Resource-use and CO2 Emissions Modelling

A report for the
East of England Development Agency

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Executive Summary

Overview of the study

This project, undertaken by Cambridge Econometrics (CE) and SQW Consulting (SQW) considers the future trends in resource use in the region. The project was identified by EEDA and its partners as an important and necessary study to enhance the evidence base for the East of England Regional Economic Strategy. The project identifies the impact of alternative patterns of development of the region's economy on resource use, using REEIO, an energy-environment-economy model. It provides evidence to support policy development to reduce the environmental impact of growth.

The particular environmental indicators that have been considered are waste arisings, water use and CO2 emissions (on an end-user basis). The alternative patterns of economic development considered are those developed within the joint RES-RSS modelling, focusing on the RSS and P2 scenarios in particular.

Resource use on current trends

- On the basis of existing underlying trends (assuming no extra policy interventions) we can expect that economic growth will be decoupled from resource use. However, for most resources it would be a *relative* decoupling as some resources would continue to rise, but at a slower rate than the projected growth in the economy.

- The draft RES proposed a challenging potential CO2 emissions reduction target of a 60% reduction on 1990 levels. This would not be met on the basis of expected future trends in energy use under any of the economic growth scenarios considered. The performance of the region in terms of CO2 emissions has to be seen in the context of future developments in the UK as a whole. Recent forecasts from CE indicate that under current policy (where it has been clearly defined) the UK would not achieve its target for a 20% reduction in CO2 emissions from their 1990 levels by 2010[1]. The region will find it increasingly difficult, as one of the fastest-growing regions, to meet its targets if national targets are not to be met.

- The outlook for future water demand depends greatly on the scale of growth in the region and in the trend in per capita water use. If per capita water use remains at its current level, then overall water demand under the RSS economic scenario remains broadly unchanged over the period. This 'water neutrality' of future growth comes about with the increase in domestic water use associated with a rising population and increased demand from services (where output growth is quite strong) being compensated by declining water use by industry (where long-term growth prospects are comparatively weak). However, within the region, there may be specific areas that will see increased water demand and others where overall water demand falls.

[1]The forecast indicates that such a reduction would not be achieved by 2020.

Further policies to achieve future resource use targets

- Given that current trends in resource use are not expected to be sufficient to reach particular resource use objectives further policies are needed to bring these about. These additional policies have focused on the domestic sector, as well as businesses (primarily services), transport and electricity generation, and involve reinforcing national policies to ensure that resulting action is more comprehensive than would otherwise be the case; lobbying national government for changes in policy and implementing regionally-specific policies. Most of the policies identified (and their impact quantified) can be seen to operate within the existing policy landscape and the final decision of how to respond to the policies is voluntary. In addition, a smaller number of polices have been identified that are more ‘radical’ in view and as such would represent a significant change to the policy landscape.

- The further policy options identified for the region could lead to a significant impact on the resource use indicators. In particular, future water use and CO2 emissions would be put on clear downward trends, even if the economy grew as strongly as indicated under the P2 economic scenario.

- As a result of the additional policies, by 2031 CO2 emissions fall to 55% of their 2005 level, an average rate of decline of 2¼% pa[2]. However, the challenge for achieving the required CO2 reductions appears greatest in the medium term. The ‘source’ of CO2 emissions most resistant to reduction is the transport sector.

- The further policies result in a strong downward trend in overall water use in the RSS scenario. They also provide an underlying downward trend in the stronger P2 scenario, albeit a modest one. The impact of the further policies is to reduce the use of water by 15-20% by 2031 in both scenarios compared to future demand under underlying trends. The greatest impact of the additional policies is on the domestic sector, as a result of the moves towards greater use of metering and an assumption that a clear downward trend in per capita water use is established through greater levels of water efficiency.

- It is assumed that the additional policies result in industry reducing the waste intensity of output by ½-2% pa depending on the sector. However, such an effect would not be sufficient to prevent waste arisings from industry and services continuing to rise, even under the RSS economic scenario. Further, unless the impact of policies focused on the domestic sector can result in per capita waste risings falling by ½% pa, the level of household waste will continue to rise.

[2] The 2¼% pa rate of decline projected is that which that would deliver a 60% reduction in emissions from their 1990 level by 2031. However, at the time of this study estimates of CO2 emissions for 1990 were unavailable on a consistent basis with the data used in the REEIO model. However, these data will be forthcoming through SCPnet. To illustrate the sensitivity of the future rate of declines necessary to achieve the 60% reduction target, if emissions in 2005 were at the same level as in 1990, then the target reduction by 2031 would require emissions to be cut by an average of 3½% pa from 2005.

CHART 1: IMPACT OF FURTHER POLICIES ON CO2 EMISSIONS

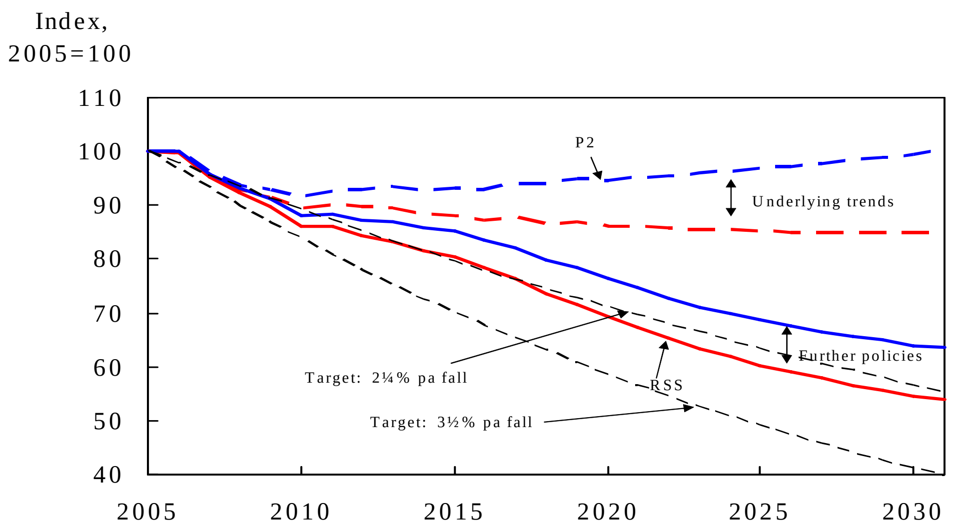
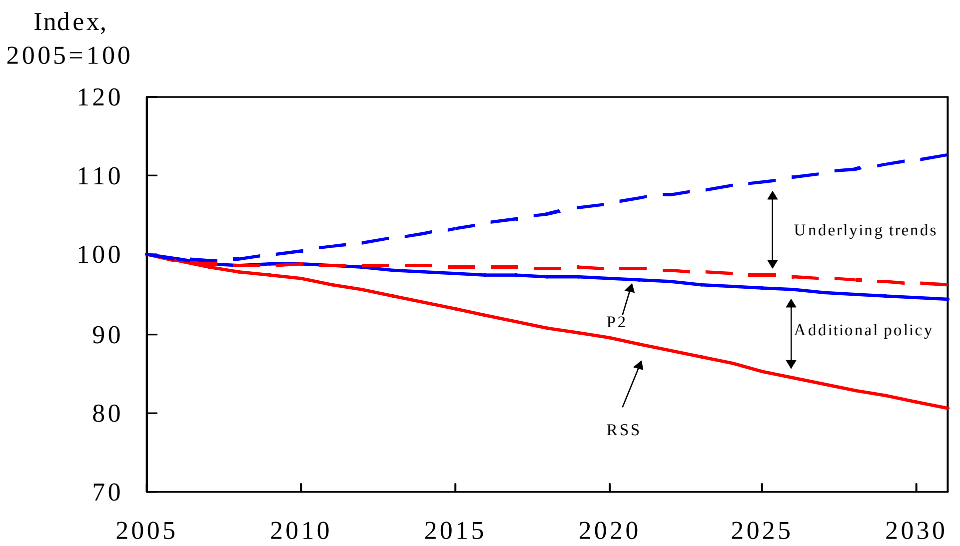


CHART 2: IMPACT OF FURTHER POLICIES ON WATER DEMAND



Uncertainty

- Although the analysis in this study has shown that it is possible that particular policy initiatives can achieve particular resource use objectives there is no certainty that these outcomes will arise. In many cases the desired outcome requires the policy to result in a change of behaviour through the ‘choices’ made by individuals and firms rather than through the legislation. Even where legislation is involved, such as in, say, strengthening building regulations in terms of efficient use of energy or water, there is an assumption that individuals will not further alter their behaviour as a result, perhaps moving away from resource conservation behaviour thinking that it is being addressed by technology. For example, people may no longer be concerned about water used by leaving taps running when the tap itself is a low flow model.

- There are uncertainties in the underlying data and assumptions for the future resource use in the region, particularly relating to the use of water. This is recognised, and the Environment Agency is undertaking a number of initiatives to improve the data and understanding of future trends.

1 Introduction

Context for the study

EEDA and its partners are in the process of reviewing the East of England's Regional Economic Strategy (RES). A new draft RES was published for consultation on 3 September 2007. As part of the consultation it was identified that various elements of the evidence base supporting the RES required further investigation and analysis. This study, undertaken by Cambridge Econometrics (CE) and SQW Consulting (SQW) was commissioned as part of this process.

The timetable for developing the RES has required this work to be conducted to a tight timescale. The work was commissioned towards the end of January 2008 and had to report by the end of March 2008.

Scope of the work

The draft RES identified as one of its overarching ambitions for the region to reduce the level of CO2 emissions and accelerate the decoupling of resource use from economic growth. A possible CO2 emissions reduction target of 3½% pa was proposed. In addition, there is commitment in the region to include a wider resource-use headline target for water use in the final document. This study investigates the economic scenarios in the consultation draft in terms of the implications for water demand, waste arisings and CO2 emissions to

- identify the impacts of different scenarios on water use, waste arisings and CO2 emissions
- provide evidence to support policy options for pathways to reduce the environmental impact of growth

Policy options are developed through which the region can achieve its stated target for resource use.

It was required that the project was conducted using an energy-environment-economy modelling approach. The study has used a version of the REEIO (Regional Economy Environment Input Output Model) model. This model was originally developed by CE for a consortium led by the Environment Agency involving a number of RDAs (including EEDA). More recently, the model has been supported through SCPnet, and copies of the model are housed in the region. This study used a provisional version of forthcoming REEIO Version 3[3].

Alternative economic scenarios

The economic scenarios that have been considered in the study come from the RSS/RES joint modelling exercise[4]. In particular, the study has considered the 'RSS', 'P1 high productivity' and 'P2 high productivity' scenarios.

