7 Future Scenarios for the South East region

This chapter is a review and analysis of future trends and alternative scenarios. The material here is a counterpart to the project website material, particularly the 'lifestyles' and 'future visions' components.

The chapter is structured as follows:

- Current trends: first for the overall region, and then for each key consumption sector, a review of trends, dynamics of change and scenario indicators or settings.
- Scenario framework, a general approach or route map for exploring a range of alternative futures on various levels of detail.
- Scenario settings: a review of how these drivers translate into a scenario framework with a large structure for quantified trends and projections.
- Exploration in more depth of the narratives of each alternative policy/context scenarios, with a focus on the role of ecological footprint and resource management.

Further detail on the policy/context scenarios, including summary indicators, and scenario storylines by decade, is shown in the Appendix.

7.1 Current Trends

7.1.1 General trends

This section looks at the current trends, firstly for the region as a whole, and then for each key consumption sector, from the perspective of the ecological footprint. The structure of these key sectors map approximately onto a simple 1-digit SIC code breakdown, with some exceptions.

Within each sector there is a table showing the modelling framework, i.e. the selected drivers/indicators of change, which are simple enough to provide numbers for, and significant enough to affect the outcome of energy, land and ecological footprint requirements. These tables show the 'high – low' settings in general terms: selected numbers for each of the settings are shown in Section 3 ('scenario settings').

South East Region 'Future Think'

Some of the most significant current trends for the South East region are highlighted in the SEEDA 'Future Think' document. This identifies some of the key driving forces which are likely to shape the future of the South East:

- Globalisation and free trade, for example enlargement of the EU
- Information and communication technologies
- Emerging technologies, in particular key fields for 'explosive' growth
- Demographic change; ageing and migration
- Skills and employment, in particular a shift from manufacturing to service jobs, and an increased polarisation between high-tech jobs and unskilled labour
- Social cohesion and deprivation, with disparities within the South East seen as crucial
- Environmental sustainability issues – both impact i.e. climate change and water scarcity, and opportunities i.e. emergence of environmental technologies;

The particular issue here is to note the specific pressures and circumstances on the South East region, where the regional agenda is identified as distinct from that of national or local agendas. As noted above, there is a concentration of wealthy globalised service activity, combined with accelerating socio-economic polarisation, combined with overheating of infrastructure. In this the position of the South East with regard to the UK is crucial. This suggests two alternative structural trajectories:

- Increasing globalisation and polarisation of the South East/Greater London from the rest of the UK, with all its implications.
- Normalisation and convergence of the South East/Greater London towards the rest of the UK, in terms of economy, society and environment.

General socio-economic trends

The primary determinant of activity in the South East is the regional population, the fastest growing in any region/country of the UK. The chart below shows recent population growth, the current projection by ONS to 2021, and the effects of this trend projected forwards to 2041. The difference between the high

and the low growth scenarios for household formation are very clear. For the purposes of the scenarios here, the calculations focus on the central growth projection, which has an average annual rate of 0.53%, and a growth rate over the planning period of 11%. Each of these projections are naturally highly sensitive to assumptions on lifestyle issues such as marriage and cohabitation, planning and housing policy, housing markets and prices, inter-regional and international migration. One such issue is the gap between the RPG projections of 28,000 new dwellings per year, and the 'Sustainable Communities' plan projection of 38,000 dwellings. The only relatively certain factor in the next 20 years appears to be the demographic mortality rates.

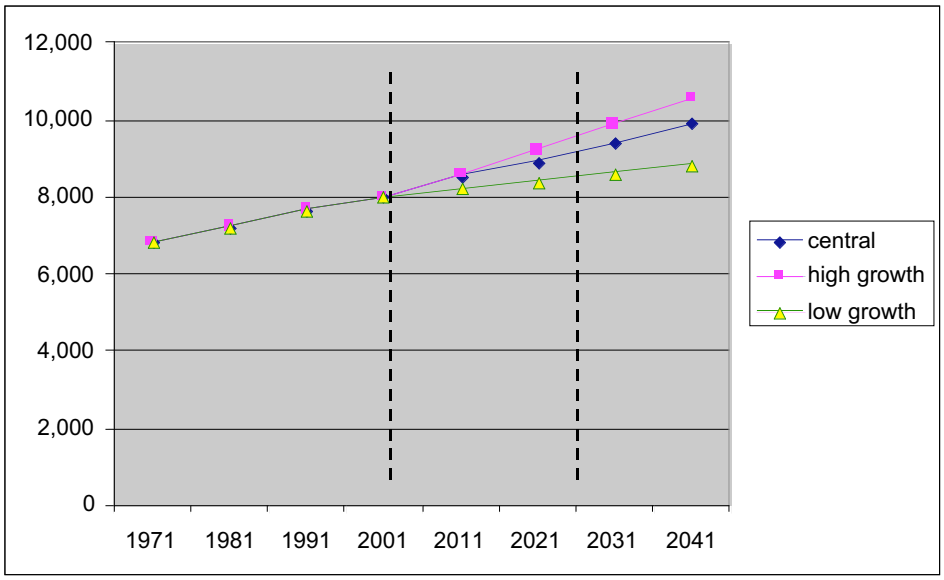

Figure 7.1 Alternative population projections: Source ONS, 2002: 'Region in Figures'

In terms of economic activity, the South East region together with Greater London is seen as the engine of the UK economy, and higher than average growth rates appear in most projections.

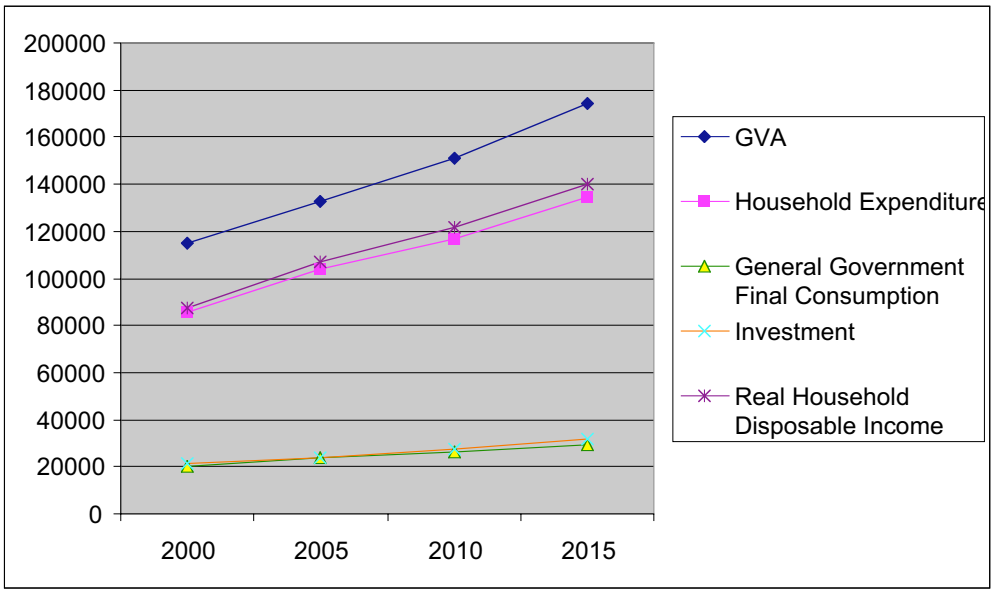

Figure 7.2 Economic projections for the South East with 'business as usual' default assumptions

If little else changes then the current trends could be projected in a 'business as usual' scenario, as in Chapter 6. The effect on household consumption (via expenditure) to 2015 can be seen in the first chart below (generated from the REWARD regional modelling system, www.reward-uk.org).

The same set of ***business as usual*** assumptions then show the effect on the projections of industry growth and change to 2015, in the second chart below. This is of course a 15 year projection with many assumptions built in, and there is little else to go on for any timescale beyond that.

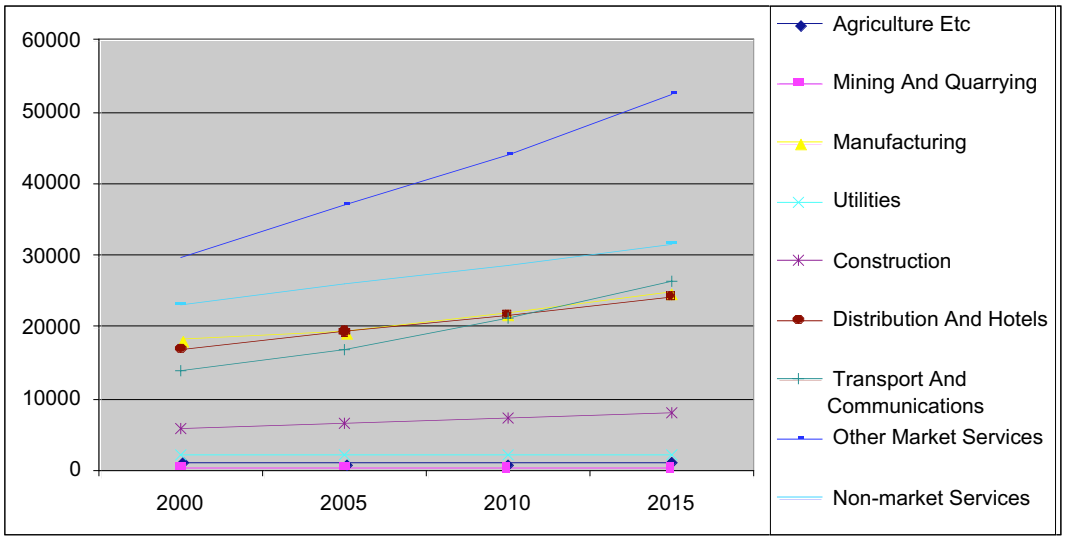

Figure 7.3 Sectoral change projections for the South East with 'business as usual' default assumptions

The third chart below then picks out the current projections of year on year growth rates more explicitly. This shows the rapid growth for 'other market services', with distribution/hotels, transport/ communications, and manufacturing all increasing at over 3% per year. In contrast, construction, utilities and non-market (public) services are all relatively static.

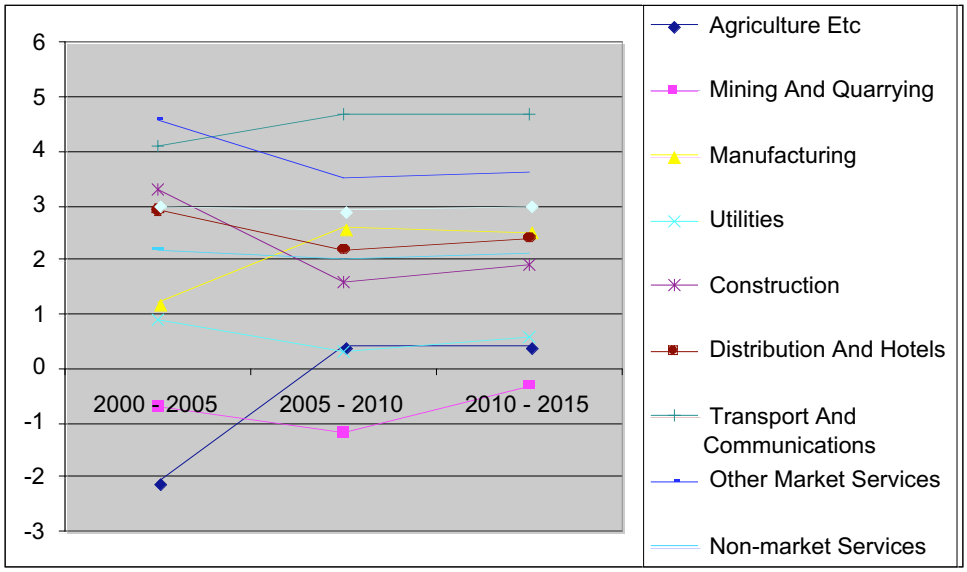

Figure 7.4 Sectoral change in 5 year/5 year averages: projections for the South East with 'business as usual' default assumptions

Material flow and resource input trends

At the regional scale there is virtually no data available on material consumption, let alone historic time series for recent decades, or for future projections. The closest approximation here is to refer to the Office of National Statistics Environmental Accounts, and the Wuppertal study (DETR 2001).[1]

The total long term trends for UK direct, indirect and total material requirements (TMR) can be seen in the chart below (*Figure 7.5*; for comparison material outputs are given in *Figure 7.6)* .

If a 30 year historic trend can be taken as an indication of a future trend, then there are interesting results:

- Fossil fuel use has increased at an annual growth rate of 1.75%, with net change over 30 years of +66%.
- Agricultural harvest has increased at an annual rate of +0.75%, with net change of 23%.

[1] DETR 2001, (Bringezu S and Schütz H) *Total Material Resource Flows of the UK (UK-MFA),* report to DETR (unpublished)

- The other largest material input, construction minerals, has decreased at an annual rate of –0.4%, with net change over 30 years of –11%.

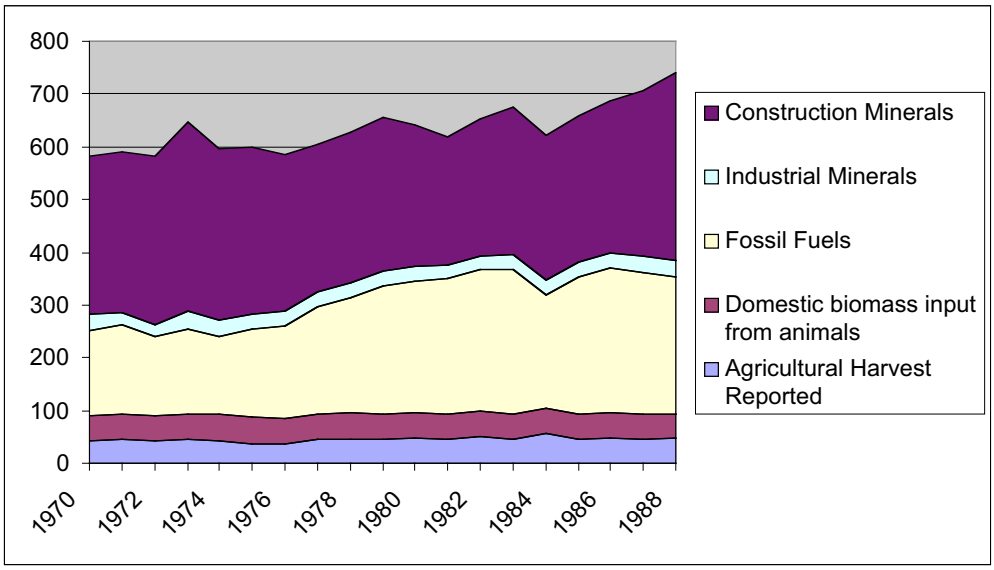

Figure 7.5 Selected main types of material inputs to UK economy
Source DETR 2001, (Bringezu S and Schutz H) Total Material Resource Flows of the UK (UK-MFA) report to DETR (unpublished) (Units in million tonnes per year)

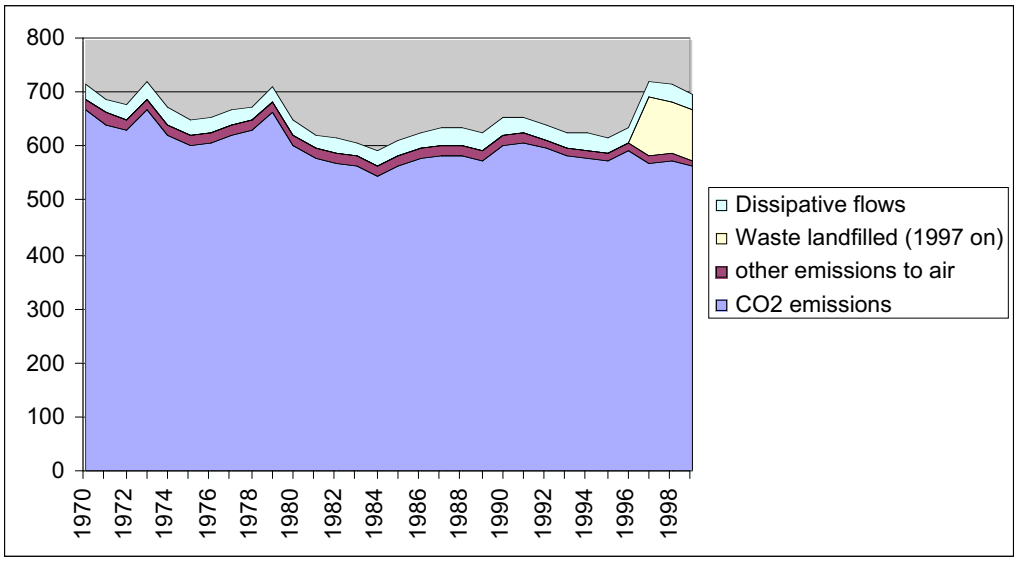

Figure 7.6 Selected main types of material outputs from UK economy
Source DETR 2001, (Bringezu S and Schutz H) Total Material Resource Flows of the UK (UK-MFA) report to DETR (unpublished) (Units in million tonnes per year)

Linking production to consumption, and policy to non-policy

The key challenge for the scenario structure, is identifying the 'policy levers and linkages' – i.e. the parts of each scenario which relate to the policy options on the table in a number of key sectors. This is less than simple because the logic between each of the sectors do not often match, in setting out the options, drivers, pressures, vulnerabilities, risks and so on. Also, the levers which are easier to simulate in the technical model do not often match with the levers which are most meaningful in policy terms. For instance it is easy to say on a spreadsheet '50% shift to public transport': but to achieve it may well involve a very complex programme of investments, taxes, regulations and partnerships.

