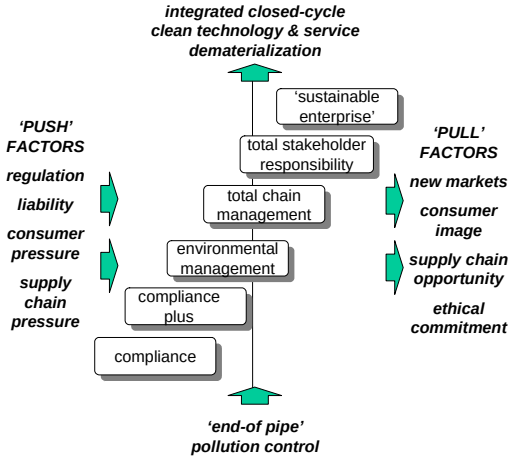
Overall impacts

For a summary of the overall impacts from production sectors we can compare the CO_2 emissions with acid rain pre-cursors (NH_3, SO_2, NO_x) and with the eco-footprint (all shown per capita in the NW region). While the major sources of overall environmental impact are broadly similar, the relative weightings of the three indicators vary significantly.

- The highest eco-footprint is from agriculture, manufacturing, the utilities and transport.



The ladder of 'sustainable business'



- The major sources of acid rain are also utilities and transport, followed by agriculture and domestic energy.
- The CO2 emissions are highest from utilities and manufacturing.

Context

Environmental sustainability is generally identified with fixed limits defined by local or global thresholds, in environmental capacity / risk / irreversible change. Meanwhile businesses are generally identified as small inter-dependent parts of a much bigger picture: as part of a economy: as part of a product supply chain: as part of a system which delivers human welfare. It is generally very difficult to translate the environmental thresholds to specific targets for business in any sector, as they are all in some way inter-dependent.

It is also clear that often the major effects of business are not direct material flows through their gates, but 'induced' effects elsewhere in the supply chain. For instance a supplier of concrete blocks might accept some responsibility for the emissions of a cement factory – but how many estate agents will accept responsibility for the factory, even while they are profiting indirectly from that activity? Many businesses will naturally argue for their interest in 'externalizing the externalities', as such costs may equate at least to their profit margin. This becomes more important, the more an economy shifts from a material basis towards a service basis, i.e. over 75% of the economy in wealthy countries. It is also significant in terms of the emerging CSR agenda, where businesses are being pressured into new linkages of social / environmental responsibility.

The resource flow analysis approach has much to offer this question, particularly in its 'next generation' form where flows between industries are represented through the input-output method. The REAP toolkit developed by SEI / CURE / WWF is potentially the foremost point of reference in identifying resource flow 'profiles' and sustainability thresholds in business sectors. The REAP calculates these at the level of sectors and product types: these are then an 'envelope' or benchmark to compare with actual business or product performance.

Linking to competitiveness

The environmental factors above then need to be linked back to factors of business competitiveness, generalized by production sector. This can be seen with the 'ladder of sustainability' diagram below. This is to be implemented in the interface which covers a range of information to be supplied mainly from industry / trade associations, and economic / business development agencies. On the 'push' side (negative pressures or risks).

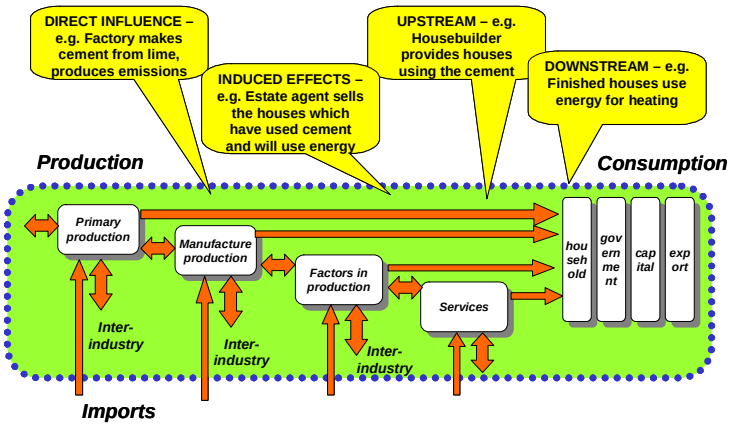
- Rising costs of energy, transport, waste, water etc
- Increasing liabilities, insurance costs
- Regulatory pressures
- Supply chain pressures from larger customers with CSR agendas.

On the pull side of positive incentives:

- New markets
- New technologies and processes
- Improved image for customer base
- Improved commitment by employees
- Increased confidence by investors.

Supply chain framework

shows different types of influence through economic transactions



Supply chain analysis

The key theme of this project looks at businesses, not only as economic units, but as part of a bigger picture:

- Business as part of a ***physical supply chain***, with resource flows from cradle to grave, and through the lifetime of their products.
- Business as part of a ***human activity chain***, from investors, managers, workers, consumers and other parts of society.