Summary of approach

The study has been conducted in three stages:

- a review of the potential impact of resource use from current underlying trends and policy environment
- developing potential policy responses to address the gap between targets for resource use and the impact of current trends
- modelling the impact of the additional policy options and drawing conclusions

[3] Further details of the REEIO model are presented in Appendix A.

[4] For more details see East of England: Joint modelling for the RES and RSS Final report August 2007, Oxford Economics.

The process of developing potential policy responses to address resource use involved a workshop with stakeholders in the region.

Defining the CO2 indicator

In the course of the project it has been necessary to clarify with EEDA the appropriate definition of the CO2 indicator for which a target may be set. The selected indictor defines CO2 emissions on an 'end user' basis. That is, the emissions associated with electricity consumed in the region are attributed to the region and not the emissions associated with the electricity generated in the region. For example, if the East of England consumes 10% of all UK electricity generated, then the CO2 indicator used in this study will include 10% of all CO2 emissions from the UK power generation sector, whether or not the sector in the region itself generates 10% of UK electricity. The selected indicator for CO2 also includes emissions from both domestic and international aviation. For reasons of attribution and data availability, the treatment of aviation in the CO2 target is restricted to take-offs and landings and an imputed share of domestic cruise.

From the perspective of emissions to air the analysis focuses entirely on CO2, rather than, say the basket of greenhouse gas (GHG) emissions. This was the pollutant proposed in the draft RES, and it is also that for which the UK government has proposed long-term targets. Further, CO2 is the main contributor to climate change, accounting for around 85% of the UK's GHG emissions (measured in CO2 equivalent) (methane is the next largest contributor accounting for 7½% of the UK's GHG emissions). The REEIO model provides separate projections for each of the six GHGs on a territorial basis. The RES is committed to establishing baselines and policy options with partners around other GHGs in the future.

Framework for developing policy

The framework within which additional policies to help the region meet potential resource use targets have been identified was agreed with EEDA. The draft RES included a potential target for CO2 emissions and there is also commitment to include a wider resource-use headline target. Policies directed on resource use often are framed so that they consider more than a single resource issue. For example, setting increased environmental standards for new homes can simultaneously address energy use (setting insulation standards) and water use (requiring appliances that are installed to meet a set standard). Developing the policies for this study has concentrated on identifying (and subsequently modelling) their potential *primary* impact on each of the environmental indicators: CO2 emissions, water use and waste arisings. However, a target based approach to the development of policies has only been possible for CO2 emissions[5].

Structure of report

The remainder of the report is structured as follows: Chapter 2 assesses underlying trends that would affect resource use in the region and Chapter 3 provides a brief summary of the alternative economic growth scenarios. Chapter 4 assesses the impact on resource use of the underlying trends under each of the economic scenarios to assess the scale of the remaining gap with targets and aspirations. Chapter 5 discusses the additional policy options that have been considered through which the resource use targets may be met and Chapter 6 presents the quantified analysis of this. Finally, Chapter 7 draws together the conclusions from the study.

[5] This was the only indicator for which an indicative target had been set.

2 Background Trends in Resource Use

In order to develop policies that will help the region meet its resource use objectives it is first necessary to consider the extent to which existing trends might already be moving the region in this direction.

This chapter provides a brief overview of underlying resource trends that are used in the REEIO model that is being used in the analysis. The initial trends used in REEIO outlined above represent 'sensible' views from which to start developing scenarios to represent future resource use under alternative policy environments. The projections for resource use arising from these trends occurring under the various economic scenarios being considered are presented in Chapter 4. An alternative policy environment is set out in Chapter 5 and the impact on resource use trends assessed in Chapter 6.

2.1 Future prospects for energy use and CO_2 emissions

Underlying trends are taken from CE's latest UK forecast

The baseline assumptions for future energy use and CO2 emissions are taken from the forecasts for UK energy use and emissions published by Cambridge Econometrics in *UK Energy and the Environment in February 2008*[6]. In particular, REEIO adopts national trends for

- energy-intensity of output by fuel users
- switching between fuels by fuel users
- carbon and GHG-intensity of electricity production

In summary,

- most sectors are expected to achieve quite strong reductions in the energy intensity of their production, with rates generally in a range of 2½-3½% pa. Broadly, the rates of energy efficiency expected in manufacturing are stronger than those forecast for services.
- there is expected to be a switch to electricity from other fuels (particularly gas), by households and commerce and also by some more energy-intensive sectors such as basic metals.
- The UK is expected to meet its target for 20% of electricity coming from renewables by 2020. This, together with an expected further move to gas generation and away from coal, will mean that by 2020 the carbon intensity of electricity could fall to 70% of current levels.

[6] The projections incorporate an independent view of many of the policies outlined in the Governments 2006 Climate Change Programme Review and 2007 Energy White Paper, such as the Renewables Obligation, the Carbon Emission Reduction Target and the Carbon Reduction Commitment aimed at improving energy efficiency in, respectively, the household and commercial sectors. However, some other proposals outlined in the strategic documents have not been incorporated because they have not as yet been followed by concrete policy measures.

CE's latest UK forecast in more detail

The Government's 2010 carbon emissions and renewables goals will be missed by a large margin and the statutory targets for emissions in 2020 are in doubt

Total carbon emissions are expected to decline by around 2¼% pa over 2005-10, following a slight average increase of ¼% pa over 2000-05, but this decline is not sufficient to achieve the Government's goal of a 20% reduction in carbon emissions from 1990 levels by 2010. Looking beyond 2010, carbon emissions are expected to decline further to 2015, though at a slower rate than over 2005-10, before levelling off after 2015.

The reduction in carbon emissions are dominated by developments in the power generation sector and energy-intensive industry. Emissions from commerce are expected to rise in the long term. Carbon emissions from households[7] are expected to fall, although this is due to an expected switch towards electricity from gas rather than from a reduction in energy consumed. A similar switch to electricity from other fuels is also expected to occur in a number of other sectors including energy-intensive industry and commerce. Carbon emissions from road transport and air transport are forecast to continue to rise.

The carbon intensity of electricity generation is expected to continue to decline, both through the increasing importance of renewable generation, but also from the expected significant shift away from coal-fired towards gas-fired generation as a result of the rise in carbon allowance prices under the EU Emissions Trading Scheme (ETS). The forecast indicates that the proportion of electricity consumption met through renewables generation will rise to around 14% by 2015, and reach almost 22% by 2020, exceeding the Government's aspiration of a 20% share. This outcome depends critically on electricity demand growing after 2010 and on fossil fuel prices staying relatively high. However, the far more ambitious, legally-binding target set by the European Commission of a 15% contribution of renewables to the UK's *overall final energy needs* (ie including all domestic heating needs and energy needs of transport) by 2020 is, on current policies, likely to be missed by a wide margin.

The UK is expected to meet the Kyoto target for greenhouse gases, despite the rise in CO2 emissions in 2004-05. The forecast indicates the UK will achieve a 22% reduction in GHGs by 2010 from their 1990 level (the Kyoto Protocol target is for a 12½% reduction). This is due in part to large expected reductions in some GHGs other than CO2.

In conclusion, the forecast indicates that the carbon challenge set out in the May 2007 Energy White Paper is unlikely to be met through current policies. The forecast did not take into account some proposals that had been outlined in the July 2006 Energy Review, or in the May 2007 Energy White Paper, because they have not as yet been followed by concrete policy measures.

2.2 Long-term scenarios for future UK emissions

CE publishes forecasts for energy use and emissions to 2020. Other studies have looked at the potential for carbon reduction in the longer term

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[7] Emissions resulting from their use of primary fuels but not including the emissions associated with generating the electricity they consume.

IPPR study shows 80% reduction in CO2 can be achieved by 2050

A recent IPPR study considered the possibility of achieving an 80% reduction in UK carbon emissions by 2050. The study used two approaches in its analysis, the MARKAL-MACRO model that was used by the government for the 2007 Energy White Paper and a model developed by Professor Dennis Anderson that was used in the Stern Review.

The study concluded that it was feasible to achieve such significant reduction in carbon emissions and that costs involved were not substantial, being in the order of 2-3% of GDP by 2050. The reduction in emissions by 2030 was around 50%. The report makes clear that the scenario it outlines is not a forecast of how the UK energy system will develop in the future, and nor does it necessarily represent a 'preferred' route to decarbonising the economy, only that it is one way by which it can be achieved.

The route through which the outcome comes about includes:

- decarbonisation of electricity generation
  - greatly increasing investment in renewable generation, and wind power in particular
  - use of carbon capture and storage
- major improvement in energy efficiency of buildings
- shift to low carbon fuels for heating
- improvements in fuel efficiency of surface vehicles and use of advanced biofuels
- assumption that aviation emissions do not exceed 2010 levels
  - assumption equivalent to the sector being within the EU ETS from this date

As a result there are almost zero emissions associated with electricity generation in 2050 despite an increase in the level of generation. Household emissions are around 60% of their 1990 levels by 2030, and almost zero by 2050.

CE work into 30% reduction in CO2 emissions by 2030

In addition to its published forecasts CE has considered scenarios in which the UK can achieve 30% reductions in CO2 emissions on its 1990 levels by 2030. Alternative scenarios considered combinations of policies including:

- increased generation from renewable power
- increased use of renewable heat generation (eg solar thermal, biomass boilers)
- increased energy efficiency throughout the economy (but particularly households)
- mothballing of fossil fuel plants to allow more new build of renewable generation capacity
- promotion of greater road transport fuel efficiency

The work found that energy efficiency improvements made the greatest cut to emissions, although at the same time it made the task of meeting a target for renewables generation more difficult. It also acknowledged that, while energy efficiency measures, supported by higher energy prices, have a significant impact in reducing carbon emissions to 2020, the longer term goals of 60% or 80% reductions by 2050 will require substantial decarbonisaton of much of the energy system.

2.3 Trends in waste arisings

While there is considerable timeseries of data on the level and composition of municipal waste there is little information on the level and characteristics of other streams, particularly the commercial and industrial waste stream. There is also little information on which to determine trends in waste characteristics of industry production (eg trends in waste arisings from a given level of production inputs).

In REEIO production of waste by key economic sectors is projected on the basis of each industry's purchases of inputs to production and the waste intensity by which those inputs are used. Therefore, overall waste from industry will depend on the changing sectoral profile of the region, the changing production technologies of each sector and the changes in waste intensity in their use. Household waste is projected on the basis of population growth and the rate of growth in per capita household waste arisings. Associated projections for waste entering the various management routes are produced from the projections of waste arisings on the basis of assumptions for the way each waste stream is managed.

