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REWARD

Regional & Welsh Appraisal of Resource Productivity & Development

SEA GUIDANCE

Strategic Environmental Assessment & Sustainability Appraisal: Guidance on the use of the REEIO tool.

Supplementary briefing for users of the SEA
illustration contained in the REWARD
website – www.reward-uk.org

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1 Introduction

The REWARD website (www.reward-uk.org) contains an illustration of how the REEIO model enhances the application of SEA to a fictitious RES review undertaken by 'Any Region'

This supplementary briefing provides some additional perspectives and materials that may be particularly useful to users of the 'SEA Illustration' part of the website. In this document we provide information on the SEA Directive, on Sustainability Appraisals, on the SEA Process, Baselines and on Sectoral assessments – showing the scope of the REEIO model. For a more detailed illustration of how the REEIO model can be applied, click the 'SEA Illustration' button on the website.

1.1.1 The SEA Directive

The European Union's SEA Directive requires a wide range of plans and strategies to have their effects on the environment systematically assessed, and where possible improved. Economic activities are a major source of human impacts on the environment, and regional and local economic development strategies will normally require SEA. The Government has published generic guidance on when and how SEA should be carried out: *A draft practical guide to the Strategic Environmental Assessment Directive*, ODPM 2004 ⁽¹⁾, and more specific guidance for some sectors including *Sustainability Appraisal of Regional Spatial Strategies and Local Development Frameworks*, ODPM 2004 (2).

SEA involves three main activities:

- Collecting and presenting baseline information about aspects of the environment which could be affected by the strategy;
- Predicting how the strategy could affect the environment (both positively and negatively);
- Considering how negative environmental impacts could be reduced or avoided, and positive ones increased, by adopting alternative options to the strategy and/or mitigation measures.

The SEA Directive also requires that:

- The public and authorities with environmental responsibilities are consulted at various stages;

¹ http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/page/odpm_plan_029817.pdf

- The recommendations of the SEA are taken into account in producing the strategy: the point of SEA is to help produce a better strategy, not to document shortcomings when it is too late to do anything about them;
- The environmental effects of the strategy are monitored and reported during its implementation.

1.1.2 Regional strategies and reviews

The ‘regional strategy’ has emerged in the last decade in England and Wales as the policy level at which many important issues for environmental impact are decided. The main types include:

- Regional Economic Strategies and Reviews: these policies generally influence directly the settings of the REEIO model. The statutory requirement to carry out SEA is taken from the schedule of the EC/42/2001 Directive.
- Regional Spatial Strategies – this will have more indirect effects, with links particularly from sectors such as construction, transport, and household energy demand. The statutory requirement is driven by the Planning & Compensation Act 2001 and the PPS 11 on Regional Spatial Strategies.
- Integrated Regional Strategies (IRS): where possible the main regional strategies should be combined into a IRS or ‘Regional Sustainable Development Framework’, and most regions have already gone some way towards this.

In addition there are also sectoral or environmental strategies which each require a more specific application of SEA / SA. In most regions these are under the authority of the Regional Spatial Strategy, ultimately answerable to the local authorities. Each of these strategy types will gain directly from the application of the REEIO:

- Waste strategy
- Transport strategy
- Energy & climate strategy
- Water strategy

1.1.3 SEA or SA?

The requirement to carry out a Sustainability Appraisal and a Strategic Environmental Assessment are distinct in legal mandate, but increasingly overlapping in practice. It is therefore preferable to satisfy both through a single appraisal process. The current ODPM guidance is intended to ensure that Sustainability Appraisals meet the requirements and are in compliance with the SEA Directive. This ODPM guidance on SA widens the SEA Directive’s approach to include social and economic as well as environmental issues. However the general structure and process is very similar, with key activities including:

- collecting and presenting baseline information

- predicting the significant effects of the plan and addressing them during its preparation
- identifying reasonable plan options and their effects
- involving the public and authorities with social, environmental and economic responsibilities as part of the assessment process
- monitoring the actual effects of the plan during its implementation

The stage by stage guidance to REEIO in Section 4 of this paper is based on the SA process structure, as in the most recent guidance from ODPM (2004).

1.1.4 REEIO, REAP or other?

Regional strategy contains many questions which are outside the scope of the REEIO modelling system – for instance land-use, housing conditions and household consumption. Many of these issues can be represented in a counterpart modelling system, the REAP (see www.ecological-budget.org.uk).

The REAP model is a new adaptation of the LEAP model (Long range Energy Analysis Programme) developed by the Stockholm Environment Institute Boston, and used in over 40 countries around the world. Its methodology is based on a comprehensive accounting of how energy and materials are consumed, converted and produced in the regions of the UK. It also includes a detailed and comprehensive breakdown of the ecological footprint, for industrial sectors, common products, and local authorities in the UK. The REAP then identifies trends, projections and alternative scenarios, and policy options for urban development or environmental management.

Generally the two systems can work well in parallel, as follows:

- the REEIO system is oriented to the RES and the regional impacts of economic *production* on environmental pressures.
- the REAP system is more focused on the RSS and its related transport, waste, energy strategies. In particular it shows the global impacts of *consumption* in material flow and ecological footprint.

2 Scoping SEA

The early stages of the SEA / SA process include for screening and scoping, i.e. establishing the relevance of the policy / programme, and defining the boundaries and assumptions for investigation. In particular the boundaries of the REEIO system need to be identified as the effects of Regional Economic Strategies on:

- Energy and climate change emissions
- Transport demand and air emissions
- Waste management
- Water demand

Some further environmental problems may be linked to these, such as noise (linked to traffic growth), or acidification (linked to air emissions). Others such as land quality or biodiversity will need different technical tools.

As a guide to this the following list of indicators is taken from the UK Government's sustainable development strategy ('Securing the Future'). Each indicator is shown with its application to either the REEIO or the REAP system.

Note that some of the indicators are yet to be developed in forthcoming versions.

		REEIO application	REAP application
1. Greenhouse gas emissions*:	Kyoto target and CO2 emissions	Y	Y
2. CO2 emissions by end user:	industry, domestic, transport (excluding international aviation), other	Y	Y
3. Aviation and shipping emissions:	greenhouse gases from UK-based international aviation and shipping fuel bunkers	N	Y
4. Renewable electricity:	renewable electricity generated as a percentage of total electricity	Y	Y
5. Electricity generation:	electricity generated, CO2, NOx and SO2 emissions by electricity generators and GDP	Y	Y
6. Household energy use:	domestic CO2 emissions and household final consumption expenditure	Y / Y	Y / N
7. Road transport:	CO2, NOx, PM10 emissions and GDP	Y	Y
8. Private vehicles:	CO2 emissions and car-km and household final consumption expenditure	Y	Y
9. Road freight:	CO2 emissions and tonne-km, tonnes and GDP	Y	Y