This toolkit concentrates on the first of these, but looking towards the second (for a future project). We use *examples in italics* to illustrate the concepts of business sustainability. Note: the scheme is not finalized and still under development.

The overall business benchmarking framework contains four types of influence:

- Direct influence – *e.g. where a factory makes cement*
- Indirect upstream – *e.g. where a housebuilder uses the cement to build houses*
- Indirect downstream – *e.g. where the houses then consume large amounts of energy.*
- Induced – *e.g. where an estate agent helps to sell houses which have used the cement*

These can be applied to different stages in the resource flow cycle, (each one of which can be very complex):

- Extraction – *e.g. cement for the houses is extracted*
- Production – *e.g. the materials are produced and houses are built*
- Consumption – e.g. *the houses are purchased*
- Operation – e.g. *the houses then use energy supplied from elsewhere, cleaned, maintained and so on.*
- End-fate – e.g. *the houses are demolished and the material goes elsewhere.*

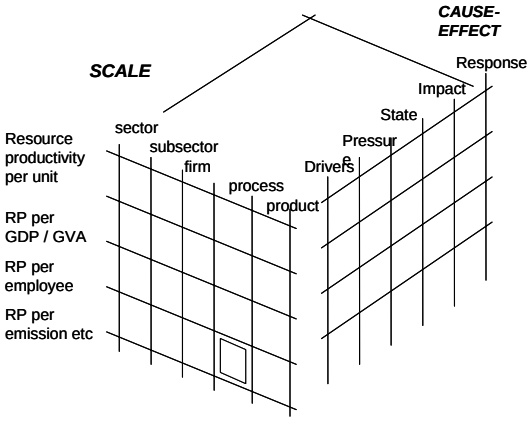
For each of these there are 3 general criteria of environmental sustainability, to be monitored and targeted for each of the impacts.

- ***environmental capital*** - i.e. depletion of resources & qualities
- ***environmental impact – i.e*** direct damage & disruption
- ***environmental risk*** – i.e. increased hazard or vulnerability

Targets for these can be drawn wherever possible from scientific evidence, social welfare or political priorities. The ***eco-footprint*** is one universal measure which represents to some degree each of these.

It is also significant that there are degrees of certainty or contention for each of these categories:

- Direct – in principle this would be measurable in terms of what physically leaves or enters the 'factory gate', at least for manufacturing sectors.
- Indirect upstream – in principle this is calculable through the input-output method and its spin-offs, if the input-output categories are reliable and representative (less so for services).
- Indirect downstream – there is more uncertainty and assumptions to be made, about what happens to the products after the factory gate, i.e. on consumer behaviour, product life etc.
- Induced – this is more debatable, as to what is an induced effect. For instance *how many estate agents would accept responsibility for the cement factory whose*



products they help to sell? This is where the influence of supply chains, investors, regulators, media, NGOs and the public, becomes crucial in setting the boundaries and allocating responsibility.

Upstream / downstream linkages

To provide further focus the upstream – downstream analysis is useful for identifying the nature of the causal chains, and definition of direct / indirect / induced influences. This works generally within the input-output methodology for inter-industry transactions, and the conceptualization of upstream / backward linkages, and downstream / forward linkages:

- Upstream / backward links: in economic terms, suppliers to the industry: in physical terms, precursor materials / products.
- Downstream / forward links; in economic terms, purchasers or users of the industry output: in physical terms, successor materials / products.

The definition of downstream / upstream depends on the position in the centre, i.e. the sectoral profile. While this appears obvious, for many businesses covering a range of activities the sector classification is not always apparent.

Benchmarking & indexing

The concept of benchmarks is to set out a framework for the interaction of economic activity with environmental impact / resource consumption. This would contain, as per the 'cube' visualization below:

- Environmental factors in waste, materials, transport, energy, water, minerals, toxicity burden if known etc
- Economic / social factors: GDP / turnover, GVA, employees, capital investment, other EHS / corporate responsibility
- average / best practice for similar firms / products
- average / worst / best practice for the sector and sub-sector
- comparison with regional pressure points, limits, goals and targets

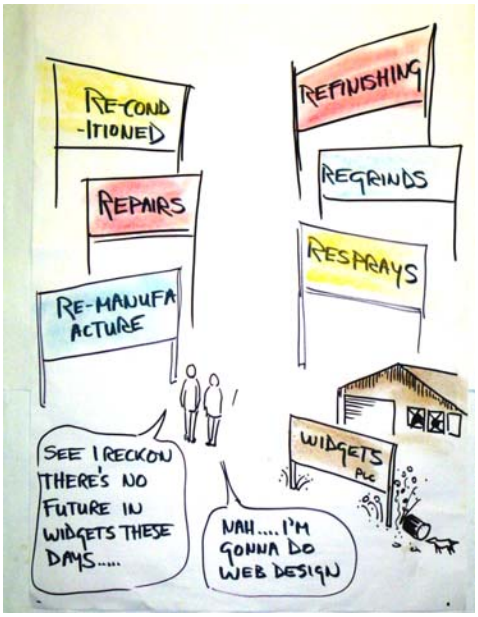
For many of these issues a close link to Environment Agency & industrial sector data systems on major processes would be essential. Recent work has formalized the direct / indirect components of the above general approach, in a ***'triple bottom line'*** analysis of all sectors in the Australian economy (Lenzen et al 2005). In the development of a practical model, the aim is to follow this model as far as is feasible within UK data and the practical needs of business. However the list of factors is adjusted here towards the material flow perspective and a service sector economy.