Waste from industry

Given the absence of timeseries data from which to estimate underlying trends, the baseline future trends for waste from industry reflect the following assumptions[8]:

- changes in the structure of inputs to production are projected based on analysis of the ONS Supply and Use Tables of the past decade. The effect is typically to reduce the importance of material inputs into the production process
- there is no change in the level of waste arisings per unit of material used in the production process.

Waste from households

The baseline assumption for future waste from households is:

- per capita household municipal waste remains unchanged (over 2000-06 the underlying rate of growth in per capita municipal waste arisings was 0.1% pa)[9].

2.4 Trends in water use

There is little by way of detailed, comprehensive data on water use in the UK regions and the datasets that underlie this part of the REEIO model have not been updated since the original data collection exercise in 2002. At the time, it was recognised that the water data were the least robust of the environmental datasets.

The Environment Agency (EA) produced a series of national water forecasts under various alternative scenarios designed to examine the uncertainties about future water demand and availability in the region[10]. These provided great variation in the potential trends in water use though they are now somewhat dated[11].

Domestic water use

The EA scenarios provided a range underlying growth in per capita water demand ranging from 6½% pa for the Anglian Water area over 2010-20 in the 'provincial' scenario to10-12% pa in the 'local stewardship' scenario.

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[8] This is the assumption made in the forthcoming release of the REEIO model, and that which was made in a previous study for Defra looking at the future trends in commercial & industrial waste.

[9] This assumption will be incorporated in the forthcoming release of the REEIO model. Since 2000 there has been a modest upward trend in per capita household municipal waste arisings (0.1% pa), although the actual year-on-year changes have been volatile. The view of the Environment Agency, who were consulted as part of work to update the REEIO models, is that the evidence of the last five years did not provide a sufficiently strong basis on which to apply a long-term trend in per capita waste arisings

[10] A scenario approach to water demand forecasting, August 2001. Environment Agency.

[11] The EA is undertaking a new water demand forecasting exercise as part of its Water Resources Strategy which is due out later in 2008.

Recent data from company returns show a mixed picture with, for example, Anglian Water reporting per capita consumption having increased by ½% pa for unmetered customers over 2000-05 while that for metered customers increased by 2¼% pa. However, there is considerable volatility in the series making it difficult to determine any discernible trend in per capita consumption. It is not possible to identify how much of the changes were related to 'core' water use and how much to more discretionary use such as that linked to climatic conditions. Work by the EA analysing past trends in domestic water demand since 2000 shows that for most of the country there has been no discernable trend in per capita water use by either metered or unmetered customers in the region, or indeed in most of the UK[12].

Given this, and that over this period there were policies in place to encourage efficient water use which are continuing, the following assumptions are considered for underlying trends in household water use:

- Per capita water use remains at the levels estimated in 2006 through to 2020
- The proportion of households that are on meters rises from an estimate of just under 40% currently to over 60% in 2020.

Industrial water use

The key assumptions made for future industrial water use are:

- Industry achieves trend savings in its use of water of 1½% pa but at the same time demand for water has an output elasticity of 0.7
- Services achieves trend savings in its use of water of 1% pa and have an employment elasticity of 1.

These assumptions are based on work undertaken by CE for several companies within the water industry but nevertheless should be considered 'indicative' rather than 'precise'.

2.5 Trends in the demand for transport

Transport is a major demand on resources and is an important source of CO2 emissions, accounting for around 20% of national emissions[13]. Therefore, the assumptions made for the future demand for transport in the region will have an important role in determining UK emissions.

Demand for transport

The key underlying assumptions made for future transport demand in the region are:

- the demand for surface freight and passenger transport (measured by passenger or freight vehicle kilometres) grows at a slower rate than GVA (an elasticity with GVA of 0.4, in line with the long-run elasticity estimated in the recent national road traffic forecasts)
- there is no significant change in modal shares of either passenger or freight transport, although car occupancy rates are expected to reduce slightly (this is in line with the White Paper 'Delivering a Sustainable Railway', which used results from the National Transport Model)
- demand for air transport grows by just under 4% pa while vehicle movements increase by just under 3% (both rates are as forecast for increase in UK demand in national forecasts)

[12] See http://publications.environment-agency.gov.uk/pdf/GEHO0907BMXP-e-e.pdf?lang=_e for further details.

[13] Road transport is the second largest source of CO_2 emissions after the power generation sector. Power generation accounts for a third of UK CO_2 emissions.

- the modal share of freight travel remains unchanged through the forecast

Vehicle efficiency The key assumptions adopted are:

- energy efficiency of vehicles is expected to improve by 1% pa for road and rail and by 2% pa for air travel

3 Alternative Growth Prospects for the Region

This study considers future resource use under three alternative scenarios for the economic development of the region that have been developed and modelled as part of the joint RSS/RES modelling project. These are the so-called 'RSS', 'P1' and 'P2' scenarios[14]. This chapter summarises the three scenarios together with, for comparative purposes, CE's forecast for the East of England published in *Regional Economic Prospects, July 2007*. This CE forecast provides the baseline economic context for the forthcoming REEIO Version 3 release, commissioned by SCPnet.

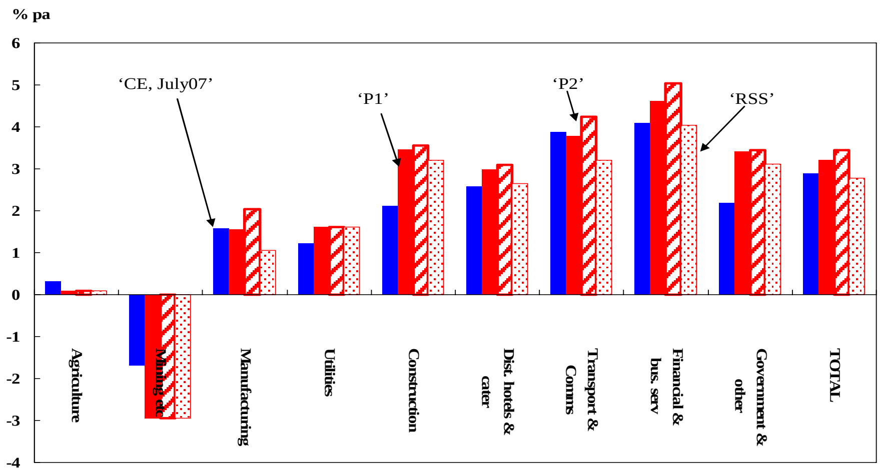
3.1 Overview of the Scenarios

Chart 3.1 summarises the underlying pattern of economic growth in the alternative scenarios over 2005-20[15].

The overall rate of growth in the CE forecast and the RSS scenario are similar at just under 3% pa. The rates of growth projected in the P1 and P2 scenarios are higher at 3¼% and 3½ respectively. Although the overall rates of growth in the CE and RSS scenarios are similar, there are noticeable differences in the expected sectoral profiles.

The corresponding growth in population is slowest in the RSS scenario at just over ½% pa over 2005-20 (a similar rate to that in the CE forecast), and this rate of growth is projected to continue to 2031. In contrast in scenarios P1 and P2 population growth is around 0.9% pa. As are result, by 2020 the population in P1 and P2 is more than 300,000 higher than in the RSS scenarios. In the P1 scenario, by 2031 the population

CHART 3.1: ALTERNATIVE GVA GROWTH FORECASTS FOR THE EAST OF ENGLAND, 2005-20



[14] The joint RSS/RES scenario P3 was not used in this study. The scenario was developed in the RSS/RES modelling project as an illustrative scenario ,with stronger productivity impacts than the other scenarios, rather than as representing an outcome for the region's economy that should be considered as a potential objective.

[15] The forecast horizon in REEIO is only to 2020. The average growth forecast in the three RSS/RES scenarios over 2005-31 is little different to that for 2005-20.

is 650,000 (10½%) higher than in the RSS scenario, while in the P2 scenario it is 700,000 (11¼%) higher.

From this broad picture of the scenarios, we would therefore expect the environmental impact of the P1 and P2 scenarios to be greater than that of CE or RSS scenarios, although the overall impact will depend on the sectoral pattern of growth.

3.2 The Scenarios in More Detail

CE forecast

The CE forecast for the East of England economy predicts underlying economic growth of just over 2¾% pa over 2005-20. This is a faster rate of growth than is forecast for the UK as a whole. The region's population is forecast to rise by ½% pa over 2005-2020, limiting output per capita growth to 2¼% pa.

Key drivers of growth are expected to include financial & business services (particularly banking & finance, computing and professional services) and transport and communications.

The strong economic growth will continue to provide new job opportunities. Over 2005-20, employment in the region is forecast to rise by ¾% pa. The most significant growth is expected in non-financial business services. In contrast manufacturing employment is expected to continue to fall, at around ¾% pa. However, the expected rate of decline is much slower than has been seen over the last twenty years or more.

RSS scenario

Compared to the CE forecast, the RSS scenario sees the prospects for growth to be stronger in construction and government and other services and construction and weaker in manufacturing and transport & communications in particular. The outlook for manufacturing output is for growth of just 1% pa. The outlook for agriculture is also weaker than in the CE baseline.

Despite these differences the broad picture of the scenario is the same as the CE forecast: the strongest prospects being in financial & business services and transport & communications, and weak growth in manufacturing.

P1 and P2 high productivity scenarios

The P1 and P2 scenarios are two of several high productivity scenarios that were developed to examine the impact on the region's economy, population and housing needs if significant increases in GVA per employee were employed. The scale of the productivity improvements rose incrementally through the scenarios, with the weaker of the scenarios involving changes that were thought possible to achieve with the resource available to EEDA and its partners.

The scenarios involved assumed increases in employment in a number of target sectors which have relatively high productivity and where the region is seen to have a comparative advantage. These are pharmaceuticals, air transport, financial services, computing services and wholesale distribution. It was further assumed that productivity in existing firms in certain key industries also improved. These were food processing, low productivity manufacturing, engineering and computing services.

P1 scenario

The P1 scenario assumes 36,000 additional jobs in the target sectors by 2030 compared to a base scenario. As a result of this and the assumed productivity improvements elsewhere the growth prospects for all the major sectors are stronger than in the RSS scenario. Compared to the RSS scenario the increased growth prospects are greatest in financial & business services and transport &

communications followed by manufacturing. Nevertheless, the projected growth in manufacturing is still only a third of that projected for financial & business services and at 1½% pa is weaker than in the CE forecast.