		REEIO application	REAP application
10. Manufacturing sector:	CO2, NOx, SO2, PM10 emissions and GVA	Y	Y
11. Service sector:	CO2, NOx emissions and GVA	Y	Y
12. Public sector:	CO2, NOx emissions and GVA	Y	Y
13. Resource use:	Domestic Material Consumption and GDP	N	Y
14. Energy supply:	UK primary energy supply and gross inland energy consumption	Y	Y
15. Water resource use:	total abstractions from non-tidal surface and ground water sources and GDP	Y	N
16. Domestic water consumption:	domestic water consumption per head	Y	N
17. Water stress:	(to be developed to monitor the impacts of water shortages)	N	N
18. Waste*:	arising by (a) sector (b) method of disposal	Y	Y
19. Household waste:	(a) arising (b) recycled or composted	Y	Y
20. Bird populations*:	bird population indices (a) farmland birds* (b) woodland birds* (c) birds of coasts and estuaries* (d) wintering wetland birds	N	N
21. Biodiversity conservation:	(a) priority species status (b) priority habitat status	N	N
22. Agriculture sector:	fertiliser input, farmland bird population, and ammonia and methane emissions and output	n / n / y	n / n / y
23. Farming and environmental stewardship:	(to be developed to monitor progress in new stewardship schemes)	N	N
24. Land use:	area used for agriculture, woodland, water or river, urban (contextual indicator)	N	Y
25. Land recycling:	(a) new dwellings built on previously developed land or through conversions (b) all new development on previously developed land	N	Y
26. Dwelling density:	average density of new housing	N	Y
27. Fish stocks*:	fish stocks around the UK within sustainable limits	N	N
28. Ecological impacts of air pollution*:	area of UK habitat sensitive to acidification and eutrophication with critical load exceedences	N	N
29. Emissions of air pollutants:	SO2, NOx, NH3 and PM10 emissions and GDP	Y	Y
30. River quality*:	rivers of good (a) biological (b) chemical quality	N	N
31. Flooding:	(to be developed to monitor sustainable approaches to ongoing flood management)	N	N
32. Economic output*:	Gross Domestic Product	Y	Y
33. Productivity:	UK output per worker	Y	N

		REEIO application	REAP application
34. Investment:	(a) total investment (b) social investment relative to GDP	N	N
35. Demography:	population and population of working age (contextual indicator)	Y	Y
36. Households and dwellings:	households, single person households and dwelling stock (contextual indicator)	N	Y
37. Active community participation*:	informal and formal volunteering at least once a month	N	N
38. Crime*:	crime survey and recorded crime for (a) vehicles (b) domestic burglary (c) violence	N	N
39. Fear of crime:	(a) car theft (b) burglary (c) physical attack	N	N
40. Employment*:	people of working age in employment	Y	N
41. Workless households*:	population living in workless households (a) children (b) working age	N	N
42. Economically inactive:	people of working age who are economically inactive	N	N
43. Childhood poverty*:	children in relative low-income households a) before housing costs b) after housing costs	N	N
44. Young adults:	16-19 year-olds not in employment, education or training	N	N
45. Pensioner poverty*:	pensioners in relative low-income households a) before housing costs b) after housing costs	N	N
46. Pension provision:	working age people contributing to a non-state pension in at least three years out of the last four	N	N
47. Education*:	19 year-olds with level 2 qualifications and above	N	N
48. Sustainable development education:	(to be developed to monitor the impact of formal learning on knowledge and awareness of sustainable development)	N	N
49. Health inequality*:	(a) infant mortality (by socio-economic group) (b) life expectancy (by area) for men and women	N	N
50. Healthy life expectancy:	healthy life expectancy (a) men (b) women	N	N
51. Mortality rates:	death rates from (a) circulatory disease and (b) cancer, below 75 years and for areas with the worst health and deprivation indicators, and (c) suicides	N	N
52. Smoking:	prevalence of smoking (a) all adults (b) 'routine and manual' socioeconomic groups	N	N
53. Childhood obesity:	prevalence of obesity in 2-10 year-olds	N	N
54. Diet:	people consuming five or more portions of fruit and vegetables per day and in low income households	N	N

		REEIO application	REAP application
55. Mobility*:	(a) number of trips per person by mode (b) distance travelled per person per year by broad trip purpose	Y	Y
56. Getting to school:	how children get to school	N	N
57. Accessibility:	access to key services	N	N
58. Road accidents:	number of people and children killed or seriously injured	N	N
59. Social justice*:	(social measures to be developed)	-	-
60. Environmental equality*:	(social measures to be developed)	-	-
61. Air quality and health:	(a) annual levels of particles and ozone (b) days when air pollution is moderate or higher	N	N
62. Housing conditions:	(a) social sector homes below the decent homes standard (b) vulnerable households in the private sector in homes below the decent homes standard	N	Y
63. Households living in fuel poverty:	(a) pensioners (b) households with children (c) disabled/long-term sick	N	N
64. Homelessness:	(a) rough sleepers (b) households in temporary accommodation (i) total (ii) households with children	N	N
65. Local environment quality:	(to be developed using information from the Local Environmental Quality Survey of England)	-	-
66. Satisfaction in local area:	households satisfied with the quality of the places in which they live (a) overall (b) in deprived areas (c) non-decent homes	N	N
67. UK International assistance:	Net Official Development Assistance (a) per cent of Gross National Income (comparison with selected countries) (b) per capita (comparison with selected countries)	N	N
68. Wellbeing*:	(wellbeing measures to be developed)	-	-

3 *Developing options & scenarios*

3.1.1 Sustainable regional development & policy options

The overall goal of the REWARD programme and the REEIO model is to analyse economy-environment linkages in order to promote sustainable regional development. The development of *policy options* is crucial to this. Policy options are needed in order to identify the possibilities, and compare the impacts of alternative choices. While a narrow interpretation of SEA / SA simply assesses the alternative options which have been developed elsewhere, a more pro-active mode of SEA / SA will help to explore a viable range of policy options for sustainable development.

As far as the REEIO modelling tool is concerned, the options generally focus on a small number of themes:

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

Behind each of these themes lies a potentially long story of politics, economics, technology etc, of which the REEIO provides a bare summary.

3.1.2 Economic growth and structural change:

The rate and type of growth raises the question of alternative development paths. Is the RES focused on economic growth alone, or more on growth as a means to the goals of quality of life and lower external impacts? Is the shift towards services dependent on increasing imports of material goods from overseas, with increasing environmental impacts? If a low-impact high-quality path is preferred, how can this be best characterized and compared to the alternatives?

3.1.3 Environmental / resource efficiency in production by sectors

The theme of resource efficiency or resource productivity can be taken in different ways – output per investment, per employee, or per tonne of waste or emissions. As the latter

environmental measures are notoriously short of good data, many assumptions need to be made. The policy options which influence the energy efficiency and emissions per unit of output in any sector, will be a combination of the financial investment, regulatory power, market development, or acceleration of technology innovation. It is fair to say that the RDA has only an indirect leverage on most of these factors. However some meaningful assumptions can be made on the overall scale of political commitment, financial investment and technological change.

3.1.4 Supply-side options for energy, transport, construction etc

This type of policy option is more specific on how energy, transport or waste management might be supplied. The details for each of these can be worked out ‘off-model’, in terms of technology, economics, regulation, consumer preferences etc. The REEIO system then provides a template for logging the assumptions and generating profiles over time. In terms of specific sectors (details in Section 5):

- ***Energy supply options:*** renewables development, with implications for land use and environmental impact: fossil fuels in terms of continuation of shift to gas: resurgence of nuclear power with various risks and liabilities.
- ***Transport supply options:*** alternative balances of transport modes, given the realities of travel for work, leisure, personal business and freight. Policy options may centre on development of new infrastructure such as trams or new motorways: or on constraint measures such as parking policies or road pricing schemes. In the background, but basically driven at UK / EU levels are the expectations over time for vehicle energy efficiencies and emissions coefficients.
- ***Construction options:*** this is a specific economic sector with potential for increased efficiency in energy, waste etc. It is also more significant in that performance then determines the pattern of demand from households for energy in buildings, and to some extent water and transport.
- ***Waste management options:*** this is shown as a ‘supply’ of services, in that the pattern of waste management / disposal then determines environmental impacts further downstream (not all covered by REEIO). The options are driven by the expectations of the EU Directives on phasing out landfill, although the best practice alternative is yet to be determined.