Perhaps the number one challenge is that the primary focus for the Taking Stock project – the question of resource consumption and ecological footprint – is not generally a policy issue at all. Therefore a large degree of interpolation is needed in making the links between the policy options in Chapter 6, and the alternative future projections for resource flows and footprint in the region.

This theme also raises the question of the links between 'production' and 'consumption' i.e. while the 'footprint' analysis is geared up to consumption, much impact on the regional environment is a result of 'production'.

Economic production can be analysed in detailed economic models, where 123 sectors each make transactions with 123 sectors. However the size and nature of consumption rests on the much more 'fuzzy' issues of lifestyles and cultures, in the sense that many choices with large effects on the footprint, are in fact not technical/mechanical but more like cultural and psychological patterns: e.g. whether people fly to foreign holidays. Therefore a smart approach would aim to use whatever means is available to get inside the hearts and minds of the consumers – this means looking at techniques from advertising, participant observation and so on. The use of graphic and narrative 'lifestyle' material on the project website is a small step in this direction.

7.1.2 Key sectoral scenarios

General resource/footprint trends and projections

There is a direct relationship between the population and the MFA-EF profile, i.e. 11% more people will generally produce 11% increase in material flow and ecological footprint, all other things being equal. This simple view might be adjusted for the effects of policy, where other things are not necessarily equal: clearly a population growth of 11% may in turn lead to rearrangement of urban pattern, travel patterns and so on.

However there is a more complex relationship between economic activity, which is measured in terms of money flow, and material consumption. The household expenditure growth in line with GVA growth of 2.6% longer term (4% short term to 2005), may for instance be spent on material intensive goods or de-materialized services. Hence it is necessary to look as far as possible at the 'micro-components' of consumer demand.

The key MFA-EF consumption sectors each show distinct patterns in trends and alternative futures. There are many economic, social, political, institutional and technology pressures acting on each sector: Some if not all of these can be captured in any numerical modelling scheme, as in the following sections. Below is a general overview of the dynamics of change in each sector:

- ***Food and farming***: Total consumption is relatively static, but there is a rapid growth trend towards high-energy, processed and air-freighted imports with high EF factors.
- ***Household energy and water***: There is relative stability in consumption per household, but the gradual growth of population and decline in household size means that the underlying trend is still upwards. There will be continuing reduction in EF from energy due to the phasing out of coal generation, and the introduction of renewable sources. However the long term future of the UK energy system is a fairly open question, where the aspiration for a low carbon future is welcome but the means to deliver it through government action are not obvious.
- ***Consumable goods***: Much of this sector is generally driven by fashion, lifestyle, cultural habits, diet and health concerns and so on. Hence forecasting of future projections is less tangible, and a scenario-based 'what-if' approach is at least as useful.
- ***Durable goods***: Household appliances and similar durable goods each show saturation levels (i.e. one dishwasher per house) and predictable residence times (e.g 10 year lifetime). There is a relationship between the efficiency in use, and the turnover of the stock, in that newer models are often more efficient than older stock. What is harder to predict is ownership effects, e.g. where the consumption pattern of televisions is now based around one per room rather than one per house.
- ***Construction and infrastructure***: Built environment construction activity is closely related to population and to economic activity, although there are counter-cyclical effects from public sector construction. However the shakeout of construction/demolition waste from the system is very sensitive to policy on regeneration, recycling, building design, use of secondary wastes etc.
- ***Transport***: The current forecasts in traffic growth are consistent with recent evidence, despite the government's goals in the 10 Year Strategy for transport. For air travel, the current growth rate of 5% per year is an order of magnitude higher than any other physical growth rate.
- ***Public services***: The government's recent expansion of the public sector is relatively resource intensive in the sense of demanding buildings and infrastructure. However it is not certain how far this capital investment can continue, and the BAU projections above show an increase in line with the population of 0.5% per year, but no more.
- ***Waste management:*** Trends are surprisingly some of the most uncertain in any sector. The 'best case' regional scenario outlined in detail in Chapter 4, is one example of thinking through the implications at the regional scale. However there is a need to look beyond the 20 year time horizon of the regional strategy, and beyond the various options which are identified in detail. To do this might draw from work such as the World Resources Institute, and the Greater London study, which shows how many cities and regions around the world have a quite different approach to waste, recycling and re-manufacturing.

Food and farming

This 'consumption' sector represents the primary industries of agriculture, forestry and fisheries, together with the manufacturing sector of food and drink processing, and the service sector of distribution, hotels and catering.

The key scenario indicators, as representative in some ways of 'driving forces', can be structured as follows:

- ***Imported %:*** The trend towards greater imported (from overseas) foodstuffs is set to continue, and the shakeout of UK agriculture and the CAP reform may well accelerate this process.
- ***Vegetarian %:*** This affects the balance between meat-based food (generally energy intensive) and others (less intensive). The current levels are 32% meat-based, 47% vegetable-based, and the remainder in drinks. Optimistic projection of the spread of vegetarian diets would see further diminishing of meat products
- ***Organic production %:*** At present this covers 0.6% of food volumes by weight, but has been increasing by 15% per year over the last decade. There are different opinions on whether this trend will continue or level off.
- ***Chemical intensity***: The inputs by weight of chemical fertilizers and pesticides have increased dramatically in the last 50 years. The organic component might be taken as the converse of chemical inputs. However it is likely that chemicals inputs by weight are likely to decrease as a result of precision agriculture (use of GIS, GPS, targeted doses, fine spray techniques etc): This trend will be independent of organic production. To some extent, chemical intensity can be taken as a proxy for the overall energy intensity of production and hence the EF.
- ***Packaging %*** (by weight): Food packaging by weight has increased slowly, but more rapid is the shift from low-energy (brown paper) packaging, to higher energy materials (plastic film and vacuum packing.
- ***Composting of food waste %*** (by weight): There is limited re-use of food for animal feed from institutional catering. The current levels of composting of food waste are a fraction of 1%. However the regional waste strategy contains objectives to increase this fraction.

In terms of future scenarios for food consumption, it is clear that the great majority of residents of the South East region have enough in food quantity. The implication is that future trends will be more concerned with food types, sources, supply chains and other qualities. For these there are few forecasting methods apart from those of projection of current trends.

Table 7.1.1 Scenario settings for food and agriculture

FOOD	SCENARIO DRIVERS							MAIN SUB-TYPES				
	Stock factors	Cons-umption factors	Prod-uction factors	Techn-ology factors	activity / stock	waste factors	TOTAL CHANG E EF					
	Import-ed %:	Veget-arian %	organic %	Chem-icals as % of yield t	Pack-aging as % of food t	Food waste com-posted %	To 2020	animal products	Veg-etable pro-ducts	Animal / veg fats/oils	Food products	drinks
Baseline 2000	31%	15%	2%	6%	6%	2%						
F-0 High growth	Rapid growth	Dec line	Dec line	Growth	Rapid growth	Growth	+50%					
F-1 Business as usual	Growth	Static	Static	Static	Growth	Static	0					
F-2 Low growth	Static	Growth	Growth	decline	Static	Decline	-50%					
F-4 Factor Four	decline	Rapid growth	Rapid growth	Rapid decline	decline	Rapid decline	-75%					

Household energy and water

For the supply of utilities there are a relatively small range of key drivers and trend indicators:

- Energy demand from services building stock
- Energy demand from household building stock

Renewable supply (from the region): The South East Renewables strategy if implemented, would provide a total of 9% of the regional power supply. There would be a small contribution to space heating by various means.

- Heat direct supply: This includes estimates of localised renewables and the effects of building design on heating requirements – i.e. passive solar energy. This does not often figure in engineering assessments, as it is technically outside the system of production and distribution. Potential design improvements for passive solar energy can deliver up to 20% of household energy demand. This is mainly at the beginning and end of the heating season, and could increase if the requirement for summer cooling is taken into account.[2]
- Combined heat and power %: This is generally framed in terms of co-generation with district heating (CHP-DH).
- Energy recovery: This is the counterpart to the same item on the waste account, showing the energy contribution of the WTE programme.

[2] Energy Conscious Design 1994….. *incomplete reference*

Table 7.1.2 Scenario indicators and settings for energy and water

ENERGY & WATER	SCENARIO DRIVERS							MAIN SUB-TYPES				
	Stock factors	Cons-umption factors	produc-tion factors	Techn-ology factors	activity / stock	waste factors	TOTAL CHAN-GE E.F.					
	Service s energy	h-hold energy / m2	Renew -able %	Applia-nce eff-iciency	CHP %	heat %	To 2020	House-hold	Serv-ices	Ind-ustry	Tran-sport	Power
Baseline 2000	31%	15%	2%	= 1	6%	2%						
F-0 High growth annual	growth	growth	Reduc-ing	Reduc-ing	Reduc-ing	Reduc-ing	+50%					
F-1 Business as usual	Stable	Stable	Stable	Stable	Stable	Stable	0					
F-2 Low growth:	stable	stable	Growth	Growth	Growth	Growth	-50%					
F-4 Factor Four:	Reduc-ing	Reduc-ing	Rapid growth	Rapid growth	Rapid growth	Rapid growth	-75%					

Water scenario trends and drivers have been simplified to reflect the relatively small contribution of the water system in the total footprint calculation.

- Household water demand/m^2: A combination of lifestyle factors, particularly garden and car use, and technology factors on the efficiency of appliances and sanitary equipment.
- Leakage: This is basically related to the investment in new and replacement pipework.
- Regional supply balance: The proportion of the total demand met from within, or imported to the region.

Durable goods

Household appliances and similar durable goods each show saturation levels (i.e. one dishwasher per house) and relatively predictable residence times (e.g 10 year lifetime).

In many cases there is an inverse relationship between the efficiency in use, and the turnover of the stock, in that newer models are often more efficient than older stock. For the total EF the effect of increased consumption may be outweighed by the reduction in EF from energy in use, due to increased efficiency of new products. This increased efficiency may itself be outweighed by changes in the product demand: For instance, where the increase in vehicle efficiencies is overtaken by the trend towards powerful SUVs. More detailed projections is pending further analysis of the datasets.

What is harder to predict is the relationship between saturation and ownership: For instance the consumption pattern of televisions is now based around one per room rather than one per house.

The table below shows the main settings taken into the scenario model, with descriptions of the type of effects which are simulated within the model.

Table 7.1.3 Scenario drivers and settings for household durables

HH DURABLES	SCENARIO DRIVERS						MAIN SUB-TYPES				
	Stock factors	Consu-mption	Prod-uction factors	Techn-ology factors	activity / stock	waste factors					
	import %	h-hold cons / £ income	EF in manuf-acture	Energy EF in use	turn-over / stock %	Recyc-ling %	large applian-ces	small applian-ces	IT	Tele-comms	radio / tv
F-0 High growth	Hi growth	Hi growth	No change	No change	Hi growth	No change	Growth due to larger houses	Growth due to inno-vation	Growth due to inno-vation	Growth due to inno-vation	Growth due to inno-vation
F-1 Business as usual	Slow growth	Slow growth	Small reduct-ion	small reduct-ion	Static	Slow growth	Satura-tion	Growth due to inno-vation	Growth due to inno-vation	Growth due to inno-vation	Growth due to inno-vation
F-2 Low growth	Static	Static	No change	No change	Low growth	Rapid growth	static	static	static	static	Static
F-4 Factor Four	Slow reduct-ion	Slow reduct-ion	Trans-form-ation	Trans-form-ation	slow reduct-ion	Rapid growth	Reduct-ion due to sharing	Reduct-ion due to long life	Reduct-ion due to long life	Reduct-ion due to long life	Reduct-ion due to long life

In summary, the main scenario model settings can be structured as follows:

- Import%: The proportion of products which are imported: this implies greater travel distances and possible less efficient production;
- H-hold cons/£income: This is the basic purchasing parameter: i.e. the propensity of households to consume new items, relative to their total income;
- EF in manufacturing: This is an aggregate measure of the efficiency of production;
- Efficiency in use: This is relevant to energy-intensive devices, not only kitchen appliances, but also TV and computing with continuous electrical loads;
- Turnover/stock %: This is another way to express the 'residence time' or ownership life: this may be determined by functional wear and tear, by aesthetic demand, or by technological innovation as above;
- Re-use and recycling %: This measures the proportion of products discarded or put to one or other form of high-level recovery.

There would be a similar range of scenario settings for durable goods or equipment in the commercial services sector.

Consumable goods

Future trends depend on 'saturation' and 'turnover', i.e. whether consumption slows down once all households have a particular item, or whether consumers will change their wardrobes and furnishings more often. 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 types of materials and products.
- The key question for future trends is 'quantity, quality or experience': If quantity increases then the trends in EF depends on downstream factors of manufacturing and sourcing and imports. If quality increases then material throughput may reduce, while energy intensity or labour intensity may increase. If 'experience' increases then people may rediscover the happiness factors above and do without the objects.
- However there are many consumable items which can be less discretionary and more mandatory, depending on cultural pressures. For instance, freshly pressed formal clothes serve no particular physical function, in fact they encourage the overheating of office buildings, but they also encourage continuous purchasing and disposal of delicate items.
- The role of technology is also paramount, and often counter-intuitive. For instance laptop computers can effectively replace paper, yet despite rumours of the 'paperless office', paper consumption continues to rise.
- The above drivers of growth are also conditioned by life-cycles and residence times, i.e. how long a product will last in functional terms, or how long it is acceptable in other terms to remain in the stock.
- Saturation effects are generally less influential on consumables than on other types of consumption, in the sense that there is no particular limit to the number of clothes or shoes which can be purchased if the money is there.
- Possibly more important are the 'locational' effects of time, place, composition and convenience: Seen at present where the economic retail value of a hot drink is several hundred times its component material/energy values. This 'locational' trend could continue through technological innovation, with the result that economic value and thereby growth is seen with disposable clothes and other consumables, delivered precisely in time and space to customised specifications.

Given the wide range of psychological and cultural factors above, there is a need to make simplified 'what-if' assumptions to enable some kind of future projections. The list and the table below shows how a set of scenario trends and drivers can be structured in very basic terms.

- Import %: The proportion from imports and the continent of origin.
- Household consumption relative to income (hh cons/£income): The elasticity of consumption as a function of disposable income growth. (This could be counted as income after housing/commuting costs or some other measure.)

- EF in manufacturing: This is a very aggregated figure representing the overall intensity of complex material supply chains in textiles, paper and other features.
- 'Efficacy' factor: This is an innovative feature which aims to represent something of the perceived satisfaction, utility or welfare derived from the consumption of any particular class of items. For instance it is clearly the case that the value of clothing depends not only on its function but on its aesthetic, cultural and symbolic appeal. Retail activity is now seen as much as 'therapy' as anything more substantial. The point here is that it may be possible to provide greater satisfaction with less material throughput, and the adjustment of this factor can reflect that.
- Packaging %: This is fairly obvious, except where related to the note on efficacy, in the sense that the packaging becomes part of the product.
- Recycling %: This is an aggregated figure which represents an average of the different levels of re-use, re-manufacture, high and low level recycling, and so on.

Table 7.1.4 Scenario settings for household consumables

HH CONSUMABLES	SCENARIO DRIVERS						MAIN SUB-TYPES				
	Stock factors	Consu-mption	Product-ion factors	Techn-ology factors	activity / stock	waste factors					
	Import %	h-hold cons / £ income	EF / t manuf-acture	Effi-cacy <>	packa-ging %	Recyc-ling %	tobacco etc.	clothing / footware	h-hold effects	Personal & pharma-ceutical	literature / other
F-0 High growth	Rapid growth	Rapid growth	Growth	Rapid reduct-ion	Growth	Reduct-ion	Rapid growth	Rapid growth	Rapid growth	Rapid growth	Reductio n
F-1 Business as usual	Growth	Growth	Stable	Reduct-ion	Stable	Stable	Growth	Growth	Growth	Growth	Stable
F-2 Low growth	Stable	Stable	Stable	stable	reduc-tion	Growth	Stable	Stable	Stable	Stable	reduction
F-4 Factor Four	Reduct-ion	Reduct-ion	Reduct-ion	rising	Rapid reduc-tion	Rapid growth	reduction	reduction	reduction	reduction	Rising

Travel and transport

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

- 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.

