Executive Summary and Overall Results

ES 1 Introduction

ES 1.1 The Taking Stock project

The Taking Stock project set out to analyse the material metabolism of the residents of the South East region of England and to investigate ways to reduce its global impacts.

- The context is the UK Government's target of ***60% reductions*** in climate emissions by 2050, as in the Energy White Paper. This is the scientific advice for reductions necessary between all nations.
- The Taking Stock project recognises the inequalities between rich and poor nations and their different contributions to climate change and other impacts. So for the South East region, one of the richest in the world, it sets out a target of ***'Factor Four'***: a ***75% reduction*** in the Ecological Footprint.
- To support this target the project has analysed the entire physical throughput of materials and energy in the South East region, using best available data.
- It has also reviewed current policies and strategies in the region, and then reviewed alternative development paths and scenarios for the next 25–50 years.
- The analysis is mainly based on 'consumption' rather than production within the region. As many industries and supply chains are increasingly global in scale, this is a more comprehensive kind of analysis.
- The results focus on three main physical indicators: direct and/or indirect material consumption; CO_2 as the main climate change emission; and ecological footprint, measured in 'global hectares per year'.

ES 1.2 The Factor Four question

The following sections keep coming back to the central question:

> *How to achieve the Factor Four levels of reduction in ecological footprint, to move the region towards environmental sustainability?*

The current conventional answer to this is to halve resource use, while doubling resource efficiency.[1] In practice most of the trends are going in the opposite direction – resource use being closely tied to economic growth: the implication is that the resource usage which we are aiming to halve, is projected to triple in size by 2050. In other words, the scale of the challenge is huge, and this report can only aim to open up the agenda.

[1] von Weizsacker, E, Lovins, A & Lovins, L.H, 1997: *'Factor Four: Doubling Wealth, Halving Resource Use'*: London, Earthscan

ES 2 Material flows and ecological footprint in the South East region

In this section the overall totals of the Material Flow Analysis and Ecological Footprint calculations are presented for the South East region in the year 2000.

The summary results are deliberately rounded to very few digits. The MFA–EF accounts are estimated to be accurate to within +/- 5%, but the definition of classifications and accounting frameworks is itself uncertain to within +/- 10 or 20% depending on the category.

ES 2.1 Material flow results

- The direct material consumption (DMC) for the South East region is 88 million tonnes per year. This equates to **11 tonnes per person**.
- The total material consumption (TMC) (including indirect material flows of imports and domestic production) is 211 million tonnes per year. This equates to **26 tonnes per person**.
- The largest single component of the direct material consumption (DMC) is the construction sector, with 50.5 million tonnes per year of bulk materials.
- The result of the TMC is a total climate change emissions in the form of CO_2, of **158 million tonnes** per year. This equates to **19.5** tonnes per person.

ES 2.2 Total ecological footprint

- The calculation for ecological footprint (EF) shows a total of **55 million** global hectares (mgha/yr). This equates to **6.8 global hectares per person.**
- The total EF from all activities is 29 times the physical land area of the region (1.9 million hectares). The total construction footprint area ('real land' + 'energy land') is 5 times larger than the actual area of the region. (As the name suggests, 'global hectares per year' is a notional accounting quantity distributed around the world).
- The largest single component of the total EF is the food/agriculture sector, with 25% of the total.

ES 2.3 Ecological footprint analysis

'Internalisation'

This is an experimental measure, based on the ratio between direct and total material consumption (DMC/ TMC):

- The least internalised sectors (i.e. the most intensively manufactured) are the cars and electronic products.
- The most internalised sectors (i.e. where production and consumption have the largest overlap in accounting frame) are the construction and transport sectors.

ES 2.4 Production vs consumption

The CO_2 emissions in 'production' (i.e. direct emissions accounted for in the region) are 36% of the CO_2 emissions in consumption. **This suggests that two thirds of the physical activity which maintains the affluence of the South East region, takes place elsewhere in the world.**

ES 3 Food and agriculture

ES 3.1 Material flow results

The ***consumption by weight*** per year of all food and drink in the South East region shows the following totals (defined as ***Direct Material Consumption***):

- Total food consumed by households in the South East region: ***5.0 million tonnes*** (620 kg per person per year = 1.7 kg per person per day).
- Total food consumed by commercial/public catering in the South East: ***0.9 million tonnes*** (111 kg per person).
- Total direct weight of packaging supplied with household food in the region: ***0.66 million tonnes*** (81 kg per person = 0.2kg per day).

Over 1 million tonnes per year of ***food and drink goes to waste*** directly, of which 88% goes to landfill disposal:

- 700,000 tonnes of household food is wasted, at an estimated rate of 14% of the total.
- 386,000 tonnes of catering food is wasted, at an estimated rate of 43% of the total.

The Total Material Consumption Requirement of food and drink (TMC) is much larger (this is defined as the total life-cycle-wide material use associated with domestic consumption activities, including indirect flows imported but minus exports and associated indirect flows):

- Total materials involved in food consumption in households in the South East region: ***25 million tonnes per year*** (3 tonnes per person per year = 8 kg per person per day).
- Total materials involved in final food consumption in commercial/public catering in the South East: ***2 million tonnes per year*** (250 kg per person per year).
- Total materials involved in packaging of all food in the region: ***4.14 million tonnes*** (500 kg per person per year = 1.4 kg per day).