3.1.5 Demand-side management for energy, transport, water etc

This theme focuses on the consumer side, and highlights the goal of reducing demand while raising quality of life – either through technology, regulation, market signals, the social economy, or public awareness. Just as anti-smoking campaigns have now become mainstream, it is quite realistic to plan for anti-consumption and anti-waste campaigns

and shifts in behaviour by businesses and consumers. Again these may come about as a combination of politics, economics, technology, attitudes and so on. Over-arching this is the first theme of alternative development paths, where the regional strategy needs to look for ‘win-win’ solutions. For instance rather than plan for unlimited growth in road traffic, there may be a ‘win-win’ combination of more and better public transport, coupled with reducing overall travel demand through green travel plans.

3.1.6 Alternative scenarios

The example above shows how a realistic result may be generated with a combination of structural change, resource productivity, supply-side and demand-side assumptions. Such a combination is generally termed a ‘*scenario*’ – a consistent and plausible account of future paths or conditions.

As above, a scenario may be formed as a combination of debate, narrative, images, visions, maps etc. The contribution of the REEIO tool is to provide a numerical summary for comparison, evaluation and benchmarking – i.e. the analytic part of the SEA / SA process.

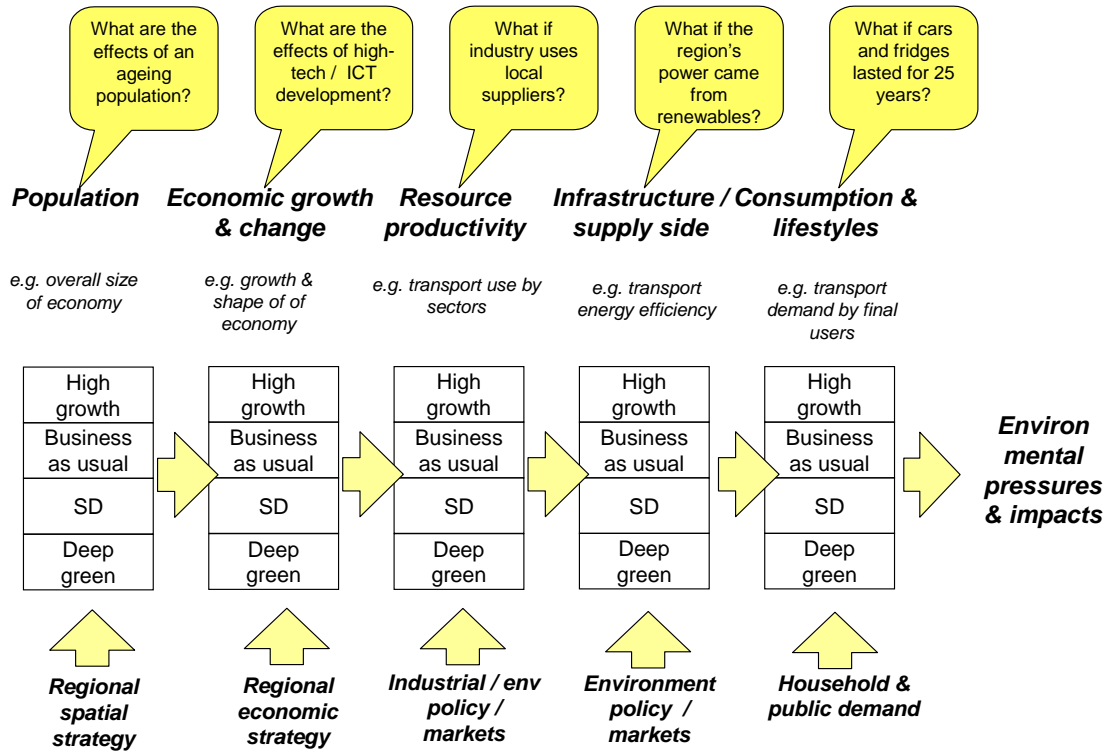
There are a small number of general scenario types, which may be combined in different ways to explore multiple combinations:

- A ‘*high-growth*’ scenario can be characterized generally as unrestricted economic growth, material consumption and environmental pressure.
- The *baseline* or *default* ‘business as usual’ scenario is given in REEIO by the pre-set assumptions and economic growth / change projections built in to the settings for each region. These are designed as ‘policy-off’ with no further policy changes at the time of assembly: obviously this is not fixed over time, and may need updating from the time of the model development.
- A ‘*sustainable development*’ scenario might combine this with political commitment, economic investment and consumer attitude change, so that quality of life and social welfare goes up independently of the economy, while environmental pressure reduces. As one variation on this a ‘*pale green*’ scenario might explore an affluent future where technological improvements reduce environmental pressures to some extent.
- Going even further, a ‘*deep green*’ scenario would envision a future of ecological protection as a top priority. It is useful to establish an alternative option beyond that of the SD scenario, so that the SD may appear as moderate and sensible.

Each of these scenarios might take different assumptions on population growth or decline, although these would not affect directly the environmental pressures per capita.

The typical range of scenario types with alternative policy options is shown in the diagram below, with examples and questions at each stage:

Developing policy options



3.1.7 Beyond 2015?

Most forms of regional strategy now extend well beyond the REEIO time horizon of 2015, but after this point the REEIO default projections reduce rapidly in their confidence level. So there is a logic for further time horizons, in leaving the projections/ scenarios in the hands of users. The simplest form of generating longer term scenarios will be to extend trend lines in spreadsheet format, to the desired horizon. However great care should be taken in selecting the most appropriate type of trend line:

- Arithmetic (linear) trends e.g. rate of housebuilding
- Geometric (compound growth) trends e.g. economic growth
- Trends approaching saturation (S curves or logit functions) e.g. traffic growth: for these the appropriate saturation limit will need to be identified.

3.2 *Alternative options in regional policy*

3.2.1 Linking REEIO to the RES & RSS

The table below contains a summary of a fairly typical Regional Economic Strategy business plan, with 10 ‘objectives’ (based on the example of the NWDA). Following that is a summary distillation of a typical Regional Spatial Strategy, together with its environmental components. This is of course outside the remit of the RDA, but it does contain specific links to the REEIO assumptions on environmental pressures.

We show some of the main policy options, in terms of questions, which could be assessed and compared through the REEIO model.

Each of these is characterized in terms of its type of ‘model input’ (i.e. economic growth / change: sectoral productivity / efficiency: supply side: demand side). E

Each of these is also identified in terms of its implications for the overall REEIO results, i.e. the degree of environmental pressure resulting from a feasible range of policy options.