In terms of projecting these trends, a very simplified set of transport scenario trends and drivers can be structured as follows:

- Vehicle occupancy: Basically, the higher the occupancy, the less the vehicle movements and the greater the efficiency. This occupancy factor will be influenced by technology, information systems, demand management, green travel plans and so on.
- Passenger travel demand intensity (economic): This is an overall measure of the linkage or 'decoupling' of economic growth from travel demand.
- Public transport proportion of all transport: This is the holy grail of the 'modal shift' It works at different geographical scales, e.g. rapid shift in Central London, but much more difficult in the diffused economy and social networks of the South East, where orbital and cross-country movements are dominant.
- Vehicle energy efficiency: Subject to fuel and engine regulations and fiscal measures at UK and EU levels.
- Vehicle new/existing stock: i.e. the turnover effect, size of the stock, and any effects on vehicle efficiency which may be higher in new vehicles.
- Alternative fuels percentage: This includes a complex set of combinations and transformations from one medium to another: Gas, renewable oil, hydrogen and other forms of electric power.

Table 7.1.5 Scenario settings for transport (passenger and freight)

TRANSPORT	SCENARIO DRIVERS						MAIN SUB-TYPES				
	Stock factors	con-sump-tion	produc-tion factors	techno-logy factors	activity / stock	waste factors					
	vehicle occu-pancy	Pass-enger travel de-mand	public %	vehicle energy effic-iency	vehicle new / exist-ing stock	Altern-ative fuels%	car	public	air	Lorry freight	Other freight
F-0 High growth	Reduc-tion	Rapid growth	Reduc-tion	Reduc-tion	Growth	Reduc-tion	Rapid growth	Reduc-tion	Rapid growth	Rapid growth	Reduc-tion
F-1 Business as usual	Stable	Growth	Stable	Stable	Stable	Stable	Growth	Stable	Growth	Growth	Stable
F-2 Low growth	Reduc-tion	Stable	Reduc-tion	Reduc-tion	Reduc-tion	Growth	Stable	Reduc-tion	Stable	Stable	Reduc-tion
F-4 Factor Four	Rising	Reduc-tion	Rising	Rising	Rapid reduct-ion	Rapid growth	Reduc-tion	Rising	Reduc-tion	Reduc-tion	Rising

Construction and infrastructure:

Generally the South East region is under more pressure than any other region, to incorporate new housing on a massive scale. There is a population growth forecast of 5.5% per decade, and a reducing household size from 2.4 to 2.1, and current problems of over-heating, congestion, housing affordability and shortages of key workers. Dealing with such problems raises interesting questions for the application of a footprint method:

- Construction of 28,000 dwellings per year will consume massive amounts of materials and energy, wherever it is done.
- However the new dwellings have the potential to be much more efficient in energy and water than the existing stock: There is technological potential to reduce resource demands almost to zero.
- Calculation of the MFA-EF depends on estimates of the life-cycle and end-fate of the new houses: this is assumed at 80 years but in practice is intended to be indefinite.
- Concentration of new construction in urban areas will tend to generate more reclamation and demolition waste than the equivalent in a green field location.
- The planned concentration in urban areas will contribute to more sustainable transport demand patterns: However the scale of the effect may be much smaller than previously thought, and has been estimated at a 3% reduction in transport emissions
- It is likely that the social and economic effects of regeneration, and their effects on affluence and consumer spending habits, will be much more significant certainly than the transport effects, and possibly than the direct energy requirements of the new housing.

In the light of this, there are several kinds of analyses to be carried out on current conditions, trends and projections, and their implications for policy:

- Analysis of alternative demand strategies, in terms of volume, location and type of construction.
- Analysis of alternative supply strategies, in terms of materials, design, specification and efficiency in use of construction.

Built environment construction activity is closely related to population and to economic activity, although there are counter-cyclical effects from public sector construction. However the shakeout of construction/ demolition waste from the system is very sensitive to policy on regeneration, recycling, building design, use of secondary wastes etc.

Given the complex set of factors above, a very simplified set of scenario trends and drivers can be structured as follows, and tested out in the MFA-EF scenario model:

- Household floorspace per head of population, for both existing and new housing (hh m^2/ pp): This equates to a simple stock and intensity model, i.e. where the growth in floorspace may be less or more than the growth in population and the growth in number of dwelling units.
- The turnover in the stock itself, as a proportion of existing stock, and the demolition of older dwellings (hh new/existing stock).
- Household energy efficiency per unit of floorspace, for new and existing dwellings (hh energy efficiency new/existing): This equates to a composite measure of energy demand, which is then broken down into shares of end-uses, i.e. heating, lighting etc, and shares of fuels, gas, power etc.
- Household material efficiency per floorspace (hh material eff/m^2): This applies to new construction, the volume of materials used per unit of floorspace, and the EF intensity of those materials. Again this is on a highly averaged level.
- Waste arising and material life cycle (arising/re-use %): This is a compound assessment of how much bulk material stays in the system or comes out as waste, and how much of the waste then re-enters the system.
- Commercial and public services buildings need a similar range of units as for housing above. The difference is that they are not related to population in the same way, rather to economic growth, the structure of the economy (commercial/public/industry), and the intensity of floorspace per unit of economic activity.

Table 7.1.6 Scenario settings for construction (housing and services)

CONSTRUCTION	SCENARIO DRIVERS						MAIN SUB-TYPES			
	Stock factors	Consu-mp tion	Produc-tion factors	Techn-ology factors	activity / stock	waste factors				
		h-hold m2/ pp	h-hold material use & EF/ m2	h-hold energy eff new / exg	h-hold new/exg stock	re-use %	Housing	Commercial	Public	Industry	Infrastr-ucture
F-0 High growth		Rapid growth	Growth	Rapid growth	Rapid growth	Reduct-ion	Rapid growth	Rapid growth	Reduct-ion	Growth	Growth
F-1 Business as usual		Growth	Stable	Growth	Growth	Stable	Growth	Growth	Stable	Stable	Rapid growth
F-2 Low growth		Stable	Stable	Stable	Stable	Reduct-ion	Reduct-ion	Reduct-ion	Reduct-ion	Stable	Reduct-ion
F-4 Factor Four		reduct-ion	Reduct-ion	Reduct-ion	Reduct-ion	Rising	Stable	Stable	Rising	Reduct-ion	Growth

Waste management

The uncertainty in waste management trends and forecasts is surprisingly high. The 'best case' regional scenario outlined in detail in Chapter 4, is one example of thinking through the implications at the regional scale. However there is a need to look beyond the 20 year time horizon of the regional strategy, and beyond the various options which are identified in detail. To do this might draw from work such as the World Resources Institute, and the Greater London study, which shows how many cities and regions around the world have a quite different approach to waste, recycling and re-manufacturing.[3]

Municipal Solid Waste (MSW): Four scenarios for waste arisings were developed for examination. A central, or best estimate, scenario is used for the sustainability assessment of scenarios, with three other profiles considered in a sensitivity analysis of the capacity of infrastructure needed to meet targets under the alternative scenarios.

- ***Base case***: As assumed by the EC Directive and UK Waste 2000, 3% annual growth throughout, net change 2000/2025 amounts to +103%.
- ***Central scenario***: Starting at actual household growth plus 2% (2.9784%), tapering off to household growth +0.5% (1.2834%), net change to 2025 amounts to +59%.
- ***Household growth***: i.e. related to population size with no other changes, current annual growth of 0.9762%, tapering to 0.7834%, net change 2000/2025 amounts to +23%.
- ***Rapid minimization***: Initially 3% annual growth, tapering to –3% annual reduction, giving a –14% net change (reduction).

Commercial and industrial (C&I) waste forecasts: Two scenarios are considered jointly, starting from a current high rate of growth at 3.27%.

[3] Murray R et al (1999) *Re-inventing Waste: towards a London Waste Strategy,* London, Ekologica

- Declining growth: Initially 3.27% growth, tapering to 1% growth, net change 2000/2025 amounts to +64%.
- Rapid minimization: Initially 3.3% growth, tapering to –3% growth, net change 2000/2025 amounts to +4%.

Scenario settings for waste arisings are apparently quite simple in technical terms. However there is great uncertainty on the current growth rate of waste arisings, and forecasting of future trends need a more extended scenario approach to deal with the complexities of legislation, contracts and new technologies.

- Product composition and structure: Materials and compounds, particularly those which are chemically hazardous or physically difficult to separate.
- Packaging, 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 recyclate markets.
- Infrastructure for distribution collection and re-distribution.
- Infrastructure and new technology for waste management.

7.2 Scenario Framework

Scenario types

This section is an outline of the development of 'scenarios' – i.e. composite descriptions of alternative future conditions and trajectories. Some of the main types of scenarios are shown in the diagram below, with examples drawn from the transport sector.

- Technical scenarios: Variations on specific and quantified issues, e.g. proportion of waste recycled.
- Policy scenarios: Wider possibilities for policy actions, e.g. large increases in disposal taxation.
- Contextual scenarios: General possibilities for society and the economy.

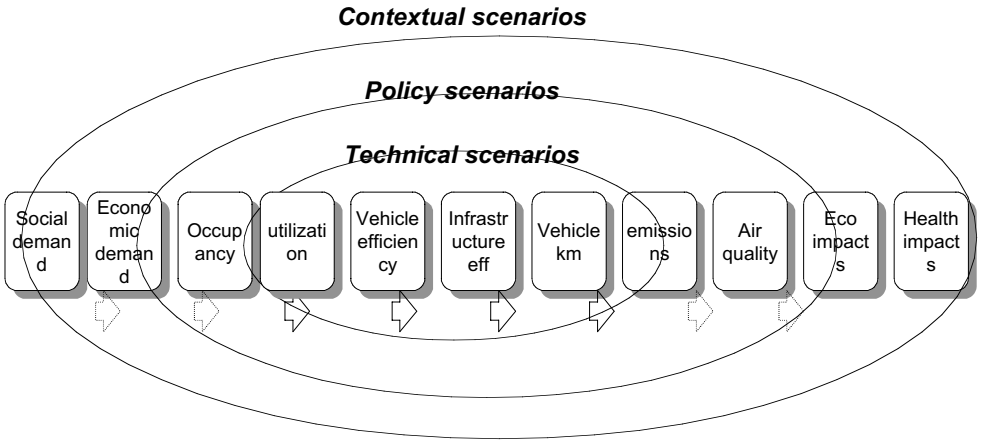

Figure 7.7 Scenario framework

This diagram is arranged around an expanded version of the DPSIR (driving forces, pressures, state, impacts, responses) framework (European Environment Agency 1996: Ravetz 2000). A very simple breakdown of the likely interactions of these factors is charted in the table below, in terms of technology, policy, economics and lifestyles.

Table 7.2.1 Mapping policy approaches onto material metabolism

	KEY STAGES IN MATERIAL METABOLISM								
POLICY APPROACHES	Under-lying forces	Driving forces	Press-ure	Infrastr-ucture	Techno-logy	State	Im-pacts	Out-comes	Respon-se
Technology innovation				•	•				
Policy: regulation / planning			•	•		•			•
Policy: fiscal / management		•					•		•
Market change	•						•		•
Lifestyles & values	•							•	

Scenario framework

The development work in this project has identified several different types of scenarios, based on different degrees of linkage with the resource management/ecological footprint agenda. Each of these is relevant to regional MFA-EF studies and the modelling of resource management:

- ***Policy/sectoral scenarios***: Structured around topical and conflicting sectors and themes. In the South East such themes might include transport, housing and environmental protection.
- ***Contextual scenarios***: These illustrate possible alternative trajectories for general socio-economic conditions, at the UK/EU/world levels.
- ***Footprint scenarios***: These provide 'envelopes' for the footprint as a measure of aggregated environmental impact, in particular referring to the 'Factor 4' targets.
- ***Resource scenarios***: These are focused more on 'how to do it' to achieve the footprint targets above. This involves a more complex discussion of the management of materials and resource flows, in terms of technology, regulation, markets and consumption choices.

Policy and sectoral scenarios

Various examples of policy scenarios can be found in sectors such as transport, energy or housing policy. On close examination they are often ad hoc and uncoordinated. The South East regional policy documents do not show visibly much structured scenario analysis, with the exception of the waste strategy. Sectoral scenarios are more common at the national level, and generally involve a combination of basic factors:

- Economic growth: Low/high
- Population growth: Low/high
- Market prices (e.g. energy, land): Low/high
- Technological rate of change (e.g. rate of energy efficiency improvement): Low/high, global/local, etc…

Context scenarios: the Foresight programme

The foremost reference point for environmental policy scenarios in the UK is the Foresight programme of the DTI Office of Science and Technology.[4] This is an ongoing series of forums and reports on a national level, and also more detailed studies on sectors such as energy and manufacturing.

The Environmental Futures Foresight report sets out four futures scenarios developed to provide a broadly consistent framework for structuring alternative trends in UK economy and society for 2010 – 2030. The scenarios have been framed in the context of two underlying drivers of change, selected as the more qualitative factors, less easy to put number to: Social values (individual/community) and systems of governance (interdependence and autonomy). A synopsis of key drivers and underlying assumptions is given in the table below. This is used as the basis for the proposed scenario structure in the next section.

Table 7.2.2 Environmental Futures: UK Foresight scenario framework

	World markets	National enterprise	Global responsibility	Local stewardship
DRIVERS				
Social values	Internationalist Libertarian	Nationalist Individualist	Internationalist Communitarian	Localist Cooperative
Governance structures	Weak Dispersed Consultative	Weak National Closed	Strong Coordinated Consultative	Strong Local Participative
Role of policy	Minimal Enabling markets	State-centred Market regulation to protect key sectors	Corporatist Political, social and environmental goals	Interventionist Social and environmental goals
ECONOMIC TRENDS				
Economic development	High growth High innovation Capital productivity	Medium-low growth Low innovation Maintenance economy	Medium-high growth High innovation Resource productivity	Low growth Low innovation Modular and sustainable solutions
Structural change	Rapid towards services	More stable economic structure	Fast towards services	Moderate towards regional systems
Fast growing sectors	Health and leisure, media and information, financial services, biotechnology, nanotechnology	Private health and education, domestic and personal services, tourism, retailing, defence	Education and training, large systems engineering, new and renewable energy, information services	Small scale manufacturing, food and organic farming, local services
Declining sectors	Manufacturing, agriculture	Public services, civil engineering	Fossil fuel energy, traditional manufacturing	Retailing, tourism, financial services
SOCIAL TRENDS				
Unemployment	Medium-low	Medium-high	Low	Medium low (larger voluntary sector)
Income	High	Medium-low	Medium-high	Low
Equity	Strong decline	Decline	Improvement	Strong improvement

[4] A range of Foresight material is on www.Foresight.gov.uk

Areas of conflict	Social exclusion, immigration / emigration, political accountability	Unemployment, poor public services, inequality	Structural change, change of skills, political accountability and institutional rigidity	Land-use conflicts, under investment, environmental restrictions

The four futures scenarios are then developed further in the report through the use of detailed narratives or 'storylines'. The diagram below shows the basic framework with the Foresight scenario titles. This also shows arrows which suggest how each scenario is not a static fixed agenda, but one where the dynamics of change can lead from one type of future pathway to another.

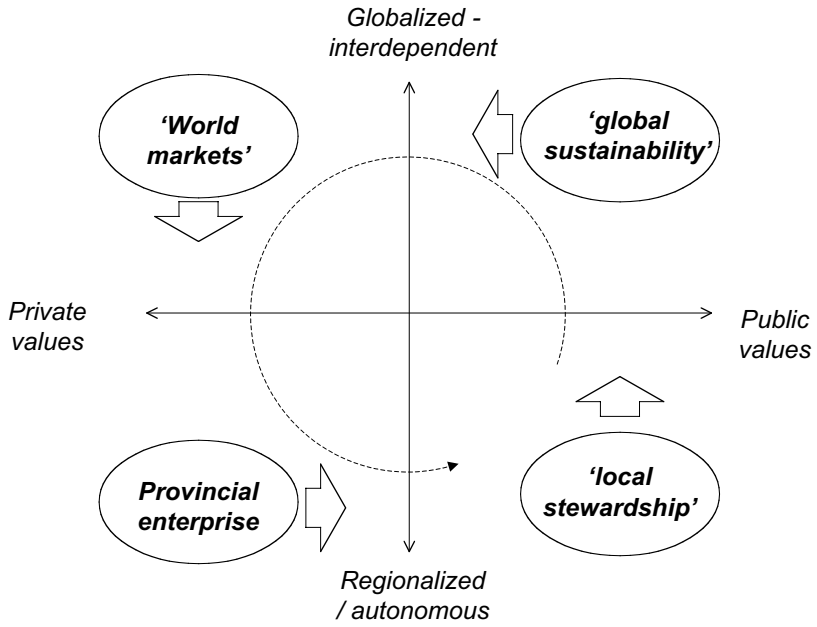

Figure 7.8 Environmental Futures scenario framework. Source: DTI Foresight www.foresight.gov.uk

Footprint scenarios

Alternative scenario types can be arranged around their effect on the aggregated reductions in ecological footprint. The 'Factor Four' concept is taken here as the reference point, where the '4' reflects a fundamental combination:[5]

- Doubling of resource efficiency
- Halving of resource usage

For each of these scenarios, a time horizon of between 25–50 years is probably appropriate (2000–2050). A 50 year horizon reflects the direction and scale of change, in the longer term restructuring of economic and social systems needed. A 20–25 year horizon is a more practical reference point for strategic goals and objectives, which are likely to be implemented on a 5–10 year timescale.

