United Kingdom

One Planet Economy Network Prospectus

Evidence, applications and networking: the way forward
OPEN (One Planet Economic Network)

Building the evidence base, applications and capacity to support sustainable consumption and production

Prospectus

“Towards a One Planet Economy”

Main report to WWF-UK

June 2006
Status of this report

This report is a consultation draft version 0.9 as of August 2006.

Consultation responses will be compiled, together with the results of a consultation workshop, and incorporated in the final version. There are 3 key documents available for consultation:

1. OPEN – Consultation questions
2. OPEN – Prospectus (main report)
3. OPEN – Technical Report:
   Part A – policy & research framework
   Part B – macro-economic modelling
   Part C – food & international trade
   Part D – built environment
   Part E – products & services
   Part F – energy & waste

This last is available as a set of pdf files from www.ecologicalbudget.org.uk. Hard copies are available by request.

NOTES

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Research Team

Joe Ravetz, principal author:
With assistance from Serban Scrieciu

Centre for Urban & Regional Ecology,
School of Environment & Development,
Manchester University, Oxford Rd, M13 9PL,
t.+44 (0)161 275 6879 / 6938:  f. 275 6893
www.sed.manchester.ac.uk/research/cure/
www.eco-region.org

with contributions from:

Cambridge Econometrics
Covent Garden, Cambridge CB1 2HS
Tel: +44 (0)1223 460760
Fax: +44 (0)1223 464378
www.camecon.com

and drawing on data supplied by:

Stockholm Environment Institute
Sally Baldwin Building, Block D,
University of York,
York YO10 5DD UK
Tel: 01904 434403
www.sei.se

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For further information, please contact:
Stuart Bond
WWF-UK, Panda House, Godalming
Surrey GU7 1XR
Tel: 01483 426444
Fax: 01483 426409
www.wwf.org.uk
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1. Summary & consultation

This section is an overview of the baseline accounts: the One Planet Economy theme: and the consultation questions.

In a world of accelerating climate change, deforestation, urbanisation, water scarcity and a host of other problems, it is clear that a step change for the UK is needed.

The One Planet Economy Network (OPEN) is helping to create a more sustainable future for the UK, and its place in the world. This is based on the One Planet Economy agenda, which aims to transform our patterns of consumption and production, and to work within global resources and limits.\(^1\) In reality the One Planet Economy is a huge concept, with many dimensions and many uncertainties. This is why we set it out as a “network” process – not a fixed solution, so much as ongoing research and debate to take these questions forward.

This Prospectus is the main report for consultation. It comes in three main parts, following this summary:

I. One Planet Economy – concepts, targets, methods:

II. Key sectors – outline of strategies:

III. Making it happen:

The appendix shows the pilot UK resource accounts so far. For details of the methodology and application, see the OPEN Technical Reports (Parts A-F).

1.1 UK ACCOUNTS

1.1.1 The Ecological Budget UK

The background to the OPEN is the Ecological Budget UK – the UK’s first detailed analysis of resource flows in all types of consumption and production. The Ecological Budget UK is unique in that it shows the global impact of UK consumption from all imports and exports; and the upstream and downstream impacts of each sector and activity. It also shows the distribution between regions, local authorities and social types. Each of these is shown by key measures – material flows from cradle to grave; energy and emissions, particularly CO\(_2\); and the Ecological Footprint for aggregate global impacts.

The Ecological Budget UK report Counting Consumption presents a comprehensive set of baseline accounts, together with the implications for sustainable consumption and production around the regions. Several regional projects in the North West, North East and West Midlands

\(^1\) The foundation for this is contained within the UK Government’s commitment to a ‘One Planet Economy’ as endorsed by Tony Blair in the UK SD Strategy ‘Securing Our Future’, and in WWF’s One Planet Living Programme and Campaign – see www.wwf.org.uk.
were drawn from this. Interactive access to this data is provided through the REAP toolkit, a software package for baseline data and assessment of future scenarios.

**ECOLOGICAL BUDGET UK**

**Baseline**

- “Counting consumption”
  - CO2 emissions, material flows & ecological footprint of the UK

**Strategy**

- One Planet Economy Network
  - A strategic framework for transformation of consumption & production

**Regional reports**

1. North East
2. West Midlands
3. Sustainable Communities in the West Midlands

**OPEN prospectus**

**Evidence**

- “REAP toolkit”
  - Software & databases for modelling & analysis of consumption & production

**OPEN reports**

- Policy & modelling
- Macro-economic modelling (CE)
- Food & trade
- Built environment
- Products & services
- Energy & waste

**REAP reports**

1. Outline & methods
2. Data structure
3. Input-output method
4. UK / regional results
5. Scenario modelling
6. REAP user manual
7. REAP applications
8. OPEN strategy

**OPEN prospectus**

**1.1.2 Comparison of climate strategy and OPEN**

With all the policy and scientific attention on climate change and carbon emissions, what is the unique added value of the Ecological Budget UK data and OPEN strategy? Generally, most climate/carbon policy tends to be problem focused - measuring the carbon at the point of emissions, and with the policy and business focus on mitigation of the emissions.

In contrast, the Ecological Budget UK data and the OPEN approach tends to be solutions focused. It looks at resource flows as the underlying dynamic of society; it measures total direct and indirect impacts, as represented by Footprint analysis, throughout the supply chain, and it also looks at imported goods and their embedded impacts. Overall, the integrated approach of the OPEN is a pro-active way to turn the perceived “costs” of climate emissions reduction policy into the “opportunities” of a transformation strategy.

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*All project materials are on www.ecologicalbudget.org The REAP model is available on www.sei.se/reap Further demonstrations and interactive tools are on www.eco-region.org*
1.1.3 Accounting methods
The Ecological Budget UK accounts follow the UN ‘System of Environment-Economic Accounting’ framework, and as far as possible are linked to the UK indicators for sustainable consumption and production.

The accounting framework contains a balance sheet and profit/loss account, just as the financial accounts of a major business. Each of the basic measures of materials, emissions, energy and Ecological Footprint can be indexed to show resource productivity.

1.1.4 Results
Some key findings from the UK accounts are as follows:
- The UK’s Ecological Footprint is 5.4 global hectares per person, or about three times the fair “Earth share” of 1.8 global hectares per person.
- The overall resource dependency – imports as a proportion of direct material inputs – ranges from 17% in agriculture to 34% in manufacturing.
- The total resource efficiency – material flow per £ output – is 0.34 tonnes per £million.
- The total hidden flows – the energy and emissions impacts embedded in imports – are 20-30% of the direct flows accounted by the UN Framework Convention on Climate Change.
- The overall resource re-investment – the rate of recycling and re-use from total (controlled) waste – is 35%.

1.2 TOWARDS A ONE PLANET ECONOMY
1.2.1 Goals and Factor Four targets
The key result of the Ecological Budget UK shows that the UK is exploiting the Earth’s available resources, as measured in bio-productive land area or ‘bio-capacity’, at more than...
three times its “fair” share, as measured by the Ecological Footprint in ‘global hectares per capita’ (gha/cap).

- By 2050 there is likely to be a 50% increase in population, up to 9 billion.
- There may be some additions to bio-capacity through land reclamation and reforestation, but there may be other damage to eco-systems.
- Therefore a mid-range estimate of change in bio-capacity would be from 1.8 to 1.3 gha/cap in 2050.
- To reduce the current UK footprint of 5.5 gha/cap to the 2050 fair share bio-capacity of 1.3 gha/cap would need a ‘Factor Four’ reduction.
- This equates to a year on year reduction in total resource use of 3.2% per year (if starting from 2007), as measured by the Ecological Footprint.

This provides the overall horizon for the sustainability of the UK economy i.e. the path towards a Factor Four goal. At that point it will take up the challenge of the UK Sustainable Development Strategy, and move towards a real ‘One Planet Economy’ – “an economic system of production and consumption which respects environmental limits, local and global, while being financially and socially sustainable”.

1.2.2 OPEN principles
The idea behind the OPEN is very simple – sound management of national assets for the longer term. Whether we are dealing with a corner shop, a multi-national corporation, or the UK as the fifth largest economy in the world, we need to manage our assets and liabilities, be aware of future risks and opportunities, and be responsible to suppliers, customers, employees and shareholders. But while the principles are clear, the practice is complex and uncertain. Here the OPEN offers an innovative and powerful approach – ‘integrated asset management’ and ‘industrial evolution’ – in order to take the principles of a One Planet Economy towards reality.

- The first is the integrated polluter pays principle, under which users of environmental resources pay for the risk or damage caused, locally or globally, and accept responsibility either as consumers or as producers.
- These funds should be used not only for cost recovery, but also for eco-investment for innovation and low-impact infrastructure, aiming towards a step change in efficiency and productivity.
One Planet Economy – principles

- This re-investment should be based on the principle of integrated asset management – i.e. the whole of the resource should be managed and budgeted for the longer term. This applies, for example, to the national stock of buildings, vehicles and other assets.
- To achieve this needs an integrated supply chain approach: including technology and management on the supply side; logistics and distribution; and consumption and lifestyle changes on the demand side.
- This strategy depends on shifting the role of government from making environmental policy for others, towards a much more proactive and responsible role of environmental stewardship.
- Otherwise, each sectoral investment case should of course be financially viable, aiming at net gains in both national and individual benefits.
- The strategy will also be socially responsible, aiming towards equalising the differences between social groups, between regions, and between the UK and the developing world.
- Such a programme requires a practical business case and investment strategy for each sector, each product type and so-on. Economic, social and environmental costs / benefits (as far as can be defined) should all stack up.

Overall, this adds up to a quite radical ‘industrial evolution’ – a process of structural innovation and market transformation, involving business, finance, science and technology, NGOs, consumers and government at every level. Such an evolution can be both the cause and effect of business development, thus turning the “costs” of resource efficiency into “opportunities” for economic growth and competitiveness.
1.3 ONE PLANET ECONOMY NETWORK

The OPEN takes forward the theme of the One Planet Economy into a four-year programme of research, development and capacity building – “a programme for building the evidence base, applications and capacity, to promote a One Planet Economy in sustainable consumption and production”.

The OPEN programme has three broad objectives:

- Building the evidence base to support a One Planet Economy;
- building applications for policy and business sectors; and
- building capacity with stakeholders.

1.3.1 How the O.P.E.N. works

The OPEN Strategy is structured in three parallel strands as per the objectives – the evidence base: applications: and capacity. This triple strand approach is to be mobilized in specific programmes (with timing depending on partnerships and available funding). The likely contents of each of these strands are outlined below.

Building the evidence base: accounting, budgeting and modelling of all consumption and production in the UK economy, in order to move towards the One Planet Economy goals.

Scenario box: UK 2050

How would a sustainable UK look in 2050? We can envisage a vastly more efficient economy, where energy and materials are used to maximum effect. Shops will no longer need to sell useless goods to make profits for multi-nationals, and waste mountains would be a thing of the past. Buildings will use nano-tech components to produce structures of elegance and efficiency, responding to the climate and producing their own energy needs. Innovation in science and technology becomes everyday practice in all branches of industry.

There is an equal and opposite agenda on the consumption side - consumers demand low impact products and services, and share cars or equipment where possible. They actively prefer products which are adaptable, long-lived, and designed for re-manufacture. The principle of stewardship ensures that resources are shared according to need, rather than squandered in conspicuous consumption.

To achieve such a One Planet Economy in a globalizing world did not have to change the whole of the world with it, although international trade did adjust rapidly. Many other countries were learning the hard way about limits to resources and eco-systems, and they were leaning in the One Planet Economy direction, even as populations grew and eco-systems started to collapse. The UK as the home of the industrial revolution was able in a modest way to point the way towards an industrial evolution.
• **Integrated accounts** & reports on the resource balance sheet and profit & loss of the UK economy (i.e. environmental capital, throughput, and resource productivity).

• **Forward strategy**: proposed actions in fiscal policy, economic development and public investment: reported as demonstration versions of the UK budget and Comprehensive Spending Review.³

**Building the applications**: applying the evidence base to all relevant areas of policy and business in production and consumption:

• **Sector strategies** – these take the forward strategy to a more detailed analysis of the opportunities for ‘market transformation’ in each sector, including economic, organizational, technological and behavioural issues.

• **Best practice library**: this assembles case studies of Factor Four increases in resource efficiency from around the UK, EU and the world. These are mounted in an online searchable database.

**Building the capacity**: in order to make new links and mobilize the potential of public, private and civic sectors to follow up the applications and examples:

• **Virtual networks**: internet-based community for consultation, exchange of methods and data, best practices etc.

• **Sector partnerships**: a more targeted workshop and consultation program in key sectors, for exchange between knowledge users and producers on the OPEN agenda.

**1.3.2 Next steps**

This OPEN consultation invites all interested parties to contribute to the three parallel strands:

• **Building the evidence**: accounting and forward strategy at the national level.

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³ The term 'forward strategy' is used to distinguish a future program / strategic plan, from a 'budget' as in a summary of current resources.
• **Building the applications**: industrial evolution strategies at the sector level.
• **Building the capacity**: virtual networks & partnerships to mobilize expertise.

In the first instance, contributions are invited in the form of responses to the consultation questions below on the content and methods of the OPEN.

### 1.4 CONSULTATION QUESTIONS


Please supply your responses on the sectors wherever you have expertise, using the forms overleaf as a guide. Each response might be anything from a short note marked up on the form, to an extended discussion. The main form is reproduced in each of the technical reports.