Table 1: linking policy options to REEIO

Policy objectives	Policy options	Model input types	Implications for REEIO results
<i>ECONOMIC STRATEGY</i>			
1 business clusters	Focus on hi-tech or low-impact sectors? Focus on economic growth or quality?	Ec growth / change	Marginal Marginal
2 competitiveness & productivity	Accelerated environmental improvements? Increase import fractions?	Sectoral prod. Trade balance	Strong Marginal
3 regional knowledge base	Hi-tech industry for low-impact development? Accelerated environmental improvements?	Ec growth / change Sectoral prod.	Marginal Marginal
4 urban renaissance	New construction or rehabilitation? Invest in energy efficiency?	Construction prod Hh energy demand	Strong Strong
5 rural renaissance	Reduce farming impacts? Reduce rural commuting & travel? Improve water balance?	Agri prod Tran demand Water eff	Strong Marginal Marginal
6 economic inclusion	ILM for recycling & resource management? Social enterprise to replace service sectors?	Supply side Demand side	Marginal Marginal
7 labour market	Upgrade labour occupations / skills? Import commuting labour?	Labour balance	Marginal Marginal
8 transport & infrastructure	Invest in energy supply efficiency? Invest in renewable energy sources? Transport demand side management? Promote low impact transport modes? Expand / constrain road traffic?	Energy supply side Trans mode eff. Trans demand side	Strong Strong Strong Strong Strong

Policy objectives	Policy options	Model input types	Implications for REEIO results
9 employment sites	Expand / constrain air travel?		Strong
10 image & visitors	Promote inward / indigenous industry?	Ec growth / change	Marginal
	Promote mass tourism / eco-tourism?	Tourism prod	Marginal
SPATIAL STRATEGY & ENVIRONMENT SECTORS			
Housing development	Accelerate HH energy efficiency? Promote low-impact construction? Location for low-impact travel?	HH energy demand Construction prod Trans demand	Strong Strong Marginal
Other development	Accelerate building energy efficiency? Promote low-impact construction? Location for low-impact travel?	Other energy demand Construction prod Trans demand	Strong Strong Marginal
Urban regeneration	Accelerate building energy efficiency? Promote low-impact construction? Location for low-impact travel?	Other energy demand Construction prod Trans demand	Strong Strong Marginal
Transport strategy	Transport demand side management? Promote low impact transport modes? Expand / constrain road traffic? Expand / constrain air travel?	Trans demand Trans eff Trans demand Trans demand	Strong Strong Strong Strong
Waste management	Accelerate waste minimization? Promote recycling economy? Re-cycle construction / agricultural waste?	Waste eff Waste supply Waste demand	Strong Strong Strong
Energy / climate strategy	Accelerate demand side management? Invest in energy supply efficiency? Invest in renewable energy sources?	Energy demand Energy supply Energy supply	Strong Strong Strong
Water strategy.	Promote water demand management?	Water demand	Strong

3.2.2 Linking regional strategy objectives to REEIO

The next table below is an extended summary of a typical Regional Economic Strategy business plan, with 10 ‘objectives’ and over 50 ‘key activities’ (again based on the NWDA economic strategy). Most of the key activities can be linked in some way or other to the REEIO. However it is clear that the focus of the REEIO on environmental pressures is not necessarily the main object of most of the key activities.

Basically there are two types of inputs. Firstly, most of the key activities can be linked somehow to *economic and labour market* inputs:

- Economic structural change,
- trade balance,

- sectoral productivity
- growth in specific sectors.

Secondly, some of the key activities can be linked to environmental coefficients by sector (also to transport modes). Various assumptions or off-model calculations will be needed to translate economic variables into environmental pressure coefficients.

- Energy use and supply.
- Climate and air emissions
- Solid waste arising and management
- Water demand

Note that these issues are more the remit of the Regional Spatial Strategy than the economic strategy.

Table 2: linking strategy objectives to REEIO

	Relevant model input	Model output	Implications for RES
1 BUSINESS CLUSTERS			
Business cluster network development	Key sector growth	Economic change	Env technologies / clusters
International trade for business clusters	Exports / imports	Trade balance	Env technologies / clusters
incubation facilities for business start-ups	Key sector growth	Economic change	Env technologies / clusters
2 COMPETITIVENESS & PROD			
strategic partnerships with key businesses	Key sector growth	Economic change	Env technologies / clusters
innovation and enterprise for productivity	Energy / emissions	Energy / emissions	Env technologies / clusters
Encourage international trade & export	Exports / imports	Trade balance	local sources / markets
Develop supply chain businesses	Waste min.	Waste	Env technologies / clusters
Promote ICT incl e-commerce	Hi tech shift	Economic change	restructuring opportunities
Environmental management	Energy / emis / waste	Energy / emis / waste	Env technologies / clusters
3 REGIONAL KNOWLEDGE BASE			
Universities & research	Education / skills	Labour market	Env technologies / clusters
R&D investment	Hi tech shift	Economic change	Env technologies / clusters
Science parks	Hi tech shift	Economic change	Env technologies / clusters
4 URBAN RENAISSANCE			
Economic regeneration of deprived areas	Construction sector	Energy / emissions	
Derelict land reclamation	Construction sector	Energy / emissions	
High quality design & flagship buildings	Building energy eff.	Energy / emissions	
Regional park resources	Sector growth & prod	Economic change	
Coastal towns diversification & tourism	Sector growth & prod	Economic change	
Housing stock improvements	HH energy demand	Energy / emissions	
5 RURAL RENAISSANCE			
Rural regeneration plans	Sector growth & prod	Economic change	

	Relevant model input	Model output	Implications for RES
Tourism & farming initiatives	Sector growth & prod	Economic change	
Market towns actions plans	Labour market effect	Labour prod	
6 ECONOMIC INCLUSION			
Business startups in deprived areas			
Social enterprises	Waste recycling	Waste	
Community finance initiatives			
Employment & skills in deprived areas			
7 LABOUR MARKET			
Workforce & management development	Labour prod.	Labour prod.	
Learning for competitiveness			
equality of opportunity for learning			
8 TRANSPORT & INFRASTRUCTURE			
Strategic plan for roads	Trans demand / eff	Energy / emissions	
Strategic plans for rail, water, air	Trans demand / eff	Energy / emissions	
broadband infrastructure	Hi tech shift / prod	Economic change	
9 EMPLOYMENT SITES			
strategic regional sites	Transport demand	Energy / emissions	
knowledge based industry	Hi tech shift	Economic change	
strategic distribution sites	Trans demand / eff	Energy / emissions	
10 IMAGE & VISITORS			
Regional identity marketing			
Cultural Strategy	Services shift		
Regional Tourism Strategy	Inward tourism		

4 The SEA stages

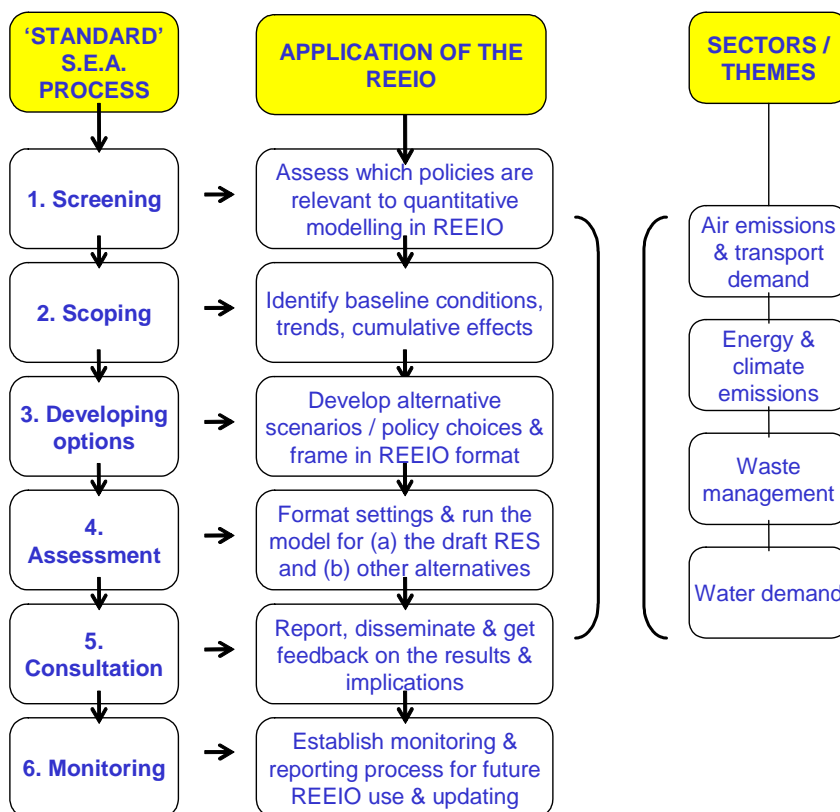
4.1.1 Using REEIO in the SEA process

The application of REEIO at each stage of the appraisal process is shown in the flow charts and tables below. These are based on a combination of the Environment Agency SEA guidance, and the ODPM guidance SA. Therefore the exact titles and tasks vary from the website examples to the flow chart and the tables.