[5] von Weizsacker, E, Lovins, A and Lovins, L.H (1997) *Factor Four: Doubling Wealth, Halving Resource Use,* London, Earthscan

The scenario set identified is shown here with some generic titles, and with an overview of the annual growth rates in ecological footprint:

- ***FACTOR 0: 'High growth':*** Generally 2–2.5% compound (= 250% growth in 50 years)
- ***FACTOR 1: 'Business as usual':*** Stabilization of growth trends: 0% growth
- ***FACTOR 2: 'Low growth':*** 'Regional autonomy': 50% reduction in material impact
- ***FACTOR 4: 'Factor Four':*** 'Sustainable communities': 75% reduction in material impact.

Each of these involves a combination of many factors as below. This list can be seen as a kind of hierarchy, where the top may be generally perceived as the easiest or lowest level of 'risk', in terms of the institutional 'decision space' of decision makers.

- Technology change: Usually, this is only the concern of policy as far as finance can be found to fund new technology.
- Spatial development and infrastructure: The issues which are central to public planning and investment.
- Regulation and management: Can be acceptable where trade-offs and public benefit is clear.
- Fiscal, market and taxation: The core of the political economy agenda.
- Economic market change: Risk of unproductive interference by government.
- Economic sectoral change: Risk of being perceived as socialist intervention.
- Lifestyle and cultural change: Strong risk of 'nanny state'.

Resource management scenarios

These scenarios draw from the resource/footprint framework above, and then explore in more depth the main practical questions – i.e. how to achieve the desirable, and avoid the undesirable. Further questions include – what would be the specific objectives and targets: How these could be achieved; who would be responsible; and what might be the trade-offs or impacts? These are some of the key principles which can be used to structure resource management scenarios:

- Smart technology: Doing more with less; reducing primary inputs.
- Closing loops through local/regional economy: Linking of production to consumption.
- Smart regulation: Targeting of policy; whole life responsibility; reduced waste arisings.
- Smart fiscal measures: Charges and incentives.
- Smart markets: Whole life responsibility; integrated supply chains.
- Smart consumption: Leasing, networking, service concepts.
- Integrated materials management: Information systems and frameworks to deliver maximum effect with minimum impact.

Each of the above is potentially a long story, involving new kinds of interactions between business, government and consumers. So to translate the footprint scenarios into 'resource management' scenarios involves such complexity and there is no straightforward way to build this into any model or other simple analysis.

Scenario trends and 'givens'

A recent international review of global scenarios identified key driving forces with a very high probability of continuing in the short and medium future.[6] For a regional resource scenario framework, such trends might be taken as external 'givens':

- ***Social factors***: The ageing of the population as life expectancy increases, birth rate reduces, healthcare improves and environmental protection improves.
- ***Economic factors***: The globalisation and liberalisation of business organisations, supply chains, factor markets, financial flows, production and consumption.
- ***Technology factors***: The breakneck rate of innovation in ICT and bio-technology, and the implications for economies, organisations, technologies, cultures.
- ***Environment factors:*** The onset of serious anthropogenic climate change, causing ecological stress and disruption to economies and societies.

What is interesting is that these 'givens' appear to be quite certain at first sight, but on closer inspection, they open the door to many more layers of uncertainty. While the fact of climate change, for instance, is now widely accepted, the actual results are still very uncertain, and even more so are the impacts of climate change on a regional economy, society or environment. The projection of such trends into the future raises the question of surprises or 'side-swipes' – unexpected events coming from outside the frame. Some common surprises which surface in many scenario exercises include:

- ***Social factors***: New forms of diseases and vulnerability reduce life expectancy.
- ***Economic factors***: Global capitalism falters due to currency speculation or terrorism.
- ***Technology factors***: Global ICT systems are overtaken by viruses and saboteurs.
- ***Environment factors***: A flip in ocean currents reverses the effect of climate change.

More generally, the purpose of generating scenarios through social processes or technical models, is not just to imagine future conditions, but also to explore and bring to the surface the dynamics of present day trends. The emerging techniques of interactive scenario workshops deliberately look beyond normal policy horizons, as a means of taking such trends and shifts to their logical conclusion, and exploring different angles on the dynamics of change:

- ***Visible changes and trends***: Their conflicts and tensions, which can be projected for the shorter term.
- ***Underlying dynamics:***, Which may be projected in waves or cycles for the medium term.

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[6] European Environment Agency, 2000. *Cloudy Crystal Balls – An assessment of recent European and global scenario studies and models*. Environmental Issues Series 17, EEA, Copenhagen.

- ***Transitions and transformations:***, Where social and economic structures change irreversibly in the longer term. One example would be the growth of IT and the structural changes which come from it.
- ***Surprises and discontinuities***: Unexpected 'side-swipes', for example the September 11th attack.
- ***Results, outcomes and impacts*** of such future possibilities: For instance the impact on the environment of social change, or vice versa.
- ***The implication of such possibilities*** for present day decisions and activities.

Many participative scenario workshop sessions show a strong tension between aspiration and reality – between 'what we want' and 'what we get'. This forms the essential matrix on which scenarios for 'sustainability' may be constructed.[7]

Scenario applications

The above 'normative' theme highlights the application of scenarios as information systems in their own right, on a spectrum between different kinds of systems:

- direct control of 'engineering' type systems;
- practical operation of management systems;
- competition for agendas in political systems;
- expression of much deeper fears/hopes in cultural systems.

Within this spectrum a range of possible user applications can be charted out***:***

- ***Long term practical***: Strategy and planning issues, for the public sector and larger organizations.
- ***Short term practical***: Investment and management issues, for larger and smaller businesses.
- ***Long term rhetorical***: Values debates and awareness raising, in the NGO and public sector.
- ***Short term rhetorical***: Values, priorities and topical issues, for consumers and the public.

In the dissemination strategy for Taking Stock, the range of audiences includes education, business, local authorities, NGO/community groups and so on. The website and any other facilities need to be designed as far as possible with the interests and capacities of these in mind.

- Education: Focus on easy access to materials and downloadable reports.
- Public sector: Focus on the implications of scenarios for policy choices.
- Business: Emphasis on signposts i.e. what responses and actions business might take, and what are the practical benefits.
- Community/NGO sector: A combination of the above.

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[7] European Environment Agency, 2001. *Participatory integrated assessment methods. An assessment of their usefulness to the EEA.* Technical Report 64. European Environment Agency, Copenhagen

- Research and academics: The role of this project in the UK Mass Balance programme, and parallel initiatives in the research councils is very significant, and the final documentation will need to reflect it.

The more pro-active and interactive development of scenarios with a wider stakeholder community could be through different approaches, either stand alone or in conjunction with other events and programmes:

- Full participative scenario workshop(s)
- Expert focus group format
- On-line 'Delphi' facility with survey – response format
- Web mounting with facility for interactive feedback

The structure and objectives of any such event will need to be designed carefully, and this is for consideration of the dissemination strategy.

7.3 Scenario Settings

Scenarios and growth rates

The objective of a 'footprint' scenario is to explore the implications of achieving a certain reduction in the aggregate ecological footprint over a period of time. This effective time horizon is taken to be 50 years in this study, i.e. in the 'grandchildren's world' of the future visions component. This extended horizon allows for major restructuring of economic and technological systems, and is equivalent to one of the Kondriateff 'long waves' of economic theory.

The mathematics of compound growth can then be applied to each of the footprint scenarios (F-0, 1, 2, 4) to determine the annual growth/reduction rates needed to converge towards that total over a 50 year period. The table below shows a summary of relevant growth and reduction rates, compounded by decades 2000–2050.

Table 7.3.1 Growth and reduction rates for key parameters and scenarios

Footprint factor / other trend (italics shows numerical multipliers: others show percentages)	growth rate	2010	2020	2030	2040	2050
ICT speed	60.00%	109	12088	1.3 million	146 million	16069 million
	20.00%	5	37	236	1469	9099
	10.00%	2	6	16	44	116
Air travel	7.50%	1	3	8	17	36
Air travel	5.00%	63%	165%	332%	604%	1047%
Waste trends (a)	3.00%	34%	81%	143%	226%	338%
Waste trend (b)	2.50%	28%	64%	110%	169%	244%
F-0 scenario	2.25%	25%	56%	95%	144%	204%
	2.00%	22%	49%	81%	121%	169%

	1.50%	16%	35%	56%	81%	111%
Built environment	1.00%	10%	22%	35%	49%	64%
SE population	0.50%	5%	10%	16%	22%	28%
F-1 scenario	0.00%	0%	0%	0%	0%	0%
Household size	-0.50%	-5%	-10%	-14%	-18%	-22%
	-1.00%	-10%	-18%	-26%	-33%	-39%
F-2 scenario	-1.50%	-14%	-26%	-36%	-45%	-53%
Climate emissions	-2.00%	-18%	-33%	-45%	-55%	-64%
	-2.25%	-20%	-37%	-49%	-60%	-68%
F-4 scenario	-2.50%	-22%	-40%	-53%	-64%	-72%
	-3.00%	-26%	-46%	-60%	-70%	-78%
	-3.50%	-30%	-51%	-66%	-76%	-83%
	-4.00%	-34%	-56%	-71%	-80%	-87%
F-10	-4.50%	-37%	-60%	-75%	-84%	-90%
	-5.00%	-40%	-64%	-79%	-87%	-92%

The table shows the following footprint factors:

- F-0: 50 year doubling, with 2.25% annual compound growth rate. This growth rate is based on long term GDP growth, and on the assumption that the long term 'coupling' of economic growth with global resource consumption continues.
- F-1: Zero change with zero annual compound growth rate. This is based on the assumption of that the recent '**DE-**coupling' of economic growth with resource consumption continues.
- F-2: Halving of the footprint. This needs annual compound reduction rate of approximately –1.5%.
- F-4: Current total footprint is divided by a factor of four. This needs an annual compound reduction rate of –2.5%.
- Also shown is a hypothetical F-10, or a reduction in total footprint of a factor of 10, as advocated by the Factor 10 Club, the Carnoules Declaration and others. This would require an annual compound reduction rate of –4.5% over 50 years. The F-10 scenario is referred to in the scenario summary as 'cyber-worlds', and may be conceived in terms of the step changes possible through accelerating improvements in ICT, bio-technology and nano-technology, assuming no 'bounce back' effects.
- Also shown for reference is a notional F** scenario, based on the lower projection of air travel as below. This is chosen as perhaps the most intractable of problems on the environmental–technological agenda in the world today, and also very topical for the South East region's future.
- The chart above then displays the various growth curves, normalized to 2000 = 1.

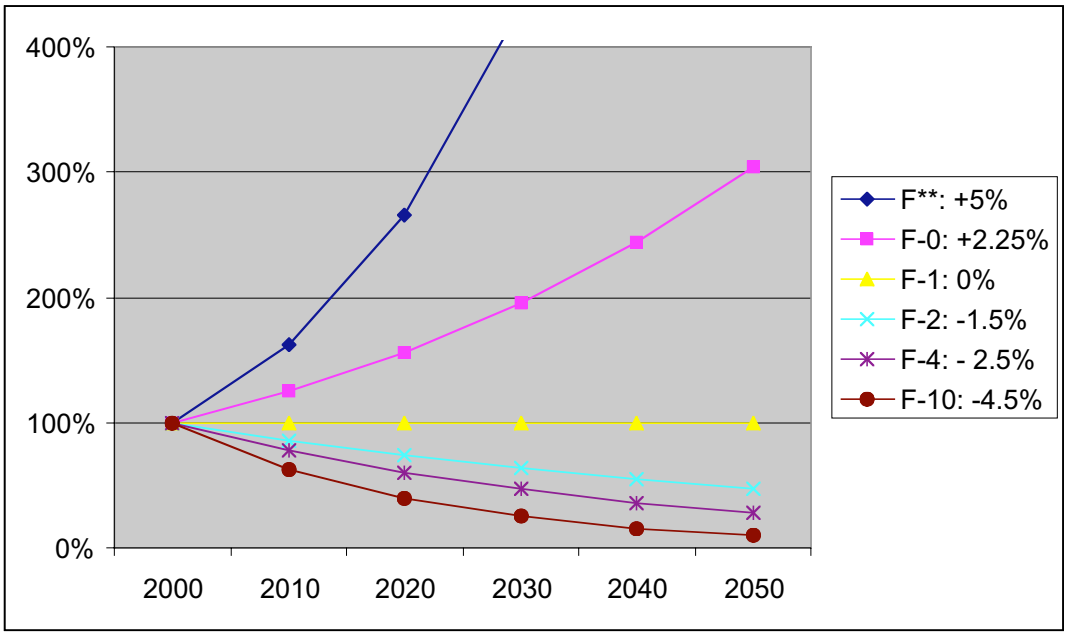
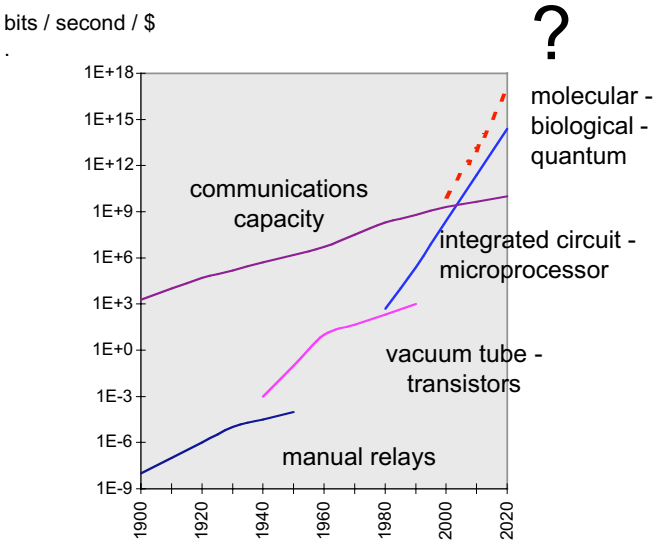


Figure 7.9 Effect of alternative rates of compound growth over 50 years

These target growth rates can then be contrasted with various growth rates already embedded in the current system. These are shown with cautionary question marks, as it is clear that any trend cannot be projected 50 years into the future with anything but speculation to justify it.

- ICT processing speed and power: While Moore's Law observes the doubling of speed and power every 18 months on average, the effect of a projected 10,000-fold increase by 2020 is almost beyond imagination *(Figure 7.10 below)*. It would also be approaching the physical limits of current silicon technology, and to continue past there molecular, quantum or biological computing would be needed, which at present is at the concept stage.
- Air travel globally is on an annual growth rate of between 5%–7%, depending on the region: This means a doubling between 2015 and 2025. If this growth curve was projected to 2050 without any other constraint, the effect would be to multiply current traffic by between 10 and 36 times.
- Waste arisings in the UK are at present estimated with a growth rate of 3%, projected from the previous decade's growth. However the evidence is not at all clear and there is now alternative datasets which appear to show a very low growth rate. If the 3% figure is taken as compounded annually, then the effects are drastic: 81% growth by 2020, and 338% growth by 2050.
- On a more modest scale, the growth of infrastructure and the built environment use of land and bulk materials can be estimated at about 1% per year. If this can be projected as compound growth then the effect is an increase of 64% by 2050.
- South East population on recent trends and projections to 2021, is increasing by 0.53% per year, or 5.5% increase per decade. However some authorities such as Bracknell Forest and Milton Keynes have growth rates of twice that, over 1% per year.

- Household average size is declining by about 0.5% per year, leading to a 10% reduction in 2020 and 22% reduction in 2050 (implying respectively 10% and 22% more dwellings will be needed).
- Climate emissions: If the IPCC recommendation for 60% cut in climate emissions by 2050 is taken at face value, this requires an annual reduction of about -2%.



Trends in ICT: computing power in bits/second/$1 cost:
standard communications bandwidth in bits / second.
Source: adapted from Graham & Marvin 1996: Ayres 1998.

Figure 7.10 Long term trends in information and communications technology
Source: adapted from Graham and Marvin 1996

Scenario structure in the model

The general structure of the model operation can be simplified into about four components, as in the mapping below *(Figure 7.11)*:

- ***Population and demand***: Factors which affect the overall size of the economy, labour force and consumption; regional migration, demographic factors, and household incomes/savings.
- ***Technology and production***: Factors which affect the share between economic sectors, and the transactions between each of the sectors; e.g. the size of the waste management sector, and its use of transport services.
- ***Productivity and eco-efficiency***: The resource intensity or the amount of waste/emissions produced for each £ of turnover in each sector; e.g. the waste from construction activity.
- ***Environmental management***: For some topics, there is further choices to be made; e.g. waste disposal/recycling methods.