Where possible the research team will follow up selected responses by phone. Otherwise, respondents are invited to submit a marked up form and/or extended responses by email. Responses will be treated in strict confidence, unless permission is given for attributed quotes. When complete, please return email responses and/or marked up forms to:

Stuart Bond, WWF-UK, Panda House, Godalming, Surrey GU7 1XR  
sbond@wwf.org.uk
<table>
<thead>
<tr>
<th>Question</th>
<th>Example</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is your estimate of the most probable trend in resource use in your sector, by 2020 and/or 2050?</td>
<td>(e.g. rapid rise: some increase: no change: reduction: rapid fall)</td>
<td></td>
</tr>
<tr>
<td>2. What is the likelihood of achieving a Factor 4 resource efficiency in your sector, by 2020 or 2050?</td>
<td>(e.g. very strong, probable, possible, unlikely, impossible)</td>
<td></td>
</tr>
<tr>
<td>3. What are the main priorities for action in achieving a Factor 4 efficiency in your sector?</td>
<td>(e.g. new technology: tax &amp; spend policy: infrastructure: behaviour change: regulation &amp; planning, etc).</td>
<td></td>
</tr>
<tr>
<td>4. What are the most significant barriers and challenges to achieving a Factor 4 efficiency in your sector?</td>
<td>(e.g. too expensive, too risky, consumer resistance etc).</td>
<td></td>
</tr>
<tr>
<td>5. If there is a realistic chance of achieving a Factor 4 efficiency, who has the main responsibility for making this happen?</td>
<td>(e.g. government, local authorities, businesses, retailers, consumers, media, new technology).</td>
<td></td>
</tr>
<tr>
<td>6. If government needs to take a lead, what are the most important actions they should take?</td>
<td>(e.g. taxes, subsidies, investment, procurement, regulations, infrastructure: local, regional or national?)</td>
<td></td>
</tr>
<tr>
<td>7. If business needs to take a lead, what are the most important actions they should take?</td>
<td>(e.g. new technology, pollution control, longer product life, higher efficiency, changes to retail etc?)</td>
<td></td>
</tr>
<tr>
<td>8. If consumers and retailers are involved, how can current trends of growing material consumption be altered?</td>
<td>(e.g. ethical trading, health scares, education &amp; marketing, media features, community action, spiritual change?)</td>
<td></td>
</tr>
<tr>
<td>9. If international trade is significant in your sector, what are the most important changes which are needed?</td>
<td>(e.g. trade liberalization, ethical trading, economic partnerships, overseas investment, tariffs &amp; quotas?)</td>
<td></td>
</tr>
<tr>
<td>10. Are there any other issues which are important to the question of achieving / not achieving a Factor 4 efficiency in your sector, by 2020 and/or 2050?</td>
<td></td>
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</tr>
</tbody>
</table>
The second section below is aiming to sound out how far and what basis, respondents might wish to be involved with the networks / partnerships programmes.

<table>
<thead>
<tr>
<th>Consultation: The network</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Would you be willing generally to be involved with the virtual network?</td>
<td></td>
</tr>
<tr>
<td>12. Would you be able to act as an expert reviewer for the OPEN reports?</td>
<td></td>
</tr>
<tr>
<td>13. Would you be able to contribute case studies and best practice examples to the OPEN on-line library?</td>
<td></td>
</tr>
<tr>
<td>14. Would you be willing to take part in forum and/or working group meetings for your sector?</td>
<td></td>
</tr>
<tr>
<td>15. Do you have relevant methods, tools and/or data, for research collaboration?</td>
<td></td>
</tr>
<tr>
<td>16. Overall, have you any other suggestions or comments on the running of the Network?</td>
<td></td>
</tr>
</tbody>
</table>

This section is to record your details and interests:

<table>
<thead>
<tr>
<th>Your interests</th>
<th>Example</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. Which institutions are you most active in?</td>
<td>Government (national / regional / local): business: consultancy: NGO: academic</td>
<td></td>
</tr>
<tr>
<td>18. Which sectors are you most active in?</td>
<td>(e.g. agro-food, built environment, transport &amp; communications, product manufacture, services, public services, energy, waste, other environmental policy).</td>
<td></td>
</tr>
<tr>
<td>19. Do you wish to keep your responses in strict confidence/ or are you happy for them to be attributed?</td>
<td>(strict confidence / attributed)</td>
<td></td>
</tr>
<tr>
<td>20. Please supply your name, position, address, phone / email, and any other contact details.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Many thanks for your contribution and we look forward to future collaboration.
Part 1 ~ One Planet Economy

2. Introduction

This section reviews the context and the overall goals of the One Planet Economy

2.1 BACKGROUND

Every generation faces new challenges, and sometimes these challenges are so great that they ‘define our time’. Living in a world with environmental limits is ours. Never before has humanity had to come face to face with the unintended consequences of its past endeavours, that are so global in scale and require such a united effort to address. The threats of global climate change and resource depletion are now real – there is daily evidence of de-forestation, advancing deserts, melting ice-caps, sea level rise, water conflicts and runaway urbanization. To address these challenges, the UK Government has highlighted the concept and goal of a One Planet Economy, and the evidence base needed to support it.

However as yet, the government has not clearly defined a One Planet Economy or provided evidence or policies to help achieve it.

2.1.1 The role of OPEN

This is where the One Planet Economy Network (OPEN) aims to contribute. It starts with the national resource flow data from the Ecological Budget UK, and provides a set of ‘consolidated accounts’, on an annual basis, just as with any major company.

Then the OPEN applies this data to the One Planet Economy goals. This involves looking at key sectors, such as transport, housing or energy. For each of these there are new methods of benchmarking, policy appraisal, economy-environment analysis and so on.

Then it outlines a forward strategy for the UK economy as a whole – aiming at a step-change in resource efficiency, and transforming our current patterns of consumption and production. This starts with the pro-active use of public finances, focusing on eco-investment as well as eco-taxation. This enlarged policy agenda has to work with science and technology, corporate management, spatial planning, international trade and many other issues.

2.1.2 Role of this paper

This paper is the main report of the first phase of the OPEN programme. It is in the form of a Prospectus, in order to invite contributions and involvement from a wider community. Further
details can be found in the Technical Report Parts A-F, and materials and updates are available on www.ecologicalbudget.org.uk and www.eco-region.org

Behind that, this paper is a demonstration of the *integrated framework* approach and the *network process*.

Clearly, a step change in the UK pattern of resource use is a huge challenge – involving science and technology, economics and public finance, corporate management, urban infrastructure, international trade policy, consumer behaviour, and so on. Yet the need is clear, if humanity is to survive and prosper equitably on the resources of one planet. To put these many dimensions together needs a *framework approach* – an open minded coordination of many kinds of evidence, with different methods, from different sectors, from different levels. And this is not so much a fixed solution, as a process of research, investigation, debate, consultation, testing and so on. This is envisaged as a *network process* – building the capacity of stakeholders for foresight and learning.

Overall, this paper is work in progress for the framework approach to evidence building, pointing the way to lines of research and action for the network coming years. It does not aim at detailed economic modelling, at this point, as the focus of discussion is more on structural and institutional questions. It does not aim at final solutions, as the focus is more on the most interesting and useful questions. There is more on methodology in Section 3.

### 2.2 THE ECOLOGICAL BUDGET UK

The background to the OPEN is the Ecological Budget UK – the UK’s first detailed analysis of resource flows in all types of consumption and production. The Ecological Budget UK was funded by the Biffaward trust and others, and run by WWF-UK, the Stockholm Environment Institute, and the Centre for Urban & Regional Ecology.

At the core of the Ecological Budget UK is a method of calculating the throughput and impacts of every type of consumption and production in the UK economy. This is unique, in that it shows the global impact of UK consumption from all imports and exports: the upstream and downstream impacts of each sector and activity: and the distribution between regions, local authorities, and social types. Each of these is shown by key measures – material flows from cradle to grave: energy and emissions, particularly $\text{CO}_2$: and the ecological footprint as the measure of aggregate global impacts.

The Ecological Budget UK report “*Counting Consumption*” presents a comprehensive set of baseline accounts, together with the implications for sustainable consumption and production around the regions.\(^4\) Several regional projects were drawn from this, in the North West, North

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\(^4\) Barrett, Ravetz & Bond 2006: Wiedmann & Barrett, 2005
East and West Midlands. Interactive access to this data is provided through the “REAP toolkit”, a software package for baseline data and assessment of future scenarios.5

**ECOLOGICAL BUDGET UK**

2.2.1 The REAP approach

The ‘Resource & Energy Analysis Programme’ is a database and modelling system which shows the total impacts of the flow of materials and energy throughout the UK economy. It calculates these flows for 123 sectors of production by industry, and 68 types of consumption by households and government, at local and regional level. The REAP data system focuses on 3 main indicators of environmental performance in production and consumption:

- CO₂ emissions, as the largest cause of climate change, together with energy flows as the main cause of CO₂ emissions.
- Material flow and mass balance: a perspective on the overall resource metabolism and efficiency.6

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5 All project materials are on [www.ecologicalbudget.org](http://www.ecologicalbudget.org); the REAP model is available on [www.sei.se/reap](http://www.sei.se/reap); further demonstrations and interactive tools are on [www.eco-region.org](http://www.eco-region.org)

6 Eurostat 2000
• Ecological footprint, as the overall measure of global impact.\textsuperscript{7}

The REAP system is built on input-output methodology, and provides several unique features. It tracks both direct and indirect impacts, upstream and downstream: it accounts for the embedded energy and emissions of imports and exports: and it provides a consistent database for all UK regions and local authorities.

\textbf{2.2.2 Comparison of climate strategy \& OPEN}

With all the policy and scientific attention on climate change and carbon emissions, what is the unique added value of the Ecological Budget UK data and OPEN strategy? Generally, most climate / carbon policy tends to be \textbf{problem focused}:

- Generally, assesses carbon flows at point of emissions:
- policy focus on climate impacts
- business focus on energy \& emissions technology

In contrast the Ecological Budget UK and the OPEN tends to be \textbf{solutions focused}:

- it examines resource flows as underlying dynamic of industrial-consumerist society
- it measures total direct and indirect impacts, as represented by footprint analysis
- more concerned with origins to end fates, i.e. integrated supply chain management:
- focused on the interdependence of consumption, logistics and production:
- also concerned with imported goods and their embedded impacts.

Overall, the integrated approach of the OPEN is a positive and pro-active way to turn the perceived ‘costs’ of climate emissions reduction policy, into the ‘opportunities’ of a transformation strategy.

\textsuperscript{7} Rees \& Wackernagel 1995: Simmons, Chambers \& Wackernagel 2000
2.2.3 Accounting methods
The UK clearly needs a system of environmental accounts at least as detailed as its economic accounts, and the Ecological Budget UK accounts show what is possible for further research. They follow the UN ‘System of Environment-Economic Accounting’ (SEEA 2003) framework of core and satellite accounts. As far as possible these also link to the UK indicators for sustainable consumption and production.

The accounting framework contains a balance sheet and profit / loss account, just as with the financial accounts of a major business. It also looks at external impacts on the rest of the world, and the costs and benefits of environmental policies and programs. Each of the basic measures of materials, emissions, energy and ecological footprint, can be indexed by economic output, to show some basic measures of resource productivity. The prototype UK accounts are shown in the appendix to this report.

The result is unique and topical in several ways. Firstly, it shows the total global impact of our consumption, not only from resource flow and pollution within the UK, but from the imports of products and materials. On current calculations, up to one third of our total impact is from imports, and as yet invisible in the national accounts:

It also shows the indirect or supply chain effects, upstream and downstream of any sector or product – particularly relevant in the service-dominated economy of the UK.

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9 DEFRA 2005
10 Performance & Innovation Unit 2001
For instance the financial services, which apparently consume only office space and telecommunications, are in fact responsible for large impacts, locally and globally. Thirdly, the analysis of the data can be pushed forward, to show more detail on resource flow and eco-footprint – particularly to show the differences between regions and local authorities: wealthy and poor lifestyles; and between business high performers and laggards. With this structure, a series of leading questions on SCP can be asked, and the answers measured (Fig 2).

2.2.4 Implications

Some key findings from the UK ecological accounts are as follows:

- The UK’s ecological footprint amounts to 5.4 global hectares per person, or about 3 times the fair ‘earth share’ of 1.8 global hectares per person.\(^\text{11}\)
- The overall resource dependency, i.e. imports as a proportion of direct material inputs, ranges from 17% in agriculture, to 34% in manufacturing.
- The total resource efficiency, i.e. material flow per £ output, is 0.34 tonnes per £million.
- The total hidden flows, i.e. the energy and emissions impacts which are embedded in imports, are 20-30% of the direct flows accounted by the UN Framework Convention on Climate Change.
- The overall resource re-investment, i.e. the rate of recycling and re-use from total (controlled) waste, is 35%.

The full evidence base from the Ecological Budget UK provides a huge range of data on consumption and production. The question then, is how to apply all this to practical choices, in policy or business. Should we track a carbon index as we currently track inflation? How far can fiscal tax and spend policy go towards meeting these targets? How far can the UK go itself?

\(^{11}\) WWF 2005: This is calculated on the basis that the earth’s bio-productive land and sea area is divided equally between the world population, no matter what their monetary income or wealth. More detail on www.gfn.org
in the context of international trade policy? There are many more questions than answers at this point, as raised by many recent reports on *Sustainable Consumption and Production (SCP)*.\(^\text{12}\)

\(^{12}\) Jackson & Michaelis 2003: other material is found on www.sustainable-development.gov.uk
3. One Planet Economy – principles

This section reviews the goals and principles of One Planet Economy thinking, and the targets for rates of change

The over-arching idea behind the One Planet Economy is very simple – sound management (in the best British tradition). Whether we are dealing with a corner shop, a multi-national corporation, or the UK as the fifth largest economy in the world – we need to manage our assets and liabilities, and be aware of future risks and opportunities. We need to think both short and long term, be responsible to suppliers and customers, and look after both employees and stakeholders. This is the way to organize an economy which lives well on One Planet rather than squandering three or four.

3.1 ONE PLANET ECONOMY GOALS

The overall messages from the results above are now emerging:

- The footprint measure shows that consumption by UK residents (5.5 gha/cap) is using up the earth’s resources at over 3 times their per capita share of 1.8 gha/cap.
- As a service-led economy we are now exporting our environmental impacts, by importing more goods from overseas, even while the UK becomes cleaner & greener.
- To reduce the current UK footprint of 5.5 gha/cap to the 2050 fair share of bio-productive land area would need a Factor Four reduction.
- This also translates into a long term goal of Factor Four increase in resource efficiency.
- Such resource efficiency improvement can be both cause and effect of economic growth and competitiveness.
- This can be achieved through the principle of ‘industrial evolution’. We interpret this as environmental sustainability, achieved by a combination of technological, economic, organisational and social change.

As and when the UK economy is clearly moving on this strategic path towards a Factor Four, then it will take up the Prime Minister’s challenge in the UK Sustainable Development Strategy of 2005, and move on the path of a real ONE PLANET ECONOMY:

“an economic system of production and consumption which respects environmental limits, local and global, while being financially and socially sustainable.”

The concept of the One Planet Economy was referred to in the UK Sustainable Development Strategy of 2005, but not defined, measured or otherwise followed up at that point. This is the aim of the One Planet Economy Network (OPEN).
3.1.1 One Planet Economy principles
These are the principles which have emerged from the conceptual research phase and the consultation on key sectors. They are not fixed in stone, rather they are discussion points for further investigation.