Note that this process includes a range of activities which all demand some facility with REEIO, the data formats which it uses, and general spreadsheet skills:

- Assembling & managing data
- Defining scenarios and policy inputs
- Analysing model outputs
- Reporting & communicating results

Generally it will be more economical and effective to integrate the REEIO system into the regional monitoring and reporting structure, rather than commission one-off external studies. However there is also a case for bringing in specific expertise on model assumptions, scenario settings etc. These issues are covered in the REEIO user manuals and 'Linking-up' reports (www.reward-uk.org)



4.1.2 SEA stage process map

The diagram above is adapted from the Environment Agency SEA website, to show the ‘standard’ SEA process stages and the relevant application of the REEIO model. It also shows for illustration on the right hand side, the environmental themes which are represented within the REEIO system. (note that other environmental themes such as land-use or biodiversity need different kinds of modelling / technical support).

Note that we have inserted an extra stage 3 – “developing options” – which would otherwise be the responsibility of policy-makers rather than SEA consultants. This is particularly important for sustainability objectives, as the assessment is only significant when comparing alternative courses of action, and meeting sustainability targets often needs more than conventional thinking. Therefore ‘developing options’ is recommended as an essential part of the REEIO process.

Also note that as on the website, stage 4 – ‘assessment of options’ – can be divided into two parts. ‘Assessment of the RES’ focuses on the existing draft RES: ‘assessment of alternatives’ compares a wider range of possibilities.

In the tables below, the two left hand columns are based on the ODPM Guidance on SA: the right hand columns have been developed for the REEIO.

4.1.3 Stage 1 & 2: screening & scoping: boundaries & baselines

This first stage concerns setting the context and objectives, establishing the baseline and deciding on the scope of study. The EA equivalents are identified as ‘screening’ and ‘scoping’.

<i>PLAN STAGE</i>	<i>ACTIONS TO BE TAKEN</i>	<i>USE OF REEIO</i>	<i>EXAMPLE</i>
A1: Identifying other relevant plans, programmes, and sustainability objectives	To document how the plan is affected by outside factors and suggest ideas for how any constraints can be addressed.	Review the basis of the economic model and particularly the default projections for economic growth & industrial change.	<i>Compare the RES to the regional energy or climate strategy</i>
A2: Collecting baseline information	To provide an evidence base for sustainability issues, effects prediction and monitoring.	Review the baseline database and update where possible.	<i>Check the default REEIO projections for CO2 in the region.</i>
A3: Identifying sustainability issues	To help focus the SA and streamline the subsequent stages, including baseline information analysis, setting of the SA Framework, prediction of effects and monitoring.	Examine the REEIO inputs and outputs, and their relation to regional SD objectives, indicators and targets. Review the issues which have no direct connection to REEIO, and explore ways to make a link.	<i>Compare the CO2 target with the CO2 projections. Consider other causes / effects of climate change.</i>
A4: Developing the SA Framework	To provide a means by which the sustainability of the plan can be appraised.	Identify more specifically the REEIO indicators, trends and targets which are most relevant to regional objectives.	<i>Identify which RES objectives / actions are relevant to the CO2 problem</i>
A5: Testing the plan objectives against the SA Framework	To ensure that the overall objectives of the plan are in accordance with sustainability principles and provide a suitable framework for developing options.	Review the plan / strategy objectives in terms of REEIO inputs and outputs.	<i>Test each RES objective / action for flexibility & leverage on the CO2 problem.</i>
A6: Consulting on the scope of the SA	To consult with statutory bodies with social, environmental, or economic responsibilities to ensure the appraisal covers the key sustainability issues.	Report and consult on the REEIO outputs from the default projections.	<i>Consult all agencies concerned with climate causes / effects</i>

4.1.4 Stage 3: Scoping: developing and refining options

This focuses on the development of policy options as in Section 2. The issue then is how to frame and quantify these options in the format of the REEIO model.

<i>PLAN STAGE</i>	<i>ACTIONS TO BE TAKEN</i>	<i>USE OF REEIO</i>	<i>EXAMPLE</i>
B1: Appraising issues and options	To assist in the development and refinement of the options, by identifying potential sustainability effects of options for achieving the plan objectives.	Review the scope of REEIO inputs from regional policy options and priorities. Identify the appropriate REEIO scenario assumptions.	<i>Characterize the strategy actions in terms of effect on climate emissions</i>
B2: Consulting on the SA of emerging options	To consult with the public and statutory bodies on the SA of emerging options to ensure the SA covers all the reasonable options and key sustainability issues.	Report and communicate on the scenarios chosen for REEIO analysis, and the connection made to external scenarios and regional policy options.	<i>Compare the strategy actions & assumptions with other targets & scenarios for energy / climate emissions</i>

4.1.5 Stage 4a & 4b: assessment of alternatives

This stage involves ‘running’ the REEIO model – i.e. identifying the alternative assumptions based on the above options: inputting the relevant data: running the model: checking the outputs: and storing them in a structured format.

Also note that as on the website, this stage can be divided into two parts. ‘Assessment of the RES’ focuses on the existing draft RES: ‘assessment of alternatives’ compares a wider range of possibilities.

<i>PLAN STAGE</i>	<i>ACTIONS TO BE TAKEN</i>	<i>USE OF REEIO</i>	<i>EXAMPLES</i>
C1: Predicting the effects of the plan, including plan options	To predict the significant effects of the plan and its plan options.	Run the REEIO for each scenario and log the results.	<i>Run the REEIO model with a range of assumptions for economic change, sectoral productivity, supply side and demand side.</i>
C2: Assessing the effects of the plan	To assess the significance of the predicted effects of the plan and plan options and assist in the refinement of the plan.	Comparative analysis of the main results from each of the scenarios.	<i>Compare the results in terms of contribution to CO2 targets</i>
C3: Mitigating adverse effects and	To ensure all potential mitigation measures and measures for maximising beneficial effects are	Identify the mitigation options for the most significant results from	<i>Revisit the regional strategy options to identify the most viable</i>

maximising beneficial effects	considered and as a result residual effects identified.	the REEIO.	<i>contributions to CO2 targets.</i>
C4: Developing proposals for monitoring	To detail the means by which the sustainability performance of the plan can be assessed.	Identify monitoring of the indicators and performance indices which are relevant to the REEIO format.	<i>Identify the CO2 indicators / indices / precursors which are most relevant to achieving the CO2 target</i>
C5: Preparing the SA Report	To provide a detailed account of the SA process, including the findings of the appraisal and how it influenced the development of the plan, in a format suitable for public consultation and decision-makers.	Report on the REEIO results: including the baseline projections framing of scenarios, comparison of options, and the impacts of the preferred plan.	<i>Report on the above with non-technical summary</i>

4.1.6 Stage 5: Consulting on the SEA / SA Report

This stage is concerned with communications of the results of the analysis, and feedback between regional stakeholders and the technical team.