ES 3.2 Ecological footprint results

The ***ecological footprint (EF)*** of food/drink consumption in the South East is the consumption sector with the largest single EF, equivalent to over a quarter (25%) of the total EF from all activities:

- Food/drink in households: 1.48 gha/yr (global hectares) per person per year
- Food/drink in catering: 0.15 gha/yr per person per year
- Food/drink packaging: 0.07 gha/yr/yr per person per year

In contrast to other sectors, the ***'energy land'*** (notional land to take up energy and emissions) is of a very similar size to the ***'real land'*** (actual land used in food production). Each is approximately 0.8 gha/yr/cap.

In terms of the breakdown of ***food types,*** including both household and catering:

- Meat and meat/dairy product consumption accounted for two thirds (66%) of the total EF from food and drink.
- Cereals and other plant based food accounted for ***23%*** of the total EF.
- Drinks of all varieties accounted for ***6%*** of the total EF.
- Packaging of all kinds accounted for ***4.5%*** of the total EF.

ES 3.3 Trends in food policy

Regional policy has had little engagement with food issues since World War II, when basic production became an overriding priority. This is now changing and a range of factors are involved:

- ***Regional image and marketing*** - The Countryside Agency programme 'Eat the view' is a forerunner of more regional based food activity, already well established in many EU countries.
- ***Food and drink production*** as a priority sector for economic development. Often low skill with high environmental impact, this industry is seen as an essential part of many regional strategies.
- ***Regional countryside policy*** - this may prioritise farm or land-related employment and intermediate labour market activity.
- ***Regional housing policy*** - may seek to encourage new forms of low impact rural housing, to maintain populations and landscape quality, while avoiding the spread of commuter settlements.
- ***Regional landscape policy*** - in most areas the social or visual amenity is closely linked to the maintenance of a populated and diverse agricultural landscape.
- ***Regional climate change policy*** - the extra pressures put on the landscape and habitats by climate change and extreme events may be ameliorated by a diversified and productive countryside.

ES 3.4 Scenarios for the future

- ***F-0: High growth scenario*:** with rapid economic growth food supply follows a free market model, with falling subsidies, rising imports and chemical use and more pre-cooked convenience foods.
- ***F-1: Business as usual scenario*:** Based on a continuation of current trends, i.e a rise in packaging, processing and imports, alongside a rise in vegetarian and organic production and food waste composting.
- ***F-2: Low growth scenario*:** In a scenario of market failure and environmental hazards, prices rise steeply and food hazards affect spending choices, resulting in a move to more localised production. Demand for cheap 'industrial' food also rises in towns, increasing chemical intensity and packaging.
- ***F-4: Factor Four scenario***: This scenario represents a gradual adjustment towards a more sustainable, low impact food system. Imports decrease, with more regional and organic production and greater diversity. Plant based diets increase, accelerated by further food scares. Packaging becomes re-usable and recyclable and composting increases. EF for food and drink reduces by 75% by 2050.

ES 4 Energy and water

ES 4.1 Energy consumption in households

- Total energy consumed in households per year: 75,000 million units or kWh (kilo-Watt hours), or 9,000 units per person. Three quarters of this is supplied by gas.
- This energy supply produces over 2 tonnes of CO_2 per year per person.
- Total EF of this energy is 4.7 million hectares, or 0.6 hectares per person. This equates to about 9% of the total per person.
- Over half of the energy consumed in homes is for space heating, 18 % is for cooking, lighting and appliances, and most of the remaining 24% is for heating water.
- The current price of electricity per unit is 4.5 times as much as the price of gas (7.3p/ kWh, compared to 1.6p/kWh)

ES 4.2 Energy consumption in services

- Total energy consumed in services: 28,000 million units. Half of this is in gas, a third in electricity, and the rest mainly in oil.
- Total EF of this energy: over 2 million hectares: or over 4% of the total.

  (Industrial energy and its footprint is counted indirectly, via the products which are consumed in the region)

ES 4.3 Energy supply and demand balance

- Nearly all the energy produced directly within the region is in the form of electricity: 30% from coal, 25% from gas, and 40% from nuclear. The region imported about one third of its power via the national grid.
- Electricity supplied only 13% of the total energy demand in the region: but because of the relative inefficiency of power generation and transmission, the primary fuels for power were nearly 30% of the total.

ES 4.4 New forms of energy supply

- Renewable energy supply in the South East region was under the national average, at less than 1% of the total, nearly all of this coming from waste incineration.
- The South East renewable energy strategy anticipates half of the potential coming from offshore and onshore wind farms, and most of the rest from biomass fuels.
- Woking Borough Council is possibly the most energy efficient in the UK. It has established the UK's first Energy Services Companies, demonstrated new technologies in combined heat and power distribution, and achieved a 40% reduction in its own CO_2 emissions.

ES 4.5 Trends and targets

- The current 'best practicable' target is for renewable energy to supply 6% of the South East production of electricity. This is lower than the national target to supply 10% by the year 2010.
- At present demand is rising slightly, while CO_2 emissions are reducing slowly due to the shift to gas power.
- A recent report on energy futures foresaw the end of cheap North Sea gas at a time when most of the world's diminishing fossil fuels reserves will be in the most politically unstable regions.
- The long term target is for the UK and the South East region to move towards the scientific target of 60% reduction in CO_2 emissions by the year 2050.
- The key question in achieving a Factor 4 reduction is whether this can be achieved by greatly expanded renewable energy, greatly improved efficiency, or a new set of nuclear power plants.