- The first is the integrated polluter pays principle, under which users of environmental resources pay for the risk or damage caused, locally or globally, and accept responsibility either as consumers or as producers.
- These funds should be used not only for cost recovery, but also for reinvestment in technological innovation and low-impact infrastructure, aiming towards a step change in efficiency and productivity.
- This reinvestment should be based on the principle of integrated asset management – i.e. the whole of the resource should be managed and budgeted for the longer term. This applies, for example, to the national stock of buildings, vehicles and other assets.
- To achieve this needs an integrated supply chain approach: including technology and management on the supply side; logistics and distribution; and consumption and lifestyle changes on the demand side.
- This strategy depends on shifting the role of government from making environmental policy for others, towards a much more proactive and responsible role of environmental stewardship.

One Planet Economy – principles

3.1.2 Industrial evolution
All of this adds up to a full ‘industrial evolution’ or sector transformation program, in its wider sense – including low impact technologies, integrated logistics, equitable distribution and sustainable consumption patterns.

- Such a programme should be financially viable, aiming at net gains in both national and individual costs and benefits.
• Such a programme should also be socially responsible, aiming towards equalising the differences between social groups, between regions, and between the UK and the developing world.

• Such a programme requires a practical ‘business case’ and ‘investment strategy’ for each sector: each policy level: each product type, and so on. Economic, social and environmental costs / benefits (as far as can be defined) should all ‘stack up’.

By its nature, industrial evolution is not likely to be simple and predictable – so the OPEN strategy is as much about responding to uncertainty as it is to fostering mutual learning between different sectors and social groups.

3.1.3 A pro-active role for government
Such a programme also depends on a shift in attitudes, not only for producers and consumers but for the government itself. There are implications for how responsibility is counted and divided, and implications for the details of tax policy, industrial policy etc. Such institutional revolve around the concept of ‘property regimes’:

• The government as a stakeholder, custodian and stake-owner, in the national and global common resources of climate, biodiversity and so on.

• A pro-active role as investor and manager in common resources, through active intervention with taxation and trading systems (just as Keynesian demand management is the basis for macro-economic management).

• A pro-active role as standard setter, so that firms and other organizations will be required to be transparent and responsible at all times (through the Operating and Finance Review and similar procedures).

• A pro-active role through procurement and contract specifications – the prime interface between the public and private sectors.

3.2 TRENDS AND TARGETS

3.2.1 One Planet Economy targets
The key result of the Ecological Budget UK shows that the UK is exploiting the Earth’s available resources, as measured in bio-productive land area or ‘bio-capacity’, at more than three times its “fair” share, as measured by the Ecological Footprint in global hectares per capita (gha/cap). This is not a universal catch-all measure, but it does draw attention to the totality of global impacts and limits. These of course change over time, so that the sustainability target is a moving target:

• By 2050 there is likely to be a 50% increase in world population, up to 9 billion people.

13 Eder & Narodoslawski 1998
14 Knoepfel 1995
There may be some additions to bio-capacity through land reclamation and reforestation, but there may be other damage to eco-systems.

Therefore a mid-range estimate of change in bio-capacity would be from 1.8 to 1.3 gha/cap in 2050.

To reduce the current UK footprint of 5.5 gha/cap to the 2050 fair share bio-capacity of 1.3 gha/cap would need a Factor of Four reduction.

To reduce the future UK footprint (assuming current growth trends of 0.8% per year) of 7.7 gha/cap in 2050, to the 2050 fair share bio-capacity, would need a Factor Six reduction.

For climate emissions the figures are somewhat different but the principle is similar:

- The UK government has set out a long-term target, in line with international scientific advice, for 60% reduction in climate emissions by the year 2050.
- As the UK as a wealthy high-impact nation causes about 2.5 times more emissions per head than the global average, there is a strong case for increasing global equity through the “contraction and convergence” principle. In that case the 60% target would be increased to over 80% cut in emissions by 2050, exceeding the Factor Four target.

This provides the overall horizon for the sustainability of the UK economy i.e. the path towards a Factor Four goal, (named after the book of the same name). At that point it will take up the challenge of the UK Sustainable Development Strategy, and move towards a real One Planet Economy – “an economic system of production and consumption which respects environmental limits, local and global, while being financially and socially sustainable”.

### 3.2.2 Trends, targets and decoupling

Clearly, the transformation of the UK into a One Planet Economy will not happen overnight. But we can define the target rate of change by setting the Factor Four goal at a strategic point such as 2050 (the current horizon for UK climate policy).

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15 Von Weizsacker et al 1997
- This equates to a year on year reduction in total resource use of 3.2% per year (if starting from 2007), as measured by the Ecological Footprint.
- By 2020, at this rate of change, the reduction in total Footprint would be about 35% and by 2050 about 75%.16
- If we factor in economic growth at an average of 2.25-2.5%, then the required rate of “decoupling” or improvement in the resource efficiency (Footprint/£GDP) would be a reduction of more than 5.5% year on year for the next half century. This is about twice the rate of decoupling in the recent past, which held resource use more or less level while the economy grew.
- For comparison, if we take the UK’s current target of a 60% cut in climate emissions by 2050, that equates to a year on year reduction of 2% (starting from 2007).17

The Factor Four target rate – 3.2% in absolute resource use and 5.5% in relative decoupling – is the ultimate benchmark for a pathway to environmental sustainability. It is also a guide to the long-term policy framework for public policy and business performance which enables organisations to plan ahead. It can then translate into schemes such as the ‘cap and trade’ principle of the European Emissions Trading System: using the ‘cap’ as a ceiling on emissions, this would be targeted to reduce by 3.2% per year.

### 3.2.3 Time horizons

Clearly, the OPEN may not achieve its goals in 1 year or even 20 years. However there is a need for early results within a longer term strategic approach. We define the target rate of progress by setting the Factor Four goal over a period of 40 years, from 2010 - 2050.18

The time horizons for targeting and monitoring are then in three bands:

- **2010 – ‘soon’** - direct effects of decisions in the next Comprehensive Spending Review (CSR) and this ‘term of office’. **2020 – ‘later’** - forward planning to the horizons for most economic strategy, infrastructure planning, and urban / regional spatial development. At the target rate of progress the reduction in resource use would be 35-40%.
- **2050 – ‘beyond’** - longer range targets based on global environmental limits, which involve a deeper transformation in our systems of production and consumption. The target reduction in resource use would be 75%.

### 3.2.4 Key sectors

The OPEN strategy is focused on eight key activity sectors as below. Each involves a set of supply chains linking production activities (supply sectors) and consumption activities (demand types). It has to be said, in the light of current trends, that the goals of a Factor Four transformation are extremely challenging, although technically quite possible. The next sections and the OPEN technical reports provide the details, but the overall shape is emerging:

16 The calculation depends on which year is set as the baseline year, and whether figures are rounded.
17 This is not at all clear from the DTI Energy Review of July 2006.
18 The year 2010 is taken as the start, allowing for a lead in time: 2050 is taken as a horizon, in view of its significance for the UK energy strategy and emissions targets.
• **Food**: a rapid shift towards more low-impact, local, clean and healthy food.

• **Shelter**: household carbon quotas as part of the tax and benefits system; investment in high-efficiency housing and construction.

• **Transport**: investment in high-efficiency low-impact vehicles, fuel and travel modes, funded by air and road fuel levies.

• **Products**: a coordinated framework of incentives for low-impact production and consumption.

• **Services**: strong financial and market incentives for sustainable tourism, leisure, retail etc; particular focus on financial services as the key to all other sectors.

• **Public**: best possible practice in low-impact health, education and other services, using the immense power of public procurement as the main mechanism.

• **Energy**: rapidly accelerated investment in renewable sources, funded via quotas and levies.

• **Waste**: accelerated investment in reused and recycling technologies, funded by disposal levies.

In each of these sectors and their sub-sectors, there is an agenda for integrated asset management, a business case for reinvestment for innovation, and the potential for full-scale industrial evolution across supply and demand sides. This strategic approach underlies the day to day challenge of changing policy and business on the ground.

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**Scenario box: UK 2050**

How would a sustainable UK look in 2050? We can envisage a vastly more efficient economy, where energy and materials are used to maximum effect. Shops will no longer need to sell useless goods to make profits for multi-nationals, and waste mountains would be a thing of the past. Buildings will use nano-tech components to produce structures of elegance and efficiency, responding to the climate and producing their own energy needs. Innovation in science and technology becomes everyday practice in all branches of industry.

There is an equal and opposite agenda on the consumption side - consumers demand low impact products and services, and share cars or equipment where possible. They actively prefer products which are adaptable, long-lived, and designed for re-manufacture. The principle of stewardship ensures that resources are shared according to need, rather than squandered in conspicuous consumption.

To achieve such a One Planet Economy in a globalizing world did not have to change the whole of the world with it, although international trade did adjust rapidly. Many other countries were learning the hard way about limits to resources and eco-systems, and they were leaning in the One Planet Economy direction, even as populations grew and eco-systems started to collapse. The UK as the home of the industrial revolution was able in a modest way to point the way towards an industrial evolution.
4. One Planet Economy – methods

This section looks at how the current research has worked: the integrated framework behind it: and how this applies to the details of resource flow analysis.

4.1 RESEARCH PROCESS

Just the goals of the One Planet Economy are beyond the conventional assumptions of economic growth, it is clear that conventional analysis and modelling can only provide some of the solutions. Therefore a more open-ended and lateral thinking approach is needed to envisage the potential. This report was produced for the initial phase of the OPEN program, with 6 basic steps:

- Development of the REAP database and modelling toolkit, covering 69 types of consumption and 123 sectors of production (this part was led by Stockholm Environment Institute).
- Development of the ‘resource flow framework’ and sector templates as in Section 3, to investigate the scope of the likely effects on the UK economy and physical metabolism. These templates then form the ‘activity model’ for the further development of the REAP toolkit.
- Review of each key sector in terms of trends, projections, scenarios, driving forces and determinants for technology, markets, infrastructure etc. Also, comparison with experience of regional policy applications.
- Investigation of potential for new institutional principles and fiscal policy frameworks: this being a more wide-ranging theme including schemes such as eco-systems trading, credit transfers, pro-active stewardship etc.
- Testing of an example policy option by macro-economic modelling: this was carried out by Cambridge Econometrics, and the results are shown in the Technical Report Part B.
- Integration of each of the above into a framework approach for continuing research and consultation.

The following theory & methodology discussion is shown in more detail in the Technical Report Part A.

4.1.1 Background - challenges of the One Planet Economy

There are clearly huge challenges for suitable methods which can deal with the One Planet Economy. Firstly, many features of advanced industrial economies do not fit easily into current modes of environmental-economic analysis: such as globalizing supply chains: a service sector focus to economic activity: and the global division of wealth and power.

Secondly, the One Planet Economy goals lie beyond most current policy horizons, which are marginal by comparison. A Factor Four increase in efficiency is technically possible in most...
cases, but most trends and pressures are heading the opposite way. The agenda calls for structural transformation of production and supply chains, and of consumption and logistics. It also calls for new concepts in environmental stewardship and corporate responsibility, and in international trade and development. Such a sea-change could be compared with the scale of the impact of IT, which was hardly imagined, let alone modelled 50 years ago. The implication is that no single economic model or method is likely to provide the whole of the feedback needed on policy options.

Thirdly, most current measures of sustainable development have little to say on this transformation approach.

- Environmental Kuznets Curves are apparently focused on the mid-late phase of industrialization, e.g. where SO$_2$ emitting plant is being replaced by cleaner technology.\(^\text{19}\)
- Sustainability of ‘capital’ methods are useful concepts but very difficult to measure effectively, if at all.\(^\text{20}\)
- Ecological Footprint is useful as a global limit indicator, but does not deal with the structural transformation process.\(^\text{21}\)

4.1.2 Integrated planning approach

In response to the challenges above, we follow an ‘integrated planning’ approach to economic – resource analysis:\(^\text{22}\)

- Integrated planning looks at a whole spectrum, from purely economic values (fully tradeable and substitutable): to purely embedded values (non-tradeable & non-substitutable).
- This works with a soft-systems mapping approach to identify potential cause-effect linkages between complex, qualitative and intangible factors.
- It also works with an opportunity-focused approach, which leads from ‘re-active’ assessments, to ‘pro-active’ evaluations for policy learning and development.
- It aims at integration – vertically, between different levels: horizontally between different sectors: laterally, between causes and effects.

For this last point, such integration is highly challenging of any knowledge system. In practice it does not need ‘to happen all at the same time’ – we can work with different modes of knowledge as parallel strands:

- **Integrated assessment** – to analyse the totality of problems, and possible options - between sectors, cause and effects.
- **Integrated planning** – to design holistic solutions, integrated between stakeholders, short & term long term, local and global, etc.
- **Integrated investment** – to provide systems of incentives within or outside market processes, including taxes, subsidies, trading etc, in public / private / civic sectors.

\(^{19}\) Stern et al 1996  
\(^{20}\) Pearce & Atkinson 1993: Porritt 2005  
\(^{21}\) Nijkamp 2005  
\(^{22}\) Ravetz 2000: Ravetz 1998
- **Integrated governance** - to make decisions and implement the actions – integrated between levels, sectors, ethical values, institutional responsibilities, etc..

The **integrated investment** approach is a priority for demonstration in the OPEN forward programme.

**4.1.3 Implications for OPEN methods & modelling**

There is a major research challenge on how to analyse and model the One Planet Economy. As above, the OPEN goal involves wide ranging structural changes and transitions, and therefore any modelling system needs to range a long way beyond the assumptions of conventional economic modelling. The response of the OPEN program is to focus on an ‘integrated framework’ – a platform for analysis and knowledge, which works equally with economic, environmental or institutional analysis, at micro- and macro-level. The templates shown below, and more fully in the Technical Reports, are a first step towards this.

**OPEN – framework & modelling approaches**

- The ‘integrated framework’ follows firstly a template based on resource flows and the value chain: i.e. from material sources to production, to consumption, to end-fate destinations.
- This is then the basis for the ‘activity model’ for the REAP system of production / consumption analysis. This is designed as a straightforward set of linear calculations from known factors (under development as of mid 2006).
- The key components of the integrated framework are put through a ‘decomposition’ process as far as possible.\(^{23}\) e.g. effective impact = population x consumption service level x utilization level x technical coefficient x impact coefficient x exposure coefficient.
- The spectrum of economic instruments as in the Technical Report ‘economic modelling’ section, can be set out according to their suitability for modelling (tractability), evidence

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\(^{23}\) Kaya 1990: Tyndall Centre 2005
base and robustness of results. For instance the ‘elasticity of innovation’ – (innovation achieved per £ public spend) – might appear to be tractable, except that the evidence is lacking and the boundaries are unreliable. In that and similar cases we have to look for ways around with the various methods above.24

The diagram shows how such an integrated framework can link to economic or institutional issues, to be modelled at macro or micro scale. The key issue is that this framework approach is an alternative approach to modelling, but ‘not as we know it’. It does not assume a known mechanical system with clear boundaries, where policy inputs are turned into predictions and outputs. Rather, it starts from the perspective of complexity and uncertainty. It uses a variety of methods to investigate the most interesting and useful questions, and priorities for further discussion, as far as possible in a multi-level, multi-sectoral process of stakeholder participation.