P2 scenario

The P2 scenario assumes twice the number of additional jobs in the target sectors and twice the productivity improvements assumed in the P1 scenario. The result is that projected growth is stronger than in P2 for all broad sectors. Projected growth in manufacturing, transport & communications and financial & business services is around ½% higher than in P1 (and 1% higher than in RSS). The impact on projected growth in construction and distribution, hotels & catering is more modest at 0.1%.

Even in this scenario the outlook for manufacturing is for growth noticeably below that expected for the economy as a whole.

4 Impact of Underlying Trends for Resource Use in the East of England

This chapter assesses the implications for resource use from the underlying trends discussed in Chapter 3 occurring in each of the three alternative economic scenarios. This illustrates the extent to which the existing policy environment may move the region towards its targets for resource use and, by implication, the scale of the challenge for further policy initiatives.

For clarity, the charts and discussion in this chapter compare the impacts under 'RSS' and 'P2', the scenarios, as these provide the upper and lower growth projections. The results for each scenario are presented in Appendix C.

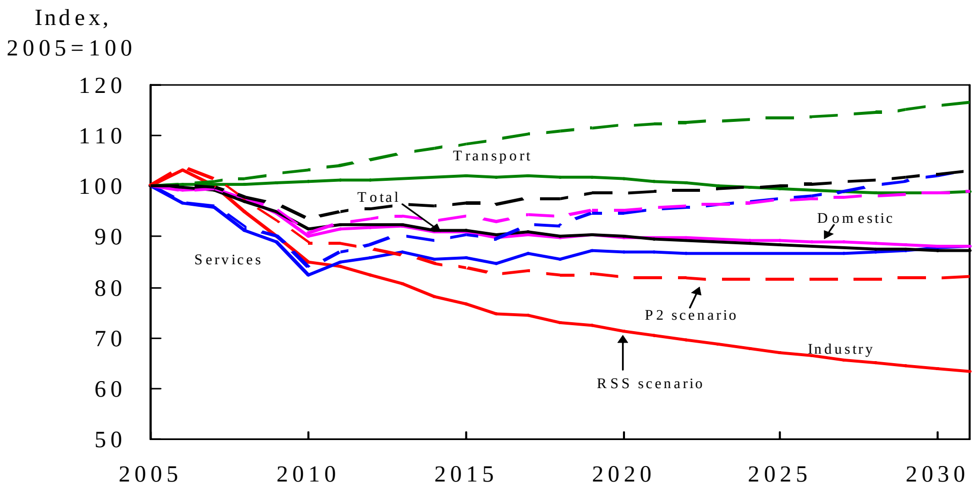
4.1 Emissions of CO2

Chart 4.1 and Table 4.1 show the projected emissions for CO2 from each major end user source within the region[16].

Under the RSS scenario CO2 emissions are projected to fall sharply to 2010 and then to continue to fall, but at a slower rate. By 2020 emissions are some 90% of their 2005 level (a fall of 0.7% pa) and by 2031 they have fallen to 87% of the 2005 level (an average reduction of ½% pa).

In contrast, in the P2 scenario CO2 emissions are 1-2% below their 2005 level by 2020 and 2-3% above it in 2031. After a projected decline in total emissions to 2010, the strength of subsequent economic growth in the P2 scenario is sufficient to result in an underlying upward trend in emissions thereafter.

CHART 4.1: CO2 EMISSIONS UNDER ALTERNATIVE ECONOMIC SCENARIOS



[16] There are significant emissions from power generation in the region. In line with the definition of the CO2 indicator chosen these are not shown directly. Those emissions associated with the electricity consumed in the region and produced nationally are.

The main differences between the two scenarios emerge in the long term. The stronger economic growth under P2 prevents the long-term decline in emissions from industry continuing and at the same time leads to absolute increases in emissions associated with the use of energy from services (excluding transport) and households.

Behind the trend in emissions are factors such as improvements in energy efficiency and trends in sectors switching between different fuels (each of which will vary in their carbon-intensity). As was discussed in Chapter 3, there is expected to be a trend towards using electricity instead of other primary fuels, and as the carbon-intensity of UK electricity generation is expected to fall this can be an important source of improvement in the level of CO2 emissions as measured by EEDA's preferred indicator.

CO2 emissions associated with the consumption of electricity account for about 30% of all CO2 emissions identified by the selected indicator. Table 4.1 shows that the level of emissions associated with the consumption of electricity does fall through most of the period but that in the P1 scenario might start to rise towards the end of the forecast period as the growth in demand for electricity outweighs the further reductions in the carbon-intensity of UK generation.

In summary, under current trends emissions of CO2 in the region may fall by an average of between 0.1 and 0.7% pa over 2005-31 depending on the rate and structure of economic growth. However, under stronger economic growth scenario by 2031 emissions may actually be above their current levels, despite trends in energy efficiency and a decarbonisation of UK electricity production.

TABLE 4.1: CO2 EMISSIONS IN THE EAST OF ENGLAND

	2005	2010	2020	2031	2005-10	2010-20	2020-31
			million tonnes C				% pa
RSS Scenario							
Industry	2.3	2	1.6	1.5	-3	-1.9	-0.8
Commerce	2.2	1.8	1.7	1.7	-4.3	-0.4	0.1
Households	3.3	2.7	2.7	2.7	-3.9	-0.2	0.1
Transport	4.4	4.4	4.5	4.5	0.3	0.2	-0.1
Total	12.2	10.9	10.6	10.4	-2.2	-0.4	-0.1
Of which emissions associated with electricity consumption	3.7	2.8	2.7	2.9	-5.0	-0.5	0.5
P2 Scenario							
Industry	2.3	2.1	1.9	2.0	-2.2	-0.8	0.5
Commerce	2.2	1.8	1.9	2.0	-4.0	0.3	0.7
Households	3.3	2.8	2.8	3.0	-3.7	0.3	0.6
Transport	4.4	4.5	5.0	5.2	0.8	0.9	0.4
Total	12.2	11.2	11.6	12.3	-1.8	0.4	0.5
Of which emissions associated with electricity consumption	3.7	2.9	2.9	3.4	-4.7	0.2	1.2

4.2 Water use

Domestic water demand accounts for more than half of the identified water use in the region. Overall trends in water demand are therefore heavily influenced by the trends in domestic demand.

Chart 4.2 and Table 4.2 show the projected increase in water use over 2005-31 in the alternative economic scenarios.

The impact of the additional growth in the P2 economic scenario has a clear impact on the underlying trend for water demand.

In the RSS scenario overall demand in 2031 is about 3-4% lower than in 2005, with increases in demand from households (from the increase in population) and services (where growth is expected to outpace efficiency savings) being slightly smaller than the projected decline in water use by industry. In contrast, in the P2 scenario water demand in 2031 is projected to be 12% higher than in 2005. The higher level of industrial activity assumed in the scenario prevents overall demand from industry falling in the long term (as occurs in the RSS scenario) while demand from the domestic and services sectors is also stronger than in the RSS scenario as a result of stronger population growth and output from the service sector.

Major differences between the two scenarios

The greatest difference between the alternative economic growth scenarios is in their impact on demand from the domestic sector and from industry. The chemicals sector in particular is a major source of the additional water demand (though this will be sensitive to the assumptions for which sectors in particular support the stronger growth in manufacturing).

Although the difference in overall water demand between the two scenarios is comparatively small in terms of overall magnitude, it does contain some noteable changes in trends. For example, the long-term rate of growth in water demand by the service sector in the P2 scenario is more than twice that in the RSS scenario, at just over ¾% pa.

CHART 4.2: IMPACT OF REDUCED PER CAPITA CONSUMPTIONS ON WATER DEMAND

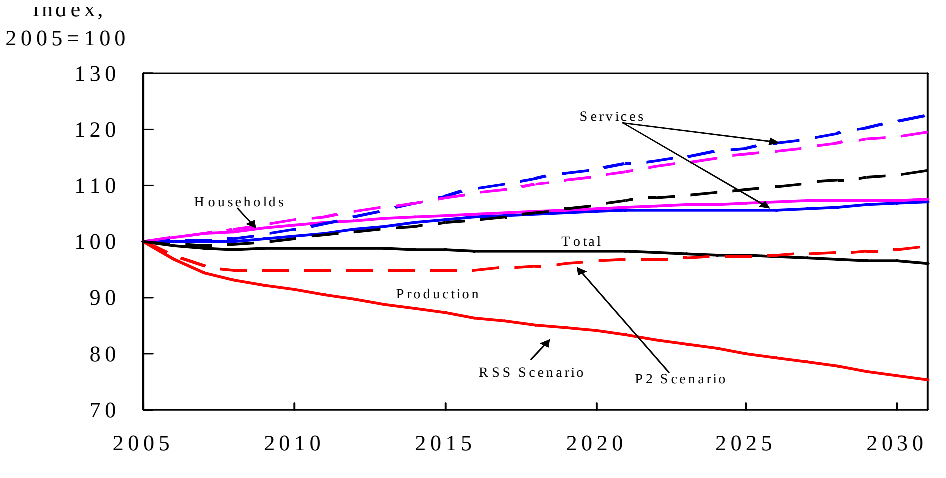


TABLE 4.2: WATER DEMAND IN THE EAST OF ENGLAND

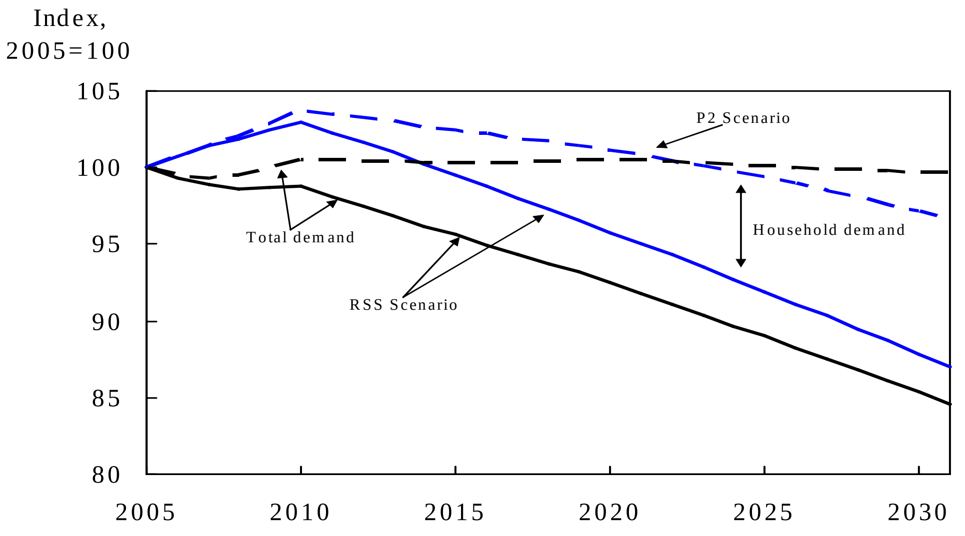
	2005	2010	2020	2031	2005-10	2010-20	2020-31
				Ml/d			% pa
RSS Scenario							
Production	564	515.2	474.7	424.6	-1.8	-0.8	-1
Services	137.1	138.4	144.5	146.9	0.2	0.4	0.2
Domestic	919.9	947.2	974.2	988.4	0.6	0.3	0.1
Total	1621	1600.8	1593.3	1560	-0.2	0	-0.2
P2 Scenario							
Production	564	534.6	545.1	558	-1.1	0.2	0.2
Services	137.1	140.1	155	168	0.4	1	0.7
Domestic	919.9	954.8	1028	1098.9	0.7	0.7	0.6
Total	1621	1629.5	1728	1824.9	0.1	0.6	0.5

Sensitivity to trends in per capita consumption

Given the share of overall water demand accounted for by the household sector, the projections are particularly sensitive to assumptions made about growth in the per capita use of water.