<i>PLAN STAGE</i>	<i>ACTIONS TO BE TAKEN</i>	<i>USE OF REEIO</i>	<i>EXAMPLES</i>
D1: Consulting on the SA Report alongside the plan	To provide the public and statutory bodies with an effective opportunity to express their opinions on the SA Report and to use it as a reference point in commenting on the plan.	Frame the REEIO results and communicate the policy implications, in terms of changes to the strategy.	<i>The quantitative results will be built into a non-technical summary of the policy case.</i>
D2: Appraising significant changes	To ensure that any significant changes to the plan are assessed for their sustainability implications and influence the revision of the plan.	Re-run adjusted scenarios in REEIO to pick up any improvements to the environmental performance.	<i>Revisit the REEIO results in the light of refinements and mitigations to the plan.</i>
D3: Decision making & providing information	To provide information on how the SA Report and consultees' opinions were taken into account in preparing the plan.	Track and report on the comments received and the linkage with the REEIO results.	<i>Establish a database of the feedback and responses, as far as possible linked to the measurement of trends and targets.</i>

4.1.7 Stage 6: Monitoring implementation of the plan

This stage is concerned with a structured approach to monitoring and feedback, with appropriate selection of data, and management of the communications system.

<i>PLAN STAGE</i>	<i>ACTIONS TO BE TAKEN</i>	<i>USE OF REEIO</i>	<i>EXAMPLES</i>
E1: Monitoring the significant effects of the plan	To measure the sustainability performance of the plan in order to determine whether its effects are as anticipated, and thereby inform future revisions.	Develop a monitoring system which is compatible with REEIO inputs and outputs.	<i>Set up monitoring & management indicators for key REEIO results in energy, emissions, waste and water</i>
E2: Responding to adverse effects	To ensure that the adverse effects can be identified and appropriate responses developed.	Apply the monitoring system to major changes to the regional economy and environment.	<i>Apply the monitoring system particularly at times of rapid change or shock to the regional economy.</i>

5 *SEA in regional strategy*

(adapted from RL text of Dec 2004)

This section looks in some more detail at the kinds of regional strategic thinking that should support and be supported by the SEA / SA process. The use of REEIO is then an added value to this process, in terms of providing tangible quantitative baselines, projections, comparisons and benchmarks.

5.1.1 Use of baseline material

The SEA Directive specifies several kinds of baseline information required. Appendix 4 of '*A draft practical guide to the Strategic Environmental Assessment Directive*' lists sources of information. This section discusses the economic development aspects of these.

b) The relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan

This should include the current state of resources likely to be affected by economic development, for example the availability - and environmental effects of exploiting - aggregates, water, energy, and any other raw materials which businesses would use. The REEIO baseline database contains much of this material.

Traffic is an important cause of environmental problems, and businesses a major generator of traffic, so future trends in traffic and its impacts are likely to be significant in most SEAs of economic strategies.

It is often possible to 'borrow' environmental capacity from elsewhere, for example by importing water into dry regions, or exporting waste from densely populated ones. Even manufacturing industries that grew up in particular places to exploit local raw materials often now import them from distant sources. So regional environmental capacities do not set simple or absolute limits on economic development. However, importing and exporting resources and wastes adds to transport impacts and relies on other places continuing to have spare capacity. It is therefore prudent in sustainability terms to minimise dependence on other places, and thus to develop so far as possible within local environmental capacities. The 'proximity principle' of dealing with wastes as close as possible to their origin is now entrenched in law. Plan makers should be aware if development is going to increase the region's reliance on environmental capacity from elsewhere.

d) Any existing environmental problems which are relevant to the plan

This should include any of the issues mentioned under (b) where economic activities are making a significant contribution to impacts which are problematic: for example where commercial activities are generating a significant proportion of energy or water demand, traffic, waste or pollution. REEIO can provide some ability to model or estimate the business contribution to such problems.

e) The environmental protection objectives, established at international, Community or national level, which are relevant to the plan and the way those objectives and any environmental considerations have been taken into account during its preparation;

The UK Government's Kyoto and manifesto commitments to greenhouse gas reductions by 2010, and the energy strategy target of a 60% reduction by 2050, should now form the background to all policy decisions including economic development ones. The job of SEA is to show the consequences of strategies, not to decide what should be in them. However, given the importance and urgency of greenhouse gas reductions and the ambition of the targets the Government has adopted, it could be argued that any plan or strategy that does not aim for a net reduction in greenhouse gas emissions from the activities being planned for (not just a reduction per unit of activity, or a reduction in the rate of increase) would not meet the requirement that climate change objectives had been 'taken into account' in any meaningful way.

Other relevant objectives should include targets derived from European directives for water efficiency, waste reduction and recycling, air and water quality, transport, and protection of designated areas.

5.1.2 Assessment of environmental impacts

The SEA directive requires a thorough and detailed assessment of how a plan or strategy would affect the environment:

f) The likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors. (These effects should include secondary, cumulative, synergistic, short, medium and long-term permanent and temporary, positive and negative effects)

An economic development strategy will affect these matters in complex and indirect ways, since it is only one of a number of influences over how the economy will develop, and this is in turn only one of a number of influences over the environment. 'Secondary, cumulative and synergistic' effects - that is, ones that are caused indirectly, ones where the total from different causes matters, and ones where different changes interact to amplify or offset each other - are particularly important in strategic planning.

The REEIO model is a powerful tool for predicting the effects of economic activities on several of these environmental topics over different timescales and different

assumptions. It could for example model and predict how business impacts could change as a result of different economic development choices, for example which business sectors are encouraged to develop, and with what incentives to reduce environmental impacts. It can thus strengthen the evidence base for judgements about how economic development could combine with other changes (for example housing growth) to affect the environment.

5.1.3 Mitigation of negative impacts

The point of SEA is to help achieve the least possible negative impacts on the environment, and the greatest possible benefits. The Directive therefore requires a clear statement of what has been done to achieve this:

g) The measures envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the plan;

The Directive emphasises the need to consider alternatives and justify the options chosen:

reasons for choosing the plan as adopted, in the light of the other reasonable alternatives dealt with . . .

h) An outline of the reasons for selecting the alternatives dealt with

Sustainability Appraisal of Regional Spatial Strategies and Local Development Frameworks suggests a hierarchy of alternatives following the same principles as the well known waste hierarchy of ‘reduce, reuse, recycle’ and also offers examples of how the hierarchy could be applied to economic development:

- ***Need or demand: is it necessary?*** Can the need or demand be met without implementing the plan at all? Can the proposal (development, infrastructure etc) be obviated? E.g. could a road project be substituted by a public transport project?
- ***Mode or process: how should it be done?*** Are there technologies or methods that can meet the need with less adverse effects than ‘obvious’ or traditional methods?
- ***Location and timing:*** are there issues which could affect the overall environmental performance, or the influence on other sectors? (however it should be noted that REEIO does not deal directly with location issues).