Towards a business toolkit

The general experience so far is that on-line or questionnaire type survey forms work most effectively:

- with human contact as backup,
- where data collection is very easy,
- where there are strong incentives for data collection.

However, on-line benchmarking is seen as often technically complex & costly, and prone to failures of one of the above. In response the REAP-Benchmark toolkit is developing a methodology concept for business benchmarking which is



- Based on application of the REAP structure
- Can be directly linked to the ENWORKS or similar front-line activity
- Builds on existing data capture schemes from regulators & CSR managers.

The key question is, what does business need to know?

Business performance within the sector –

- The sector performance and profile is summarized by the above indices
- the general idea is that businesses can benchmark themselves to sectoral averages, in the absence of more detailed data.

Supply chain pressures & opportunities –

- this is generally shown by the TBL analysis above.
- Close examination of the data will show how a business embodied energy profile is built up e.g. from stages in the upstream supply chain of the 1st or 2nd order.

Product pressures & opportunities –

- requires more focus on the matching of products to industry sectors.
- In principle this could be calculated by matching of products to sectoral financial output to final demand, and then following the direct / indirect paths

Given the drawbacks of on-line benchmarking above, it is now proposed to provide a ready made 'low-tech' spreadsheet template to be downloaded. This can be generated directly from the REAP system, with data simply extracted for that industrial sector.

This will contain pre-generated data for that sector, normalized by GVA, GDP and employees, including:

- Energy by fuel
- Transport by mode
- Waste & recycling
- Raw materials
- Exports & imports
- Typical product range
- Overall footprint as calculated in REAP, direct & indirect
- Where possible, best practice / best available technology for each of the above.

Businesses can then fill in as much of this as they can. Each item they fill in will generate intelligence on benchmarking of direct value to themselves. Items not filled in still have the default values for that sector.

(this needs some incentive or reminder system for returning the forms…)

- This will be fed into existing schemes e.g. Enworks, who have the active outreach programmes on the ground
- It would also be fed into industrial / trade associations, who have the more detailed knowledge of opportunities in each sector.

10

Policy agenda

The overall implication of this report is to highlight the challenge for the Northwest to move towards environmentally sustainable development.

We take the ***measures*** of this as consumption-focused CO2 emissions, material flow and eco-footprint, as defined by the Ecological Budget UK analysis. We take the ***target*** as the 4-fold increase in resource efficiency, as defined by the F-4 scenario.

This is a tightly focused agenda, which leaves aside for the moment the many other dimensions of sustainability – social, cultural, economic and so on. Even so this material challenge raises huge questions on ***who*** is responsible, ***how*** it can be achieved, ***what*** are the next actions required, and ***how much*** are the costs and benefits to each party involved.

This report can only provide a sketch of such questions, and point to other more in-depth discussions in other parts of the UK.[17]

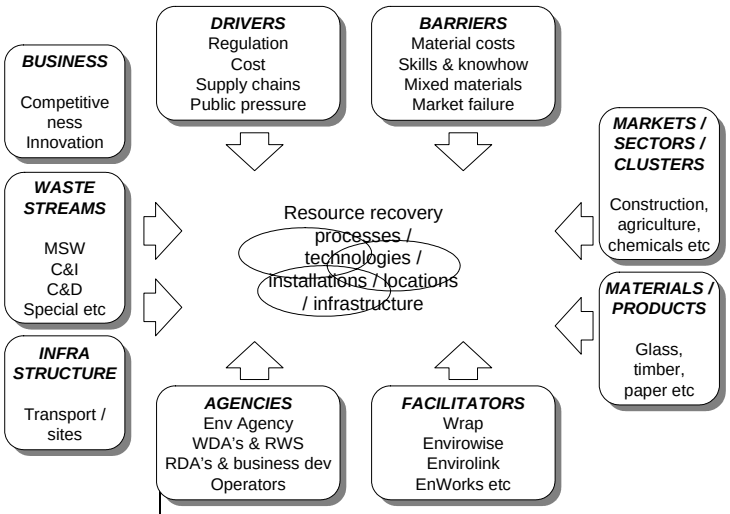
- There is a question on ***governance***. Although the NWDA, GONW, NWRA etc are the main coordinating bodies for the region, (with many other acronyms to support them), their actual powers are limited in comparison to central and local government. How far can the NWRA and its member authorities mobilize real capacity to achieve their goals, in the complexities of regional and local policy?
- A second question is on ***resources.*** To make realistic progress requires public finance for investment. There are also wider issues on the role of the public sector in the market, and in market development of technology and infrastructure. For instance, if all public bodies in the region were to require their buildings to have solar panels produced in the region, the price would fall rapidly and the renewables programme could achieve viability.
- A third question is on ***attitudes*** - how far are the general public and businesses committed to this kind of strategy, and what it would take to increase such commitment. For instance, there is evidence that the most cost-effective action to reduce climate emissions is not so much technology, as in how it is used – coming back to the agenda of public awareness and business attitudes.