Chart 4.3 shows the trends in household demand and total water demand on the assumption that per capita water use falls by 1% pa from 2010. As this rate of decline exceeds the underlying growth in population, even in the P2 scenario, it results in an underlying reduction in domestic water use. In the P2 scenario this is sufficient to mean that there is little change in the overall level of water demand in the long term.

CHART 4.3: UNDERLYING GROWTH IN WATER DEMAND UNDER ALTERNATIVE ECONOMIC SCENARIOS



4.3 Waste arisings

Source of waste arisings

Of the estimated waste arisings in 2005, around 35% is construction & demolition waste, much of which is recycled or reused. Commercial & industrial waste accounts for 20-25% of waste arisings and household waste less than 10%. Agriculture waste accounts for a further 12-15% of the total and the majority of ‘other waste’ is residue from mining & quarrying activity. The volume of waste entering the commercial waste stream is similar to that entering the industrial waste stream. The services sectors producing the most waste include retailing, other distribution, supporting business services, hotels & catering, and health & social services while in industry the most waste is generated in food & drink, printing & publishing, and non-metallic mineral products.

Impact of alternative growth scenarios

Chart 4.4 shows the impact of the alternative growth scenarios on the projections for waste arisings. The general pattern of change is the same in each scenario: growth in waste entering each main waste stream, with the exception of ‘other waste’, which comprises mainly waste from mining & quarrying, and output from the sector is expected to fall over time.

As would be expected, the broad pattern shown mirrors that of the relative growth prospects, with arisings in most sectors higher in the P2 scenario than in the RSS scenario (or, not shown, the CE forecast). Overall waste arisings are projected to rise by an underlying rate of 1¾% pa in the long term in the RSS scenario and 2-2½% pa in the P2 scenario. This means that by 2020 the level of waste arisings will be around 13-19% (4¾m-6.8m tonnes) higher than in 2005 depending on the economic scenario and 40-55% (14-19.5m tonnes) higher by 2031. The strongest growth is projected for construction & demolition waste (with waste arisings growing in line with industry output), and non-household municipal waste (as a result of strong growth in the service sector). Even so, growth in this stream (which is small in absolute tonnage) is projected to be slower than for the economy as a whole.

CHART 4.4: GROWTH IN WASTE ARISINGS UNDER ALTERNATIVE ECONOMIC SCENARIOS, 2005-2031

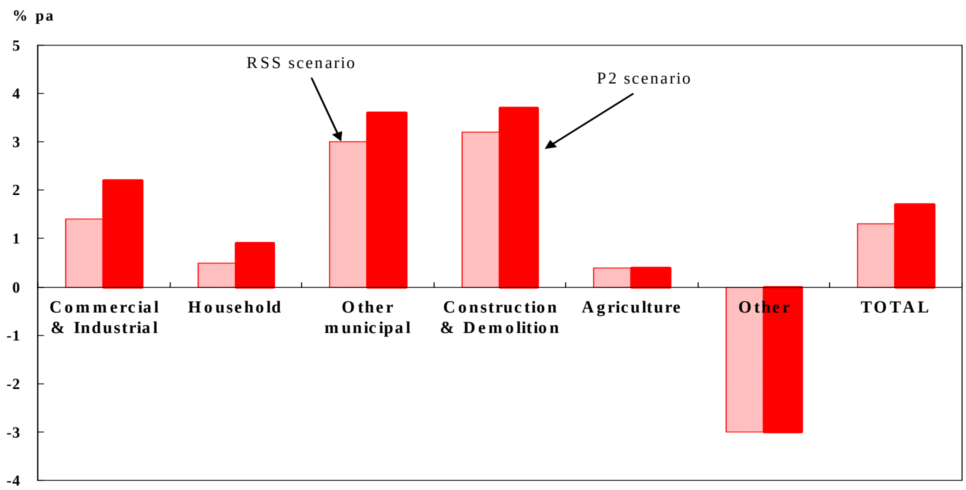


TABLE 4.3: PROJECTIONS OF WASTE ARISINGS IN THE EAST OF ENGLAND

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				000 tonnes			% pa
RSS Scenario							
Commercial & Industrial	6765	6765	7817	9821	0	1.5	2.1
Household	2847	2953	3093	3202	0.7	0.5	0.3
Other municipal	167	189	250	361	2.5	2.9	3.4
Construction & Demolition	11600	13356	18705	26551	2.9	3.4	3.2
Agriculture	4574	4339	4740	5079	-1	0.9	0.6
Other	9185	6166	5331	4194	-7.7	-1.4	-2.2
TOTAL	35137	33768	39935	49207	-0.8	1.7	1.9
P2 Scenario							
Commercial & Industrial	6765	6931	8628	11837	0.5	2.2	2.9
Household	2847	2977	3264	3559	0.9	0.9	0.8
Other municipal	167	192	271	418	2.8	3.5	4
Construction & Demolition	11600	13441	19720	29641	3	3.9	3.8
Agriculture	4574	4339	4740	5079	-1	0.9	0.6
Other	9185	6166	5331	4194	-7.7	-1.4	-2.2
TOTAL	35137	34046	41953	54728	-0.6	2.1	2.4

The level of waste entering the commercial and industrial waste stream is projected to increase by 1-1½% pa in the RSS and P2 scenarios, with the strongest growth in commercial, rather than industrial, waste (reflecting the strength of sector growth prospects). Household waste is projected to rise in line with population growth in the absence of trends in per capita waste arisings. In the RSS scenario this means an increase of 0.25m tonnes of waste by 2020 rising to 0.35m by 2031. In the P2 scenario the increases are 0.4m tonnes and 0.7m tonnes respectively.

4.4 Conclusions

The following points are drawn from the analysis:

- Existing underlying trends are expected to result in a decoupling of resource use (as represented by the small number of indicators considered in this study). It would, however, be a 'relative' decoupling as use of some resources would continue to rise but at a slower rate than the projected growth in the economy.
- The region has proposed a challenging target for achieving reductions in CO2 emissions. This would not be met on the basis of current trends in energy use and projected rates of economic growth. However, this has to be seen in the context of future developments in the UK as a whole. Recent forecasts from CE indicate that under current policy (where it has been clearly defined) the UK would not achieve its target for a 20% reduction in CO2 emissions from their 1990 levels by 2020. The region will find it increasingly difficult, as one of the fastest-growing regions, to meet its targets if national targets are not to be met.

- In the long tern CO2 emissions and water use fall slightly in the RSS economic growth conditions, while under the stronger growth of the P2 scenario the underlying trend for both indicators is clearly upwards.

5 Policy Options

This chapter sets out the proposed set of policy options through which the additional efficiencies in resource use (principally carbon emissions) could be achieved. Further detail on the process by which the policies were determined is provided in Appendix B.

5.1 Background to the policy options

Expansions and additions to current policy

The purpose of the policy options developed here is to provide potential mechanisms at the local, regional and national level that could deliver reductions and efficiencies in resource use. The scale of reduction we are seeking to achieve is by the carbon reduction target set out in the draft RES. In the case of other resources it is anticipated that this study will contribute to the development of regional targets.

As existing policy mechanisms are taken into account in the REEIO model, only expansions of current policy or additional policies can be expected to impact on the trend. As a result, it is necessary for these policy options to examine ways in which current policies could be increased in nature or scope; or to examine additional policy mechanisms altogether.

In many cases the development of policy options has come from the identification of policies that enable the achievement of national targets. That is, a policy framework exists but specific delivery mechanisms have not yet been fully developed.

Collective impact of a set of policy options

It was acknowledged early in the project that regional and local policy mechanisms alone were unlikely to be sufficient to achieve the level of resource use and carbon reduction necessary. Therefore the set of policy options include a combination of local, regional and national policies. The local and regional role in policy development is therefore a twin track approach:

- developing resource efficiency mechanisms in its own sphere of influence
- working with government to develop the necessary policy at national level

Ultimately to be successful the policies highlighted here may have to be accompanied by supporting policy or legislation. For example, a *'pay as you throw´* policy would need to be accompanied by measures to manage the risk of fly-tipping. We have focused on the primary policy option but risks and complementary policies which may be required to ensure full effectiveness are highlighted where appropriate.

Holistic approach to policy development

A holistic resource approach has been taken to policy development and most of the policy options are targeted at energy, water and waste reduction. This approach fits with the strategic imperative for the region to achieve carbon, water and waste savings. It also acknowledges the natural synergies that are associated with resource use management and the co-incidence of demand. For example, resource efficient washing machines and dishwashers save water and energy, and reduced packaging reduces material use, waste and demand for transportation.

In the course of this project we have focused on the primary effect of policy but where secondary effects are relevant or significant they have also been highlighted.

Policy option framework

The policy options have been developed in relation to broad sectors of emissions and the policy mechanisms that can be used in each of these sectors. The development of policy options acknowledges that the local and regional policy role must be seen as part of the wider national policy framework. Although this study focuses on the local and regional role we have also included national policy assumptions where it is relevant to do so. More detail on the development of policy options is provided in Appendix B.

The policy options presented in the following sections are structured by the four broad sectors of emissions which correspond to available data sets and the categories of emission within the REEIO model. They are the domestic, transport, industrial & commercial sectors, and energy generation.