For each of these components there will be a range of available settings. In the REEIO model there is the facility to input numbers with very high precision: Other models simplify things for the user by providing

sliders with 'low-medium-high' settings. Whichever method is in use, these settings will vary according to the topic, but there is a general menu of settings, which provides a template for more detailed inputs to fit into:

- ***High growth***: High population/economic growth, material consumption, low environmental protection etc.
- ***BAU ('business as usual')*** – Projections which extrapolate from existing trends as far as possible.
- ***Low growth***: Low population/economic growth, material consumption etc.
- ***Green option***: Assumes rapid shift towards more sustainable economies, technologies, lifestyles and environmental management.

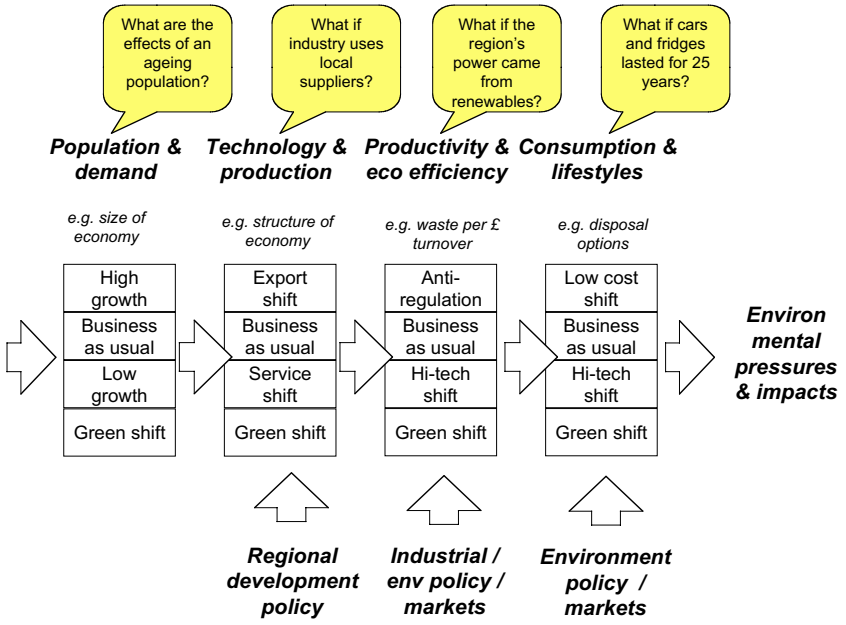


Figure 7.11 Scenario structure: inputs and questions

Scenario inputs

The direct inputs to the model scenario settings will be in most cases be one of four types:

- Policy
- Markets
- Technology
- Consumption

The crucial distinction is between factors which are inside or outside the policy space:

- Regional and local policies, actions and trends ('endogenous').

- Inter-regional, national and global level policies, actions and trends ('exogenous').

With these 4 simple components, and 4 simple settings, the scenario structure diagram provides a kind of mapping through the infinite number of possibilities for the future. In theory this 4x4 approach would generate 256 different combinations in total. This is logical but far too many variations to consider: So what is more useful in practice is a tree approach, which contains several layers:

- 4 'high level' scenarios: Very general packages of future possibilities, with much contextual and non-model information (The UK Environmental Foresight programme also defined 4 scenarios).
- 4 variations on each of the above.
- 16 or more detailed test variations on each of the above, with specific aims of visualisation of particular policies, actions or trends.

Questions on specific environmental technologies or policies can then be projected against this framework. One benefit of this approach is consistency and comparability between regions, and another is to simplify communications.

Scenario setting framework

The table below is an extract from a larger spreadsheet in the form of a 'scenarios' function and dataset. The trend and scenario factors are generated from reference to previous scenario modelling exercises, in particular the 'Integrated Sustainable Cities Assessment Method' (ISCAM) (Ravetz 2000). This was originally constructed for the case study of Greater Manchester and then extended to the North West region. In adapting the framework to the South East region, checks were made line by line to ensure compatibility with the different situation in the South East.

This has been designed to coordinate with the 'baseline' or present day MFA - EF spreadsheets. It has also been designed to coordinate with the more in-depth discussion of 'scenario trends' in the previous section.

These trend factors are as always composed of a variety of sources and assumptions:

- government and industry historic data and projections, as far as these exist;
- policy objectives or scientific targets, where these apply;
- 'what-if' questions where these are relevant.

Settings for ecological footprint scenarios

The above scenario settings framework can be condensed down to a very few variables, as summarised below, and at the end of the scenario storylines section:

- ***F-0: high growth scenario***: In general terms the aggregated EF per capita would be anticipated to increase in line with a simple calculation based on a combination of growth rates in structural economic features:

EF per capita growth at 4.50%
=
material throughput based on simple real household expenditure growth at 3.5%
÷ reduced delinking factor 1.25%
x increased imported fraction (long distance) at 1.25%
x energy intensity at 1% annual growth

- ***F-1: business as usual scenario:*** In resource flow terms this business as usual scenario projects the recent trends of zero growth in direct material flow – i.e. the observed 'de-linking' of the UK economy. This can be described as a reduction in the MFA per £GDP, at about the same rate as GDP growth, i.e. long term 2.25%. The generalized calculation to support this focuses on some key structural growth rates:

EF per capita growth at 0.5%
=
household incomes based on GDP (GVA) growth at 2.25% long term:
x tonnage of material throughput per £GDP factor, reducing at 2.25% long term
x increased imported fraction (long distance) at 0.5%
x increased energy intensity in manufacture at 0.5% annual growth

- ***F-2: Factor 2 scenario:*** The aggregated EF per capita would be anticipated to move gradually towards a 50% reduction over 50 years, or an annual change of –2.5%, in line with a simple calculation of structural change characteristics:

EF per capita growth at –1.5%
=
household incomes based on GDP (GVA) growth at 1.25% long term:
x reducing material throughput per £GDP factor, reducing - 0.75% annual change
x reduced imported fraction (long distance) at –1% annual change
x reduced industrial processing at –1% annual change

- ***F-4: Factor Four scenario:*** In general terms the aggregated EF per capita is anticipated to move gradually towards a 75% reduction (Factor Four) over 50 years, or an annual change of –2.5%, in line with a simple calculation of structural change characteristics:

EF per capita growth at –2.5%
=
household incomes based on GDP (GVA) growth at +1.00% long term:
x reducing material throughput per £GDP factor at –1.5% annual change
x reduced imported fraction (long distance) at –1.00% annual change
x reduced industrial processing at –1.00% annual change
.

Format of scenario table

The large table below is arranged in the following way:

- Data item and units: This shows the specific item of data which is required to activate the spreadsheet. Where regional data is not identified from primary sources, the spreadsheet model can generally supply a default item.
- Scenario choice: The shaded column on the right shows the choice of preset scenario, and the annual growth factors per year shown below each of the 4 choices. The general description and logic of the four scenarios is shown in previous sections. The key scenario is in fact in this case 'F-1' as this is the closest to the BAU/SD: the 'business as usual' setting, the main 'default' projection. This assumes smooth continuing progress in technology, economy, policy and lifestyles. In contrast, the F-4 'Sustainable Development' scenario represents an aspirational frontier in each of the above factors, as far as this can be identified.
- Time span: This then displays the results of compound growth according to the % growth factors set, for the period 2000–2050. Note that these annual growth factors apply only on the inputs to the spreadsheet calculation. On the outputs side of the calculation the changes will not be similar compound growth curves, as each one is calculated as the sum, product and/or remainder of many other factors.
- Slider settings: This shows the settings for the 'interactive sliders' i.e. user controlled specific inputs, which may alter the settings for each one of the data items. The eventual linked database will contain only a selection of the possible user input sliders.

Note that all figures in this table are for change/growth factors only, e.g. % change per year of the number of households. A parallel worksheet contains the actual data items e.g. number of households. We can see from this summary table that there are several types of numbers which all interact to form a composite scenario.

- Input data items – these are assembled whenever the spreadsheet is applied to a region or other unit.
- Assumed 'default' change factors – these are built in as central assumptions. They are for the most part reproduced as the F-1 scenario figures.
- Scenario input change factors – these attempt to simulate the alternative scenarios in technology, policy, markets and lifestyles.

Table 7.3.2 Selected scenario settings for MFA-EF scenario model

Data item	Units	Alternative scenarios				Default growth trends (BAU)				
Working title		**Hi growth**	**BAU**	**Lo growth**	**Factor Four**					
Foresight scenario nearest equivalent		**World mar-kets**	**Global gover-nance**	**Regio-nal auto-nomy**	**Local stewar-dship**					
Footprint type		**F-0**	**F-1**	**F-2**	**F-4**	**2010**	**2020**	**2030**	**2040**	**2050**
GENERAL										
Growth in population from 2000	%	0.30%	0.20%	0.30%	0.10%	2.0%	4.0%	6.0%	8.1%	10.2%
Growth in GDP/head from 2000	%	3.00%	2.25%	1.50%	1.50%	24.9%	56.1%	95.1%	143.7%	204.5%
GDP share: Industry/primary	%	-1.30%	-0.66%	0.00%	0.00%	-6.4%	-12.3%	-17.9%	-23.1%	-28.0%
HOUSEHOLDS										
Dwellings										
Change in H-hold size from 2000	%	-2.00%	-0.65%	0.00%	0.00%	-6.3%	-12.2%	-17.7%	-22.9%	-27.8%
Change in current stock proportion	%	-0.50%	-0.16%	0.00%	0.00%	-1.6%	-3.2%	-4.8%	-6.3%	-7.8%
New stock floorspace/unit	m2/unit	1.00%	0.60%	0.00%	0.00%	6.2%	12.7%	19.7%	27.0%	34.9%
Intensity and Demand										
Existing stock - intensity change from 2000	%	0.00%	-0.20%	-0.50%	-0.50%	-2.0%	-4.0%	-6.0%	-7.9%	-9.8%
New stock - intensity change from 2000	%	0.00%	-0.89%	-1.80%	-1.80%	-8.5%	-16.3%	-23.5%	-30.0%	-36.0%
Final Uses										
Space heat – share	%	0.00%	-0.23%	-0.45%	-0.45%	51.8%	50.6%	49.4%	48.3%	47.2%
Water & cooking - share	%	1.00%	-0.73%	-1.50%	-1.50%	22.3%	20.7%	19.3%	17.9%	16.7%
Lighting – share	%	1.00%	0.00%	0.00%	0.00%	5.0%	5.0%	5.0%	5.0%	5.0%
Refrigeration - share	%	4.00%	2.55%	1.00%	1.00%	10.3%	13.2%	17.0%	21.9%	28.1%
Other power - share		2.00%	1.00%	0.00%	0.00%	11.0%	0.11	11.0%	11.0%	11.0%
Delivered Energy										
Electric – share	%	1.50%	0.69%	0.00%	0.00%	18.1%	19.4%	20.7%	22.2%	23.8%
Gas – share	%	0.10%	0.01%	-1.00%	-1.00%	66.0%	66.1%	66.2%	66.2%	66.3%
Oil - share	%	0.30%	0.27%	0.00%	0.00%	1.9%	2.0%	2.0%	2.1%	2.1%
Coal - share	%	0.00%	-4.29%	-7.00%	-7.00%	9.7%	6.2%	4.0%	2.6%	1.7%
Direct renewable - share	%	3.00%	9.94%	15.00%	15.00%	0.0%	0.0%	0.1%	0.3%	0.9%
Heat		4.00%	4.00%	4.00%	10.93%	0.6%	0.8%	1.2%	1.8%	2.7%
Housing Conditions										
Rate of falling unfit	%/year	0.60%	0.40%	0.60%	0.00%	4.1%	8.3%	12.7%	17.3%	22.1%
Rate of replacement	%/year	0.00%	0.14%	0.00%	0.50%	0.60%	0.42%	0.40%	0.35%	0.30%
TRANSPORT										
Passenger travel intensity change	km/y/£ GDP	-0.30%	-0.42%	-0.50%	-0.50%	-4.1%	-8.1%	-11.9%	-15.5%	-19.0%
Freight travel intensity change	Mt.km/ y/£GD P	0.50%	0.38%	-0.30%	-0.30%	3.9%	7.9%	12.1%	16.5%	21.0%

Data item	Units	Alternative scenarios				Default growth trends (BAU)				
Working title		**Hi growth**	**BAU**	**Lo growth**	**Factor Four**					
Foresight scenario nearest equivalent		**World mar-kets**	**Global gover-nance**	**Regio-nal auto-nomy**	**Local stewar-dship**					
Footprint type		**F-0**	**F-1**	**F-2**	**F-4**	**2010**	**2020**	**2030**	**2040**	**2050**
Car / motorcycle - efficiency	MJ/km	0.30%	0.00%	-0.30%	-0.30%	2.50	2.50	2.50	2.50	2.50
Car / motorcycle - share	%	0.00%	-0.31%	-1.00%	-0.31%	0.70	0.70	0.70	0.70	0.70
Electric / other car - share	%	5.00%	13.85%	15.00%	13.85%	15%	25%	26%	27%	28%
Cycle / walk > 1km - share	%	0.00%	0.33%	5.00%	5.00%	8%	10%	12%	13%	14%
Bus / taxi - share	%	-1.20%	-0.59%	1.00%	1.00%	8%	10%	11%	12%	12%
Gas /other bus - share	%	2.00%	5.33%	8.00%	8.00%	10%	12%	12%	12%	13%
LRT - share	%	2.00%	5.02%	8.00%	8.00%	3%	5%	6%	7%	10%
Train local / national - share		-3.00%	-1.96%	2.00%	2.00%					
Air passenger travel										
Air travel efficiency	MJ/km/p	0.00%	-0.84%	0.00%	-1.70%	1.25	1.25	1.25	1.25	1.25
Growth in passenger travel	%	6.00%	4.49%	4.49%	2.81%	80%	100%	110%	120%	130%
Freight										
Air - share	%	6.00%	4.61%	4.61%	2.00%	4%	4%	4%	4%	4%
Diesel lorry - share	%	0.00%	-1.66%	-1.66%	-3.00%	40%	20%	18%	15%	12%
Gas/other lorry - share	%	10.00%	20.36%	10.00%	25.00%	20%	40%	41%	42%	43%
Rail - share	%	-3.00%	-1.07%	4.00%	4.00%	27%	30%	31%	32%	33%
Water/pipeline - share		0.00%	0.85%	2.00%	2.00%	5%				
SERVICES AND INDUSTRY										
Services Space and Intensity										
Change floorspace/GDP ratio	%	0.20%	-0.42%	-0.80%	-0.80%	-15%	-30%	-40%	-45%	-50%
Change in floorspace stock	%	-1.00%	-0.65%	-1.00%	-0.30%	-15%	-30%	-40%	-42%	-50%
Existing building energy int-ensity change	%	-0.10%	-0.20%	-0.10%	-0.40%	-5%	-10%	-15%	-18%	-20%
New building energy int-ensity change	%	-0.20%	-0.42%	-0.20%	-0.80%	-15%	-30%	-40%	-45%	-60%
Services Delivered Energy										
Electric - share	%	3.00%	1.94%	1.00%	1.00%	35%	35%	32%	30%	29%
Gas - share	%	0.00%	-0.38%	-0.60%	-0.60%	30%	30%	25%	25%	20%
Oil - share	%	-1.00%	-2.11%	-3.00%	-3.00%	18%	15%	12%	11%	9%
Coal - share	%	-1.00%	-1.60%	-3.20%	-3.20%	3%	2%	1%	1%	1%
Direct renewable - share	%	2.00%	4.01%	6.00%	6.00%	3%	8%	12%	15%	15%
Heat - share		2.00%	4.94%	6.00%	6.00%	#	#	#	#	#
Industrial Energy										
Energy intensity change	%	-0.20%	-0.42%	-0.80%	-0.80%	-25%	-50%	-60%	-65%	-70%
Electric - share	%	1.00%	0.64%	0.30%	0.30%	35%	32%	28%	26%	24%
Gas - share	%	0.20%	-0.06%	0.00%	0.00%	40%	30%	25%	25%	20%
Oil - share	%	-0.40%	-0.84%	-1.50%	-1.50%	17%	15%	12%	10%	6%
Coal - share	%	-0.24%	-0.48%	-1.00%	-1.00%	2%	10%	6%	2%	1%
Direct renewable - share	%	2.00%	4.00%	7.37%	7.37%	1%	3%	5%	10%	15%

Data item	Units	Alternative scenarios				Default growth trends (BAU)				
Working title		**Hi growth**	**BAU**	**Lo growth**	**Factor Four**					
Foresight scenario nearest equivalent		**World markets**	**Global governance**	**Regional autonomy**	**Local stewardship**					
Footprint type		**F-0**	**F-1**	**F-2**	**F-4**	**2010**	**2020**	**2030**	**2040**	**2050**
Heat - share		0.50%	1.57%	3.00%	3.00%					
ENERGY										
Power, CHP and Secondary Fuel										
Gas - share	%	7.00%	5.09%	7.00%	3.00%	40%	35%	32%	30%	25%
Oil - share	%	4.00%	2.81%	4.00%	1.00%	15%	10%	9%	8%	6%
Coal - share	%	-2.00%	-6.08%	-2.00%	-8.00%	12%	10%	8%	5%	2%
Renewables - share	%	2.00%	3.73%	2.00%	7.00%	7%	25%	30%	30%	30%
Waste - share	%	3.00%	4.49%	3.00%	7.00%	4%	10%	11%	12%	15%
Nuclear - share CALCULATED AS BALANCING ITEM		3.00%	-0.73%	3.00%	-3.00%	#	#	#	#	#
Other Indicators										
Total CH4 emissions	kt	-2.70%	-5.39%	-2.70%	-8.09%	50.0	22.0	19.0	17.5	15.0
Total CFC / HCFC emissions	kt	2.91%	1.94%	2.91%	0.97%	1.30	0.25	0.20	0.15	0.10

Adapted from Integrated Sustainable Cities Assessment Model (ISCAM): Ravetz, J, 2000: 'Integrated Assessment for Sustainability Appraisal in Cities and Regions': ***Environmental Impact Assessment Review***, 20**(2000):31-64**

7.4 Scenario Storylines

7.4.1 General outline

This section of the report is a demonstration of a scenario storyline collection. The intention is that it serves as a basis for the development of the linked model/database, and that it could also be further developed by stakeholders in the South East region. This could be through the following ways:

- Stakeholder scenario workshop
- On-line 'Delphi' survey – response format
- Expert focus group format
- Web mounting with interactive comments

Sources

The demonstration scenario framework shown below has been compiled from a combination of sources:

- OST Foresight programme: Environmental Futures (OST 2001).
- UK Climate Impacts Programme: Socio-economic scenarios (SPRU, 2001).
- UK Spatial Planning Framework, a feasibility study to the Royal Town Planning Institute (Wong, Ravetz and Turner 2000).
- EC funded project 'Integrated Visions', which included a regional scenario collection based on a series of 'futures workshops' in the NW region.
- Key reports from the European Environment Agency, including 'Scenarios as tools for international environmental assessments' (EEA 1999).
- The Biffaward funded 'Resource Flow Audit' of minerals and aggregate flows, together with various other Biffaward footprint and mass balance projects.
- The Sustainable City-Region project on Greater Manchester, and its methodology 'Integrated Sustainable Cities Assessment Method' (Ravetz 2000).