- In the centre is an ‘integrated framework’: this follows a template based on resource flows and the value chain.
- This provides a platform for investigation of structural and institutional changes.
- It helps to set priorities for macro economic modelling.
- Also helps to identify the main links between the modelling of resource flows and economic impacts.

4.2 TARGETING & MEASURING

The One Planet Economy concept is framed here in terms of resource flows and environmental impacts. This has a clear goal of respecting the limits of global bio-capacity, i.e. the capacity of planetary life-support systems – i.e. an interpretation of the concept of ‘strong sustainability’. Note that this does not deal directly with bio-diversity and other issues: rather, the footprint measure behind this is a quite simplistic aggregate measure of impact, mainly useful for comparing territorial pressures with global limits.

In practice, this environmental goal is very much entangled with economic and social dimensions. In this study we make the simple assumptions that economic growth and the macro-economic balance should continue as is. We also assume a social equity principle, i.e. convergence between wealthy and poorer nations, so that the Factor 4 target is measured in terms of fair earth-share. The resource-environment side itself is not as simple as might appear, and this is highlighted with the three parallel indicators used in the Ecological Budget UK – CO₂, material flow and eco-footprint. Each of these can be used to represent an angle, but not necessarily the whole, of the OPEN agenda.

4.2.1 Resource flow indicators

CO₂, as the major part of the basket of greenhouse gases (GHG), is a measure of human pressure on climate change, the most topical environmental issue of all. As a result there is
much focus on *decarbonization* – i.e. the generation of energy without GHG emissions. Assuming that much of our fossil fuels could be substituted for other sources, there is then a question on the other impacts of renewable energy, e.g. land use in bio-fuels, or vapour emissions from hydrogen, or other resource flows generated.\(^{25}\)

Such resource flows can be represented by *Material Flow Analysis* (MFA) – a way to understand the underlying environmental processes.\(^{26}\) – but in practice, one gram of dioxin may be more significant than one million tonnes of inert material. Research in the 1990’s on ‘environmental space’ measured the consumption of key materials (e.g. aluminium or timber) against the known reserves or optimum harvest rate, but this is not always so simple.\(^{27}\) This approach then focus attention on *de-materialization* – i.e, the continuing of economic growth decoupled from resource flow. One question raised is how much primary material input vs other recirculated material flow, and the ultimate impacts of each type of flow.

**Material flow analysis framework**

![Material flow analysis framework diagram]

Such ultimate impacts are then the focus of the *eco-footprint* measure, aiming to represent in one index all the impacts of climate change, resource use and land-use change in terms of *bio-capacity*. At present there is an agreed international standard, however the detail is still to be developed – for instance, there is no distinction made yet between timber from Swedish sustainable forestry or from rainforest primary logging.\(^{28}\)

\(^{25}\) Tyndall Centre 2005  
\(^{26}\) Bringezu & Schutz 2001  
\(^{27}\) McLaren et al 1997  
\(^{28}\) See the Global Footprint Network on [http://www.footprintnetwork.org](http://www.footprintnetwork.org)
The implication of all these limitations, assumptions, uncertainties, and what-ifs, is that each measure shows one angle of the impacts of consumption and production. The different measures then need to be combined for a bigger picture of the One Planet Economy. To help this we use a standard accounting arrangement for consumption and production, as shown for instance in the Blue Book tables of UK national accounts, and the related environmental accounts. This shows the contribution of imports, exports, capital investment, and the supply and demand from other industries, as in the figure below. A similar structure can also be followed to show the resource flows above, i.e. material and energy flows, which generate CO₂ and EF. In the arrangement of the economic accounts, the total production equals exactly the total consumption, and this is also reflected in the ‘mass balance’ principle of the Ecological Budget UK (further detail on the accounting framework is in the ‘Counting Consumption’ report and the REAP Technical reports).

4.3 SCOPING THE ONE PLANET ECONOMY

4.3.1 Resource flows
We can use the above supply chain framework to explore the likely effects of the shift towards Factor 4 and a One Planet Economy, at each stage of production and consumption. Starting on the production side, moving towards a One Planet Economy is likely to include:

- Reduce the input of natural materials to the system
- Reduce the volume of resource flows (at various points)
- Source materials locally rather than importing from overseas:
- Increase energy efficiency and transport efficiency in production
- Increase added value from re-manufacturing, re-conditioning and other forms of re-circulation of materials.

This all adds up to a rapid increase in resource productivity i.e. the level of added value for producers per unit of resource flows. There is then a counter agenda on the consumption side:

- Shift consumer demand towards low impact products and services
- Increase social utilization; for instance where cars or equipment could be shared:
- Increase the energy efficiency of products in use
- Also increase the lifetime of the average product, both consumables and durables.
- Increase the rate of re-use, recycling and re-manufacturing, and reduce the waste and emissions leaving the system.
- To achieve all this in a consumer-led market economy will need innovation on the social and cultural dimensions, to increase the welfare added of products, e.g. so that consumers will actively prefer to buy long life, low impact, zero waste products.

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29 Vaze & Balchin 1996
This adds up to an increase in the counterpart on the consumption side, what might be called the social effectiveness of consumption, or ‘consumptivity’. In other words this looks for ways for people to get more satisfaction from less ‘stuff’ (all other things being equal).

4.3.2 Economic flows

If the flow of money is unchanged, with reducing amounts of ‘stuff’ entering the system, then the price per unit of stuff would rise (ceterus paribus). Assuming that material and energy flows are restructured as above, there are major implications for changes in industrial structure, transport and energy sectors, and macro-economic balances (also see notes on economic modelling below).

- Energy costs (international) rise – either direct cost to economy, or incentive for innovation & restructuring
- Carbon taxes / quota trading costs rise – the effects depend on redistribution to least cost sectors through subsidy, tax relief or other market trading.
- Material & commodity costs rise – direct cost to economy / incentive for restructuring
- Energy consumption taxes via product charges, appliance charges, infrastructure charges, domestic / commercial quotas /tariffs
- Demand side management through ESCO-type partnerships, other micro-incentives.
- Emissions from energy fuel cycle: direct charges: tradeable quotas: combined with direct regulation: combined with incentives & direct support for innovation & industrial evolution.

There are different options for the re-investment of these funds on a ‘revenue neutral’ basis - i.e. no change is envisaged to the overall macro-economic balance of taxation: (as discussed in the next section)

- Innovation & industrial evolution direct support
- Social distribution (e.g. low income households, small business)
- Procurement & contracting
- Investment in infrastructure

4.3.3 Resource flow template for a One Planet Economy

There are many options and questions in this snapshot of a One Planet Economy. To structure the investigation process we use a series of templates to identify the full range of physical, economic and political effects. Below is the ‘general’ template which shows the expected pattern right across the economy. This is then interpreted in detail for each of the 8 activity sectors, as shown in the REAP 8 Technical Report.

- Horizontally, the template is arranged from material sources to production, distribution, consumption and externalities, in the order of the input-output tables.
- Vertically, the template is arranged by the two main scenarios, F1 baseline and F4 target: and then the ‘policy options’ i.e. the range of likely measures which may achieve the transition from F1 to F4 scenario.
- **Physical effects** are to be tested and calibrated in the REAP modelling system, as far as possible.
- **Economic effects** are to be tested and calibrated in the MDM modelling system, as far as possible (see section below).
- **Social / institutional** issues are there for reference and for the scenario narratives. It is not expected that these can be modelled directly.

| PHYSICAL | Material sources | Manufacturing | Logistics | Services | Demand side 1 | Demand side 2 | Products in use | Externality
| --- | --- | --- | --- | --- | --- | --- | --- | ---
| Import %, source & extraction mode | Energy in production | Transport distance & mode | Tertiary activity & utilization factors | Intensity & energy efficiency | Consumption / mode choice | Product life: energy efficiency | Waste, recycling, emissions |

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<thead>
<tr>
<th>F1 – projection</th>
<th>Import % growth: Decoupling rate = growth rate</th>
<th>Air freight growth</th>
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<td>Rapid energy efficiency</td>
<td>Low impact modes</td>
<td>Increased material recirculation</td>
<td>Increased utilization</td>
<td>Switch to low impact products</td>
<td>Increased product life &amp; re-use: higher efficiency</td>
<td>Integrated resource management</td>
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<tr>
<td>F1 – projection</td>
<td>Prices stay low</td>
<td>Fuel / material costs level</td>
<td>Fuel costs level</td>
<td>Service sector growth</td>
<td>High time preference &amp; short term investment</td>
<td>Efficiency gains overtaken by increased spend</td>
<td>Fixed capital increases</td>
<td>UK costs internalized, others externalized</td>
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<tr>
<td>F4 - scenario</td>
<td>Prices rise</td>
<td>Fuel / material costs rise</td>
<td>Fuel costs rise</td>
<td>Investment &amp; share value linked to CSR</td>
<td>Low time preference &amp; long term investment</td>
<td>Lower quantity, higher quality purchases</td>
<td>Increased product life &amp; re-use: higher efficiency</td>
<td>Total costs internalized &amp; marketed</td>
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<th>CSR &amp; Env. management</th>
<th>CSR</th>
<th>Social economy &amp; civic society</th>
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</table>

Table 1: general template for a One Planet Economy

Also, there are relationships between the physical options and economic policy options, as on the template. In some cases the economic policy is a means to achieve the physical policy (e.g. new technology in production). In other cases the physical policy is a means to achieve the economic policy (e.g. spatial planning in order to reduce transaction costs, in turn to promote recycling). Arguably, most options available to government fall into the first category, and most available to business are in the second, but there are many exceptions to this rule.
4.3.5 Modelling resource flows

This general policy template for the economy-wide supply chain, shows that some items are easily measured and modelled, while others are not. In order to generate quantitative scenarios and trend-target measures, a series of calculations from known factors can be taken, and this is the basis of the activity model of the REAP system. The method used is that of ‘decomposition’, i.e. breaking down a high level indicator into component parts, which in this case represent the main features of a typical supply chain. This starts with the ‘consumption’ equation:30

\[
\text{Impact} = \text{population} \times \text{affluence level} \times \text{technological intensity of consumption}
\]

This is then decomposed into the main features of a typical economy-wide supply chain, from sources, to production, to consumption, to waste. The results of such calculations are then shown in total energy terms. This is then taken to the energy module, where the carbon and land-use implications of energy supply are calculated. Likewise the direct material consumption (DMC) is taken to the resource / waste module, where the options for waste recovery can be modelled.

4.4 ECONOMIC POLICY & MODELLING ISSUES

(This section include for contributions by Cambridge Econometrics. The full working paper on the macro-economic modelling trial is in the Technical Report Part B. There is further discussion in Part III of this paper)

Fiscal policy design will be more successful and viable when grounded in political & institutional realities. At this stage in the OPEN research, the numbers coming from economic modelling are generally less significant than the institutional and political economy issues of structural change. On this theme there are some major issues for debate:

- When is a tax not a tax? (when it is a charge for services, to be reinvested?)
- When does a market fail? (when intervention is required to meet policy objectives?)
- When is investment on the capital or revenue side of the sheet? (depending on who is asking?)

4.4.1 Extending market based instruments

Market based instruments (MBIs) are the conventional and accepted way for fiscal policy for environmental objectives (see the EEA reports on MBIs, 2005 & 2006). Clearly the current MBIs are major achievements in the political & economic sphere. However, the OPEN theme requires us to look beyond the current scope of MBIs, in ways which question the normal divisions of market vs state vs citizen, in a ‘new institutional economics’.31

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30 Meadows, Meadows & Randers 1992
31 Jacobs 1997
From environmental mitigation to environmental transformation. Most prospectives and scenario modeling conclude that there may be easy wins over the next 20 years, but progress beyond that depends on a combination of technological change, institutional change and behavioural change, i.e. factors generally outside the models.

- A total supply chain approach: individual measures can be combined on an upstream–downstream basis, which makes it more clear and transparent where producers interact with consumers.

- An integrated asset management approach: progress on the ground becomes possible when collective responsibility is taken, for instance for the building stock of a city, or the travel demand of a region.

- This suggest a stewardship and ‘stake-owning’ approach, as in the next section.

From this investigation there are some emerging themes and directions for environmental fiscal policy. The supply chain principle and the asset management principle are keys to identifying the logic of each of these.

- ‘end fate tax’ – applies to all materials / products / ancillaries such as packaging, at the point of sale / transaction, which do not identify a known recovery / recycling / re-use pathway. This could potentially accumulate through the supply chain in the same way as VAT, however the administrative burden needs to be considered.

- ‘credit transfer’ – this applies a levy / duty on higher impact activities / technologies, which provides a token / ‘air-mile’ type credit or rebate, for lower impact activities / technologies.

- ‘Supply chain accreditation’ – an ‘upstream’ supply chain principle, as a guarantee of source and process. E.g. fair trade accreditation, with a possible price premium or rebate system.

- ‘lifetime levy’ – a ‘downstream’ supply chain concept, as an application of producer responsibility on the ‘4p’ (‘polluter pre-pays precautionary’) principle. E.g. cars sold with a purchase tax which reflects their lifetime emissions / energy demand. This would be realistically set at a level to provide strong incentives.

- ‘R&D transfer’ – on the principle that users & beneficiaries of services / technologies should re-invest in the upstream direction, for the improvement of those services / technologies / infrastructure.

There is clearly a need to look at the macro-economic implications of the above changes: but this is a very challenging agenda, as by its nature it questions the structure of most current models. The ideal model covering all economy-environment-resource interactions does not exist, and so to use current models to simulate such effects, involves a mental shift.

**4.4.2 New institutional models**

Much eco-taxation theory looks at the problem of one pollutant from one industry, affecting one social group with one damage function. To deal with multiple groups, competing for multiple services from multiple resources, at multiple points in space and time, goes well beyond conventional resource management or eco-taxation policy and theory. This is pointed out by the
EU concept of ‘Institutional Natural Resource Regimes’. The concept of ‘Stewardship’ builds on this, and is here proposed as an underlying principle for the design of fiscal policy.