5.2 Policies focusing on the domestic sector

Six policy options are identified. Those that can be seen as an incremental increase on current policies are

- Environmental Standards Regulation on new development
- Retro-fitting existing homes – national campaign
- Household waste and recycling – pay as you throw
- Energy Efficiency regulation via planning for extensions

Policies that would represent additions to current policies are

- Minimum domestic resource efficiency standards at point of sale
- Minimum resource efficiency standards on products and appliances sold in the UK

Overview

The policy options proposed in the domestic sector focus on the areas in which local and regional partners can act directly i.e. in local planning and environmental services. These initiatives could be supported by a national information and education campaign that encourages behaviour change and take-up of resource efficient technology in the home and garden. These type of awareness raising and information campaigns already exist but a concerted effort including energy and water companies would be necessary to support the domestic sector with the transition to the increased requirements of the proposed policy options.

The first four policies are extensions of existing policy or mechanisms to deliver existing national policy aspirations. The last two, minimum environmental standards on all homes and goods sold in the UK would be additional policy options which would require national or European legislation to implement.

Environmental standards for new homes would have an immediate effect from the point of adoption but the remainder of the policy options would have a longer term effect. This longer term effect would result from awareness campaigns gradually affecting domestic behaviour, more homes falling within the environmental standards regulation catchment, and domestic goods and products being replaced.

Policies in more detail

Environmental Standards Regulation on new development

Examples of policies and tools currently in place to regulate environmental standards on new development include:

- the Code for Sustainable Homes which constitutes the current guidance to facilitate the use and accreditation of sustainability standards in new homes. The Code is not currently mandatory but following consultations on the future of the Code in July 2007, the Government is proceeding with the implementation of mandatory rating against the Code for all new homes which applies to housing associations and developments including social housing grants from April 2008 and to all developers from 2010.

- the Merton Rule, a planning policy pioneered by the London Borough of Merton which requires the use of renewable energy onsite to reduce annual carbon dioxide (CO_2) emissions in the built environment. This policy has now been adopted by a number of other Local Authorities and is expected to become UK-wide policy in the near future.
- the Department for Communities and Local Government (CLG) announced that they expect new domestic development to be carbon neutral by 2016 but the mechanisms by which this target could be achieved are not yet established.
- Planning Policy Statements 1 and 25: PPS1, entitled “delivering sustainable development” puts climate change at the centre of planning policy by stating that "development plan policies should take account of environmental issues such as mitigation of the effects of, and adaptation to, climate change through the reduction of greenhouse gas emissions, and the use of renewable energy." In addition, PPS25 on development and flood risks acknowledges the increasing risk of flooding brought about by climate change and the need to shape current and future planning policy guidance to reduce the number of developments being approved in flood risk areas against Environment Agency Advice.[17]

The new proposal consists of a mandatory policy to improve environmental standards regulation on new development to reduce CO2 emissions and resource use in the domestic sector, ensuring that new developments are built with resource efficiency in mind. This will be achieved by ensuring that all new developments achieve at least a Code level 3 under the Code for Sustainable Homes. This score is equivalent to a very good score under the previous Ecohomes scoring system. In order to obtain this score, a home will have to be 25% more energy efficient than one built to the 2006 Building Regulations standards and will have to be designed to use no more than about 105 litres of water per person per day. These sustainability improvements could be achieved in a variety of ways such as: improvements to the thermal efficiency of the walls, windows and roof as far is practically possible; through the installation of a high efficiency condensing boiler; through the use of district heating systems or low and zero carbon technologies; through the use of water efficient white goods (dishwashers, washing machines) and through the installation of dual flush WC and flow reducing taps throughout the house[18]. This policy raises the standards of building practices and buildings in the domestic sector and could be implemented at the local and regional level as a condition of project funding and planning policy as well as at the national level through building regulations.

Retro-fitting existing homes – national campaign

The UK Government currently funds home improvement schemes providing up to £2,700 to households on certain benefits to improve their heating and energy efficiency. In England the scheme is known as Warm Front, in Northern Ireland it is Warm Homes, in Scotland it is Warm Deal and the Central Heating Programme and in Wales it is the Home Energy Efficiency Scheme. The eligibility criteria for the

[17] Communities and Local Government, Planning *for Climate Change Conference* (2006). Online, available: http://www.communities.gov.uk/speeches/corporate/climate-change-conference

[18] Communities and Local Government, *Code for Sustainable homes: A step-change in sustainable home building practice* (2006). Online, available: http://image.guardian.co.uk/sys-files/Environment/documents/2008/02/20/2006_code_for_sust_homes.pdf

schemes differ between countries - with some schemes you need to be in receipt of certain benefits, whilst others are available to anyone over a certain age.

The new proposal involves carrying out a national awareness campaign, including energy and water companies, to make people aware of the potential cost savings and CO_2 and resource savings that can be achieved with fairly simple and straight forward home improvements such as loft insulations, spray taps and low flush toilets. It would involve making people fully aware of the costs and payback periods of various home improvement options and providing advice, guidance and support to those willing to make these changes in their home. There would be no additional incentives above and beyond those cost savings that could be achieved and the policy relies on awareness raising, encouraging people to make improvements to achieve resource and cost savings. This would be an extension of existing awareness raising campaigns such as the Act on CO_2 campaign and as such is unlikely to have a significant additional impact on its own but it is important to acknowledge as a necessary part of a package of domestic measures proposed.

Household waste and recycling – pay as you throw

Currently, recycling services are provided by Councils and there are a variety of different levels of services in place in different areas. For example, the types of waste that can be recycled can differ; some Councils collect cardboard and plastics for recycling whilst others do not, and the frequency of household waste and recycling collection can be more or less frequent with some Councils collecting regular household waste and recycling on a two-weekly basis whilst others collect these on a weekly basis.

This new proposal would involve Councils charging for non-recyclable waste by weight to improve Councils' recycling rates. This would provide households with a financial incentive to recycle and minimise the amount of waste they produce. In addition, this policy is likely to encourage people to signal preferences for less packaging when purchasing goods which ultimately should result in retailers and producers responding to customer demand with more sustainable packaging options. This in turn should reduce the amount of non-recyclable waste being produced and sent to landfill overall. It is likely that improvements in the consistency of recycling services would be necessary for this proposal to be politically acceptable and effective but improvements in recycling services alone would not have the same impact on reducing customers demand for lower packaging options.

Energy Efficiency regulation via planning for extensions

Currently, some Councils, such as Uttlesford District Council, use supplementary planning documents to actively favour planning extensions applications that include consideration of energy and resource efficiency measures. This is possible for all Councils within current legislation but has not yet been widely adopted.

This new proposal would involve regulation that required up to 10% of the expenditure on extensions or modifications to existing properties to be spent on energy efficiency measures. The energy efficiency improvements could be made anywhere in the home for which planning permission was being applied. The policy would in effect make it compulsory for home owners applying for planning extensions to spend those 10% on such measures by only allowing fully compliant planning extensions applications to go ahead.

Minimum domestic resource efficiency standards at point of sale

Recent legislation on Home Information Packs (HIPs) required energy performance certificates (EPCs) for all homes offered for sale. This requirement in itself is likely to drive some improvements in the energy performance of existing housing stock as the certificate will contribute to the marketability of the home. In addition some water companies use the opportunity of change of occupancy to introduce water metering to existing properties which are already required as standard in new developments, further reducing the environmental impact of the home.

The new proposal would involve regulating a minimum standard of resource efficiency for existing homes at the point of sale. This requirement to retrofit a property to a certain standard of resource efficiency would fall on either the buyer or the seller and could be enforced by legal requirements of the sale. The resource efficiency standards would have to be specified in line with the age, type etc of the property. In the course of a 10 – 15 year period it could ensure around 70-80% of homes contributed to improved domestic resource efficiency. This could be accompanied by a requirement for all water companies to install water for all new water supply contracts at change of occupancy.

Minimum resource efficiency standards on UK sale products and appliances

Currently, EU Energy labelling requires all white goods and home appliances to display information on energy efficiency. This requirement to provide information is likely to drive improvements in the resource efficiency of products and appliances. Some customers will take this information into account in their purchasing decisions and suppliers are more likely to factor the resource efficiency standards into their product design.

The new proposal would be to set minimum standards for products and appliances to drive up resource efficiency for all new purchases. This would have the effect of driving improvements in the supply of resource efficient products and appliances and eliminating sub-standard resource intensive products from the market. This type of policy would be an addition to the current EU energy labelling requirement and would require EU legislation to implement. The regional role in relation to this policy is focused on developing a mandate for regulatory change and working with national partners to influence European policy development.

5.3 Policies focusing on the transport sector

Eight potential policies options are identified for transport, most of which are based on existing policies but involve applying them at a much larger scale. The policies presented reflect the focus of the Eddington Review by prioritising urban and strategic routes and addressing pinch points as this is where the biggest resource saving impact is likely to be achieved most efficiently.

Those that can be seen as an incremental increase on current policies are

- Local planning to encourage modal shift
- Encourage business travel plans
- Investment to ensure efficient use of infrastructure
- Improvement of infrastructure capacity
- Incentivise use of fuel efficient cars

Policies that would represent additions to current policies are

- Local planning to encourage modal shift
- Regional alternative fuels pilot

- Major investment in mass transport systems

Overview The policy options proposed in the transport sector focus on the areas in which local and regional partners can act directly with existing powers and can be seen as focusing on

- local planning to encourage modal shift
- efficient infrastructure use
- encouraging CO2-efficient vehicle use

Local and regional planning can limit car-parking, prioritise and invest in infrastructure pinch points to ensure the efficient use of current infrastructure. National government intervention would be required to continue and strengthen the tax regime to support fuel efficient cars and the uptake of alternative fuels.

The first five policies are extensions of existing policy and are already being implemented to some extent in some parts of the region. The last two policy options, a significant scale alternative fuels pilot and major investment in mass transport systems, would be additional policy options. An alternative fuels pilot could be implemented at regional level but to be a truly significant this pilot would require a national framework to support it. Major investment in mass transport systems could be regionally prioritised but would be dependent on national funding to implement.

Affecting changes in transport demand and behaviour is a long term activity. We have already seen that carbon emissions from the transport sector are one of those expected to rise despite the rises in fuel and taxation costs. The policy options set out here are ones that if implemented in the short term would affect change in the medium to long term as individuals and businesses change behaviour and vehicle or fuel purchasing decisions.

Local planning to encourage modal shift Within local planning there are a number of mechanisms to encourage modal shift they are set out separately here but are proposed as a package of measures that could be delivered together. The revenue raised under this package of measures would be used to fund improvements to public or sustainable transport alternatives. The package of measures detailed here are mixture of financial incentives/penalties and rationing which would need to be accompanied by the improvements in sustainable transport alternatives to be politically acceptable and effective in changing behaviour rather than just raising revenue.