ES 4.6 Energy futures and scenarios

- ***F-0: high growth scenario***: this sees continuing growth at 1% per year in the EF of the regional energy supply, resulting in a 60% increase by 2050.
- ***F-1: business as usual scenario:*** this combines the government's aspirations in the Energy White Paper, with the realities of globalised industry: the result is an EF which changes little between now, 2020 and 2050.

- ***F-2: low growth scenario:*** this sees energy use, carbon emissions and the total EF reducing by about 1.5% per year, a result of economic stagnation and the increasing disruption of climate change, with impacts on the distribution between wealthy and poorer communities.
- ***F-4: Factor 4 scenario:*** this combines demand reduction through pro-active efficiency programmes, and a rethinking of energy supply systems. All new development is effectively zero-energy net requirement: energy services companies mediate between suppliers, distributors and users: regional renewable energy is a major growth industry. The result is a reduction in carbon emissions and EF of 35–40% by 2020, and 75% by 2050.

ES 4.7 Water supply and demand

- Nationally, about half of all water use is for cooling power stations. Public water supply for households and for services accounts for 30 per cent of consumption.
- Household water consumption in the South East amounts to 165 litres per person per day, or about 60,000 litres per person each year. One third of this goes in flushing of WCs.
- The energy use in the South East water supply system is 860 million units or kWh (kilo-Watt hours). Supply to households, and the drainage/sewage system, are each about 40% of the total. Most of the rest goes in leakages.
- The ecological footprint of the South East water supply system is about a sixth of 1% of the total EF per person.

ES 5 Household durables

ES 5.1 Material flow results

The largest single item of household consumption is of the private car/other vehicle and the trend towards larger SUVs is accelerating the growth in material impact. However the tonnage of furniture is not far behind, although this contains a larger proportion of renewable materials:

- New cars are bought by 1 in 20 people on average every year: the result is the annual consumption of 50 kg of new car per person (415,000 tonnes per year in the South East).
- Householders consume on average 50 kg of furniture, fittings and miscellaneous fixed items (400,000 tonnes in the South East).
- Householders consume on average 13 kg per year of household electrical appliances, including washing machines, computers, television, hi-fis and so on (100,000 tonnes in the South East region).
- Almost a quarter of all appliances by weight are washing machines (22,000 tonnes per year), with fridges at 10,000 tonnes per year, large TVs (10,000 tonnes per year), and personal computers (6,000 tonnes per year).
- Overall, the household durables TMC (total material consumption) is 6% (12.5 million tonnes) of all consumption in the South East region. A third of this is from purchases of cars.

ES 5.2 Material composition

- The main materials in a new car include, by weight, over half in steel, 11% in plastics and 11% in aluminium products. Rubber for tyres is only 5% of the total.
- In household furniture, paper/pulp-based products including chipboard are a third of the total materials: wood, steel and plastics are each 8–10%.
- In household appliances, steel comprises 40% by weight, with over 20% in miscellaneous materials.

ES 5.3 Ecological footprint

- Durable items are generally highly manufactured and hence have large indirect material and energy requirements: for every tonne of direct material consumption (DMC), there are over 12 tonnes of total material consumption (TMC). However the data available is only a sketch of a very complex set of supply chains.
- The largest single footprint item is from cars and other vehicles. Ten per cent of the ecological footprint of car use is due to manufacture and maintenance of cars.[2]
- In furniture the 'real land' footprint component is half the total, mainly due to use of wood. By contrast, in electrical goods, the 'real land' component of the footprint is only 1% of the 'energy land' component.

ES 5.4 Trends in household durables

Future trends depend on 'saturation' and 'turnover', i.e. whether consumption slows down once all households have a particular item. This is difficult to predict as lifestyle and fashion becomes as strong an influence as functionality, and technological improvement is the main driver of new purchases.

- Past trends show growth in consumption from 1% to 3% per year in various items.
- Imports of manufactured goods have increased by 6 times in 30 years (a growth rate of 7% per year). Exports of manufactured goods have increased by 4 times (5.5% per year).
- 93% of households in the South East have a freezer but only 31% have a dishwasher and ownership trends are likely to reach saturation at 100%; whereas purchases of televisions is likely to grow until there is one in each room, and perhaps beyond that.
- Nearly half of households have 1 vehicle and over a third have two; in fact only 1 in 6 have no car at all. There will be some effect in saturation of ownership, while purchases and turnover continue to grow.

ES 5.5 Scenarios for the future

The scenario approach is particularly important for this sector, which is less predictable and more open to a wide range of possibilities:

[2] This analysis is provided in Chapter 3.2.

- ***F-0: high growth scenario***: the 'throw-away' economy continues to accelerate: consumers are driven by mass media to work harder and buy more.
- ***F-1: business as usual scenario***: current trends continue with steady growth in purchases of furniture, cars and electrical goods; even when every person is the owner of all common products and the quality of such products continues to rise.
- ***F-2: low-growth scenario***: material consumption declines but mostly for the wrong reasons – economic stagnation, social malaise and environmental disruption. The cost of energy and raw materials goes up.
- ***F-4: Factor Four scenario***: the win-win scenario sees the quality and efficiency of household durables continue to rise. Equally important, the fixation of consumers on acquisition of new products begins to dwindle as more people find satisfaction in non-material experiences. Much economic growth takes place in the social economy, where sharing, networking, re-use and recycling of goods is a major economic sector.