The Stewardship concept involves changes in legal structures and market structures, as well as shifts in attitudes, not only for producers and consumers but for the government itself. This amounts to a new kind of institutional platform, or compact between society, energy providers and users. The concept of public sector as custodian or stake-owner emerges as the political and ethical underpinning of the range of market and technical measures. From this there are many implications for the practical details of tax policy, industrial policy, trade policy etc.

- The government as a stakeholder, custodian and stake-owner, in the national and global common resources of climate, biodiversity and so on.
- A pro-active role as investor and manager in common resources. This may be at the national level, through active intervention with taxation, equities and trading systems (just as Keynesian demand management is the basis for macro-economic policy). It may also be at a local level as with district housing partnerships, etc.
- A pro-active role as standard setter, so that firms and other organizations will be required to be transparent and responsible at all times, as would the public sector (e.g. through the Operating and Finance Review and similar procedures.
- A direct economic role through procurement and contract specifications – the prime interface between the public and private sectors.

This is a broad and deep theme, a challenge to any modelling efforts, and is to be advanced through the course of the project.

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32 Knoepfel 1995
4.4.3 Summary of OPEN policy framework

These are the main direction for fiscal policy from each of the activity sectors detailed in the Technical Report, and summarized in the next sections.

<table>
<thead>
<tr>
<th>FOOD</th>
<th>Sources</th>
<th>Manufact &amp; material productn</th>
<th>Logistics</th>
<th>Tertiary &amp; value added</th>
<th>Demand intensity &amp; utilization</th>
<th>Demand type / mode</th>
<th>Product operation</th>
<th>Waste / emissions</th>
<th>Revenue investment</th>
<th>Revenue investment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CCL / ETS on fuel demand</td>
<td>Transport fuel levy</td>
<td>Rural dev</td>
<td>Overseas dev</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SHELTER</th>
<th>Chemical levy</th>
<th>End fate levy</th>
<th>Retail levy</th>
<th>Health program</th>
<th>Public procurenent</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCL / ETS on fuel demand</td>
<td>CCL / ETS on fuel demand</td>
<td>Transport fuel levy</td>
<td>Lifetime levy on big energy</td>
<td>Energy quota system</td>
<td>Emissions permit trading</td>
</tr>
<tr>
<td>TRANSPORT</td>
<td>ETS on major fuel users</td>
<td>CCL / ETS on fuel demand</td>
<td>Transport fuel levy</td>
<td>Lifetime levy on fuel use</td>
<td>Energy quota system</td>
</tr>
<tr>
<td>PRODUCTS</td>
<td>CCL / ETS on fuel demand</td>
<td>CCL / ETS on fuel demand</td>
<td>Transport fuel levy</td>
<td>Fair trade credit</td>
<td>Lifetime levy product fuel use</td>
</tr>
<tr>
<td>SERVIC</td>
<td>Chemical levy</td>
<td>End fate levy</td>
<td>Fair trade credit</td>
<td>Public procurenent</td>
<td></td>
</tr>
<tr>
<td>PUBLIC</td>
<td>Transport / big fuel levy</td>
<td>Fair trade credit</td>
<td>Int asset managmt</td>
<td>Direct procurenent</td>
<td></td>
</tr>
<tr>
<td>ENERGY</td>
<td>CCL / ETS on energy supply</td>
<td>CCL / ETS on energy supply</td>
<td>ESCO partnership</td>
<td>Renewable credit transfers</td>
<td>Int asset managmt</td>
</tr>
<tr>
<td>WASTE</td>
<td>End fate levy</td>
<td>Producer takeback</td>
<td>Recycling R&amp;D</td>
<td>Resource managmt infrastructure</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: One Planet Economy fiscal policy framework

4.5 SCENARIO FRAMEWORK

Scenarios are depictions and discussions of future states, as pre-set menus of trends and options: in order to show either what appears to be probable, what might be preferable, or other possibilities which might just be plausible. In this study we take a deliberately simple approach to scenarios, and focus on 2 main variations out of 5 possibilities. Each one is expressed in terms of the main OPEN targets, which are framed firstly in eco-footprint, but also referring to CO₂ and material flow. The ‘F’ word refers to the factor of reduction in overall eco-footprint, to be achieved by the target date: this is set at the notional horizon of 2050, in order to coordinate with the UK’s ‘aspirational target’ for climate change. 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 – no change to the eco-footprint. The baseline or default ‘business as usual’ scenario is given in REAP by the pre-set assumptions and economic growth / change projections built in to the settings for each region. These are designed as ‘policy-off’ with no further policy changes at the time of assembly: obviously this is not fixed over time, and may need updating from the time of the model development.

• F-2 – eco-footprint reduced by 50% in a ‘dysfunction’ scenario: this is an interesting variation which assumes that most things which can go wrong do so, and that the eco-footprint is reduced for all the wrong reasons. This includes environmental degradation and catastrophe: economic malaise and stagnation: political conflict: technological hazards and sabotage: and social exclusion.

• F-4 – eco-footprint reduced by 75%. This ‘sustainable development’ scenario (SD) might combine this with political commitment, economic investment and consumer attitude change, so that quality of life and social welfare goes up independently of the economy, while environmental pressure reduces. There could be several variations on this: one being a ‘green technology’ scenario where technological improvements reduce environmental pressures: another being a green policy scenario where the same outcome is 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.
In the templates used here we focus mainly on the preferred F-4 scenario with reference to the F-1 scenario as a baseline. This is then detailed further with 2 variations:

- High fossil fuel prices, leading to constraints on demand and emissions
- Low fossil fuel prices, leading to demand growth and other policy intervention to contain emissions.

<table>
<thead>
<tr>
<th>CONTEXT</th>
<th>F0 – high growth</th>
<th>F1 – baseline</th>
<th>F2 – recession</th>
<th>F4 – SD scenario</th>
<th>F10 – deep green</th>
</tr>
</thead>
<tbody>
<tr>
<td>World GDP growth</td>
<td>Higher</td>
<td>No change</td>
<td>Lower</td>
<td>No change</td>
<td>No change</td>
</tr>
<tr>
<td>UK economic growth</td>
<td>Higher</td>
<td>No change</td>
<td>Lower</td>
<td>No change</td>
<td>No change</td>
</tr>
<tr>
<td>UK population growth</td>
<td>No change</td>
<td>No change</td>
<td>No change</td>
<td>No change</td>
<td>No change</td>
</tr>
<tr>
<td>Material imports %</td>
<td>Higher</td>
<td>No change</td>
<td>Lower</td>
<td>No change</td>
<td>No change</td>
</tr>
<tr>
<td>Consumer expenditure</td>
<td>Higher</td>
<td>No change</td>
<td>Lower</td>
<td>No change</td>
<td>No change</td>
</tr>
<tr>
<td>Public investment</td>
<td>Lower</td>
<td>No change</td>
<td>Lower</td>
<td>Higher</td>
<td>Much higher</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POLICY ISSUES</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Material intensity per GDP</td>
<td>No change</td>
<td>No change</td>
<td>Higher</td>
<td>Lower</td>
<td>Much lower</td>
</tr>
<tr>
<td>Autonomous rate of energy efficiency</td>
<td>Lower</td>
<td>No change</td>
<td>Lower</td>
<td>Higher</td>
<td>Much higher</td>
</tr>
<tr>
<td>Commodity prices</td>
<td>Lower</td>
<td>No change</td>
<td>Higher</td>
<td>Higher</td>
<td>Much higher</td>
</tr>
<tr>
<td>Energy prices</td>
<td>Lower</td>
<td>No change</td>
<td>Higher</td>
<td>Higher</td>
<td>Much higher</td>
</tr>
</tbody>
</table>

**Table 3: scenario settings for contextual issues**

### 4.5.1 Scenario data sources

Each of these scenarios might take different assumptions on population change, (although these would not affect directly the environmental throughput and pressures per capita). The OPEN calculations and the REAP activity model are based on published data as far as possible. This includes the latest UK energy and emissions projections:33 the Environment Agency scenarios study:34 the EU projections for baseline and low carbon strategy:35 and the World Energy Council projections.36 However it is fair to say that few of these address issues which are outside of the conventional path of economy-energy-emissions modelling within closely bounded assumptions. An early component study for the OPEN is drawing these various sources together in order to provide intelligence for regional policy in the UK.

### 4.5.2 Conclusion on methodology

The One Planet Economy represents a huge challenge to any single analysis or modelling method. Therefore we follow a ‘framework’ approach as the most useful for the purpose, and the templates above show various angles on this. There is no claim that this framework is in a fixed final form, and it is likely to be still evolving at the end of the current 4-year programme.

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33 DTI 2006
34 Environment Agency 2006
35 EEA 2005 & 2006
36 World Energy Council 2004
As a working tool for helping to set priorities, shape research agendas, generate discussion and analyse models, it should be useful in its own right.
Part 2 ~ Key sectors

The following sections provide very brief summaries of the sectoral profile, and agenda for moving towards Factor Four in each key sector. Further details are shown in the Technical Reports Parts C - F.

5. Food & agriculture

5.1 FOOD AND AGRICULTURE

5.1.1 Profile of the sector

In the food sector there is generally a direct path from production to consumption to waste, i.e. there are small levels of consumer stocks, or ongoing 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$_2$O, 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 (see Section …).

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.
5.1.2 Towards Factor 4 food & farming

As in the scenario box above, the OPEN agenda suggests changes to the food system at each stage of the supply chain. UK production could shift towards more IT-enabled ‘precision farming’, niche products with networked logistics for distribution. UK 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 incentives and industrial evolution measures. This could result in much import replacement with local glass house cultivation, using wholly renewable energy sources, with advanced control and logistics systems.
5.1.3 Summary & questions

Main resource effects:
- 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.

Main economic issues:
- 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 messages and questions for public opinion surveys:
- “Eat more local & support your landscape
- “Eat healthier – more life, more nature
- “how much extra would you pay for a healthy diet?

Key questions to be addressed:
- Will mainstream consumer preferences go local?
- How much does low-impact food imply localized or organic production?
- Is there a need or role for GM foods, either as specialities or on the open market?

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**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 transnationals 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.
6. Built environment

6.1 BUILT ENVIRONMENT

6.1.1 Profile of the sector

The built environment sector includes minerals and forestry: building material and engineering components: and the construction industry itself, together with related service sectors such as property and insurance.

**Built environment resource flows**

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

In material flow terms, the largest bulk flows are in aggregates from the quarry into the construction sector: the sector also has to deal with about 100 million tonnes of construction and demolition waste, together with industrial waste from materials production. The most significant direct impact is from the energy used in buildings, and there are many other indirect impacts generated through the effect on transport, water use, land use etc.

The built environment can be divided into three main types:

- Housing – where there is generally more data & more defined standards (floorspace, efficiency etc)
- Other commercial, industrial and public buildings, of all shapes and sizes
- Other infrastructure and engineering, with overlap to transport and utilities sectors.

In each of these there are distinct stock flow effects: i.e. the average turnover in the building stock is 1-2% per year. The whole sector is very dependent on energy supply, but this is a long
term stock issue, as much as the day to day usage. For demonstration buildings it appears possible to achieve ultra low energy usage, with increasing capital costs towards zero energy: however for the mainstream industry it appears to be very difficult to improve efficiency, as there are many institutional barriers. The much larger issue is the residual building stock and the actions which may improve it. There appear to be many barriers and disincentives to rational behaviour, such as the split of responsibility between landlords and tenants: and much centres on the ‘apparent’ social cost of carbon / fossil fuel energy.

6.1.2 Towards a sustainable built environment
A Factor 4 efficiency transformation in the built environment is a very challenging goal – at present, most ‘sustainable construction’ activity is marginal to this bigger picture. We can at least point to potential transformations at each stage of the chain:

- Building materials and sources: more renewable materials, less high-energy materials such as cement or aluminium.
- Building design and specification: more low-impact design on eco-building sustainable communities lines:
- Building stock and life cycle: new-build design for long-life and loose fit: coordinated upgrading of existing buildings for energy & services efficiency.
- Planned replacement of the least efficient portion of the UK building stock, as proposed in the ‘40% house’ research.

6.1.3 Summary & questions
Main resource effects:
- Phased demolition & rebuilding
- Reducing building external energy demand.
- Phase in on site renewable sources.
- Shift to renewable / low energy materials.

Main economic effects:
- 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?
7. Transport & communications

7.1 TRANSPORT AND COMMUNICATIONS

7.1.1 Profile of the sector
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, i.e. 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.

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 outstanding questions on the potential for alternative vehicle fuel technologies:

- Liquid gas is only marginally more clean than oil:
- Bio-fuels may be very environmentally damaging on a global scale.
- Hydrogen fuel systems are attractive but untested on a larger scale.

Air travel is a major topic in itself. 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. Demand is driven not only by consumer affluence but by inbuilt pressures for globalization & networking of businesses & lifestyles. Demand management may come through limits on airport growth, but as in Hong Kong off-shoring airports is quite feasible. Also, international marine shipping is a large sector, at present invisible in the UK accounts. The scope for energy efficiency seems limited, but there may be potential in reverse logistics.

7.1.2 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’.

7.1.3 Summary & questions

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

Main economic issues:
- 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.

Key public messages & survey questions;
- “Live longer with fewer traffic jams
- “Smart movement by integrated transport
- “Let the holiday come to you, & do business by wireless
- “Do you travel to get places, or travel to travel?

Key issues & questions:
- International fuel price 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?
8. Goods & products

8.1 GOODS AND PRODUCTS

8.1.1 Profile of the sector

This 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 sector 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,

8.1.2 Towards Factor 4

Despite the complexity, there are some clear directions towards a Factor 4 approach to goods and products, and these are shown up in the general templates in the previous sections. 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, 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.
8.1.3 Summary & questions

Main 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

Main economic effects:
- Fuel levies on manufacturing & distribution: re-invested in innovation strategy.
- Public procurement incentives for industrial evolution
- Subsidy / levy incentives for energy efficient goods.
- Taxes and charges 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 public messages and issues for opinion surveys:
- “Live longer with long life goods
- “Ethical trade in the global village
- “Would you pay more for higher quality / more sustainable products?

Key issues & questions to be addressed:
- Public acceptability of lifestyle constraints:
- Willingness to buy lower impact
- Willingness to share, re-use and recycle
9. Commercial services

9.1 COMMERCIAL SERVICES

9.1.1 Profile of the sector
The resource flow metabolism of consumer 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.

9.1.2 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.

9.1.3 Summary & questions
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 public messages, and questions for the survey:
• “Green tourism in the global backyard
• “Ethical banking – so you know where your money is going
• “Would you pay 10 pence extra on your meal so the farmer can feed her family?
• “Would you like to support your local economy?