Car parking limitations Current planning guidance on car parking states the importance of reducing car parking spaces in new developments in order to promote sustainable travel choices (Planning Policy Guidance 13: Transport).

The new proposal reinforces the current planning guidance on car parking in the region by ensuring that new developments incentivise the use of public transport and sustainable transport choices in general. This will be achieved by issuing limitations on the number of car parking spaces allowed in new developments and ensuring that the development is well served by both public transport and infrastructure to support cycling and walking.

Car park charges Currently, councils own many public car parks in urban centres and therefore set the price users have to pay for use of this facility.

The new proposal suggests that higher parking charges should be applied as a financial incentive to influence people’s choice of transport towards more sustainable alternative such as buses, cycling and walking. The revenue generated by these higher parking charges would then be reinvested into sustainable transport alternatives.

Congestion charging

London currently operates a congestion charging scheme to reduce the amount of vehicles in certain areas of the centre of the city. This policy was introduced in February 2003 and has achieved some substantial results in terms of reduction of congestion in the zone and increase rate of cycling within the zone. From the end of this year (October 2008), congestion charges will increase according to the emissions level of cars (ie more polluting cars will be charged more than less polluting ones).

The new proposal states that urban centres in the region should introduce congestion charging and that the charge incurred will be dependent on the carbon emissions level of vehicles. This policy would create a financial incentive for car owners to either change their mode of transport into the urban centres by using public transport or cycling/walking or to use lower emissions vehicles. This policy would have the benefits of decreasing congestion in urban centres thereby reducing CO2 emissions through reduced vehicle use and efficiency savings.

Introduction of road tolls on strategic roads and motorways

Currently, there is only one toll charging motorway in the UK, located on the M6. The toll opened in 2004 and has proven rather controversial for a number of reasons, not least because the M6 is a private development and profits generated through the tolls are collected by Midland Express Limited, the private company in charge of the toll, and that these profits are therefore not redirected towards improvements in public transport. However, early evidence does show that congestion has been reduced on the parts of the M6 toll and M6 adjacent to the toll as a result of the charge and that there have been impressive journey time savings and increased reliability but congestion has also increased on the M6 corridor overall and the effects on alternative roads are mixed.

The new proposal calls for a more comprehensive charging mechanism that could be achieved through satellite tracking. This charging mechanism would allow variable charging to reduce demand at peak period, to reflect the public transport alternatives available and distance travelled as opposed to a flat rate. The money raised would be reinvested back into public transport options to create more capacity on the road network.

Encourage business travel plans

Currently, some Local Authorities provide local businesses with support in implementing “Travel for Work” plans. For example, Cambridgeshire County Council has set up a Travel for Work Partnership that works with a number of local employers to promote the development of these plans and some initiatives to encourage sustainable transport and increase reliability of the road network.

This new proposal would make such support universal so that all businesses in the region are able to access the same level of support and guidance regarding the implementation of Travel for Work plans for their employees. Initiatives such as making showers available to employees can encourage people to cycle to work rather than drive for short journeys, employers can also facilitate car sharing initiatives amongst their employees.

Efficient infrastructure use

Currently, there are local schemes such as the Vehicle Booking System implemented at Felixstowe, which aim to make more efficient use of the existing infrastructure to ease road congestion.

The new proposal looks at ways of limiting the number of hauliers on the roads at any one time. This can be achieved through a vehicle booking system whereby all companies using the regional ports are required to make bookings for the time slots when they are expecting their drivers to arrive with a limit on the number of bookings allowed per hour to regulate traffic and penalty charges to those that book a slot but fail to arrive.

Improvement to infrastructure capacity

Some local policies exist to improve infrastructure capacity in relation to freight transport. For example, some phased improvements have already been made to the Felixstowe to Nuneaton route to increase the capacity of the rail infrastructure to cope with large freight containers.

This new proposal calls for further improvements to tackle pinch points and increase the capacity of the regional rail infrastructure to allow more freight containers to be moved via the rail system. This would not only improve congestion but it would also help significantly reduce regional CO2 emissions from vehicles that use the region's strategic transport routes.

Encourage use of CO2 efficient vehicles

At the national level, Vehicle Excise Duty is based on a vehicle's carbon dioxide emissions, the type of fuel used and the age of the vehicle. All these factors contribute to lower emissions and therefore attract a lower level of road tax. The price varied from £35 to £300 for petrol and diesel cars registered after March 2001.

This proposal calls for stronger national policy to encourage people to use fuel efficient cars. It calls for a greater financial penalty for those cars that are least fuel efficient by means of a much higher car tax.

Significant scale alternative fuels pilot in the region

There are a number of local alternative fuel schemes in the East of England supported by the favourable duty on biofuels as opposed to conventional fuels. The East of England is well placed to be a leading supplier of bioenergy and already has the UK first bioethanol plant at the British Sugar plant at Wissingtson.

The new proposal focuses on increasing the range and coverage of alternative fuels available in the region for public transport, fleet operators or private individuals. This would require the provision of a network of alternative fuel filling stations or charging points that would offer a real choice in fuels in the region and the take up of vehicles powered by alternative fuels. As a regional pilot the impact would be limited to vehicles whose sole or primary destinations were within the region.

Major investment in mass transport systems

There are already plans by Network Rail to make major investment in the length of platforms to allow more carriages at peak times to alleviate overcrowding and provide more capacity on strategic routes. In the East of England the delivery of a guided busway is expected to ensure that housing growth to the north –west of Cambridge is served by regular, fast and reliable service into the city which is an attractive alternative to the A14.

It is not possible to be specific about the new proposal but it would include similar additional investments to deliver mass transports systems where the lack of capacity or quality of service was a barrier to modal shift. This policy addresses the fact that although financial incentives and employer facilitation may drive some change in transport demand in some cases the major barrier to reduced personal transport use is the quality of alternatives available.

5.4 Policies focused on the industrial and commercial sector

Six policy options are identified through which savings will derive from businesses improving their environmental performance through various means such as reducing business energy use.

Those that can be viewed as extensions of existing policies are:

- Incentivise Environmental Management systems and carbon clubs
- Regulate environmental standards for new commercial development
- Integrate resource use advice into mainstream business support
- Regional carbon reduction scheme

Those that would represent a departure from current policy are:

- requirement for all VAT-registered businesses to report on resource use
- requirement on all commercial landlords to develop resource efficiency plans for buildings

Overview

The policy options proposed for the business sector focus on the service sector as current policy mechanisms are already driving improvements in resource use in the industrial sector.

The first four policy options are extensions of current policy and could be implemented regionally within existing powers. The last two policy options are additions to the current policy framework and would require national government intervention to implement.

The policies directed at improving the environmental standard of new developments and incentivising businesses to change their approach to resource use would produce immediate affects as soon as they were adopted. However, requirements for resource use reporting and resource use planning for commercial landlords would have an effect in the medium term as the reporting requirement started to increase awareness and commercial leases came up for renewal.

Policies in more detail

Incentivise Environmental Management systems and carbon clubs

Currently, there are a number of schemes and regulations that companies can use to measure their environmental performance in terms of water, energy and waste usage. One of the most widely used is the ISO 14001 regulated by EMAS, the Eco-Management and Audit Scheme. This is a voluntary initiative that is designed to improve companies' environmental performance. It aims to reward and recognize those organisations that go beyond minimum legal compliance and continuously improve their environmental performance. In addition, there currently are carbon clubs in a number of companies; these clubs are a voluntary initiative for people who want to collaborate on developing new ideas to achieve carbon emission reductions in their workplace and translate these ideas into action.

This new proposal calls for financial and regulatory incentives to be put in place to ensure companies are accurately measuring their environmental performance. Financial incentives can include increases/decreases in business rates according to a company's environmental improvements and mandatory requirements for environmental performance in different sectors. In addition, it calls for more companies to facilitate the creation of such carbon clubs for their staff to take part in. It would involve, as set out in the above paragraph, generating new ideas about ways to reduce the carbon footprint of the company.

Regulate environmental standards for new commercial development

Currently, there are some tools available to assess the environmental impact of industrial and commercial buildings. For example, the BREEAM Industrial standard can be used to assess the sustainability of storage and distribution, light industrial units, factories and workshops. The 2008 Budget announced plans for all commercial development to be carbon neutral by 2019 but mechanisms to deliver this target have not yet been established.

The new proposal would make such environmental standards mandatory for new commercial and industrial buildings. This could be achieved by adapting the Code for Sustainable Homes to industrial and commercial buildings, taking into account 5 of the 6 areas that it rates developments on (excluding "household waste management") and that can be applied and adapted to commercial buildings: energy efficiency/CO2, water efficiency, surface water management, site waste management and use of materials.

Integrate resource use advice into mainstream business support

Currently, the Business Resource Efficiency and Waste Programme (BREW) funded by Defra seeks to increase the access to and take up of resource use advice/guidance and support for businesses through a number of channels such as Local Authorities and environmental organisations such as WRAP, the Carbon Trust and Envirowise.

The new proposal calls for a more systematic integration of resource use advice in mainstream business support services. As such, mainstream advice to businesses will include general guidance/advice and support on resource use including information on available recycling services, energy, water and waste audits. It will also include information on green procurement and how to minimize business travel needs by maximising the use of IT solutions such as video conferencing. The integrating of resource use into business support would be used as a mechanism to deliver support to target sectors such as the business services where trends in resource use show they are not affected by current policy and agriculture, horticulture and food and drink processing which are amongst the region's most intensive water users. This is an extension of existing policy included here to acknowledge that current demand for resource efficiency advice and the scale of programme support and services directed towards it would have to be significantly increased to an impact at the necessary scale.

Regional carbon reduction scheme

At the UK level, the government is currently committed to the implementation of the Carbon Reduction Commitment (CRC), this is a new scheme which was announced in the Energy White Paper 2007. The scheme implements an emissions cap and trade system to cut carbon emissions from large commercial and public sector organisations (including supermarkets, hotel chains, government departments, large local authority buildings) by 1.1 mtC/year by 2020[19].

The new proposal calls for a regional carbon emissions scheme to place a limit on carbon emissions being emitted by local businesses. Given that there are no regional powers to compel businesses to commit to carbon reduction, the scheme would have

[19] More background information on the Carbon Reduction Commitment can be found on the Defra website: http://www.defra.gov.uk/environment/climatechange/uk/business/crc/index.htm

to be voluntary. It would involve businesses assessing their carbon emission levels and committing themselves to reducing it on a yearly basis. Businesses opting into the scheme would have to agree that should they fail to achieve their set carbon reduction, they would have to pay a fixed penalty that would go towards funding a regional carbon offsetting scheme.