ES 5.6 Regional policy

The government published in 2003 its strategy for 'Sustainable Production and Consumption' (SCP). This is more a review of possibilities than a fixed plan of action, but the main themes include:

- "Taking a holistic approach that considers whole life-cycles of products and services, intervening to deal with problems as early as practicable in the resource/waste flow.
- Working with the grain of markets and identifying and tackling market failures.
- Integrating SCP thinking and objectives in all policy development and implementation.
- Using a well-designed package of policy measures and following the principles of better regulation.
- Stimulating innovation in all its facets."

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

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

ES 6 Household consumables

ES 6.1 Material flow results

- The South East regional direct material consumption (DMC) of household 'consumables' is over 1 _ million tonnes per year, or nearly a quarter of a tonne per person.
- The total material consumption (TMC), including indirect material flows, is six times greater at nearly 12 million tonnes per year. This comprises 5% of the TMC from all activity in the South East region.
- There are a few larger product types by weight: newspapers are 19% of the total, and other paper products over a third. Toilet paper comes in at almost 7% of the total, at around 14 kg per person per year.
- Pet food is almost a quarter million tonnes per year, with a higher than average footprint, due to the highly intensive meat content (bearing in mind that the average UK dog is better fed than the average human in the poorest 20% of the world).
- There is little data available on stocks and turnovers for most items: products such as newsprint tend to pass through the household in a matter of days, whereas clothing and shoes may last a number of years.

ES 6.2 Material composition

- The main materials in this hugely diverse range of products are dominated by paper based products in newspapers, books, cardboard boxes and chipboard products of every variety.
- Soaps and other household chemicals are 12% of the total, while textiles are 4% of the total by weight.
- Although household consumables are a small proportion of the total by weight, they form a major part of the household waste stream, at over 30%.

ES 6.3 Ecological Footprint

- The total EF from all consumables is 5% of the total EF from all activity, or 0.37 gha/yr (global hectares) per person.
- The product with the largest single footprint is pet food, with 22% of the total EF. Stationery, newspapers and books together comprise 40% of the total.
- The footprint of wood and pulp-based products such as paper, card and toilet tissue are two thirds 'real land' based. The EF of petfood is about even between 'real land' and 'energy land'.

ES 6.4 Trends in household consumables

The demand for consumables is driven by a combination of factors, which are often less predictable and apparently more volatile than with other more fixed sectors:

- Technology: the pace of innovation continues to drive or induce demand, as last year's styles or models fall behind in performance and quality.
- Economics: the relative costs and values for many consumables are changing rapidly, to a point where the material content is almost at zero value compared to the supply chain and logistics content.
- Cultural pressures: fashion and lifestyle are the drivers of the majority of consumption of textiles, and other accessories.

ES 6.5 Scenarios for the future

The scenario approach is particularly important for this sector, which is even less predictable that that for 'durables':

- ***F-0: high growth scenario***: the 'disposable' economy continues to drive economic growth. Clothes are bought for a few hours' wear then discarded, while books are downloaded, printed and then shredded in a day.
- ***F-1: business as usual scenario***: current trends continue the growth in consumption from increasingly global supply chains. There is some measure of corporate responsibility, and current levels of gross pollution and exploitation are reduced.
- ***F-2: low-growth scenario***: material consumption declines, but again for the wrong reasons – economic stagnation, social malaise and environmental disruption.
- ***F-4: Factor Four scenario***: this win-win scenario sees the quality and efficiency of household consumables increase rapidly. Pet food is made on the spot from food waste, clothes are made loose fitting and long lasting, and there is an active recycling market which uses sophisticated databasing.

ES 6.6 Regional policy

Even more than in the case of household durables, household consumables have virtually no place in current regional policy. Again it has to be said that the obvious starting point – ***consuming less 'stuff'*** – is apparently opposite to mainstream economic policy and its overriding goal of GDP growth. Again there are potential win-win opportunities:

- Encouraging industrial clusters with integrated materials management systems.
- Innovation in materials and waste management, to create markets for re-use, recycling and other forms of recovery.
- Promoting retail clusters and networks which encourage service economies, i.e. leasing and hiring for a service level, rather than one-off material purchases, where this is appropriate.
- Promoting social economy groups and networks for sharing, re-use and recycling, for items such as clothes, books, household equipment etc.

ES 7 Transport and distribution

ES 7.1 Transport activity results

- The average distance travelled on all forms of surface transport was 13,100 km per person per year, or 36 km per day per person: 85% of the distance was by car, 6% by rail, and 3% by bus. This figure divides into those people with very localised lives – the old and the young – and others who travel much more.
- Half of all journeys are for leisure/personal business, and two thirds if shopping is included. Commuting and business are 23% for males and 15% for females.
- 83% of households have at least one car or other vehicle, and 37% have two.
- The average person in the South East travelled 7,600 km by air per year: 97% of this was international travel and 26% of this was within the EU.
- For walking the reported figure is 303 km per person – less than half a mile per day (although there are questions on how this is measured). Cycling, the most energy efficient mode of all transport, is an average 74 km per person per year, or one mile per week per person. Given these trends it is not surprising that obesity is a growing problem.

ES 7.2 Material flows

- Passenger transport in the South East used a total of over 6 million tonnes of (fossil) fuels. The majority of this is used by cars (53%) and planes (39%). If hidden flows are included the total material flow is 6.9 million tonnes or 850 kg per person per year.
- The result of the combustion of this amount of fuels was CO_2 emissions of over 24 million tonnes per year (3 tonnes per South East resident).
- Air travel (for South East residents) used a total of 2.5 million tonnes of oil, with CO_2 emissions of 7.9 million tonnes per year.
- The reliance on fossil fuel oil is likely to change with the new technologies including gas, vegetable oil, hydrogen, electrical power, and various hybrids of these.