Key issues & questions:
• How far can CSR activity be shifted to the service sector?
• What are the macro-economic implications of a shift towards intermediate labour market / social economy?
10. Public services

10.1 PUBLIC SERVICES

10.1.1 Profile of the sector

The resource flow metabolism of public services has similarities and differences from that of commercial services. As above, these 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, and also major occupiers of land and buildings.

The policy context or 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/ consortia, 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 industrial evolution.

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.

10.1.2 Towards Factor 4

The Factor 4 programme for public services would include several layers from direct to indirect. 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.

10.1.3 Summary & questions
Main resource effects:
• 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 public messages and questions for survey:
• “Sustainable healthcare – makes you healthier
• “Walk your way to your local neighbourhood centre
• “Would you pay a penny on income tax to ensure a green NHS?”

Key issues & questions:
• Consumer convenience vs system efficiency / cost reduction
• Allocation of CSR to public service functions
• Shift towards intermediate labour market / social economy.
11. Energy & climate

11.1 ENERGY AND CLIMATE

11.1.1 Profile of the sector

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 programme, 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 OPEN 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 OPEN goals could be achieved even with rising energy demand. However in practice it is more plausible that changes will be spread across the board, at each stage in the chain from supply to demand.

Following the logic of the supply chain template, there are several agendas to consider:

- 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.

11.1.2 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 successful, the only drawback being that a tonne of carbon is trading at €20, a small fraction of its estimated social cost of damage.

Is there a valid response for the OPEN in the face of such complexity and controversy? The OPEN approach suggests a ‘no-regrets’ approach to UK energy policy – in other words, working with the uncertainties of emissions trading, market prices, technological innovation and so on, to provide the optimum steps forward, which are technologically robust, low risk and low impact. This ‘zen and the art of climate maintenance’ is likely to put the focus back on demand side management in the sectors above: to encourage UK renewable sources with embedded generation: avoid technologies with long term risks and uncertain hazards: encourage sources with spin-off benefits such as rural economies, and so on.

11.1.3 Summary & questions
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 effects:
- 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 public messages and questions for survey:
- “Green energy on your doorstep
- “Wind power - protecting your children’s climate.
- “Would you pay a penny per litre to support your local planet?
12. Waste & resources

12.1 WASTE AND RESOURCES

12.1.1 Profile of the sector

Waste management policy is in a state of flux at the time of writing, with the UK waste strategy review in progress, along with the continuing programme of EU directives. 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 flow of resources around the material economy, as explored in section 4:

- 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;
- A Factor 4 economy would see the main flows of materials as secondary – 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 current reference point is the landfill levy ‘escalator’, which increases to £21 per tonne in 2006. At the point when it reaches £35 per tonne, then other waste recovery technologies become comparable in terms of pure cost. 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 institutional & behavioural incentives, which are otherwise hard to shift.

SCENARIO BOX - WASTE & 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 barts, 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.
12.1.2 Towards Factor 4
By implication, the different objectives of waste recycling, waste recovery and waste minimization are not necessarily converging to one win-win solution. Rather, they may be in competition for technological options and available resources. The framing of the agenda itself as a ‘waste’ issue is in a way foreclosing other more constructive approaches which lie upstream.

A OPEN approach to a Factor 4 resource / waste system would aim towards an integrated industrial evolution 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 modest economic measure can coordinate with changing awareness, to result in major improvements in the waste stream.

12.1.3 Summary & questions
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

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 industrial evolution
- 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?
- Could the UK waste disposal shortfall be solved by sending waste to China in return load containers?
13. Policy review

This section is an extended discussion on some of the deeper themes raised here – the role of accounting: the political economy of institutions: further angles on fiscal policy, the role of international trade:

In each of the above sectors, there are major political and economic changes needed for the shift towards a One Planet Economy. Here we review briefly this wide and challenging agenda, with a review of the principles, and how they might apply in practice (further discussion is in the REAP 8 Technical Report). Again there are more interesting questions than final answers:

- Integrated accounting: this looks at the prospects for extending the national accounts and budgeting system.
- Economy-environment policy: starting from the eco-taxation agenda, this looks at a wider set of options.
- The business case for integrated asset management: this sets out the potential for re-investment, leading to an ‘industrial evolution’ transformation in key sectors.
- New institutions: the scope and need for new kinds of relationships and partnerships between public, private and community sectors.
- International trade and development: what happens at the other end of the supply chain?

13.1 INTEGRATED ACCOUNTING

Conventional economic accounts are clearly deficient as indicators of ‘real’ wealth, welfare or progress – e.g. where traffic accidents are counted as economic activity. But the task of adapting or extending the accounting system raises many questions:

- Concepts - i.e. what is it we are trying to measure? What is ‘real’ wealth, capital, welfare or progress?
- Substitution issues – if economic growth increases while environmental assets decrease, can we subtract one from the other?
- Quantification issues – how much can measurement distort or mislead with factors which basically can’t be measured?
- Displacement in space & time – many of the capital flows or impacts will be in the future, or overseas, where value judgements will determine the outcome.
For the OPEN Strategy we focus on two forms of capital – economic and environmental – bearing in mind the possibility of others: one scheme looks at 5 forms of capital. We can then use the SCP supply chain framework to chart out a spectrum as in the diagram:

- from monetary and tradeable capitals, to non-monetary or embedded forms of capital
- from upstream resources, to supply and demand interactions, to downstream ‘externalities’.

This is then a kind of route map, which shows the limits of conventional accounting, and the kinds of linkages which might be very significant, even if difficult to measure. We can then use this to throw light on recent examples:

- Index of Sustainable Economic Welfare (ISEW), Green Net National Product, Genuine Savings Index, etc: economic accounts adjusted for monetized costs and benefits due to environmental and social effects. There are questions on the valuation of non-monetary costs and benefits: distributional differences in space and time: distortion of current market values, etc.
- ‘Sustainability gap’: economic accounts adjusted for cost of meeting policy targets (at current prices). Questions on definition of targets, fluctuating prices, technological changes etc.

On the environmental side, there are the measures reported in the Ecological Budget UK:
- Eco-footprint: an aggregated environmental measure on the consumption-based supply chain principle. Problems with aggregation and definitions of ‘bio-capacity’.
- Material flow analysis: good for consistency and measurability: problems in that material flows are not always related to environmental impact or economic value.

• Carbon / other climate emissions: target based approach based on contraction &
  convergence principle. One strength is the legal requirement on all countries to provide

One way forward on the quest for ‘measuring the unmeasurable’, is to establish a coordinated
range of satellite accounts. The UN System of Environmental & Economic Accounts (2003)
goes towards this, and could be benchmarked to overall targets where these can be defined and
agreed. Such an extended accounting framework would include:
  • Economic: economy-environment: and environmental forms of capital:
  • Baseline: trend: trend-target relationships:
  • Direct: indirect: induced effects and impacts.
  • Damage: adaptation: mitigation costs and benefits.

As and where these categories can be matched to available data, then a range of combined
indices will also be relevant:
  • Trade balance: UK / rest of world
  • Assets / liabilities / concepts of liquidity
  • Resource productivity, innovation, best practice
  • De-coupling, trend-target gaps:

In terms of the OPEN goals, we can define some very simplistic trends and targets to inform the
de-coupling benchmark index:38
  • **Environmental impacts** from resource use: rapid reduction, measurable with the eco-
    footprint at a net rate of –3% per year.
  • **Economic growth**, as measured by monetary activity – a rate which appears to be self-
    sustaining for the UK within the global economy, currently about 2.25% long term
    (including for variations between regions).
  • **Social welfare** (quality of life, equity and inclusion): high growth, but unlike the others this
    is not necessarily straightforward to measure. The most advanced national triple-bottom-
    line study from Australia measures 3 social indicators for each economic sector:
    employment, wages, and tax payments.39

The implication for the decoupling goal is a target rate of -5.25% per year in environmental /
economic intensity. The national accounts can then be referenced to this overall trend-target
distance, and various adjustments made. Further development of this scheme is in progress.

38 Robinson & Tinker 1995
39 CSIRO Sustainable Eco-systems et al 2005
13.2 ECONOMY-ENVIRONMENT POLICY

There are many issues in eco-taxation and fiscal policy for environmental objectives. We could start from the text-book analysis of the theoretical ‘optimum tax rate’ for one firm and one pollutant – and then observe the reality:

- Complex supply chains in a globalized economy
- Eco-taxation as one incentive among many other social and institutional factors
- Moving boundaries between taxation, subsidies, trading systems, and investment,
- Even where an eco-taxation measure has a tangible effect, there are many other adjustment, substitution, displacement and institutional effects.
- The overall effect is highly dependent on the policy for re-investment of tax revenues.

On the re-investment issue, the key OPEN principle is that revenues should be re-invested in a strategic programme for ‘industrial evolution’. This is taken to include technological innovation, demand side management, infrastructure development, public procurement and so on. In practice to analyse or model such effects is difficult, as the results are dependent on all the institutional factors above – for instance there is little or no evidence on how much waste can be minimized per £GB of re-investment to any one sector. However, we can review the basic options for eco-fiscal policy in three broad categories.

**Direct fiscal transfers:** Questions are where best to raise taxes in complex supply chains – whether from producers / distributors / consumers / externality victims / other stakeholders?
- Direct taxation: when is a tax not a tax, but a charge or levy on services?
- Indirect taxation: when costs are spread along the supply chain, then many producers, intermediaries and consumers are also *de facto* tax-payers and beneficiaries.

**Market initiatives:** there are questions on boundaries, regulation, eligibility, ceilings, legacies, and particularly the progressive or regressive effects on lower income or smaller / more vulnerable businesses:
- Trading systems – e.g. carbon trading
- Quota systems. – e.g. packaging recovery notes
- Technology development: specific programmes for innovation

**Public sector intervention:** Questions are raised on the macro-economic balance, institutional structure etc, as in the section below on new institutions:
- Public procurement: can generate critical mass for supply chains to invest in new technologies etc
- Public infrastructure: can enable & facilitate lower impact activities
- Public partnerships – most large infrastructure is partnership investment, such as DBFO – the specific terms & conditions for balancing equity & risk are then crucial.
- Public agencies – may act as vehicles for each of the above, with the general approach of leverage i.e. multiplying the effect of public investment.
The approach is to look at how each of these fiscal measures can work best as combined packages of sticks & carrots – penalties and incentives - spread along the material supply chain, and the economic value chain.

At the macro-economic scale, the OPEN Strategy is proposing to maintain the fiscal balance of taxation at its current level. However, just as the ‘golden rule’ allows for public borrowing for investment over the economic cycle, should the Strategy consider a ‘green rule’? This would be targeted on investment in OPEN type industrial evolution, to be recouped over a longer cycle. It would be supported by the integrated accounting above, with evidence on economic and environmental costs, benefits, impacts and targets, side by side.

13.3 Evolution & transformation

Each of these themes – eco-taxation, re-investment and procurement – adds up to a wider view of how markets can serve society, rather than the other way round. This is expressed by the ‘industrial evolution’ or ‘market transformation’ concept in its wider sense – including low impact technologies, integrated logistics, equitable distribution and sustainable consumption patterns. To transform markets requires a practical ‘investment case’ to be developed for each economic sector: each policy level: each product type, and so on. Economic, social and environmental costs and benefits (as far as can be defined) should all stack up in total, on the principle of integrated asset management.

One example is the energy demand of the UK housing stock, notorious for inefficiency and resistance of the property industry to change. There are current studies showing that the UK’s climate change targets will be impossible without a strategic overhaul of the existing housing stock: but so far the business case has not been detailed.40

On outline estimates, an investment programme of about 10% of the domestic energy bill, or about £2 billion per year, could over 25 years reduce household running costs by over a third, and the external costs by two thirds, however these are defined; it might also generate in the region of 200000 jobs, largely in areas of high unemployment.

40 Boardman et al 2005
Where would such investment come from? As far as possible by market measures which adjust the huge financial flows around the property, construction and utility industries. National level revenues could be raised by direct taxation, trading of carbon permits, levies on producers, or tax breaks for energy investment. At the local level there is scope for differential rating by efficiency, planning obligations linked to energy footprint; or direct infrastructure charges. Such revenues could be recycled into direct investment in CHP networks and energy upgrading; into tax breaks for efficiency investment; underwriting of energy services companies; technology and R&D support; or financial guarantees for energy infrastructure. Otherwise the revenues could simply offset employment costs and stimulate intermediate labour markets.

Such an investment case for energy efficiency, would need all market gaps to be closed, and all market signals and incentives to work in synchrony – adding up to a whole ‘industrial evolution’. Such transformation will only happen where it is commercially profitable and politically viable, and so depends on the institutions which can balance costs and benefits in the short and long term, as in the next section. The example of energy efficiency is one of the simpler cases where there are clear linkages to technology, infrastructure, innovation and the financial regime; while other sectors, such as manufactured products, are more diverse to begin with. In general, industrial evolution is not a final answer or quick fix – it will be as complex as the markets from which it starts, and the social goals to which it aims – but nothing less is called for in making the One Planet Economy a reality.

### 13.4 NEW INSTITUTIONS

The OPEN Strategy and the Factor 4 goals suggest the need for new kinds of organization which operate in the space between public, private and community sectors. This is nothing new – the reality behind the textbook ‘perfect market’ has always been a rich mixture of cooperation, exploitation and dependency between interlocking organizations. We can type such alliances
and linkages in three basic combinations – public-private, private-community and public-community – where each sector has certain strengths, weaknesses, opportunities and threats.\textsuperscript{41} The diagram below is but a start in mapping the many possible interactions, but it does give insight on the likely shape of new institutions for the OPEN Strategy.

\textbf{NEW INSTITUTIONS & ECONOMIC LINKAGES}

\begin{center}
\begin{tikzpicture}
  \node[draw, circle, minimum size=3cm] (public) {public};
  \node[draw, circle, minimum size=3cm, below=of public] (community) {community \& civic};
  \node[draw, circle, minimum size=3cm, left=of community] (private) {private};

  \draw[-latex] (public) edge node[above] {public services} (community); 
  \draw[-latex] (private) edge node[above] {trade associations} (community); 
  \draw[-latex] (private) edge node[above] {responsive markets} (community); 
  \draw[-latex] (private) edge node[above] {consumer clubs} (community); 
  \draw[-latex] (private) edge node[above] {community enterprise} (community); 
  \draw[-latex] (private) edge node[above] {public/private partnerships} (community); 
  \draw[-latex] (private) edge node[above] {deregulation} (community); 
  \draw[-latex] (private) edge node[above] {marketization} (community); 
  \draw[-latex] (public) edge node[above] {best value \& NPM} (community); 
  \draw[-latex] (public) edge node[above] {city contracts} (community); 
  \draw[-latex] (public) edge node[above] {social trading} (community); 

  \node at (0,0) {franchising};
  \node at (3,0) {public/private partnerships};
  \node at (0,-3) {deregulation};
  \node at (3,-3) {marketization};

  \node at (-1,-1) {community \& civic};
  \node at (1,-1) {private};
  \node at (-1,1) {public};
\end{tikzpicture}
\end{center}

General linkages and potential alliances between public, private and civic / nonprofit / third / community sectors.