Scenarios in context

Business and policy decisions are made every day which will influence the region for decades to come. But the shape of the region 25 or 50 years from now is a very open question. Forecasting over 50 years is not an option, and even over 5 years it is debatable as to accuracy: But it is very useful, if not essential, to think through the possibilities.

The purpose of these scenarios is to envision alternative kinds of futures which may be one of 3 types, or the '3 P's – ***possible, plausible, probable.*** To this can be added another dimension – ***desirability or 'sustainability'***. When public forums or focus groups debate the meaning of these scenarios, many

underlying themes come to the surface, not only about obvious physical sectors such as transport or urban development, but about deeper perennial human questions of society, lifestyles and civil liberties.

Although scenarios are apparently focused on the future, their main function is to hold up a mirror on the present – extrapolating the present day trends, pressures and dynamics into the future so that they can be seen more clearly. This shows up well in the 'social process' approach to scenario workshops, visioning forums etc.

On the other end of the scale is the technical modelling approach, which uses numerical data and a systems model to simulate the issues which can be measured and projected in such a way. In that case, close attention is needed to the assumptions, the structure of the simulation, and what the user might put in and get out of the model. Both of these are combined in what the European Environment Agency (EEA) calls the 'Storyline and simulation' (SAS) approach. This works in a cycle, exploring storylines with stakeholders, simulating on the model, then interpreting the results and discussing with stakeholders and so on. This is the ideal way to do scenario work, but this combination requires both a social process which can be time intensive, in coordination with a well worked out technical model (EEA 2002).

Scenario structure

As the number of possible futures for the South East region is infinite, we have to use structuring methods in order to make sense for the practical implications. Analysis of recent developments in scenario methods shows several different types. Each of these is relevant to the scope of Taking Stock, and therefore to its scenario modelling approach:

- ***Contextual scenarios***: These illustrate possible alternative trajectories for general socio-economic trends and conditions, at the SE/UK/EU/world levels.
- ***Policy/issue scenarios***: Structured around topical and conflicting sectors and themes. In the South East such themes might include transport, housing, waste and environmental protection.
- ***Footprint scenarios***: These provide 'envelopes' for the Ecological Footprint as a measure of aggregated environmental impact. This provides a very simple spectrum of F0, F1, F2 and F4 or 'Factor 4' targets.
- ***Resource scenarios***: These are focused on the materials management aspect of resource flows, in terms of technology, regulation, markets and consumption choices.

For simplicity in this section we have presented the main scenario narratives in terms of the 'context scenario' structure. In practice there is not often an exact match between one type and another type of scenario:

- Contextual scenarios in this demonstration are based on an adaptation of the UK Environmental Futures programme, carried out initially for the North West region 'Integrated Visions' project (Rotmans et al 2000).
- Policy scenarios generally follow their own logic, whether transport, housing or waste.
- Footprint scenarios are in a sense theoretical or top down, based around aggregated footprint targets.

- Resource scenarios are constructed more in a bottom up approach, from a combination of aspirations with projected reality.

Table 7.4.1 Scenario structure and links

UK Foresight	Context scenarios	Policy scenarios	Footprint scenarios	Resource management scenarios
World markets	World markets	Economic growth approach	F0 – High growth	Unbridled consumption
Global sustainability	Global governance	Regulation based approaches	F1 – Business as usual	Managed consumption
National enterprise Regional autonomy	Risk society	Environmental risk approaches	F2 – Low growth	Environment 'bites back'
Local stewardship	Sustainable Communities	Green shift / low growth	F4 – Factor Four	Sustainable lifestyle / resource managemt
		Zero waste	F10	Spaceship region
		Total waste	F***	Out of control

In addition there are two extreme scenarios shown at the end of the table:

- ***F-10 'spaceship region'***: This represents the aspiration for a complete step change in environmental sustainability, along the lines recommended by the Carnoules Club among others.
- ***F** 'out of control'***: This represents the opposite case where technology destabilizes social and economic structures to such a degree that resource consumption 'goes wild'. Again this is not pure fiction: If the technology and the institutions became available to enable rapid economic growth in India, China and other parts of the developing world to western levels of affluence, then total global ecological footprint could easily multiply and increase by a factor of between 4 and 10.

Either of these scenarios could be used as the basis for an 'accelerated technology' scenario, where developments in ICT, bio-technology and nano-technology are so rapid and powerful they each drive other social and economic changes before them. Such a technology-driven scenario may be used either for positive outcomes (F10) or negative (F**). The purpose in bringing in the extremes or 'wild cards' is - a) to put more moderate changes in perspective, and (b) because they are often closer to reality. For examples no futurists of the last 4 decades managed to anticipate the explosive growth of the internet, and the possibilities were only picked up by science fiction writers.

Application to Taking Stock

The point of following through the above linkages between different scenario types is to place the footprint scenarios in a reality context. The Taking Stock project had a principal objective, to identify ways in which the South East could work towards a major reduction in EF, as measured on the scale of a Factor 4 reduction.

In practice this is extremely challenging. A first assessment would say that a Factor 4 reduction would be desirable but quite impractical. However there are many policy and scientific programmes which are calling for exactly that. For example, the DTI Energy White Paper holds out high aspirations without going into full detail on how these may be achieved.

Other mass balance projects have tended to present large sets of very detailed numbers which lead to fairly obvious conclusions, e.g. "if the population shifted the bulk of everyday travel to buses and bicycles then we could halve the transport footprint". While being a useful first step, this approach does not engage very well with people in policy, business or society, who are not already convinced that environmental protection is an overriding priority. So starting from the objective of reducing footprint by various degrees up to a Factor 4, over several decades, there are different kinds of questions which come up, and different kinds of scenarios which can throw light on them:

- What kind of world will we be living in? (context scenarios)
- What are the policy options and pressures? (policy scenarios)
- What would the effect be? (footprint scenarios)
- How would we start to achieve it? (resource management scenarios)

In particular it raises the issue of '***sustainable development'*** as a question not of some ideal far-off island vision, but of practical guidance in the midst of difficult conditions. For instance it might be supposed that the world economy is dominated by the USA model of market led economic growth, the South East region is decimated by floods due to climate change, and many communities defend themselves in security-patrolled housing enclaves – how then to start reducing the ecological footprint?

7.4.2 Outline of context (high level) scenarios

Each of the scenarios below is linked to a central driving force or 'dynamic' – economic, organizational, environmental or social. Each is also linked to a certain kind of 'model' or view of the world – at the risk of generalising a complex and fluid political situation, these might be termed ***American, European, Environmentalist or Communitarian.***

The purpose of arranging the scenarios around familiar 'models' is not just to re-iterate common knowledge, or the results of other studies. It is to explore the implications for the region, in various sectors, and over a long time horizon. In particular it aims to bring to the surface some underlying themes which are generally beyond the boundaries of the policy process. Each scenario is also presented not as a static vision, but as part of the flux of dynamic change, i.e. where one type of scenario transfers into another type over a time period. The time-slices which interpret such changes are shown in the appendix.

Presentation of scenarios

In each of these scenarios below we present the main theme in terms of the four context scenarios – markets, governance etc, with a particular focus on the South East region (SE). The scenario sectors aim at consistency and completeness. The website also shows fictional news items and features, drawn from guided visualisations in the scenario workshops, and from contributions by a creative writer. The results are summarised in the tables at the end, and these also show quantitative indicators, which are drawn from other parallel studies.

The 'storylines' shown in the Appendix spin out more of a narrative, which brings to life the effects through time. It also aims to show how each scenario is not a static or simple picture, but one which moves and changes: and also how each 'model' plays out through tensions and conflicts with other

models. Each scenario also shows a F-10 'technological potential', where accelerating change in ICT, bio-technology and nano-technology is seen as perhaps the most crucial branch point or alternative future.

7.4.3 Outline of scenarios

Below are the headings of the context scenarios:

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

SUMMARY OF CONTEXT SCENARIOS	
'Market rules' ***ECONOMY – LED:*** **(American model)** Much of SE region becomes a USA-owned branch plant. New jobs in corporate training centres; large-scale personal liquidation and white collar crime; gridlock, toxic pollution, climate change are major market opportunities. Large scale privatization of local assets.	***'Global governance'*** ***ORGANIZATION – LED*** **(European model)** SE holds together as cities and country reach new balance, against continuing pressures from migration, exclusion, climate hazards. New forms of local-regional and networked governance help cohesion and communication. Advanced ICT as medium for integrated governance; new forms of organization combine public, private and community sectors.
'Regional island' ***ENVIRONMENT – LED*** **(Environmentalist model)** The SE region retreats into an insular role as the outer ring of London. Prices exclude other regions of the UK, but congestion and declining services hit hard. Climate change, toxic, water shortage and epidemic stress hit the poor and elderly hardest. Local economy crumbles from branch plant withdrawal, while both inner cities & wealthy countryside are gated no-go areas.	***'Local enterprise'*** ***SOCIETY – LED*** **(Communitarian model)** Relative stability as people rediscover and reinvent local communities, affluence is spread and governance is devolved. Urban areas improve, transport demand stabilizes, local economic networks take off. Some tensions between connected and excluded, and many communities become defensive and inward looking. Regional government forms from local partnerships, and works on ecological restructuring of urban and rural areas.

SUMMARY OF FOOTPRINT AND RESOURCE SCENARIOS	
'Factor 0' ***ECONOMY – LED:*** **(American model)** Existing growth trends in resource use are continued unabated in the SE and the rest of the developed world. New sources of minerals and fossil fuels are discovered. Common assets such as forests and wetlands are privatized and extracted. Commodity prices continue to reduce compared to labour prices in a knowledge based market. Cheap technology makes large numbers redundant in the developing world.	***'Factor 1'*** ***ORGANIZATION – LED*** **(European model)** Enlightened public sector management helps to make the most of increasingly scarce resources. However there is a policy to even up the gap between rich and poor, so that larger houses, cars, appliances are spread all around. The new re-use and recycling economy just keeps pace with the growth of demand across society. The SE region becomes even more tightly regulated in the balance of property and common assets.
'Factor 2' ***ENVIRONMENT – LED*** **(Environmentalist model)** Resource use and overall footprint declines, mostly for the wrong reasons. Ecological disruption combines with a stagnating economy, so that international trade reduces. The gap between very rich and the middle classes and the poor widens: The rich consume avariciously while others tighten their belts. While ecological footprint is reduced, there are many other problems from toxic wastes, hormone disruptors, mutant genomics and radioactive waste.	***'Factor 4'*** ***SOCIETY – LED*** **(Communitarian model)** Relative stability as people rediscover and reinvent local communities, affluence is spread and governance is devolved. Urban areas improve, transport demand stabilizes, local economic networks take off. Some tensions between connected and excluded, and many communities become defensive and inward looking, while climate change leads to harsh winters. Regional government forms from community partnerships, and takes forward ecological restructuring of urban and rural areas.

7.4.4 F-0: Hi-growth 'World markets' scenario

What if global capitalism really did work, at least most of the time? What if it really took off, not only in producing the goods and the markets, but in the reshaping of towns and cities here in the UK? And what if global corporations took over not only public services but personal values as well? This classic 'American model' market-driven scenario is perhaps the closest to perceived trends, appearing in nearly all futures studies.

While much of the South East economy is taken over by trans-national corporations, there are mounting pressures from within - boom and stagnation, inflation, environmental risks, and the collapse of former community and family structures. This is in a world characterised by massive flows of goods, services and capital, privatised health and education, and widening gaps between rich and poor. The South East region in particular shows up the tensions sharply – much of the region becomes a giant property market with enclaves of security controlled suburbs complete with their own schools and health services. For the not so fortunate, the problems of urban crime, gridlock, toxic pollution, and climate change are each seen also as market opportunities by the corporations. Alongside the conflicts between global and local economies, many community and opposition groups begin to invent new forms of social organisations.

Economy and society

Social inequalities and polarisation of growth and decline increase, between inner cities and rural areas, and between competing urban regions. The growth in world markets sees rapid innovation on ICT and bio-technology with many political and ethical problems, and there are spreading risks from climate, genetic, toxic, radiological hazards, together with some resource shortages. However world markets also spur innovation and investment in technology, and wherever the price is right, there are defences or cures for each kind of risk. As emerging markets depend on premium pricing to recoup high levels of investment, crucial products such as anti-ageing hormones are priced just out of reach of the majority. The cutting-edge of new technology accelerates in ICT and bio-technology, and each decade a few small enterprises grow rapidly into global corporations.

Contrary to the fears of many, the various risks do not 'go out of control' and cause global collapse. In Europe, North America and Japan, there is a higher death rate from new technologies and development-related risks than earlier in the century. However, society is now more 'risk seeking', and a few ‘statistical fatalities’ is commonly regarded as an acceptable price to pay for progress. What's more, it is pointed out that globally, deaths have been reduced drastically as a result of greater wealth being accumulated in the formerly ‘less developed’ regions.

Public services are also put into private hands wherever possible. The transfer of funds from the working population to the young and old became so difficult to manage that all ‘connected’ individuals now have personal share-credit ratings with corporate equity and balance sheets, just like private companies. However market swings cause many to fall into liquidation and become ‘owned’ by their shareholders, and this form of economic ownership then enables most manual and basic service jobs to be carried out. A tension emerges over what some see as economic 'slavery'. Various laws are passed which restrict the personal liability of individuals in the market place. There are still some nations and older populations in the UK who are not ‘connected’ with share-credit equity, and these find themselves in a battleground between global and local currencies. The hyper-complex systems of finance, insurance, design and marketing needed to maintain this inter-connected economy generates a large proportion of total employment.

In terms of politics, despite some moves towards devolution, UK government remains highly centralised, the new regional authorities having minimal real decision making powers. The 'third way', promoted at the start of the century, turned out to be impossible to define and operationalise and was dropped as being inconsequential. The market emerged from all this (and in the absence of any thing perceived as being better) as an even more powerful force for the efficiency of consumption and production. Globalised trade and production become ever-more concentrated in a small number of huge multi-national organisations. Consumption, culture, media, and most public services are heavily market based, and most functions of government are also deregulated or privatised.

For citizens there is little opportunity to participate directly in the democratic process beyond national and local elections, and true power lies in the hands of large multi-nationals, financial entrepreneurs and media operators. Although citizens hold a token influence as electors and consumers, companies have in practice become so big and their products standardised, that only the occasional media-induced 'scares' influence corporate thinking rather than mass protests. Meanwhile, the whole question of who ‘runs’ and ‘owns’ the region or the nation is more complex than ever before. This is a golden opportunity for white-

collar organized crime, and also for countless groups and networks which seek to bypass the constraints of nation states and corporations.

Food, energy and water

With demand rising, the alternatives of pricing, rationing and efficiency are assessed for profitability. Water resource management moves to a price-based approach, in which companies can trade between themselves as necessary. At first there is some measure of regulation, so that the utilities are forced to maintain supplies at a given price and disconnections are not permitted. Over time the situation is reversed, so that high users get cheaper rates, and the rate of disconnections goes up. As water becomes more of a luxury, many turn to recycling and local supplies. Following several major droughts in the 2020s water has to be imported at high cost from the continent. Following this, a further round of takeovers occurs, and a European wide-system of water provision is promised by the new globalised utilities.