This study provides an outline of how each of the policy options can be addressed in the short, medium and longer term. A typical strategic programme for reducing eco-footprint will contain both 'demand side' and 'supply side' components: both 'physical' actions and 'human' actions: and will need both technical and economic resources. The 'next steps' are the actions which cost little, use available technology, gain political viability and generate social benefits – the ideal win-win situation. In general these will include:

- vision: generate scenarios, projections and visions in combination with all stakeholders
- resources: build institutional 'capacity' for cohesion, cooperation and longer term thinking
- action: strategic business planning for short, medium and longer terms

The likely shape of a strategic program can be charted out on a material 'cradle to grave' basis, showing the

[17] Ravetz 2000: WWF 2004:



likely actions at each stage for now, soon and later.

General recommendations

For regional and local authorities, the first question is how they can most effectively work together, whether through Local Strategic Partnerships, sub-regional groupings or inter-regional networks. Following this are some suggestions for practical 'horizontal' actions in the shorter term, 2006-2011:

- Corporate policy and mission: promote Sustainable Community Strategies, Local Agenda 21, and other vision and consensus building exercises
- Information and management: enhance the existing audits and benchmarking schemes for State of Environment, social and community audits, place checks, quality of life surveys and so on.
- In-house improvements: beginning of green purchasing policies, travel demand management, environmental management systems, targeting and monitoring.
- Policy integration between sectors, levels and agencies, to take forward the regional sustainable development framework.

Recommendations - targets

Sooner or later the North West RES and RSS, and all the sub-regional or local strategies which follow on from these, will need to take on board 'hard' targets and measures to fulfil their aspirations. The following suggestions are put up for further debate in future reviews of the RSS, RES and associated documents:

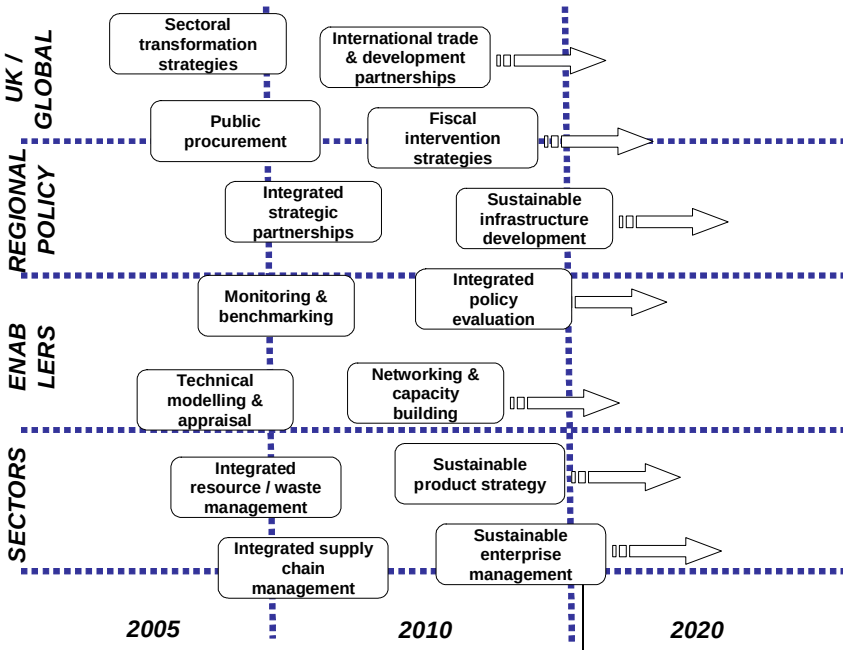
- 'Stabilization': reducing current growth trends in eco-footprint, as discussed in section xxxx.
- Consumption targets: a phased programme of reductions in the purchasing eco-footprint of households and other final consumers
- Production targets: a phased programme of reductions in the business and industrial sectors of the West Midlands
- Infrastructure targets: likewise a phased programme of reductions in the built transport, energy and utilities sectors of North West.

Each of these will generally aim at the basic target trend-curve of -2.5% per year. This challenging target will then require further research and evaluation as below.