6 Key sectors & themes

(updated from Linking-up Technical Report, Sept 2003)

6.1.1 General issues in each sector

This section is an outline of the key environmental sectors which are produced as REEIO modules. *(This material is updated from the Linking-up reports on the REWARD website).*

The transport sector is shown separately, as one of prime policy significance, although in the REEIO it is a sub-routine in the energy and emissions calculations. For each environmental sector the key issues include:

- policy context: what are the main policy questions to be addressed?
- scope of model: what topics does the model cover?
- general issues in modelling: what can or can't the model do? What are the boundary issues and uncertainties?
- foresight and scenario structure: i.e. what type of scenarios are generally used and relevant at regional / national level?
- appraisal methods: what specific types & methods are currently used?
- environmental modelling / off models: are there more specialized issues which may be covered in other models, or in purpose made off-model components?
- Economic modelling / off model development: as above:
- Other technical systems in use at the regional level: what can the REEIO system usefully link to or from?

6.2 Waste management

Policy issues

Regional economic strategies have some effect on resource use and waste arisings, but mostly via influence on county / local strategies. The majority of waste tonnage is from industrial, commercial and agricultural sources, where regional strategy has some influence. Industrial clusters and environmental technologies have great potential for integrated waste/ resource management.

Scope of model

The general role of the REEIO will be to highlight the linkage between medium-long term economic growth, and its direct implications for waste arisings. The main inputs are then the sectoral waste arising coefficients, the import / export balance, and the allocation of disposal methods.

General issues in modelling

Waste generation is difficult to model reliably, as policy has a larger influence. In the absence of detailed projections a simple trend figure of 3% per year is often used for municipal solid waste (MSW). For other waste streams there is almost zero growth over the last decade, but it is unclear whether this is due to economic change or technological change.

The data situation is improving rapidly, but there are questions on data quality, and absence of reliable time-series or forward projections. For waste arising coefficients, perspectives on technology innovation and supply chains are the main issue. Spatial factors are important constraints on waste disposal methods, and other environmental effects are complex. There is emerging evidence on social factors and the variation of household waste / recycling efforts between different social groups.

Foresight & scenario structure

The scenario structure should be related to the regional waste options / strategy assessments: within the context of national waste strategy targets and EU directives.

Appraisal methods

Existing tools include the WISARD method, although this has shortcomings. Regional waste options assessments are building up a library of methods and databases, mainly in the hands of consultants.

Environmental model / off-model development

- Further details on waste incineration & energy loops:
- sectoral waste coefficients & minimization policies:
- material feedback loops from recycling and reuse.
- Spatial & social group breakdown of arisings, particularly urban / rural split.
- spatial location of landfills, incinerators etc.
- Waste regional balances by type & source:
- Linkage to regional mass balance / resource flow audit
- Ecological footprint of waste & resources.

Economic model / off-model development

- Effect of landfill tax & other levies on arisings
- Linkage from minimization to competitiveness:
- Economic and employment effects of recycling:

Linkages to other technical systems

The 'Wisard' system is the principal system operating at the regional level.

6.3 **Water demand**

Policy issues:

Water demand is increasingly an issue for large scale new urban development, and from some large industries. There is increasing pressure for regions to be more self-sufficient, and the effects of climate change are likely to exacerbate the situation.

Scope of model

The model method is a calculation of water direct demand from each of the 50 economic sectors, and from households. It also includes a regional water balance of imports and exports. It excludes any consideration of the water resources and supply infrastructure, and any issues on water effluent and water quality.

General issues in modelling

Water company regions differ from catchment areas and from administrative regions. The majority influences on change in the demand forecasts are driven by off-model factors:

- agricultural activity and spray irrigation, and the impact of CAP reform:
- technological innovation in sectors such as textiles, food & drink, and chemicals:
- impact of climate change on domestic water demand:
- effect of lifestyle, affluence & technology on domestic water demand.

Foresight & scenario structure

The Environment Agency carried out detailed forecasts of national and regional demand and resources, as a counterpart to the water utilities' calculations. This adapted the UK Environment Foresight scenario structure and developed a series of micro-component demand models. It would be useful for the REEIO water modeling to follow a similar structure.

Appraisal methods

Water demand does not feature greatly in current SEA / SA / EIA methods in this country. However it is increasingly a constraint on major new development in more remote areas, and potentially in larger urban areas in the Eastern and Southeast regions. There are obviously indirect effects on water resources and supply infrastructure, which is where SEA and EIA are applied in great detail.

Environmental model / off-model development

- Replacement of housing / commercial building stock as a factor in demand
- Relationships between water demand and water supply – these are very specific to the region, but some proxies might be drawn.
- Energy use, transport and emissions as factors in water supply.
- Factor in risk levels and safety margins due to drought years, i.e. when demand increases and resources reduce.
- Climate change impacts based on global / national / regional climate modeling.

Economic model / off-model development

- Impact of water pricing on demand management
- Investment in leakage control
- More detailed analysis of agriculture water demand, and other key sectors as above.
- Social factors in water demand in both households and commercial buildings.

Model linkages

At the regional / national scale, the main link is to the Environment Agency's modeling of water demand and water resources as above. The water / drainage utilities also operate their own forecasting models and there are further links to be explored.

6.4 Energy sector

Policy context

Energy is a recent addition to regional strategy: some forward-looking regions are actively forming energy / climate strategies, and all have carried out renewable energy studies. For energy policy there is the useful guidance of an overall emissions target, given by the UK's climate change commitment under the Kyoto protocol, in particular the national commitment to 20% reduction in CO2 emissions by 2010. Carbon reduction action can be either supply-side (fuels) or demand-side (usage) focused. There is a policy link between mitigation of emissions and adaptation to climate change impacts, although the latter is notoriously difficult to model.

At the regional level of policy there is a perceived link between the climate change business levy and the competitiveness of manufacturing. Tracing the inter-regional impacts of energy fiscal policy is not within the scope of the REEIO, but could potentially draw on national and EU level work.

Scope of model

In summary, the scope of the model is generally to provide strategic intelligence on the link between economic development, energy demand and the basic profile of energy supply. Development of renewable sources is the hot topic, although the markets are uncertain and the land-use implications of this can be contentious.

General issues in modeling

There is a long tradition of energy-economic modeling at the national scale, so the issues raised here refer to the regional level in particular:

- Source versus end-use allocation of emissions,
- bottom-up versus top-down methodologies for data and modelling,
- regional effects of macro-economic influences i.e. oil prices, climate levies, energy subsidies (as above)

- boundary issues, urban demand v. national grid.
- Regional economic / employment effects of demand management

Foresight & scenario structure

There is a long tradition of energy modeling scenario development at national and global scale, although little at the regional scale. The UK Foresight 'Energy Futures' provides a high level framework, and the EP 68 is the most recent national study to quantify this. The national decarbonisation agenda under the Kyoto protocol includes for 20% carbon emissions reduction, development of regional renewable capacity. The UK Climate Impacts programme applies the global modeling scenarios for climate change to the UK.

Appraisal methods

Again, most SEA and EIA techniques are used for the assessment of supply infrastructure, with little attention on the demand side.

Economic model / off-model development

- Effects of business climate change levy.
- Effects of oil / power prices on demand elasticities.
- Economic / employment inputs to efficiency programmes
- Competitive gains through industrial energy efficiency programmes,
- Net costs of different fuels & energy sources.