\textit{Public-private linkages} include the topical ‘Private Finance Initiative’ (PFI), various shades of partnerships and consortiums, ethical procurement, supply chain initiatives, and much economic development activity. Public intervention has generally aimed to correct market failures or gaps, in line with economic theory. Private finance by contrast, is now aiming to close a ‘public gap’, in access to capital and entrepreneurial management, and more public services could find themselves operated or financed by business, as the boundaries between the sectors are blurred. There are obvious and controversial problems – lack of democratic control and accountability, risks to public ethos and equality of service, the lock in effect on major projects, and the added cost of transferring risk to the private sector.

\textit{Private-community sector linkages} include local business or regeneration partnerships, social investment funds, what remains of the ‘mutual’ financial institutions, corporate trusts and guarantee companies, consumer clubs and networks, cooperatives, community development trusts and other forms of social enterprise. Even in straight producer-consumer markets, the consumer community can take shape as an alliance or ‘community of interest’. Such potential can be mobilized either for commercial gain, as with advertising, or for social enterprise through product fan clubs, consumer lobbies, NGOs and other networks. The voluntary and charitable sector in the UK is already a major sector with over 4\% of GDP, and may expand rapidly to take on a new generation of devolved public services.

\textsuperscript{41} the ‘community’ or ‘third’ sector includes local informal or social economies, ‘civic’ or non-profit institutions, associations, unions, churches and so on.
For the third axis of *community-public sector linkages*, the political mandate of government itself seems increasingly to depend on alliances or ‘social contracts’. Such linkages include the voluntary sector compacts, neighbourhood partnerships, resident or customer charters, intermediate labour markets, social trading and other forms of community enterprise. Newly emerging groups and networks put new demands on government and all its agencies. While there is constant financial pressure on government, there are many cases where community linkages may save money, target spending better, or bring in voluntary labour. In schools for example, the contributions of parents can be seen as partly social enterprise, partly self-interest, partly work experience and so on.

Each of the above cases is likely to be involved in the industrial evolution agenda. For instance the energy efficiency example above calls for a public-private consortium for energy services supply: a public-private agreement between mortgage companies and regulators: a business-consumer partnership on the spreading of investment and costs: a public-community alliance which steers intermediate labour market contributions: and so on. Such an extended partnership or network structure with new types of organizations emerging, is not easy to model or analyse, but appears to be the best way to make things happen.

### 13.5 INTERNATIONAL DEVELOPMENT

Finally, while the OPEN Strategy focuses on the UK, there are boundary questions and issues on globalization, international trade and overseas development. It appears unlikely at present, that the UK would carry out policies which impede the trend towards a WTO-based model of liberalized trade. So what is the most useful way to construct a scenario and framework for a One Planet Economy in the UK, bearing in mind the question of ‘what happens at the other end of the supply chain’? (This is discussed in more detail in the Technical Report Part C):

- Assume a highly globalized free market under the current WTO model, and focus on the issues which the UK can most efficiently influence. This could include e.g. value added on the supply side, consumer behaviour on the demand side etc. There could be a risk of flooding the UK with cheap & environmentally damaging imports.
- Assume a highly globalized free market, in which the OPEN Strategy for the UK is mirrored around the world. This is simple but is the least plausible of the alternatives.
- Assume some level of market protection, from a combination of regulatory, CSR, tax and subsidy measures. This would be most plausible at the EU level, where the single currency and EFTA already operate controversial levels of protection.
- A variation of each would be to assume the extension of the EU Emissions Trading Scheme concept to other areas of production and consumption, i.e. eco-services trading, domestic tradeable quotas, where there is scope to be more international in scale.

For developing countries there is potential for extending economic partnership agreements to enable conversion to modern mixed economies, at the same time achieving industrial evolution in supply chains in the UK. As imports of materials, goods and services form an increasing share of the UK’s consumption, there would be major effects on the supplier countries of
following this F-4 path. This raises many questions for international trade & development, such as –

- what are the effects of radically changing the UK’s resource imports on the supplier economies?
- What changes in international trade agreement would be needed to help the move towards a One Planet Economy, both in the UK and overseas?
- What changes or complementary / flanking measures in overseas development policy can steer towards positive outcomes at both ends of the supply chain?
- What other international agreements are relevant, e.g. to the question of reverse logistics and the export of waste to developing countries?

This is a cross cutting theme with particular relevance to sectors such as food, construction, industrial products, commercial services and recently waste. The issues hinge on the question of how far the OPEN Strategy should assume the international dimension simply as a backdrop – OR - how far it should be an enabler of positive changes itself, through economic partnerships and trade reform. There are some fundamental options to be considered -

- International commodity price rises, as a result of equalization of incomes and wealth in developing countries. AND / OR
- International commodity price rises, as a result of energy price rises which affect manufacturing and transportation worldwide - AND / OR
- International commodity price rises, as a result of climate emissions taxation or trading markets, where the revenues can then be re-invested.
- Conversion of commodity-intensive economies in developing countries to more industrialized mixed economies – AND / OR
- Continuation of commodity-intensive production overseas on the basis of economic advantage, with continuing service sector shift in the UK.

Overall, such issues raise the possibility of integrated resource management at the global level, to be supervised by a reformed WTO or similar body – can this be envisaged, (or can we afford not to?). This is a challenging agenda, where the UK may have only small or indirect influence at the world level. However it is an essential part of the OPE picture, not least because the OPE is designed to be transferable to other nations, and eventually fed into policy advice to WTO and similar bodies, where there is great potential for the UK to act as a catalyst and leader.
14. One Planet Economy Network

This section reviews the research so far, and sets out the forward programme for the OPEN

14.1 IMPLICATIONS

14.1.1 Review of Phase 1 research

The research so far has focused on scoping and agenda setting; an ‘integrated framework’; and the beginnings of the applications to key sectors. Here we look at implications for the OPEN programme of research and dissemination.

- Each sector represents a complex mix of supply side, demand side and market conditions, involved in the SCP agenda.
- Eco-taxation is a significant part of the agenda. But to achieve the OPEN goals on its own, eco-taxation would need to be at a level which is almost unthinkable in political terms.
- Likewise the scale of the public subsidies and investment programmes which would be needed might be deemed politically risky, if not impossible in today’s context.
- We see the way forward via integrated asset management, leading to a business case for industrial evolution: this aims to coordinate all economic, regulatory, market and institutional actions.
- To achieve this needs a more pro-active concept of environmental stewardship from the government, in partnership with producer-consumer groups.

14.1.2 Uncertainties and questions

There are distinct branch points and outstanding questions in the OPEN scenario outlook:

- Oil spike or carbon taxes? i.e. will fossil fuel shortages help to force efficiency measures, or will taxation and other means do the same job?
- Global equity? i.e. will the UK / EU retain its wealth differential with the majority of the world’s population?
- Targets vs trading? If climate emissions and resource flows are to become more scarce and more valued, is this best achieved through regulation and joint targets, or tradeable permits and quota systems?
- Social change or social resistance? i.e. whether the ‘great British consumer’ will go along with the SCP agenda, or actively resist any restraint on material consumption.

There is little chance of anticipating the outcome to such divisions. So the implications for the operation of the OPEN Strategy would include:

- Flexibility to take opportunities
- Responsiveness to take risks
• Long term outlook on assets and capitals
• Integrated supply chain approach, from producers to consumers
• Innovation in technology, logistics, management, markets, consumptions and resource recovery.

14.1.3 Next developments
For the OPEN research program, there are questions raised for analysis and modelling. Economic and econometric modelling has a central role, but needs further development in order to deal with the scope of structural changes, technological and institutional changes seen in the OPEN. As in Section 4, this may shift the angle of application from a narrowly bounded modelling, towards a wider ‘what-if’ process of structured enquiry.

Resource flow modelling also has a central role, but needs further development, and there are several possible strands, depending on funding:
• Sectoral level analysis, looking at supply chains and clusters, using structural path analysis and simile
• Local policy analysis – provides closer focus on economic / urban development and environmental management policy options.
• Consumer & product breakdowns – further detail on product types and LCA, and their place in the overall system of production
• International trade & development – further detail on the opportunities in trade, imports and economic development partnerships. This would connect with a multi-regional input-output model now under consideration.42

In particular there is the potential for an invaluable contribution to national level policy analysis and modelling. A range of possibilities is in discussion with various departments and agencies:
• Integrated resource / climate accounts and budget, to be presented alongside the fiscal budget, on an annual basis.
• Analysis and benchmarking of direct, external, embedded and induced impacts of economic activity: using CO2, MFA, EFA and other appropriate measures.
• Analysis and benchmarking of strategic policy options and alternative scenarios, using the above measures, indexed against economic activity, employment, consumer expenditure and so on.

14.2 ONE PLANET ECONOMY NETWORK - PRINCIPLES
The One Planet Economy Network is a vehicle to take forward the research and development above, in collaboration with a wider community of stakeholders. It follows from the Phase 1 activity under the Ecological Budget UK, and extends over a 4-year programme to 2010.

42 SEI & PSI, 2006
14.2.1 Scope of the OPEN

The OPEN has a challenging remit: it is aiming to provide a viable and measurable pathway for the transformation of the UK economy and its place in the world. It covers both economic and environmental flows and changes, both for the UK and for its place in international trade. It is aiming to fit research analysis to policy agendas: and it is looking from a short term to a longer term horizon (2050). The table here shows the main components:

<table>
<thead>
<tr>
<th>THEMES</th>
<th>BASELINE</th>
<th>PROJECTIONS &amp; SCENARIOS</th>
<th>ACTION &amp; EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENVIRONMENT</td>
<td>Physical balance sheet &amp; analysis</td>
<td>Resource scenario modelling</td>
<td>Resource policies &amp; effects</td>
</tr>
<tr>
<td>ENVIRONMENT-ECONOMY</td>
<td>Enviro-economy balance sheet</td>
<td>Enviro-economy linkages</td>
<td>Enviro-economy linkages</td>
</tr>
<tr>
<td>ECONOMY</td>
<td>Economic activity balance sheets</td>
<td>Economic scenario modelling</td>
<td>Economic policies &amp; effects</td>
</tr>
<tr>
<td>POLICY / SOCIAL</td>
<td>Policy review</td>
<td>Scenario issues &amp; narratives</td>
<td>Household &amp; regional issues</td>
</tr>
<tr>
<td>INTERNATIONAL</td>
<td>Imports, trade &amp; development issues</td>
<td>Global context</td>
<td>Macro-economy, trade &amp; development issues</td>
</tr>
</tbody>
</table>

Table 4: scope of the OPEN Strategy

14.2.2 Networking & capacity building

All this is not only an interesting research exercise – it should be focused on the urgent need to mobilise and build capacity, for innovation, learning, participation and new forms of networking. At a local level, if there is enough ‘community capacity’ so that neighbours are happy to share car journeys, then traffic congestion could be cut at a stroke. At the UK economy level, if industries can find a user for their by-products in advance, to be delivered by a low-impact logistics system, then the national waste ‘problem’ could be transformed into a national resource ‘opportunity’.

Such examples demonstrate the ‘network’ principle of the OPEN. This is deliberately framed in terms of a networking process, basically as it is much too diverse and complex to be coordinated by one organization (even the UK government). It is too fast moving to be planned at one point in time, or achieved in one programme. It requires flexibility to risks, responsiveness to opportunities, capacity for rapid innovation, and communications between a vast number of organizations and activities. We envisage such a network as a continuous process in parallel arenas:

- Policy arena: focusing on territorial issues, fiscal issues, public procurement etc
- Business arena: focusing on finance, supply chains, markets and logistics
- Technology arena: focusing on science and innovation priorities
- Lifestyle arena: focusing on demand side, social, community and cultural issues.
A start has been made on such a network at the regional policy level by the SCP-net network (www.scpnet.org.uk). This experience could be extended to other levels in the public sector, private sector and civic sectors.

**Sustainable consumption & production: road-map**

14.2.3 Road map for OPEN

Some of the main opportunities in the OPEN forward strategy are outlined in ‘road map’ form, as in the diagram above:

- National & global level: sectoral transformation; international trade; fiscal intervention – tax subsidy etc; procurement by the public & partnership sector
- Regional & local level: local strategic partnerships; economic clusters & networks; infrastructure development
- Firm and product level; integrated supply chain management; integrated resource / waste management; sustainable product strategy; sustainable enterprise management

There is a notional timescale on the road map, shown from 2005 – 2020, while in reality each item will be a continuous programme. However, clear milestones ahead, e.g. such as the forthcoming EU Directives on waste, can fit on more detailed road maps. In the centre are the ‘enablers’ – for example, at the regional level of the SCP agenda in the UK, these are currently focused on the ‘SCP-net’ programmes:
• Technical modelling & appraisal tools – REAP and REEIO.
• Monitoring, indicating, benchmarking, databases, libraries etc.
• Policy appraisal and evaluation – applying the above to planning & management.
• Networking & capacity building – training, dissemination etc.

At the national level there is also a need for an enabling network, forum or partnership, to coordinate as far as possible the many linkages and opportunities. This would look far beyond the current round of ‘sustainability strategies’ in industrial sectors, and ‘sustainability appraisals’ of policies and plans – very few of these have set their sights on the goals of a One Planet Economy. So the OPEN aims to fill that need.

14.3 ONE PLANET ECONOMY NETWORK - PROGRAM

14.3.1 OPEN Objectives
The OPEN program, as set out in this Prospectus, aims to provide demonstrations for the One Planet Economy goals. There are three main objectives:

• building of the evidence base to promote a One Planet Economy.
• building of applications, to specific issues in policy and business.
• building of capacity as an ongoing process in policy and business.