Recommendations: research

To enable the above, the Ecological Budget UK research programme is being taken forward into future phases, at both the national and regional level. Collaboration with bodies in the North West will be essential along with other regions, to ensure that the results are topical and timely:

- More detailed analysis of the RSS options, links with the RES, and localized impacts.
- Spatial analysis of infrastructure and regeneration activity to focus on opportunities for resource efficiency.
- Public procurement analysis, covering buildings, transport, materials etc, to ensure that the public sector is in the lead.
- Business-environment benchmarking, to



enable more accurate monitoring and priority setting for business sectors.

- Product-environment benchmarking, to enable more responsible consumer purchasing.
- Comprehensive and detailed 'triple bottom line' accounting and appraisal framework for all forms of policy evaluation and impact assessment.
- Target-based programme development for 'consumption', 'production' and 'infrastructure', as above: using least-cost and integrated asset management techniques.

Recommendations: programs

Regional level activity is likely to be most effective as a coordinator and enabler of national and international actions in the public and private sectors. These are shown in concept form in the road map above ***(Fig…)***. The 'road map' concept is used here to show the general direction of travel and the cross-linkages between these broad and challenging themes.

National & global level: these are general principles which are being explored further in the One Planet Economy Network research programme.

- Ecological transformation: the general prospect is that each industry and business sector will need to develop a transformation strategy, in order to maximize added value, minimize environmental impacts and risks, and enhance corporate social responsibility.
- International development and trade policy is a key issue, relating particularly to material intensive imports of commodities.
- Fiscal intervention – environmental tax and subsidy is a key principle in shifting market patterns towards environmental responsibility.
- Procurement by the public and quasi public sectors. Procurement is possibly the first priority as the principles of least-cost planning and integrated asset management can be applied.

Firm and product level: the business –environment programmes below are not exactly new – but the incentives and urgency have increased, and the tools and techniques to enable them have also improved:

- integrated supply chain management – rather than each firm drawing a line at its gate, this looks at the total supply chain for opportunities in new processes, logistics, technologies and business models.
- integrated resource and waste management: integrated energy and climate emissions strategy.
- sustainable product strategy – includes the issues of operational impacts, end of life fates etc.
- sustainable enterprise management – includes the issues of CSR, employee welfare, shareholder value, risk management etc.

Role of enablers

In the centre of the 'road-map' are the so-called 'enablers'. At the regional level these are currently focused through the ***SCP-net*** ('sustainable consumption and production network') for technical

development and capacity-building:

- Technical modelling & appraisal tools – of which REAP and REEIO are the most relevant at the moment.
- Monitoring and benchmarking techniques, with continuous improvement of audits, databases, case study libraries etc.
- Integrated policy appraisal and evaluation – applying these tools and techniques to the policy & management cycle
- Networking & capacity building – training, dissemination etc

There is a notional timescale shown from 2006 – 2020, where each of the above factors is an ongoing programme. However where there are clear targets and milestones, such as in the series of EU Directives on waste, then a more specific application of this road map would be useful. A further stage would then link back various targets and technology factors to the analytic models of REAP, REEIO and similar.

Next steps

Overall, this report will have served its purpose if it helps to illuminate a much longer programme of investigation and debate in the North West.
We aim to show that environmental sustainability is the only responsible path to follow in the 21st century.

To back this up we provide the beginnings of an evidence base to measure conditions, trends and targets. We put the case that the NWDA and all organizations involved, should take forward these recommendations. This will involve a multi-level programme of evidence and capacity building, in preparation for major actions over the coming decades.

11

Appendix

Summary accounts

This section shows some key summary tables from the Ecological Budget UK accounts. All tables are based on the REAP tool and associated workbooks.

Table 1: material flows

Shows aggregate material flows through the NW economy, per person: note that Direct Material Input (DMI) includes primary industries plus all imports.

	Domestic production *t/cap*	**imports** *t/cap*	**exports** *t/cap*	**controlled waste** *t/cap*	**other waste** *t/cap*	**recycled & reused** *t/cap*	**import fraction of DMI** *%*	**waste fraction of DMI** *%*
Agriculture, forestry, fish	1.65	0.28	0.06		1.47		17%	89%
Mining and quarrying	9.63	1.69	1.92		1.57		18%	16%
Manufacturing	5.74	1.95	1.30	0.72	0.00	0.33	34%	13%
								recycling % of waste
Electricity, gas, water								
Construction					1.72			
Wholesale & retail				0.31		0.14		45%
Transport & comms				0.04		0.02		36%
Financial intermediation				0.14		0.04		28%
Public administration				0.03		0.01		28%
Education, health, social				0.07		0.01		22%
Other services								
Domestic				0.59		0.12		20%
Private transport								
Other flows					0.61			
Total		**3.92**	**3.28**	**1.91**	**5.37**	**0.67**		35%
Direct Material Input (DMI)	**15.2**							