Most electricity comes via the European network: In response to the Climate Convention, French nuclear power now supplies a large part of UK energy, but the rising costs of imports also encourages renewable energy sources in the redundant parts of the South East countryside. However, the high capital costs of and intermittent supply from such developments puts off the private sector. The main source of gas and oil supply from Siberia is protected by a pan-European security force, brought in after political disturbance in Russia threatened supplies.

Severe storms and flooding are becoming increasingly common and cause the abandonment of parts of some towns and settlements on the south coast. In 2040 the worst happens with tidal surge inundating the chemicals complex on the Solent, causing chemical fires and contaminating the area's groundwater. Climate change is now accepted as a fact of life, but political debate focuses on whether to concentrate on defensive measures or on emissions controls. As the arguments continue the prospect of a clear strategy or leadership remains out of reach.

Urban development

Towns and cities show an increasing shift towards major hubs as cultural exchanges and gateways to capital, and the major city centres each compete for the 'cappuccino' model of affluent urban renaissance. Meanwhile large and small towns struggle to maintain their functions and identities in the face of more efficient and secure out-of-town facilities. Where these are restricted then older centres are transformed from within, with ever larger complexes containing themed malls, leisure, services and car parking, and then housing tends to be added on to make a complete 'urban village'. In spite of this there is accelerated outward migration from urban to rural in lifestyles and workplaces. Developers put together larger market town schemes to generate the sense of quality, place and community which commands premium prices. Such inflated prices are financed by equity from the personal share-credit of all the occupants, and local politics is focused on the pressure for privatization and security fencing of residential areas.

The market-led logic of urban development is focused on maximizing value and profit. This does not necessarily mean unrestricted suburban sprawl, but rather a kind of managed 'extensification' of space across the landscape, where it is profitable to restructure existing built up areas into new and larger-scale developments. The inevitable decentralisation tends to polarise communities, and there are many areas with falling or negative values. Meanwhile there is added re-investment in urban areas, coming from the

larger capital resources of global markets. The acceleration of ICT-based business and lifestyles sees continuing specialisation across the South East region, with long distance mobility and multiple locations for home and business.

Many new commercial areas are often formed underground or with high-rise development, and surrounded by huge new landforming and landscaped areas, on the basis of added value.

Housing shows polarisation of growth and decline based on access to hubs and services, so that prices in desirable areas are sky-high, and in others falling below zero. More households find themselves 'hot-housing' between a number of dwellings in different locations and tenures, which suits the new pattern of extended kinship networks coming from multiple marriages, children and other dependents. For commercial property, there is rapid turnover with increased fluidity and restructuring in skills, occupations, tele-work and job migration. Many people are now distributed and networked in both housing and workplace, on a continuous round of short or long term commuting and migration. Dwelling sizes and disposable incomes increase steadily while household sizes reduce, so the average space per person doubles over 50 years.

Transport

Transport is increasingly privatised and there is a new generation of large scale road building on private finance lines. There are some new forms of public transport such as light rapid transit, and high speed links between the growing network of regional airports, and the latter require much cutting and filling to ensure smooth routes. Car parks are often built underground, and in urban centres there is a trend towards connecting tunnels to link one car park to another.

A market driven approach to transport sees increased differential access to roadspace and public transport. Congestion charging and area or route charging is commonplace, and there is no perceived problem with rationing access by the ability to pay. This helps to polarise communities in new developments and urban hubs into: those with car-based individualised access: those with collective investments in public transport connections: and the residuals without any particular accessibility at all. The ability of big business to make big investments is seen in the increasing scale and integration of transport and development, regionally, nationally and globally. For instance the new generation of mixed urban villages with built in transport links are then replicated with floating airports/shopping/retirement villages.

Implications for resources

- The impacts of unrestricted climate change begin to accelerate over 50 years, and there is increasing investment in sea walls, flood defences and storm proofing.
- To overcome environmental constraints on road-building, large scale tunnelling and bunding becomes normal in populated areas, with large increases in earthmoving and demand for aggregrates.
- Landforming and intensive landscaping increase as the scale of housing development increases, planning controls are relaxed, and large areas of the countryside become privatised.
- Buildings are constructed to higher structural and sound insulating specifications to withstand climate extremes and hazards, and also security concerns.

- The result is that basic demand for construction bulk materials increases at about 2.5% per year.
- The bulk material coming out of the system from the large scale tunnelling and landforming increases at about the same rate.

Implications for resource management

In a situation of growing demand and restrictions from the growing amenity value of rural and upland areas, bulk material supplies from regional quarries cannot keep up.

- The volume of imported material grows rapidly, and several sea-based super-quarries are found in places as far as north Africa, where environmental controls are lax.
- In the South East there is a growing materials management industry, as the outgoing material from landforming and tunnelling has to find a place, and as the demand for new landforming material increases.
- Several giant materials handling centres are set up in on deep sea ports in the Thames and Solent estuaries, with direct motorway connections.
- These centres are operated by a consortium of major materials handling companies including utilities, road builders and waste management companies. The leisure industry begins to adapt these materials mountains for special activities such as off-roading and extreme sports, and also special ecological zones, where unusual landforms are required.
- The materials mountains start to become leisure and tourist destinations in their own right, drawing more primary materials from overseas, and taking the overspill from a rapidly expanding urban system.

Regional indicators

GDP growth is over 3.5% per year, however this figure includes many 'defensive' expenditures such as crime prevention and flood defences. Population growth in the UK might be higher at 1.2% per year, due to enhanced levels of global migration. Emissions of CO_2 in the UK show higher growth at 2% per year, or a doubling time of about 35 years – despite the relative cheapness of renewable energies, the multi-nationals still prefer the centralised infrastructures of fossil fuels. Climate change impacts are severe in the UK and devastating for some developing nations, but like occasional wars, they are generally seen as business opportunities rather than social costs.

Implications for ecological footprint

In general terms the aggregated EF per capita would be anticipated to increase in line with a simple calculation based on a combination of growth rates in structural characteristics:

EF per capita growth at 4.50%
=
material throughput based on simple real household expenditure growth at 3.5%
÷ reduced delinking factor 1.25%
x increased imported fraction (long distance) at 1.25%
x energy intensity at 1% annual growth

This accelerated rate of growth is not at all beyond possibility: It is actually less than the current growth rate for air travel worldwide. The rate of growth would produce a doubling time of 18 years, and within the time horizon of 50 years it would see a factor increase of approximately 9 times.

A more detailed breakdown of this very simplified calculation can be seen in the spreadsheet analysis. This shows how existing growth trends in resource use are continued unabated in the South East, as one of the most affluent areas in the developed world. New sources of minerals and fossil fuels are discovered, while common assets such as forests and wetlands are privatised and extracted. Commodity prices continue to reduce compared to labour prices in a knowledge based market. Cheap technology makes large numbers redundant in the developing world. While physical space for 'consumption' of fixed assets in the South East region is limited, there are few limits to physical throughput given that waste mountains are continuously converted to energy.

7.4.5 F-1: Business as usual: 'Management take-over' scenario

What if the 'third way' became the dominant reality, where the mobile professionals completed their take-over of business, politics, society and the media? what if it was possible to harness technology, markets and social trends for the greater good of all, and what if cities could actually be run efficiently and equitably? This is the classic 'rational government' scenario, where the balance of market and state is shifted to a more European model of planned social democracy. 'Management take-over' is a more pluralist kind of regime than the traditional 'big city' bureaucracy: It uses ICT to its full, and generates new kinds of organization on the boundaries between public, private and third sectors. This scenario also represents the ***'myth of the third way',*** *a composite bundle of worldviews, values and expectations.*

BUSINESS AS USUAL sees a continuous management take-over in all areas of market, government and civil society. It shows some kind of 'third way' version of liberal globalisation, combined with extended stakeholding and corporate responsibility based on sophisticated performance monitoring. A one-nation social model prevails at least in theory, where public services are enhanced through partnership decision-making, and the merging of public and private sectors is based on sophisticated social cost-benefit analysis. Innovation on ICT, bio-technology and other leading edge science is constrained by ethical questions, and there are increasing conflicts between rationalist society and individual civil liberties. Environmental problems are contained via democratic risk management, with high priority for integrated planning, insurance, health screening and so on.

Economy and society

The managed approach has great success in taming the tiger of global markets, and balancing economic forces with social and environmental needs. Unfortunately even a very sophisticated technocratic approach is prone to the problems of 21st century social democracies – namely that much of what makes an economy or culture work is not amenable to rational planning or management at all. The stronger the rules become in this technocratic utopia, the more energy is focused on bending them, until a fully double system emerges – a surface economy which is monitored and taxed, and a real economy which is underground. The sophistication of public management then encourages sophistication in the real economy and access to public services.

The planned welfare approach sees a stabilisation of the gap between rich and poor, with some re-distribution of wealth. Social structures become arranged around the dominant meritocracy, and the diversity of subcultures is tolerated but not encouraged. Public services such as health and education are in an unstable balance between privatisation and a wider stake-holding. There is constant tension between the new meritocracy who assume natural leadership, and a new sub-cultural constituency who assume natural stakeholder-ship.

Food, energy and water

The landscape of the South East region becomes increasingly managed and patterned to meet a complex set of social, economic and environmental objectives. There are a few areas of intensive farming mostly producing niche foods, drinks and pharmaceuticals: The rest of the landscape is diversified for wildlife, leisure, amenity, and not least to maintain the complex web of property values. In this situation, the majority of food is imported from overseas, except for the niche foods which serve organic and regional markets with increasing use of precision agricultural methods.

Most utilities become horizontally and vertically integrated consortiums, nominally private companies with a wide set of stakeholding interests: The EU wide regulatory system has managed to fit global ownership with regional accountability. Water shortages become increasingly common over the decades, until by 2050 it is cheaper to recycle most of the water of a new household than to provide new supply: the challenge is then in managing demand for water intensive agriculture, and maintaining fringe and rural landscapes in the character which the public demands. Energy resources are networked and carbon quotas are traded globally: the power mix in 2050 of 33% renewables worldwide has reached a plateau due to the opening up of the massive and cheap fossil fuel reserves of India and China.

Urban development

In towns and cities there is some redistribution of urban hub functions towards smaller settlements, enabled by ICT, and planned rationalisation of settlement patterns to avoid sprawl and waste. Total urbanisation is contained, and there is rapid restructuring of urban form and rural settlement patterns and activity, which aims at greater diversity and quality of life in each. The effect is that the outward movement due to affluence and ageing is just balanced by a re-urbanisation of centres and inner cities by large scale re-investment and regeneration. There is a planned re-structuring of urban form for clustering and densification around the nodes of a new transit network.

Building construction and urban development is transformed from its current almost ad hoc style to a sophisticated operation of integrated planning, which matches producers, consumers, locations and total values to society and the economy. This uses advanced IT and the cyber-net as a medium, but also many social process tools such as focus groups, which now form a sophisticated toolkit for finding out what people ‘really’ want and need.

For ***housing,*** there is strategic management of the balance of housing demand and supply, with sophisticated market intervention to ensure balanced provision of tenures, prices, types and fitness. The effects of such technocratic social engineering shows most strongly in housing, where some of the forms are in danger of over control. There is tension between the surveillance for security and civil liberties. There is a general re-urbanisation of housing which then relies on more complex multi-storey designs and management. For property markets, there is an enhanced framework for re-distribution and reinvestment,

and the extended stakeholding and local equity base of most enterprises enables longer term investment and return. Employment is more flexible but also more stable and broad-based arrangement between individuals and industrial sectors, and so the regional disparities from restructuring are much reduced.

Transport

For transport infrastructure a planned management of integrated transport on both supply and demand sides results in a very sophisticated system, where users and providers are in continuous networked contact. The effect is to enable a doubling of traffic in all modes over the 50 years, while air traffic multiplies by 5 times. While the public policy objective was to support public transport, private cars still show a greater facility for self-organising systems, and now that congestion management and differential pricing can be organised in real time, the benefits of car travel are even greater. However the widespread sharing and leasing of cars is widely available as a quasi-public service, while the digital surveillance which pervades public and private modes raises fears and opposition to loss of civil liberties. The ultimate prize then becomes a private car which is disconnected from automatic traffic management and positioning systems, so the wealthy pay large sums for the privilege of sitting in traffic jams with full-immersion cyber-net fantasy games.

The London Congestion Charging scheme now extends over most of the South East region, but of course the complex pattern of charges for urban centres and for motorway links has helped to redistribute not only traffic but commercial activity right across the region.

Spatial implications for the region

The South East region is often seen as a kind of kludge – not quite a cohesive region, more a collection of counties and ex-urban communities in the Greater London hinterland. However in this scenario the regional identity and management is strengthened, and for once the region sees its efforts in strategic planning and public-private partnership rewarded – as though the dreams of the 20th century development agencies came true. Across the region there is much redistribution and re-investment, with a focus on the network of suburbs right across the South East geography. This is very much a kind of fine tuning of the already complex patterns of social class, occupation, age structure and property dynamics. However for the worst of the inner city and deprived estates the recouping of values requires a very large scale of development and social engineering, and the result is open conflict between local communities and the development agencies. The horizontal ‘sorting’ and vertical ‘stacking’ of the urban structure according to class and culture becomes highly organised, and is also a target for opposition groups to the technocratic consensus.

The more rural areas across the South East are if anything more contested than the urban areas, and the complexity of overlapping interests and territorial claims is immense. The rational management approach aims to resolve these but the result often satisfies no-one. In the further parts of the shire counties the rural areas are generally more stable, and tensions between natives and incomers, technocrats and occupational workers, are generally contained. The result is a continuing spread of villages into a highly managed countryside, on the basis of meeting public demand in the most efficient way.

Implications for resource flows

This scenario sees more of the same, in the sense that the growth in total resource volumes is very small, while the travel distances and energy intensities still change.

- In the South East region the first onset of climate change begins to stabilize: But the increased priority for security brings increasing investment in sea walls, flood defences and storm proofing of structures.
- To meet environmental concerns, tunnelling and bunding becomes normal in populated areas for road and rail. Urban areas are built and managed more intensively, with many more medium-rise mixed use developments on the 'urbanist' model.
- The countryside is generally more protected: This makes new minerals and waste sites very difficult to find. Environmental constraints and policies also apply to imported aggregates. The result is that the price of aggregates climbs steadily to a point where recycled material is the first choice.
- Buildings are constructed to higher structural specifications: Much concrete and masonry is substituted by timber, some mass fill is substituted by smart geotechnics (chemical and electrostatic).
- The result is that basic demand for bulk construction materials increases more slowly at about 0.4% per year. The recycled and secondary aggregate/total ratio increases much faster at about 2% per year.

Implications for resource management

- Construction and other material industries are increasingly organised on a 'mass balance' principle as far as possible (inputs = outputs). Materials management centres (MMC) become the majority source of aggregates and some construction minerals, stockpiling and processing a wide range of material
- MMCs are distributed around urban areas with a catchment population of about 1 million: Materials throughput of about 5 million tonnes. MMCs are connected by heavy rail: Road transport is minimized as many lorries are laden both ways.
- The substitution by timber for building superstructure reduces minerals demand but increases transport use and /embodied energy of sea transport (coniferous plantations not so popular in the UK).
- MMCs are operated by consortium partnerships where the public sector underwrites some material prices for sale and return. MMCs are also linked to the remaining landfill operations, so that the definition of 'waste' 'residue' and 'resource' are all much more flexible than formerly.

Implications for ecological footprint

The key indicators for this scenario show that GDP growth continues at its current rate of about 2.25%: population growth continues its projected rate of about +0.53% per year. Climate change emissions are contained with a very modest reduction of -0.5% per year.

In resource flow terms this business as usual scenario projects the recent trends of zero growth in direct material flow – i.e. the observed 'de-linking' of the UK economy. This can be described as a reduction in the MFA per £GDP, at about same rate as GDP growth, i.e. long term 2.25%. The generalised calculation to support this focuses on some key structural growth rates:

In general terms the aggregated EF per capita would be anticipated to increase in line with a simple calculation, based on a combination of structural growth characteristics:

EF per capita growth at 0.5%
=
household incomes based on GDP (GVA) growth at 2.25% long term:
x tonnage of material throughput per £GDP factor, reducing at 2.25% long term
x increased imported fraction (long distance) at 0.5%
x increased energy intensity in manufacture at 0.5% annual growth

A more detailed breakdown of this very simplified calculation can be seen in the spreadsheet analysis. Generally, the sophisticated organisation of the economy, and complex interfacing of public and private sectors, manages to avoid the worst excesses of a free market economy, and maintain a credible environmental policy, at least in the short term, and in the region and the UK. However the continuous drive for affluence and display of affluence is a deeper structural force which the public policy cannot really control, and this then continues to drive larger environmental problems on a global scale - climate change, water shortage, desertification, deforestation.