ES 7.3 Ecological footprint

- Transport as a sector is centred on the consumption of fossil fuels, the resulting carbon emissions, and their direct relationship with the footprint. Other effects such as ‘real land’ and other greenhouse gas emissions are a small percentage of the total.
- The total EF of surface travel is 0.53 gha per person, of which 92% is from cars. The total EF of air travel is 0.25 gha per person per year.
- The total EF from all transport is 0.78 gha per person, or 11% of the total aggregated EF for the region. This number includes the environmental impacts of the manufacture and maintenance of cars.

- The relative efficiency of different modes is the key: taxis are by far the least efficient (assuming one-way trips), followed by short-haul air and petrol cars. Long distance coach, rail and long distance flights are relatively efficient. The net effect of course depends on the distance travelled, which in the case of air travel, can be very large.

ES 7.4 Freight transport

The total EF of freight transport is 0.6 gha per person, or three quarters of the total for passenger transport. This includes distribution within the South East region and UK transports as well as imports destined for consumption in the South East. (This category is accounted for elsewhere in the embodied energy and EF of manufactured goods.)

ES 7.5 Trends in transport

- Trends and projections in transport are the subject to many engineering models and policy studies. In recent decades the overall demand for surface transport has been closely linked to economic growth at 2–2.5% growth per year (i.e. a 30–40 year doubling time). Most 'business as usual' projections continue these trends.
- Light commercial transport is growing at a faster rate than passenger, at 3–3.5% per year.
- Air travel is growing at the unprecedented rate of 5–6% per year, with a doubling time of less than 15 years.
- Increasing the rate of growth are affluence/lifestyle factors, technology improvements, the falling price of fuel, and induced demand, for instance from internet-enabled business activities and social networks.
- Restricting the rate of growth are physical limits and infrastructure congestion, time constraints on the part of consumers and businesses, government pricing and fiscal policies, and not least, environmental objectives which may encourage regulation and market measures.

ES 7.6 Scenarios for the future

The scenario approach is well established in transport studies, which combines the engineering approach with a more volatile 'lifestyle' approach:

- ***F-0: high growth scenario***: unrestricted growth in travel demand, and privatisation of networks and infrastructure.
- ***F-1: business as usual scenario***: continuation of current trends, with an uneasy balance between economic, social and environmental objectives.
- ***F-2: low-growth scenario***: decline in the rate of growth through economic slowdown and social division. Climate change, international terrorism and fuel shortages disrupt networks and infastructure.
- ***F-4: Factor Four scenario***: a win-win scenario based on integration of networks, coordination of supply and demand, accelerated technology improvements, and demand side management.

ES 7.7 Regional policy

Transport can be seen as an inbuilt contradiction in late-industrial society, which national and international governments appear to be powerless to solve. It is not surprising that the South East region does not possses hardly a fraction of the resources to provide real solutions. However there are various kinds of enabling measures:

- a multi-sectoral sub/regional integrated transport strategy would use the combined weight of public purchasing for bargaining power, expertise and added value
- incentives for clean technology
- diversification of ownership and access
- integration of diverse networks
- coordination of supply and infrastructure with journey demand and cultural mobility
- use of ICT as the catalyst for integration, diversification and coordination
- demand management, social economy networks for car and lift sharing, green travel plans, coordination of public transport

ES 8 Construction

ES 8.1 Regional activity

- Construction as a whole uses 50.5 million tonnes of materials directly (DMC), and used 100 million tonnes in total material consumption (TMC). This equates to over 12 tonnes for every person in the South East region.
- The construction industry is by far the most mass-intensive of any sector: the direct material consumption is 57% of the regional total DMC from all activity, and the TMC is 47% of the total from all activity.
- However the bulk of this mass is not so energy intensive: construction activity produced 23% of the total CO_2 emissions, and 17% of the total ecological footprint from all activity in the South East region.
- There are 3 million dwellings in the South East region and approx 300,000 other buildings. New housebuilding has recently been at a rate of 22,000 per year. A much greater rate of 28,000 per year, at a 1% per year expansion of the building stock, is proposed in the regional strategy and the government's 'Sustainable Communities' programme.

ES 8.2 Material flows in construction

- Quarry products, including aggregates, sand, crushed rock and limestone, was by far the largest type of material flow, at 43 million tonnes, or 43% of the total material consumption (TMC).
- Cement, concrete and plaster products are the next largest, at 19 million tonnes TMC.
- Slate, bitumen, stone and other non-metallic minerals are also at 18 million tonnes TMC.
- Metal and metal products of all kinds were 8 million tonnes and wood/wood-based products are 6 million tonnes.

ES 8.3 Ecological footprint

- There is an interesting comparison between the EF of construction of the built environment and the actual land area of the South East region, which is 1.9 million hectares. The construction footprint area ('real land' + 'energy land') is 5 times larger than the actual area of the region.
- Most of the EF is taken up with 'energy land', reflecting the high energy intensity of key construction materials (cement, bricks, glass and so on), and the small proportion of renewable materials.
- The total EF from all construction amounted to 9.5 million gha/yr per year: the EF per person was 1.2 gha/yr per person. This amounts to 17% of the total EF from all activity.
- The largest material EF type was 41% with minerals, bitumen and other mineral products: these are both heavy and energy intensive.
- 22% of the construction EF is taken by quarry products, where most of the energy/emissions are involved with transportation.
- 14% of the construction EF is taken by cement and plaster manufacture, which are particularly energy intensive.
- The total footprint from all activity in the South East region is 6.8 gha/yr ('global hectares') per person, which is 29 times larger than the actual area of 0.25 hectare per person.