Environmental model / off-model development

- Spatial development links to energy demand - planning, transport etc.
- CHP / co-generation efficiencies and distribution
- Energy from waste incineration
- Rate of development of renewables
- Future of generation nuclear, oil, coal & gas
- building technology e.g. non-domestic emissions work by BRE,
- building adaptation to climate change e.g. air conditioning.

Linkage to other models

- Links to national / international indicators for energy / climate emissions.
- Urban energy models: EEP (Energy-Environment Programme): e.g. DREAM / Leicester Energy model.
- Housing / urban models: models of housing demand generally link population and income projections to housing stock models, linked in some cases to GIS-based service provision models.
- Economy –energy modelling: links to more detailed national MDME3 model: DTI Markal model.

6.5 Transport demand

Policy context

Transport is a major issue for regional strategy, and seen as a key opportunity or constraint on economic growth. However the majority of transport impacts come from private car usage on the household demand side of the matrix. Regional transport strategies are generally linked with RPG, also closely associated with the RES, and have a strong connection to any environmental strategy. While such a transport strategy is intended to be ‘sustainable’, in practice there are many conflicting pressures.

Scope of model

The REEIO does not contain a detailed transport model: the main function of the transport calculation is to provide inputs for the energy and emissions modules. However it may be able to provide some useful material on the transport demand side, i.e. in terms of projections of unconstrained demand.

This draws on the detailed freight coefficients from each economic sector: assessment of private car travel demand would ideally want more detail on the ownership / income / travel / alternative mode functions. The emissions functions are in any case limited by the lack of constraints from network congestion, distance, time etc. Most transport questions are concerned with major infrastructure, or for urban or rural area policies, and ideally the model might be developed with some form of disaggregation to reflect this.

General issues in modelling

Transport modeling has a long history and literature, and there are well-established spatial / network models in use. There are also many questions on such models:

- The fastest growing sector is that of air travel, driven by external factors.
- Behavioural and social group factors are crucial and difficult to model.
- Boundary effects & apportionment, e.g. traffic on through routes.
- Actual emissions coefficients depend on network and congestion effects as above, and on the vehicle fleet composition.
- Theoretical emissions coefficients depend on vehicle technology and fuel content policy at national and EU level.
- Many transport impacts are highly localized and specific to social groups.

Foresight & scenario structure

This will revolve around the National Road Traffic Forecasts method and the consideration of alternatives under the current multi-modal study framework. Other EU work may be useful, for instance the POSSUM project on transport scenarios, and the current EC Transport Foresight project.

Appraisal methods

There is a huge body of practice including the SACTRA studies, drawing on mature CBA / MCDA methods, and applied to the new generation of multi-modal studies.

Economic model / off-model development

- External costs of transport are well researched and could be factored in:
- Economic effects of demand side management:
- Technological change, supply chains and logistics:
- Road pricing, fuel duty and other demand elasticities:

- Household models: car ownership, running costs, disposable income, occupancy.
- Effect of economic structural change on commuting.
- Effect of consumer sectors e.g. leisure and retail, on household travel demand.

Environmental model / off-model development

- Vehicle fleet models with engine / emissions factors
- Alternative fuels and emissions factors
- Alternative modes e.g. light rail, guided bus etc
- Spatial disaggregation: urban / fringe / rural locations.
- Major infrastructure proxies at the regional scale: motorways, airports etc.

Links to other models:

These are generally in a hierarchy from the strategic to network level, and there are recent developments in linking transport flows to land use changes. There is potential to link the REEIO outputs for long run transport / commuting demand, with the data inputs and scenario structures of current models.

6.6 Air emissions

Policy context

Air quality issues are generally contained within environmental strategies where these exist, and/or sub-regional air quality management programmes. Air Quality Standards were introduced in the late 1990s and local air pollution data is collected by local authorities, and other bodies, to check for exceedences. Such data will also be used to assess compliance with EU AQ legislation and targets for reduction. Most air quality strategy work is at sub-regional and local level, with an overall

Scope of model

The REEIO model will generate emissions inventories at the strategic level for common pollutants including NO_x, SO_x, PM etc. It also includes CO₂ and other greenhouse gases which are often reported separately. As there are much more detailed emissions / dispersion models in use, the contribution of the REEIO is a better means of projecting changes in activity data that then drive 'off model' spatially resolved emissions projection models (ie that have a sub-regional geographical emphasis). This in turn can then provide the inputs into dispersion models, to investigate the potential impacts of these scenarios of local air quality in sub-regional/local areas.

General issues in modelling

'Bottom up' inventories are broadly of the form of using source specific activity data with emission factors to build up to an emission estimate. This contrasts with the 'top down' approach which uses nationally derived emissions data, and apportions an approximate regional proportion according to the regional contribution to the polluting activity, as measured through a surrogate statistic (e.g. population or v-km travelled).

Current air emissions studies now generally require spatially resolved emissions inventory projections to use a series of national forecasts for changes in the economy, energy use, road traffic growth (e.g. as with NRTFs). These assessments could be improved with some regionalised dimension to the projections in these sectors. This detail could also potentially be fed into the National Atmospheric Emissions Inventory, in the same way that national projections and emissions data feed into European inventory projects such as CORINAIR. There is an issue to be explored on the data sources for the REEIO, which is a combination of top-down, bottom up and spatially resolved methods.

Foresight & scenario structure

Particular policy questions to be tested through the scenario structure include:

- Extent and cost of likely controls needed in order to achieve targets
- Assessment of long term trends in economic activity.
- Relationship to transport policy, transport technologies
- Regulation of large combustion plant and key industrial sectors.

Appraisal methods

- SEA may use directly the model outputs: EIA applications may use the model indirectly, to feed dispersion models as above, or as contextual information on cumulative trends.
- The emerging methods of health impact assessment also have something to gain from this approach. This would use proxies where appropriate, to link regional air emissions to local air quality, and then air quality to health outcomes.

Economic model / off-model development

- Link between pollution control expenditure and emissions coefficients
- Link between industrial competitiveness and emissions coefficients
- Future projections & scenarios for industrial emissions coefficients.
- Future projections and scenarios for transport emission coefficients

Environmental model / off-model development

- Overview of the intensity of regional emissions, assessment of trends, guiding & refining air quality monitoring networks, and scenario assessment – estimating the extent & cost of controls needed in order to achieve targets.
- Technical input format for dispersion modelling and empirical models
- Any correlations / proxies between mass air emissions and health impacts.

Model linkages

- DETR Urban inventory projects carried out by the London Research Centre and RSK Radian. Also, NETCEN, the Transport Research Laboratory (TRL) and various other organisations carry out testing and update emission factors in line with changes in technology.

7 Signposts & links

- Environment Agency full guidance and advice on SEA is available on <http://www.environment-agency.gov.uk/aboutus/512398/830672/>
- A Draft Practical Guide to the Strategic Environmental Assessment Directive, OPDM and Devolved Administrations, 2004
<http://www.dover.gov.uk/localplanreview/StrategicEnvironmental.pdf>
- The Strategic Environmental Assessment Directive: Guidance for Planning Authorities: Practical guidance on applying European Directive 2001/42/EC ‘on the assessment of the effects of certain plans and programmes on the environment’ to land use and spatial plans in England (October 2003)
http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/page/odpm_plan_025198.pdf
- ODPM, 2004: Sustainability Appraisal of Regional Spatial Strategies and Local Development Frameworks: Consultation Paper
http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/page/odpm_plan_030923.pdf
- Source material on the REAP tools and the Ecological Budget UK project:
www.ecologicalbudget.org.uk: <http://sites.wflearning.co.uk/ecobudget/>