Table 2: resource productivity

This shows the material flows as above, per unit of economic output, for a basic measure of physical resource productivity: (data as at 2003)

	Domestic production t/£M	**UK imports** t/£M	**UK exports** t/£M	**controlled waste** t/£M	**other waste** t/£M	**recycled & reused** t/£M	**total economic output** £billion
Agriculture, forestry & fish	3622	609	135		3224		27
Mining and quarrying	12439	2180	2484		2027		46
Manufacturing	269	91	61	34	0	16	1262
Electricity, gas, water							48
Construction					806		127
Wholesale & retail				175		78	106
Transport & comms				15		5	167
Financial intermediation				17		5	488
Public administration				20		5	82
Education, health, social				20		4	205
Other services							81
Domestic							
Private transport							
Other					0		
Total	**16330**	**2881**	**2680**	**280**	**6057**	**114**	2638

Table 3: energy & emissions

This shows key indicators of energy demand & supply, with climate change emissions & ecological footprint per person.

	Total energy toe / cap	**Electrical energy** toe / cap	**Fossil fuel energy** toe / cap	**Greenhouse gases** t CO2 eq/cap	**Acid rain precursors** t SO2 eq./cap	**Carbon dioxide** t / cap	**Eco-footprint** gha/cap
Agriculture, forestry & fish	0.03	0.01	0.02	0.85	0.009	0.06	0.86
Mining and quarrying	0.14	0.00	0.13	0.56	0.001	0.42	0.12
Manufacturing	0.96	0.12	0.84	2.28	0.009	2.09	0.53
Electricity, gas, water	1.11	0.09	1.02	3.20	0.017	3.02	1.04
Construction	0.04	0.00	0.04	0.11	0.000	0.10	0.03
Wholesale & retail	0.14	0.05	0.10	0.31	0.001	0.25	0.08
Transport & comms	0.56	0.02	0.54	1.59	0.014	1.56	0.44
Financial intermediation	0.09	0.04	0.05	0.14	0.000	0.13	0.07
Public administration	0.07	0.01	0.07	0.17	0.001	0.17	0.04
Education, health, social	0.12	0.02	0.10	0.23	0.000	0.22	0.08
Other services	0.05	0.01	0.04	0.33	0.001	0.12	0.04
Domestic energy	0.83	0.17	0.66	1.58	0.003	1.52	0.49
Private transport	0.38	0.00	0.38	1.12	0.004	1.05	0.28
Total	**4.51**	**0.53**	**3.98**	**12.46**	**0.06**	**10.72**	**4.09**

Table 4: energy & emissions by demand

Shows key indicators of energy & emissions as above, by demand side category:

	Total energy	Electrical energy	Fossil fuel energy	Greenhouse gases	Acid rain precursors	Carbon dioxide	Eco-footprint
	toe / cap	toe / cap	toe / cap	t CO2 eq/cap	t SO2 eq./cap	t / cap	gha/cap
households	3.20	0.39	2.81	9.00	0.040	8.20	4.20
government	0.36	0.04	0.32	1.00	0.004	1.00	0.40
capital	0.41	0.05	0.36	1.20	0.006	1.40	0.80
exports	1.10	0.10	1.00	3.10	0.019	3.50	0.00
other demand	0.02	0.00	0.02	0.06	0.000	0.10	0.00
total	**5.09**	**0.58**	**4.51**	**14.36**	**0.069**	**14.20**	**5.40**

Table 5: resource productivity by energy & emissions

Shows resource productivity in terms of energy, emissions & footprint, per unit of economic output.

	Total energy	Electrical energy	Fossil fuel energy	Greenhouse gases	Acid rain precursors	Carbon dioxide	Eco-footprint
	t/£M	t/£M	t/£M	t/£M	t/£M	t/£M	gha/ £billion
Agriculture, forestry & fish	0.06	0.01	0.04	1.86	0.02	0.13	1.88
Mining and quarrying	0.18	0.00	0.17	0.72	0.00	0.54	0.15
Manufacturing	0.05	0.01	0.04	0.11	0.00	0.10	0.02
Electricity, gas, water	1.38	0.11	1.27	3.99	0.02	3.76	1.29
Construction	0.02	0.00	0.02	0.05	0.00	0.05	0.01
Wholesale & retail	0.08	0.03	0.05	0.17	0.00	0.14	0.05
Transport & comms	0.20	0.01	0.19	0.56	0.00	0.55	0.16
Financial intermediation	0.01	0.00	0.01	0.02	0.00	0.02	0.01
Public administration	0.05	0.00	0.05	0.12	0.00	0.12	0.03
Education, health, social	0.03	0.01	0.03	0.07	0.00	0.06	0.02
Other services	0.03	0.01	0.03	0.24	0.00	0.09	0.03
Domestic energy	0.60	0.12	0.48	1.15	0.00	1.11	0.36
Private transport	0.27	0.00	0.27	0.81	0.00	0.77	0.20
Total	0.10	0.01	0.09	0.28	0.00	0.24	0.09

Table 6: trends & targets

This is a different approach to the baseline tables above, in order to show the alternative directions of change. The data is based on UK average ecological footprint components in gha/cap: business as usual growth rates are drawn from DTI 2006: EEA 2005: DoT 2003. The target data is based on a Factor Four calculation.