ES 8.4 Construction end uses and life cycles

- The figures shown here are for construction as a whole. If we assume that material use is evenly spread by construction spending, then there is 25% in housing, 33% in commercial, 11% in public services, 12% in industry and 19% in infrastructure (this last category is likely to use much greater proportions of bulk materials, but regional data is not available.)

ES 8.5 Trends and projections

There are many issues on different levels involved in construction, its environmental impacts, and its future trends and projections:

- Spatial strategy: the location, density and form of buildings.

- Built environment activity in the urban system: the provision of new buildings for housing, commercial and public services, and the balance of stock/turnover/demolition.
- Construction design and materials: the materials and their energy intensity required per unit of floorspace.
- Building energy and other demands over their life cycle: the length of that life cycle and their eventual fate.
- Each of the above is influenced by property market, finance, legal and professional issues: for instance where landlord/tenant split responsibility is a constraint to energy efficiency.
- Each of the above is also influenced by lifestyles and cultural shifts: for instance the move towards urban living, or away from timber frame housing.

ES 8.6 Scenarios for the future

The many issues above suggest a scenario approach. Any 'bottom up' studies on the future of construction need to combine an engineering approach with a more intangible approach:

- ***F-0: high growth scenario***: unrestricted growth in urban development, with privatisation of infrastructure, and growing use of energy and materials.
- ***F-1: business as usual scenario***: continuation of current trends, with strict controls on land use, but increasing amounts of imported materials for buildings which tend to be larger, multi-storey and higher density.
- ***F-2: low-growth scenario***: this sees a decline in the rate of construction through economic stagnation, social conflict and environmental hazards. Materials are increasingly expensive but environmental regulation is a luxury that few can afford.
- ***F-4: Factor Four scenario***: a win-win scenario based on integration of planning and development at different scales, coordination of supply and demand, accelerated technology improvements, and demand side management.

ES 8.7 Regional policy

The regional spatial strategy has an influence on density and location, and local planning and building regulations have limited influence up to a point on building form and energy efficiency.

To go further than this, particularly for the existing building stock, would require a new raft of regional powers and resources, which might include:

- Integrated energy services consortiums which achieve step changes in energy efficiency by coordination with utilities, financiers, developers, designers, contractors, owners and tenants.
- Integrated resource management enterprises, which achieve step changes in material efficiency and material impact, by coordination between designers, contractors, material suppliers, demolition and waste managers, in the re-engineering of the built environment.

ES 9 Waste management

ES 9.1 Material flow results

A total of 36.8 million tonnes of waste were produced in the South East region in 2000. Over one third of this was in construction and demolition (C&D) waste – nearly all of which is inert waste (non-biodegradeable).

The waste management industry dealt with 25 million tonnes of this waste, including 4.2 mt of municipal solid waste (MSW), 7.2 mt commercial and industrial (C&I), and 13.5 mt of construction and demolition waste (C&D). Special and hazardous wastes, such as car tyres and hospital wastes, amount to 500,000 tonnes.

- The 6 million tonnes of quarry and mining waste is generally managed on site, as is the 6 million tonnes of agricultural waste.
- The 4.2 million tonnes of 'municipal' waste (i.e. collected by local authorities) is only 11% of the total, but the most difficult and expensive to deal with, as it is a mixture of material types, spread around in many locations.
- Commercial waste was around 5.8 million tones, almost 16% of the regional total, with industrial waste (excluding all construction waste) of approximately 1.4 million tonnes. Each of these have much higher rates of recycling and recovery, as they have generally larger volumes of recycleable materials.
- Commercial waste is notable as nearly half of it is in paper and card products; around 30%of the total is recycled at present.
- Sewage sludge amounted to 151,000 tonnes per year: this is small in relation to total waste flows, but a sizeable problem.
- The South East also took 3.2 million tonnes of waste from Greater London, much of this in C&D waste, and this volume is projected to be halved in 20 years.

ES 9.2 Ecological footprint

The EF method is detailed in the next section, and should be seen as a 'satellite account', i.e. not to be added to the EF of the main consumption sectors for the region as a whole.

- The EF for municipal solid waste management in the South East region amounts to 4.5 million gha/yr: this equates to 8% of the overall regional total EF.
- From the Municipal Solid Waste stream (MSW), paper and card carries over 50% of the total EF from MSW landfill. Other combustibles account for 16%.
- For construction and demolition waste (C&D), some notional EF can be derived in terms of the tonnage of bulk material taken to landfill, which amounts to 13.4 million tonnes (this excludes hazardous and contaminated waste).
- Other waste streams including agricultural and quarry wastes are accounted for separately in the EF factors for production in the relevant sectors.

ES 9.3 Regional strategy analysis

The regional waste strategy was analysed in terms of each material stream and for the overall EF (Chapter 4). The results show that a 58% reduction in EF from the waste sector is possible by 2020. This assumes the 'central' growth scenario of the regional strategy, which forecasts a 60% growth in waste arisings by 2020.