14.3.2 How the O.P.E.N. works
The OPEN Strategy is structured in three parallel strands as per the objectives – evidence base: applications: and capacity. This triple strand approach takes shape in 6 specific programmes; shown here is a summary, with further details in the following sections:

• Integrated accounts: the resource balance sheet and profit / loss accounts of the UK economy.
• Forward strategy: proposed policy developments for the UK budget and Comprehensive Spending Review.
• Sector strategies – opportunities for ‘market transformation’ in selected sectors, including economic, organizational, technological and behavioural issues.
• Best practice library: case studies of Factor Four increases in resource efficiency, in an online searchable database.
• Virtual networks: internet-based community for consultation, exchange of methods and data, best practices etc.
• Sector partnerships: workshop program and policy / industry forums in key sectors, to consult and follow up on the OPEN agenda.
14.3.3 ‘Integrated accounts’
This is an annual report to the stakeholders of “UK plc”. – on the same basis of accounting for economic policy, the OPEN is founded on comprehensive resource and environmental accounts. These follow from the Ecological Budget UK pilot accounts: these contain for the first time, resource flow and environmental metabolism data on 123 sectors of production, and 68 categories of consumption. The next steps include:

- Consolidate the accounts into a summary profit & loss / balance sheet approach as if for ‘UK plc’.
- Elaborate the accounts towards a full breakdown of different environment-economy interactions, as proposed in the UN System of Environmental-Economic Accounts.\(^43\)
- Identify the accounts and satellite accounts which relate to sectoral themes, such as transport or construction, so that policy applications can follow.
- Develop related measures, particularly for social and institutional issues, to form an integrated ‘social accounting matrix’ framework.

While these steps are easy to summarize, they represent major advances in the state of the art, taking place in stages over the 4 year programme.

14.3.4 ‘Forward strategy’
The UK ‘forward strategy’ takes the present-day integrated accounts into the future, with horizons of 2020 and 2050. It also presents an outline of fiscal and other policies to achieve the targets, or at least establish the relevant rate of change. This OPEN forward strategy differs from the UK budget in several ways:

- The focus is on longer term directions of change: so the current focus on short term public sector finance shifts to the longer term

\(^{43}\) SEEA 2004
• There is a focus on innovation, not only in technology but in markets, logistics, behavioural
change etc: and a focus on environmental goals.

With that in mind the ‘forward budget’ contains the following:
• Future accounts over 40 years for economic flows, resource flows and environmental
loadings;
• Fiscal measures in terms of eco-tax and re-investment, designed to achieve these;
• Other economic measures, such as producer responsibility, tradeable quotas etc;
• Institutional measures, such as partnership structures, stewardships etc;
• Analysis of robustness under different scenarios, as far as possible: flexibility under
uncertainty: transparency for democratic control etc.

14.3.5 ‘Market strategies’
The market strategies are the components which inform and ‘reality check’ the national level
strategy. They apply the principles of the OPEN to each of the key sectors, as per the outline
demonstrations in the OPEN Technical Reports:

• The first principle is ‘integrated asset management’, covering economic, social and
environmental capitals and risks – in other words, that the UK economy should manage its
assets and liabilities, as intelligently as any other large organisation.
• This should be followed through on an integrated supply chain principle, i.e. by tracking
material and energy resources from cradle to grave, and from supply sides to demand sides.
• All of this adds up to a full ‘industrial evolution’ programme of transformation, in its wider
sense – including low impact technologies, integrated logistics, equitable distribution and
sustainable consumption patterns.
• Such a programme requires a practical ‘business case’ and ‘investment strategy’ for each
sector: each policy level, and so on. Economic, social and environmental costs / benefits (as
far as can be defined and projected) should all ‘stack up’.

14.3.6 ‘Best practices’ library
This is focused on case study examples of Factor Four achievement in business, technology,
policy and lifestyles. The criteria for inclusion is a clear contribution to a Factor Four scale of
increase in resource efficiency / reduction in impact.
• The library is mainly targeted to an on-line access, although a print summary may also be
produced.
• The online database would be searchable by sector: technology: location: etc.
• It is anticipated to be an ongoing initiative building up through the life of the project.
• Also serves as the focus for the contributions of the virtual network community.

14.3.7 Virtual networks
The Virtual Networks program aims to mobilize the interests and experience of a wider
community, from policy, business, NGOs and academics. Its main functions would include, as
in the consultation questions in the next section:
• act as an expert reviewer for the OPEN reports
• contribute case studies and best practice examples to the OPEN on-line library
• contribute or collaborate with methods, tools and/or data, for the research
• other contributions to dissemination & the running of the Network

14.3.8 Partnership programme
The partnerships program is basically the human side of the research and advocacy, and has the main roles of consultation, dissemination, consensus & vision building. There are likely to be three types, which will be active according to the reporting cycle & policy focus:
• Government partnerships: these will be centred on the lead departments of Treasury, DEFRA, DCLG, DTI: and other agencies such as SDC, EA, NE.
• Industry partnerships: these will follow the annual cycle of sectoral studies: likely to include construction: energy: food etc.
• NGO partnerships may also emerge as specific initiatives in collaboration with others.

14.3.9 Milestones & follow-on
The programme is arranged on a rolling annual basis with a clear pattern of delivery, linked into the external policy cycle.

• Integrated accounts: released in November to coincide with the Pre-Budget Report / Comprehensive Spending Review.
• Forward budget: published in March: to coincide with the national Budget
• Market strategy: published in July: to coincide with the pre-recess policy cycle.

The final outputs are projected to the 2009-2010 year. This will contain final versions of each of the 3 main outputs, together with a national launch, final reports, and a follow-on or exit strategy. For this the details are yet to emerge, but at this stage there are possibilities:

• A freestanding One Planet Economy ‘Institute’, or other organization which is able to build the evidence, assemble best practices and provide advocacy.
• This may be formed as a company limited by guarantee with charitable objectives.
• The ‘Network’ component of the OPEN will over time be structured into layers of ‘supporters’, ‘friends’ and ‘subscribers’, in order to harness the expertise, and particularly the legacies, of a wider community.

14.3.10 Next steps
In the first instance, interested parties are invited to:
• Register for the virtual network on www.ecologicalbudget.org.uk
• Contribute to this consultation process as follows, using the form as in Section 1.

The consultation questions are raised for each of the sectors in the Technical Report: i.e. food & farming: built environment: transport: goods & products: commercial services: public services:
energy & emissions: resources & waste. The main form is reproduced in each of these technical reports.

Please supply your responses on the sectors wherever you have interest and expertise, using the forms as a guide. Each response can be anything from a short note marked up on the form, to an extended discussion by email. Where possible the research team will follow up selected responses by phone. Otherwise, respondents are invited to submit a marked up form and/or extended responses by email. Responses will be treated in strict confidence, unless permission is given for attributed quotes.

When complete, please return email responses and/or marked up forms to:

Stuart Bond, WWF-UK, Panda House, Godalming, GU7 1XR
Tel: 01483 426444: Fax: 01483 426409
sbond@wwf.org.uk
www.wwf.org.uk
15. Appendix

15.1 SUMMARY ACCOUNTS

This section shows some selected summary tables from the Ecological Budget UK accounts. These tables are based on the REAP database and related workbooks.

15.1.1 Table A: material flows

Shows aggregate material flows through the UK economy, per person: note that Direct Material Input (DMI) includes primary industries plus all imports. Detailed material data is available only for SIC sectors 1-84, ie. Primary & manufacturing.

<table>
<thead>
<tr>
<th>Domestic production</th>
<th>UK imports</th>
<th>UK exports</th>
<th>controlled waste</th>
<th>other waste</th>
<th>recycled &amp; reused</th>
<th>import fraction of DMI</th>
<th>waste fraction of DMI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t/cap</td>
<td>t/cap</td>
<td>t/cap</td>
<td>t/cap</td>
<td>t/cap</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Agriculture, forestry, fish</td>
<td>1.65</td>
<td>0.28</td>
<td>0.06</td>
<td>1.47</td>
<td>17%</td>
<td>99%</td>
<td></td>
</tr>
<tr>
<td>Mining and quarrying</td>
<td>9.63</td>
<td>1.69</td>
<td>1.92</td>
<td>1.57</td>
<td>18%</td>
<td>16%</td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>5.74</td>
<td>1.95</td>
<td>1.30</td>
<td>0.72</td>
<td>34%</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>Electricity, gas, water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>45%</td>
<td>36%</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28%</td>
<td>28%</td>
<td></td>
</tr>
<tr>
<td>Wholesale &amp; retail</td>
<td>0.31</td>
<td>0.14</td>
<td></td>
<td></td>
<td>22%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Transport &amp; comms</td>
<td>0.04</td>
<td>0.02</td>
<td>0.04</td>
<td></td>
<td>28%</td>
<td>28%</td>
<td></td>
</tr>
<tr>
<td>Financial intermediation</td>
<td>0.03</td>
<td>0.01</td>
<td>0.01</td>
<td></td>
<td>22%</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>Public administration</td>
<td>0.07</td>
<td>0.01</td>
<td></td>
<td></td>
<td>22%</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>Education, health, social</td>
<td>0.07</td>
<td>0.01</td>
<td></td>
<td></td>
<td>22%</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>Other services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22%</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>Domestic</td>
<td>0.59</td>
<td>0.12</td>
<td></td>
<td></td>
<td>20%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Private transport</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Other flows</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3.92</td>
<td>3.28</td>
<td>1.91</td>
<td>5.37</td>
<td>35%</td>
<td>35%</td>
<td></td>
</tr>
</tbody>
</table>

Direct Material Input (DMI) 15.2
### 15.1.2 Table B: 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)

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

### 15.1.3 Table C: energy & emissions

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

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

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

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

### 15.1.5 Table E: resource productivity by energy & emissions

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

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

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


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### 15.3 Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>BATNEEC</td>
<td>‘best available technology not entailing excessive cost’</td>
</tr>
<tr>
<td>BAU</td>
<td>‘business as usual’ scenarios</td>
</tr>
<tr>
<td>BPEO</td>
<td>‘best practicable environmental option’</td>
</tr>
<tr>
<td>CAP</td>
<td>Common Agricultural Policy</td>
</tr>
<tr>
<td>CE</td>
<td>Cambridge Econometrics</td>
</tr>
<tr>
<td>CCL</td>
<td>Climate Change Levy</td>
</tr>
<tr>
<td>CCP</td>
<td>Climate Change Programme</td>
</tr>
<tr>
<td>COICOP</td>
<td>national database of household expenditure</td>
</tr>
<tr>
<td>CSR</td>
<td>corporate social responsibility</td>
</tr>
<tr>
<td>CURE</td>
<td>Centre for Urban &amp; Regional Ecology</td>
</tr>
<tr>
<td>DA</td>
<td>devolved administration, i.e. Wales, Scotland, Northern Ireland</td>
</tr>
<tr>
<td>DBFO</td>
<td>design, build, finance &amp; operate scheme</td>
</tr>
<tr>
<td>DCLG</td>
<td>Department of Communities &amp; Local Government</td>
</tr>
<tr>
<td>DEFRA</td>
<td>Department of Environment, Food and Rural Affairs</td>
</tr>
<tr>
<td>DFT</td>
<td>Department for Transport</td>
</tr>
<tr>
<td>DPSIR</td>
<td>‘driving forces, pressures, state, impact, response’ framework for indicators</td>
</tr>
<tr>
<td>DTI</td>
<td>Department of Trade and Industry</td>
</tr>
<tr>
<td>EA</td>
<td>Environment Agency</td>
</tr>
<tr>
<td>EEA</td>
<td>European Environment Agency</td>
</tr>
<tr>
<td>EFTA</td>
<td>European Free Trade Area</td>
</tr>
<tr>
<td>ESCO</td>
<td>energy services company</td>
</tr>
<tr>
<td>ETS</td>
<td>Emissions Trading Scheme</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>F-4</td>
<td>factor four reduction scenario</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>IA</td>
<td>integrated assessment</td>
</tr>
<tr>
<td>ICT</td>
<td>information &amp; communications technology</td>
</tr>
<tr>
<td>IPCC</td>
<td>Inter-Governmental Panel on the Scientific Assessment of Climate Change</td>
</tr>
<tr>
<td>IPPC</td>
<td>‘integrated pollution prevention and control’</td>
</tr>
<tr>
<td>ISEW</td>
<td>‘Index of Sustainable Economic Welfare’</td>
</tr>
<tr>
<td>LCA</td>
<td>life-cycle analysis of environmental impacts</td>
</tr>
<tr>
<td>MBI</td>
<td>market-based instrument</td>
</tr>
<tr>
<td>NE</td>
<td>Natural England</td>
</tr>
<tr>
<td>NHS</td>
<td>National Health Service</td>
</tr>
<tr>
<td>ODPM</td>
<td>Office of the Deputy Prime Minister</td>
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<tr>
<td>ONS</td>
<td>Office of National Statistics</td>
</tr>
<tr>
<td>OPEN</td>
<td>One Planet Economy Network</td>
</tr>
<tr>
<td>OST</td>
<td>Office of Science &amp; Technology</td>
</tr>
<tr>
<td>PBR</td>
<td>Pre Budget Report</td>
</tr>
<tr>
<td>PFI</td>
<td>Private Finance Initiative</td>
</tr>
<tr>
<td>RDA</td>
<td>Regional Development Agency</td>
</tr>
<tr>
<td>REEIO</td>
<td>Regional Economy-Environment Input-Output (software model)</td>
</tr>
</tbody>
</table>
REAP  Resource & Energy Analysis Programme (software model)
RSS  Regional Spatial Strategy
RSDF Regional Sustainable Development Framework
SA sustainability appraisal
SCP Sustainable Consumption & Production
SCPnet ‘Sustainable Consumption & Production network’
SD ‘sustainable development’ scenario
SEA strategic environmental assessment
SEI Stockholm Environment Institute
WFD EU Water Framework Directive
WTO World Trade Organization
WDA waste disposal authority
Biffaward Programme on Sustainable Resource Use

Objectives  This report forms part of the Biffaward Programme on Sustainable Resource Use. The aim of this programme is to provide accessible, well-researched information about the flows of different resources through the UK economy based either singly, or on a combination of regions, material streams or industry sectors.

Background  Information about material resource flows through the UK economy is of fundamental importance to the cost-effective management of resource flows, especially at the stage when the resources become ‘waste’.

In order to maximise the Programme’s full potential, data will be generated and classified in ways that are both consistent with each other, and with the methodologies of the other generators of resource flow/waste management data.

In addition to the projects having their own means of dissemination to their own constituencies, their data and information will be gathered together in a common format to facilitate policy making at corporate, regional and national levels.

More than 30 different mass balance projects have been funded by Biffaward. For more information on the Mass Balance UK programme please visit www.massbalance.org

The mission of WWF is to stop the degradation of the planet’s natural environment and to build a future in which humans live in harmony with nature, by:

- conserving the world’s biological diversity
- ensuring that the use of renewable resources is sustainable
- promoting the reduction of pollution and wasteful consumption

www.wwf.org.uk