	2005	2015	2025	2035	2045	BAU projected growth rate
Food and drink	1.16	1.29	1.44	1.61	1.80	1.10%
Home and energy	1.17	1.25	1.33	1.42	1.51	0.65%
Travel / air travel	0.97	1.24	1.59	2.03	2.60	2.50%
Consumables	0.54	0.60	0.67	0.75	0.84	1.10%
Services	0.36	0.38	0.41	0.44	0.46	0.65%
Fixed Capital	0.76	0.81	0.87	0.92	0.99	0.65%
Government & other	0.40	0.41	0.42	0.44	0.45	0.30%
Total BAU trend	**5.36**	**5.99**	**6.73**	**7.61**	**8.65**	**1.16%**
Factor Four target	**5.36**	**3.95**	**2.91**	**2.15**	**1.58**	**-3.00%**

Table 7: Construction productivity indices

	domestic material intensity: MFA / £GVA domestic production	imported / domestic material input: %	waste / material input: waste as % of DMI	fossil fuel intensity: tonnes oil equiv / £million domestic production	electricity intensity: tonnes oil equiv / £million domestic production	eco-footprint intensity: gha / £million total demand	CO2 intensity: tC02 / £million domestic production	embedded CO2 import intensity: tC02 / £million domestic production	IMPORT INTENSITY: import as % of domestic by tonnes	EXPORT INTENSITY: export as % of total demand by tonnes
Metal ores extraction	2.97	483657%	0%	4666	0	36	13	338	47306%	150%
Other mining / quarrying	74.33	2%	4%	116	35	4	0	1	114%	77%
Wood & wood products	1.38	94%	187%	4100	403	202	13	5	44%	24%
Pulp, paper, board	1.54	150%	91%	1624	88	50	4	4	105%	101%
Paper & board products	1.01	15%	238%	2875	155	50	7	6	16%	21%
Rubber products	0.35	71%	206%	3840	557	43	10	14	55%	48%
Plastic products	0.33	46%	233%	1767	863	55	5	6	23%	51%
Glass, glass products	1.68	31%	36%	3379	1038	67	10	13	35%	40%
Ceramic goods	0.71	113%	33%	2535	706	19	6	16	46%	28%
Structural clay products	14.02	2%	40%	10155	1080	331	26	1	3%	31%
Cement, lime, plaster	17.96	4%	39%	29332	2138	3023	217	1	9%	40%
Articles concrete, stone	17.63	1%	40%	1171	464	65	3	3	9%	60%
Iron and steel	2.95	41%	304%	21657	633	607	63	17	38%	101%
Non-ferrous metals	0.48	109%	333%	3587	1981	65	12	45	113%	105%
Metal castings	0.39	0%	473%	1465	1240	1784	4	0	0%	259%
Structural metal	0.49	8%	425%	834	342	14	2	3	5%	11%
Metal boilers, radiators	0.16	57%	381%	1358	557	14	3	5	23%	17%
Metal forging, pressing	0.04	0%	473%	69	28	14	0	0	0%	14%
Cutlery, tools etc	0.08	253%	251%	1572	644	14	4	6	60%	43%
Other metal products	0.34	75%	363%	962	394	14	2	4	39%	47%
Construction				2313	142	44	7	0	0%	0%

FAQ's

A more detailed set of frequently asked questions is available on www.eco-region.org

What is an eco-footprint?

The eco-footprint calculates the land area needed to feed, provide resources, produce energy, and soak up the pollution from our lifestyles.

As this land is distributed around the world, the figure is put in 'global hectares' (gha). At the moment the average person in the NW region has an eco-footprint of 5.45 global hectares. This is 3 times bigger than our fair 'earth share' of 1.8 global hectares, i.e. if the world's productive land area was equally shared with the world's population.

What is a One Planet Economy?

This is a system of production and consumption which respects environmental limits, local and global, which is also financially and socially sustainable. Its main target is the fair 'earth share' footprint of 1.8 gha per person. This means a long term goal of 75% cut in resource use – i.e. **Factor Four** increase in resource efficiency.

What is the F-4 scenario?

If the UK and other affluent nations halve resource use and double resource efficiency, we will be able to live on one planet alongside the rest of the world's population (von Weizsacker 1997). This factor four reduction in footprint will need an efficiency increase of about 2.5 - 3% per year from now until 2050. As this can only be imagined from the present day, it has to be developed in the form of a 'scenario' – this might be more technical, more narrative, or a combination of both.