The benefits in EF depend on moving rapidly towards the technical optimum for recycling of each material type, with 70–80% for metal, glass and paper, and 55% for the waste stream as a whole. This also assumes that recycled materials are put to 'high-level' uses, i.e. substituting for the original material, rather than being used as bulk fill. It also assumes, bravely, that recyclables markets are working perfectly, i.e. that there are no mountains, dumps or pinch points. (This has not been confirmed by recent experience in recyclables markets.)

ES 9.4 Policy context

The South East Regional Waste Strategy (consultation draft 2003) is based on the 'central' growth scenario for waste arisings, a 60% rise by 2020. To achieve the reduction in landfill disposal required by the EC Directive and UK guidance, the Strategy proposes rapid increases in recycling, and a diversity of treatment technologies, with more benefits coming from larger facilities.

However in the sustainability appraisal, the question of waste minimisation was left outside the study boundary. Arguably this question is crucial to considering the waste strategy as part of a larger regional strategy for 'integrated resource management'.

ES 9.5 Future trends and drivers

Waste arisings are difficult to project and to model: there is great uncertainty on the current growth rate of waste arisings, and future trends need a scenario approach with a range of factors.

The basic drivers are population, which is relatively predictable, and economic growth and/or disposable income, which is less so. Hence the estimation of the strategy's 'central' scenario as based on 'population growth + 2% tapering off to 0.5%', represents a combination of aspiration and anticipation, rather than anything more scientific. Behind this lies a great diversity of influences:

- Product composition and structure: materials and compounds, particularly those which are chemically hazardous or physically difficult to separate.
- Packaging volumes and designs, which is a result of supply chain logistics and distribution as much as technology.
- Design for re-use, re-engineering, disassembly or other means of recycling or recovery.
- Cost of raw materials vs recycleate markets, and the degree of intervention in such markets.
- Infrastructure for distribution collection and re-distribution, and 'participation rates' among householders and businesses.
- Infrastructure and new technology for waste management.

ES 9.6 Scenarios for the future

F-0: high growth scenario: 3% annual growth in waste arisings continues as increasing amounts of material are processed, purchased and disposed, in ever shorter time cycles. Mechanical biological treatment (MBT) is increasingly used, but this is energy intensive and waste EF doubles in 25 years.

F-1: business as usual: This scenario reflects a combination of aspiration and reality on the part of the SE Regional Waste Strategy. Waste grows at around 2% per annum. A diverse mixture of larger scale technologies is introduced, with a rather brave assumption that recycling rates increase up to 50-75%.

F-2: low growth scenario: This assumes that whatever can go wrong probably will. Householders don't participate, new facilities cannot get planning permission, the MBT technologies don't work as expected, and there is a shakeout of commercial operators, all of which results in chaos.

F-4: Factor Four scenario**:** This scenario assumes rapid waste minimisation giving a 14% reduction in waste by 2020*,* coupled with maximising recycling rates for each material stream. It depends on social and political changes to produce the desired framework for integrated resource management. There would be a halving of waste arisings, with a doubling of efficiency in recovery or recycling by 2050.

ES 9.7 Implications for regional policy

The regional waste strategy has set out its stall, with the implication that only an ambitious shift towards a low-impact waste system can deliver the targets with the maximum of benefits. The consultation question is basically on the appropriate balance of aspiration (exceeding the targets) with practicality (meeting the targets). However there are risks in relying partly on new methods with unproven technologies and commercial viabilities. There is also a risk that the environmental and EF targets will be missed, because the question of where the waste comes from, and how far the stream can be minimised, is mainly outside the powers or resources of the public sector.

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

ES 10 Conclusions and next steps

ES 10.1 Material flows in the South East region

The first set of findings sums up the material flow or throughput of the region:

- The direct material consumption (DMC) for the South East region is 88 million tonnes per year. This equates to ***11 tonnes per person***.
- The total material consumption (TMC) (including indirect material flows of imports and domestic production) is 211 million tonnes per year. This equates to ***26 tonnes per person***. The total input is 2.5 times the direct material input to the regional economy.

- The direct outflow of materials in solid waste form amounts to 36.8 million tonnes per year: 25 million tonnes of this goes into the waste management system.
- The build up of products in the regional economy is in the order of 33 million tonnes per year (4 tonnes for every person).

ES 10.2 Climate emissions in the South East region

The second set of findings focuses on the difference between production and consumption, or between regional and global figures for climate emissions, (here expressed as CO_2):

- Total CO_2 ***emissions within the region*** are 58 million tonnes per year: about half of this is in private transport and heating of homes.
- Total CO_2 ***emissions due to consumption*** by the region, are 158 million tonnes per year: i.e. the emissions involved in delivering the level of affluence of the South East region.
- Therefore, depending on how the calculations are done, around 3 times as much CO_2 is involved in 'consumption' with impacts spread around the world, as in 'production' within the region.
- ***This shows that current policy targets for climate emissions are at best incomplete, and at worst misleading. The UK is now on course to meet its short term domestic climate emissions targets, while continuing to increase its real impact at a global level.***
- There is an urgent need to standardise EF methods and databases so that a more significant indicator of global impact can be reported at regional and national levels.