7.4.6 F-2: Low growth: (Risk society/regional autonomy)

What if the rush for affluence sowed the seeds of its own demise? What if we learnt nothing from BSE, the nuclear waste problem, and the spread of genetically modified organisms? The theme of the risk society seems to go hand in hand with the consumer society – the more you have, you more you have to lose, and the less you trust your neighbours. A region of risk and paranoia is a very plausible backdrop for whatever we then might do in the name of 'sustainable development'.

Regional autonomy is a metaphor for a future driven by an environmental and technological change, hazard and uncertainty. Many regions in the UK experience water shortages, floods and droughts, storms and erosion, sea-level rise, toxic accumulation, food chain risks, genetic disruption, radiological contamination, morbidity and tropical diseases, ecological and agricultural stress, among many possible effects. In the face of this there could be some redistribution of benefits in tourism, agriculture and in urban civic life. The crucial theme is the implications of these shifting costs and benefits for the economy, for urban development, and for civic society.

Economy and society

Market globalisation continues with large growth in defensive industries such as environmental protection, healthcare and internal security. In politics the character of governance is defensive and territorial, however the public distrust of large-scale institutions tends to regionalise and localise decision-making, and balances globalising pressures. Unfortunately the new localisation is not benign so much as xenophobic, and characterised by jealous competition for territory, water, mineral rights and others.

Social polarisation is forced by environmental stress and associated paranoia of risk and contamination, even while new lifestyles bring new opportunities for those who are geared up to hazard and uncertainty.

The worst single effect is in the healthcare field, where conventional antibiotics lose their potency just as genetically modified renegade bacteria multiply. The effect is to drastically increase mortality rates, with a series of flu epidemics and new allergenic conditions. The defence against collective hazard also encourages new communities and sub-cultures to spring up, especially in reaction to the perceived ills of capitalism and modern science.

Food, energy and water

Food chains which were becoming increasingly sophisticated and globalised, are now increasingly disrupted by storms, droughts, floods, and new forms of pests and rodents. Water is now the central concern of international terrorism is fought on all fronts, driven by the new global divisions of wealth and poverty. The theme of the 'risk society' is pervasive, and every day there are new scares, hazards and lawsuits centred on food and food systems. The health insurance companies now act in tandem with the food multi-nationals, the genomics laboratories, and what remains of the health service, to deliver each consumer with a personalised 'minimum risk' health and diet plan. Deviations from these plans are monitored with surveillance cameras, as are the new genetic modified organisms: Many of these spread soon after their trials and are now beyond effective control.

Each of the utilities is hit by environmental uncertainty, technological risk, and not the least new forms of social anarchy, which sees many tapping illegally into the networks. Huge investment goes into bringing icebergs from the arctic as a water supply, which is then wasted as ocean current fluctuations make it impractical. In attempts to meet carbon emission targets the life of nuclear generation is prolonged, until a long term groundwater leak at Dungeness stops the programme. Large investment goes into autonomous energy solutions, but again much is wasted as the climatic uncertainty and wild fluctuations make solar and wind technology difficult to operate.

Urban development

In towns and cities there is a managed retreat to major urban hubs which offer the best in controlled climate, sealed environments and continuous security, but among these there are steep price differentials. Some inner city areas are effectively abandoned, subject to climatic hazard, toxic and bacteriological contamination, and the result are large 'wild zones' beyond normal society, together with grass-roots inspired 'eco-zones' where new forms of community and cooperation spring up. In the countryside, managed coastal retreat and defence, rural diversification and agricultural restructuring, ecological migration, and new sun-belt leisure and mass tourism each contribute to rural opportunities.

Housing activity is driven by many areas which see increasing household size, due to the need for indoor comfort, containment and security. To enable this new housing forms and tenures are evolved, with many ending up in condominium-style blocks in the cities, and self-contained private villages in the countryside. There are large inter-regional displacements of housing and jobs due to climate stress, and large flows outwards to rural new communities. Inward migration to the city centres is seen as highly desirable and available only for the wealthy, so the majority are channelled towards mixed developments of flats over shopping centres with sealed environments and continuous security.

In property, much workspace is generally more costly, and employment more uncertain due to environmental and social conditions. Leisure activity, health and education each gain added value by containment and exclusion of other social groups with potential contamination.

Transport

The defensive stance of many territories and communities continues the state of the transport system as a huge problem for everyone concerned – users, providers, financiers and neighbours. Congestion soon reaches the point at which it is self-regulating, so car manufacturers in response continue the trend towards self-containment, with mobile in-car leisure, lifestyle and work facilities improving all the time. The sealed environment approach is also reinforced by worsening hazards and associated paranoia. The result is that many live spend hours and days in gridlock on major routes, in a lifestyle of slow but continuous mobility. Air travel also continues to double every 15 years as environmental hazards create restlessness, paranoia, displacement and migration for large populations.

Spatial implications in the South East

The regional map is shaped by new forms of environmental stress and the social insecurity which comes from it. Cities such as Oxford, Reading and Portsmouth redraw their maps with increasing size of sealed living and working spaces in city centres, transport hubs, retail parks and other strategic locations. The remaining urban areas are a patchwork of smaller scale defences and individual ownerships. There are some wild zones in the inner cities and on the less favoured parts of the urban fringe. Surrey, Hampshire and Berkshire are under growing pressure for development for those escaping the urban heat island, but are struggling with ecological stress and flooding in low-lying areas. The Chilterns smaller scale hilly areas are seen as even more desirable, and the wealthy extend their estates as far as possible. In rural areas, eco-restoration and natural resource management is often 'after the event', and many hills and woodlands are barren and eroded, but the collective defence effort helps to generate new forms of rural community.

Implications for ecological footprint

Economic growth is halved to about 1% per year growth: Defensive activity is good for business but slows the rate of innovation throughout the wider economy. Population growth is also down at 0.4% per year. Environmental impact as in CO_2 emissions is up at 1% per year growth, as climatic hazard and ecological stress reduce the scope for alternative energy and for demand management.

In resource flow terms this scenario achieves 'low growth' for mostly the wrong reasons. The previous 'de-linking' of the UK economy is now related to economic stagnation, social breakdown and environmental disaster. In general terms the aggregated EF per capita would be anticipated to move gradually towards a 50% reduction over 50 years, or an annual change of –2.5%, in line with a simple calculation of structural change characteristics:

EF per capita growth at –1.5%
=
household incomes based on GDP (GVA) growth at 1.25% long term:
x reducing material throughput per £GDP factor, reducing - 0.75% annual change
x reduced imported fraction (long distance) at –1% annual change
x reduced industrial processing at –1% annual change

7.4.7 F-4: Factor Four: ('Sustainable communities')

What if many hopes and desires really came true – for communities, neighbours, safe streets, good schools – a city and region where people cared and looked after each other. What if global markets became regional and local again, and the exploitation of country by city turned to mutual support? But can things really work in such harmony, or would the rich get richer while the poor stay poorer? And if such 'sustainable communities' were possible, what would it mean for the shape of the city and the region?

Factor Four or Sustainable Communities sees new social solutions as the dynamic of change towards a more integrated and equitable society; new communities working together and bypassing market divisions and bureaucratic constraints. Social and environmental values are the driving force for smaller scale cleaner technologies, with increased viability from technological innovation and community applications. Urban areas improve, transport demand is stable, and local economic networks take off. Regional independence and local agency drive future developments, and common resources such as the internet are increasingly self-regulated. The environmental and social benefits are many; cleaner air, more children playing outside, increased organic farming, and greener production in general.

Sustainable communities is led by the dynamic of social change, focused on the 'third sector' – a way of organizing society through local action, self-help and mutual aid, networks and non-profit organizations of all shapes and sizes. This apparently utopian vision raises many questions. One question is how far globalising trends could be reversed towards the local, or simply shifted towards a more connected global identity. Another question is how far such a society could be 'sustainable' in the sense of stability over time – whether in practice such balanced communities are unstable and temporary states in a cycle of change. The final question is whether such apparent harmony itself could only rest on a stable but inequitable social structure. This scenario cannot provide answers to all these, but plays out some of the key implications.

Economy and society

Consumer pressure helps to shift business towards ethical purchasing and the internalisation of environmental and social costs. With many overseas economies thriving in the new global order, it is no longer cheaper to transfer manufacturing or even ICT services – local sourcing is as far as possible helped by a shift in emphasis to 'quality' and 'meaning' away from services and products. Mutual cooperation between countries is achieved as global and local networks find new ways of meshing together, facilitated by the internet. There is rapid growth in LETS (Local Economic Trading Scheme) schemes, which help to change the culture in which people are valued in terms of their contribution to society.

While this might seem to be a communitarian utopia, it appears likely that globalisation, technical shock and environmental stress would continue. Local autonomy and self-reliance could produce problems, in that rich and poor communities would each tend to stratify and reinforce patterns of dependency. There would be an agenda for regional/national redistribution and strategic management, as much as with the other scenarios, but the context for doing this could be quite different to that of today. The UK and the South East would see a more federal regional structure with largely autonomous local authorities, together with more levels at neighbourhood, parish and street level.

A significant but socially isolated minority refuse to reject their consumerist lifestyles of the last century. By the 2020s these are mostly found in pockets of the older population forming increasingly isolated

communities following their own ideas. These do not represent the majority of older people who remain economically and socially active well into their 70s and some into their 80s, experiencing a gradual reduction in their number of working days. The former pattern of migration to rural areas is reversed, as the coasts have become rather difficult places to live, and more of the elderly move to enjoy the cultural centres.

By 2050 there is a long-established regional government, which has achieved a high degree of regional independence. The national parliament remains, but its main role is to bring the regions together and provide certain centralised resources (e.g. for information and training) ensuring that there is effective co-operation between regions (across the country and across Europe). There remains a strong European institution which provides the mechanism for this regional co-operation - mutual benefits are gained from sharing skills and experience - and we see a Federation of regions within nation states. Local government is replaced by many small community fora which provide the interface between the community and the regional government. Representatives on these are elected during community meetings and receive non-monetary benefits. ICT acts as an empowering force in terms of facilities, independence and agency for formerly marginalised people.

Food, energy and water

There is a rapid shift towards locally based services and products: in the food sector, for instance, this results in less 'food miles' as locally produced, organic food becomes widespread. Consumers are willing to pay a premium for greener goods and demand for high quality domestically produced goods overtakes that for mass produced imported goods. This is enabled by new technology and small-scale batch production based on the internet or cyber-net as the organising medium. Most production is in zero-waste processes for products which are then leased over their life-cycles, so that employment and general satisfaction increases, while material consumption reduces. The new model for a ‘responsive’ economy is helped by new forms of stakeholding in firms and organisations, and an ICT-based participative democracy in business and public policy.

As the European regions recognise climate change impacts, economic opportunities for environmental technology are great. With the decline of the aerospace industry in the South East new companies in wind and wave energy in partnership with European market leaders, become significant players in the region's economy. Smaller scale local production becomes the norm and the farming community also take advantage of the changing climate as the range of viable crops for the regions expands - not quite "bananas at Southport" but certainly a new phase in crop production.

Despite being able to take advantage of these climatic impacts there is still widespread disruption. Although with increased temperatures and drier summers the region is attracting more tourists, it is not to the traditional coastal destinations of the 20th century. These resorts have suffered greatly from coastal inundation, becoming unpleasant in the humid heat and in some cases quite dangerous in storm conditions.

The countryside retains its strong farming identity - some rural areas improving in their aesthetic appeal as large-scale monoculture reduces. The growing healthstyle fashion maintains recreational uses but these tend to involve activities that depend on preserving and reinforcing appreciation of high environmental quality. A new form of 'living with the land' (more collective and varied uses of land for growing food,

fuel crops, recreation, and wildlife gardening), is possible as a result of an increase in leisure time through changing work patterns and lifestyles.

Urban development

The renaissance of city living allows large-scale re-development of brown field sites, particularly around the estuary and former industrial/military sites. Affordable housing is managed through community owned housing associations and co-ops, exploiting the availability of old office space as the demand for this reduces. The greater proportion of older people in society and generally increased life expectancies reinforce the collective social conscience and lead to a reintegration of community centres; schools, daycare centres and nursing homes are located together. There is a strong move towards community living, extended families sharing houses, etc., people and organisations are more concerned with reducing their 'ecological footprints' than in the 20th century.

There is some redistribution around towns and cities, but also a kind of 'drawbridge' effect – to maintain community spirit, many neighbourhoods become more mono-cultural and inward looking. Urbanisation of the country slows and there is a net balance of counter- and re-urbanisation between countryside and urban areas. The shape of the region shows rapid changes as many former differences are reversed, where inner city communities become desirable, and where expensive suburbs decline and restructure.

The ideal bottom-up participative planning and development based on social-ecological values is finally put to the test, and found difficult in practice: The cyber-net helps but the integrity of community life means that people are more defensive and argumentative than ever. Many choose to take over under-used buildings and sites, and while some *favelas* or squatter camps show great creativity and idealism, there is often huge wastage in the building and moving of temporary structures.

In housing, majority lifestyles now favour the quality of space and proximity over the quantity of space, as for once people seem to what to live together. There are new housing forms and tenures to reflect new patterns of organisation, where groups and networks of families and cooperate on childcare, schooling and transport. Older terraces and even suburban estates are converted for such networks, but social differences often turn such arrangements into defensive territory with high physical security and inward orientation.

In property, the distribution of space for work and public services shows rapid changes, as specialised functions in warehouses and offices are replaced by generalised mixed functions organised at the local level. Offices are converted to housing in city centres, and vice versa in the suburbs, while increased manufacturing space is distributed to meet the needs of a localised economy.

Transport

Integrated accessibility (walking, cycling, train, bus, multiple occupancy, single occupancy) is the basis for new development. Some changes occur through new strategies of existing organisations, for example the major supermarkets contribute to the dispersal into smaller outlets, with greater centralisation for efficient management of supplies. As banking services shift to the internet traditional clusters of local shops built around the bank disappear, replaced by other services, such as over the counter treatment centres, and community virtual reality points.

The demand for travel is stabilised and in some areas actually reduces, as more people live and work locally, and local communities offer more in the way of cultural identity. Unfortunately one of the effects is a rapid worsening of the transport system, as many inner city areas declare UDI on major roads which cut up their neighbourhoods, and the 'Reclaim the Streets' movements are a major political lobby. The general congestion actually serves to worsen emissions even while total mileage is reduced. While all residential streets are converted to pedestrian zones, there is rapid re-arrangement of property values to favour areas not adjacent but very nearby to the urban transport hubs. Air travel continues to double every 15 years as one of the features of the community-oriented society is the desire to share cultures and kinship networks which are increasingly global.

Implications for resource management

In summary this preferred, desirable or 'sustainable' Factor Four scenario involves a range of principles for integrated resource management:

- Increased eco-efficiency and reduced materials intensity per unit of floorspace.
- Reduced primary inputs, and increased recycling and secondary use.
- Zero-waste construction and demolition practices.
- Integrated materials management systems.
- Economic and institutional systems to promote integrated materials management.

These principles will apply to many changes and many professions in practice:

- Building lifecycles and urbanization - planning agenda.
- Environment and planning policy for extraction and waste.
- Forcing up the price of raw material.
- Materials ownership and shared leasehold.
- Materials logistics and distribution systems.
- Minerals and waste taxation: Integrated system.
- Transport policy and taxation: Sticks and carrots.
- Materials specifications/performance specifications.
- Recycling and secondary use – link to economic development.

It is also important to be aware of the tensions and conflicts in the factor four approach, including the key issues below:

- building durability vs recyclability
- resource reduction vs jobs in the industry
- lean design vs building flexibility
- lean design vs secondary aggregates

- integrated consortiums vs out-sourcing
- guaranteed material markets vs dangers of intervention
- integrated material management vs transport costs
- material substitution vs transport costs

One example is the construction industry in the UK, generally known for being conservative, inefficient and materials intensive. Again achieving a Factor Four scenario will depend on a totally integrated approach:

- Designers and specifiers
- Smart geotechnics, concrete and masonry
- Construction management in the industry
- Labour skilling and tooling
- Alternative construction methods
- Alternative materials specifications
- Performance based specification: Risk factors
- From demolition to demounting
- From waste management to resource management

Implications for ecological footprint

In this scenario many conventional indicators show their limits: for instance GDP growth is down to 1% per year – not because there is less welfare – but simply because many growth areas are outside of the money-based economic calculation. Population change in the South East region is at the lower limit of 0.3% growth per year, as migration slows and social responsibility increases. Environmental impacts as with CO_2 improve with a –2% per year reduction in total emissions.

In resource flow terms this scenario achieves Factor Four reduction in ecological footprint, this time for mostly the right reasons – i.e. the win-win situations where environmental, social and economic objectives all come together.

EF per capita growth at –2.5%
=
household incomes based on GDP (GVA) growth at +1.00% long term:
x reducing material throughput per £GDP factor at –1.5% annual change
x reduced imported fraction (long distance) at –1.00% annual change
x reduced industrial processing at –1.00% annual change