What is the REAP toolkit?

The '**R**Esource & **E**nergy **A**nalysis **P**rogramme' is a database and modeling system which calculates the total impacts of all kinds of production by industry and consumption by households, at local and regional level. Produced in a partnership led by SEI-York with CURE and WWF-UK. It is now available in Version 1.0, but development is continuing, on scenario modeling, sectoral applications, appraisal packages and business toolkits. For further details see - **www.sei.se/reap/**

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Data resources

(Available on www.eco-region.org)

C&I waste:

<<EcoNW – C&I waste & MFA tables May06>>:
(CURE): waste data based on EA survey 2003, released 2005

- full 123 sector mass balances,
- 123 sector waste arising, recycling / re-use,
- 123 sector waste composition.
- To follow – calculation of footprint / carbon lost / potential
- To follow – matching with Envirowise sector data.

MSW waste

<<EcoNW – MSW waste footprint May06>> (SEI)

- Full MSW composition & recycling data (WRAP)
- Disaggregated by local authority in the NW (all England available)
- Calculates eco-footprint lost / potential through management / recycling
- Provides detailed account for individual LAs

Business benchmarks

<<EcoNW – business benchmarks May06>>
This is a demonstration (not operational) of a 'REAP-business' benchmarking scheme

- full 123 sector resource productivity benchmarks, based on mass balances,
- energy by 10 fuels from ONS 76 sector environmental accounts: allocated to 123 sectors
- air emissions by 26 substances from ONS 76 sector environmental accounts: allocated to 123 sectors
- C&I waste as above.

Local area footprints

Local area footprints breakdowns are available individually on www.sei.se/reap/local
This file provides a full set for analysis.
These are calculated statistically from:

- ACORN social group distribution by local area:
- ACORN expenditure data
- Household expenditure from COICOP
- Consumption based footprint as from REAP system

Activity accounts

Activity accounts are a prototype supply chain analysis system. This works well as a summary overview of a more detailed structural path analysis approach to follow. <<EcoNW – activity accounts March06>>

- 24 sector input-output tables
- 24 sector Mass balance summaries
- 24 sector Energy & emissions
- Activity sector supply chain accounts

Abbreviations

BATNEEC	'best available technology not entailing excessive cost'
BAU	'business as usual' scenarios
BPEO	'best practicable environmental option'
CAP	Common Agricultural Policy
CE	Cambridge Econometrics
CMS	Caleb Group
COICOP	national database of household expenditure
CURE	Centre for Urban & Regional Ecology
DCLG	Department of Communities & Local Government
DfT	Department for Transport
DTLR	(the former) Department of Transport, Local Government and the Regions
DEFRA	Department of Environment, Food and Rural Affairs
DETR	(the former) Department of Environment, Transport and the Regions
DPSIR	'driving forces, pressures, state, impact, response' framework for indicators
DTI	Department of Trade and Industry
DUKES	Digest of UK Energy Statistics
EA	Environment Agency
EEA	European Environment Agency
ECA	Enhanced Capital Allowance
ERDF	European Regional Development Fund
EU	European Union
EUWFD	EU Water Framework Directive
F-4	Factor 4 reduction in resource use
GDP	Gross Domestic Product
GONW	Government Office NW
IA	integrated assessment
ICT	information & communications technology
IPCC	Inter-Governmental Panel on Scientific Assessment of Climate Change
IPPC	'integrated pollution prevention and control'
LCA	'life-cycle analysis' of environmental impacts
LDF	local development framework
LFT	Land Fill Tax
LSP	Local Strategic Partnership
NWDA	North West Development Agency
NWRA	North West Regional Assembly
NDPB	non-departmental public body
ODPM	Office of the Deputy Prime Minister
ONS	Office of National Statistics
OST	Office of Science & Technology
PIU	Performance & Innovation Unit (former) of the Cabinet Office
PMSU	Prime Minister's Strategy Unit
PREST	Policy Research for Engineering Science & Technology
PRODCOM	database of products and materials of Customs & Excise
RDA	Regional Development Agency
REAP	Resource Analysis Programme
REEIO	Regional Economy-Environment Input-Output (Model)
RES	regional economic strategy
REWARD	'Regional & Welsh Appraisal for Resource Productivity & Development'
ROHS	Restriction of Hazardous Substances (directive)
RPG	Regional Planning Guidance
RSS	Regional Spatial Strategy
RSDF	Regional Sustainable Development Framework
SA	sustainability appraisal
SCP	sustainable consumption & production
SCP-net	Sustainable Consumption & Production network
SEA	strategic environmental assessment
SEI	Stockholm Environment Institute
SEPA	Scottish Environment Protection Agency
SU	Strategy Unit of the Cabinet Office
TEPI	Towards Environmental Pressure Indicators (EEA)
UDP	Unitary Development Plan
UKCIP	UK Climate Impacts Programme