ES 10.3 Ecological footprint in the South East region

The third set of findings focuses on the ecological footprint (EF) itself *(This is measured in 'global hectares per year', a notional accounting unit for impact which is distributed around the world. The totals here are provisional and subject to resolving questions on double counting and definition of boundaries.).*

- The ecological footprint (EF) from all consumption-related activity shows a total of **55 million** global hectares (mgha/yr).
- This equates to 6.8 global hectares per person..
- This total EF is 29 times the physical land area of the region (1.9 million hectares). This land area equates to 0.25 hectare (2/3 acre) per person, or 0.1 hectare in built up areas (4 persons per acre).

ES 10.4 Ecological footprint targets

Here we return to the first question – how to achieve the Factor of Four reductions in ecological footprint for the region as a whole. Clearly, not all sectors are equal to this challenge. As change in each sector involves a combination of social, economic, political, technology and infrastructure factors, we can only suggest where the barriers and opportunities might lie:

- The food sector produces the largest single impact at 25% of EF and 16% of CO_2 There is great scope for localising food production, reducing energy intensive processing and meat content. This could produce an EF reduction target of Factor 4 or 75% reduction.
- The utilities sector (household and commercial energy and water) is responsible for 17% of total CO_2 emissions and 12.5% of total EF. Here, while the technological potential for almost zero energy buildings is proven, achieving it depends on lifestyles and institutions (for instance for the problem of split responsibilities between landlord, utilities and tenants). In this sector an EF reduction target of 'Factor 8' or 87% reduction is suggested.
- Manufactured durables and consumables each show opportunities for demand management, supply chain management, process efficiency, and localised production. In combination these could produce an EF reduction target of Factor 4 or 75% reduction.
- Construction activity is materials and land intensive but again there is potential for demand management, supply chain management, process efficiency, and localised production, with an EF reduction target of Factor 4 or 75% reduction. .
- Commercial and public services show somewhat greater potential for integrated resource management than households. In these sectors an EF reduction target of 'Factor 8' or 87% reduction is suggested.
- The transport sector is responsible for 21% of total EF and 27% of total CO_2 emissions, (including freight transport). Growth is partly due to social equity and cohesion at the local and global scale, and where there are few alternatives to energy intensive technologies: this is particularly the case for air travel. So there is a case for less stringent targets, combining social equity with technological innovation. In this sector a EF reduction target of Factor 2 or –50% is suggested.

Even so the overall targets for 2050 may look extremely challenging but 50 years is a long time. If we look at the 2020 horizon, we see that most of the sectors are aiming at a Factor 1.7 (or around a 40% improvement), in other words a challenging but not impossible rate of progress. The South East Regional Waste Strategy shows a very similar or even greater rate of change.

ES 10.5 Integrated resource management and the next steps

The Factor 4 targets above appear strategic in scope and challenging to achieve. Meanwhile the day to day business of running the South East goes on. So the final question is, what can the region do today and tomorrow? There is much detailed advice coming out of the review of each key sector, up to now in this chapter. However there are also common principles which run through each of the sectors. These can be used as directions for regional and local policy, producers and distributors, and consumers and communities.

There are a range of 'models' or general principles, which help to coordinate Material Flow Analysis and Ecological Footprint programmes. These are shown here with 'images' or signposts to examples, to be found in the Taking Stock fact-sheets and other sources.

- ***Strong environmental management model***: this principle puts environmental issues to the forefront, as a driver for economic competitiveness and resource productivity. Where there are 'externalities' of pollution and waste, the business or organisation will aim to account for these. The image comes from the Co-operative Bank which has put environmental and ethical goals at the top of its agenda, with the result of faster growth than any other.

- ***Evolutionary model:*** the Factor 4 approach to 'dematerialisation' and 'decarbonisation' of the economy will be a shift on a massive scale. It relies on businesses and organizations anticipating such shifts in their own terms over years or decades, and steering their own evolution to turn potential problems into opportunities. One image comes from the local authority in Woking, possibly the most energy efficient authority in the country.
- ***Service model***: this works on the producer/procurement side, where products are leased, taken back, re-manufactured or recycled, with huge savings in raw materials, processing energy and waste impacts, plus the consumers' facility is continuously updated. The image is one of the new generation of floor covering firms which lease their products rather than selling them.
- ***Social economy model***: this works on the consumer demand side. In many cases there are opportunities to reduce material consumption while increasing human satisfaction, by social trading schemes, equipment banks, lift sharing, and social cohesion in general. The image comes from the car-sharing club at the BedZed development in Surrey.
- ***Integrated resource management model***: this brings each of the above together, and aims to provide the infrastructure to make it work. Such infrastructure can be 'hard' pipes and wires, and/or 'soft' organisations and networks. The image comes from Copenhagen, where over 90% of the construction waste is recycled within the city.

ES 10.6 Implications for the region

In terms of scope for action, it is clear that the current structure of governance in the English regions is often partial and compromised. The regional assemblies and development agencies between them manage a small percentage of the total public sector expenditure. The South East is a special case, being the largest and richest region, the closest to the hub of London, and at the same time one of the weakest in institutional terms.

The scope of policy influence on integrated resource management is seen in Chapter 6. The main conclusions are that regional strategies for economic development, spatial development, transport, energy, waste etc, each have a very important part to play, along the lines of the general principles above.

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

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

However to achieve Factor 4 targets in each of these sectors will be very difficult unless new forms of networks, partnerships and consortiums can be found. At present the fragmentation between sectors, departments and different levels, makes coordinated action very difficult.

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

The government has set an agenda and a direction in 2003 with the Sustainable Consumption and Production strategy. At this point it is very general and deserves to be followed through in every sector and at every level, including the regional level. Hopefully the Taking Stock project is a step in that direction.