Requirement to report energy, water use and waste production

Some companies voluntarily report on the environmental impact of their business as part of a corporate social responsibility policy. This type of initiative is supported by government policy but tends to be taken up by larger companies, who have the capacity to undertake this type of reporting, or by organisations that have a social enterprise ethic which requires them to be aware of their environmental impact and report on it. In both cases the companies voluntarily reporting environmental impact are those likely to already be actively engaged in managing and minimising that impact.

The new proposal would require all VAT registered business to report annually on their energy, water use and waste production as part of filing their accounts. This requirement in itself would not achieve any resource efficiencies but the increased awareness of resource use and costs over time should drive change in business behaviour. Also, the greater availability of business resource use information would enable better targeting of support and development of policy.

Commercial landlords to develop resource efficiency plans for its building stock

In England and Wales, landlords of commercial properties are currently subject to a Code of Practice for Commercial Leases. This code provides guidance for increased flexibility and shorter lease lengths and encourages landlords to provide priced alternatives for services and facilities. Currently, this Code does not include guidelines for landlords or tenants to incorporate energy efficiency and environmental management into the commercial building as part of the lease.

This new proposal calls for the integration of energy efficiency and environmental management improvements into the current Code of Practice for Commercial Leases and for those improvements to be made mandatory up to a certain value of the lease. Under this new policy, landlords and tenants would have to make reasonable improvements to the energy efficiency and environmental management of the building through the introduction of energy efficient technologies, appliances and water reduction methods amongst others.[20]

5.5 Policies focusing on energy generation

The domestic, transport, industrial & commercial sectors policy options discussed so far look at resource use and CO2 emissions from an end user perspective, including the region’s energy use from the national grid. It is also important to consider the impact on resource use, primarily reduction of CO2 emissions that can be made by looking at CO2 emissions at source. This includes the region’s contribution to national energy generation and reducing regional demand from the national grid through the development of local or distributed energy generation systems.

Five policy options are identified. Three relate to the structure of generation nationally and two relate to local/regional provision. The policies are

[20] New proposal based on a project commissioned by the Carbon Trust (2004), *Incorporating Energy Efficiency and Environmental Best Practice into Lease Contracts*. Online, available: http://www.carbontrust.co.uk/NR/rdonlyres/39631474-0440-4139-92E4-2475AD007213/0/200355.pdf

- Carbon capture and storage
- UK Nuclear policy
- Renewable Obligation Certificates (ROC)
- Encourage and enable micro and distributed generation
- Special planning status for renewable/distributed generation schemes

Overview

The policy options proposed in the energy generation sector are based on the achievement of national policy aspirations. Energy generation policy is governed by national strategic policy decisions for the UK but is ultimately delivered in the regions. The East of England has a particular role to play in carbon capture and storage, nuclear generation and renewables because of its offshore gas fields, its legacy of nuclear generation and its leading role in renewable generation. Locally and regionally there is also an opportunity to lower the energy demand through the incorporation of micro and distributed generation in new and existing developments.

The first four policy options are extensions of current policies but the final policy option would be additional to the current policy framework and would act as a mechanism through which renewable and/or distributed energy targets might be achieved.

The policies suggested here are all long term, as they set the direction for network and generation infrastructure development which by their nature are delivered over relatively long time horizons.

Policies in more detail

Carbon capture and storage

Carbon capture and storage (CCS) is the process of pre or post combustion isolation of the CO_2 associated with power generation from fossil fuels and storage in natural geological facilities such as old oil and gas fields or saline aquifers. These processes have the potential to reduce carbon emissions from fossil fuel generation by 90%. Studies have shown that the UK has potential sites which collectively have the capacity to store over 500 years of UK total carbon emissions which would allow time for low carbon technologies to be developed and commercialised. The UK government supports the development of these technologies in the Energy White Paper and the DTI's Carbon Abatement Strategy. The Treasury conducted a review of barriers to the commercial deployment of these technologies in 2006 and has made a £35million programme of funding available for carbon abatement technologies including CCS as well as hydrogen and fuel cell development[21]. A competition to develop the first commercial scale carbon capture and storage system in the UK was announced in the 2007 budget with the aim of being operational between 2010 and 2015.

The new proposal is for an increase in the deployment of carbon capture and storage systems in the UK and would need to be taken forward at the national level. It would be based on the UK's successful demonstration of technology on the equivalent of 300MW of plant by 2015 and a phased increase such that a third of the UK's electricity is generated in this way by 2030[22]. The effect of this policy at regional level would be to reduce the carbon intensity of the region's proportion of electricity

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[21] HMT, Carbon capture and storage: A consultation on barriers to commercial deployment, March 2006

[22] BERR, CCS demonstrator will put UK ahead in global race for clean, Press Release by John Hutton, Tuesday 9 October 2007

consumed from the overall UK supply. The regional role in relation to this policy would be the development of a regional mandate with the region's generation and CCS industry and work with national partners to develop mechanisms to ensure implementation of national policy ambitions.

UK nuclear policy

The UK government announced in January 2008 that it believed that nuclear power had a part to play in the long term UK energy mix and therefore invited energy companies to bring forward plans to build and operate new nuclear power stations. There are plans to fast track an Energy, Climate Change and Planning Bill to make this possible but this may be difficult given the legal challenges that have been raised so far and are likely to be raised again.

The new proposal for modelling assumes that decommissioned fossil fuel and nuclear power stations are replaced with new nuclear power capacity. This means that nuclear power continues to be part of the UK electricity generation mix after the life of the current generation sites. Nuclear operators say they could have new plants running by 2017 [23] but the government's analysis is based on new capacity coming on stream in 2020. It is estimated that a total investment in 30-35GW of capacity is required in the next two decades and that two-thirds of that should be delivered by 2020[24]. The effect of this policy at regional level would be to reduce the carbon intensity of the region's proportion of electricity consumed from overall UK supply. The regional role in relation to this policy is dependent on regional policy towards new nuclear capacity which is still being developed. The policy decisions here are national and commercial ones but regional and local partners have an important part to play in supporting or opposing nuclear developments.

The assumptions about the overall generation mix are made on the basis of current government policy and an alternative non-nuclear scenario would require significant increases in the scale and speed of carbon capture and storage and renewables technologies which are outside of the current energy policy.

Renewable Obligation Certificates (ROC)

The Renewable Obligation places an obligation on electricity suppliers to source 10% of their electricity from renewable sources by 2010. Electricity Supply Companies who meet their targets receive a proportion of the fines paid by those companies that don't achieve the target. The fines are set at a buy-out price of £30/MWh. The fine and recycling of fines create an additional income stream for renewable generation projects which give certainty and market price that make renewables generation projects viable. The level of the Obligation is set to increase in annual steps from 6.7% in 2006/07 to 15.4% by 2015 and to remain at that level until 2027 when the mechanism is due to end. However, the Energy White Paper announced plans to raise the levels of the Obligation up to 20% as necessary to keep ahead of actual levels of generation[25].

The new proposal for modelling assumes that the policy sets a target of 20% renewable generation by 2020. According to the impact modelling of the ROC policy

[23] Online link available at

http://uk.reuters.com/article/oilRpt/idUKL192861420080102?pageNumber=1&virtualBrandChannel=0

[24] BERR, The Role of Nuclear Power in a Low Carbon UK Economy, Consultation Document, May 2007

[25]BERR, The Role of Nuclear Power in a Low Carbon UK Economy, Consultation Document, May 2007.

by BERR this would result in 14% of electricity supply being delivered by renewable sources by 2020[26].

Encourage and enable micro and distributed generation

There is no current target for electricity from microgeneration but the government is looking into the feasibility of setting a target this year[27]. However, a study commissioned by the DTI (now BERR) from the Energy Saving Trust suggest that "by 2050, microgeneration could provide 30-40% of the UK's electricity needs and help to reduce household carbon emissions by 15% per annum"[28]. The study acknowledged this target as ambitious given the obstacles to wide scale deployment of microgeneration such as upfront costs, poor promotion and information, as well as technical and supply chain issues.

The new policy proposal includes a combination of regional support and regulation to encourage micro and distributed energy generation along with mechanisms to overcome the barriers to wide-scale deployment such as ability to sell excess energy into the grid. The Merton Rule policy, mentioned earlier in this report, is picked up here as part of the contribution to reducing regional demand from the national grid. In the absence of a distributed energy target it is proposed that a version of the ambitious micro-generation target should be used as a basis for making assumptions about regional policy. That is, 40% of the region's electricity needs are produced by a combination of microgeneration and distributed energy generation by 2050 with around half of that being achieved by 2030. The carbon reduction impact associated with the achievement of this would be dependent on the proportion of the new generation capacity from renewable energy sources and the extent to which local generation delivered lower losses compared with conventional power stations.

Special planning status for renewable or distributed generation projects

Currently planning applications for renewable or distributed generation projects go through the local planning process like all other developments. Because of the range of technologies and the lack of in-house expertise in assessing this type of application the process can be slow and inefficient. The planning process is cited as a major barrier to the development of renewables and distributed generation projects in the UK.

This new proposal consists of developing a special planning status for renewable or distributed generation projects that would enable them to be decided upon more quickly by an expert assessment team. This could either work alongside the existing local planning process with a fast tracking of the decision making process with additional resources from the expert assessment team or with the development of a

[26] BERR, Renewables Obligation Consultation, Updated Modelling for Government Response, January 2008. Available online at http://www.berr.gov.uk/files/file43622.pdf

[27] DTI 2006, The UK Government's microgeneration strategy *Our Energy Challenge: Power From The People*, (http://www.berr.gov.uk/files/file27575.pdf)

[28] The Guardian, *Micro-Winds of Change*, Wednesday, February 14th 2007. Online, available: http://www.guardian.co.uk/environment/2007/feb/14/energy.society

parallel planning process for these schemes that took them outside the current local planning process.

6 Future Resource Use

This chapter summarises the impact that the further policies influencing resource use in the region could have. Details on the assumptions made to represent the policies in the REEIO model are set out in Appendix D.

6.1 Emissions of CO2

The draft RES identified as one of its overarching ambitions for the region to reduce the level of CO2 emissions and accelerate the decoupling of resource use. A possible CO2 emissions reduction target of 3½% pa was proposed.

Chart 6.1 shows the projections of CO2 emissions on the preferred indicator in the RSS and P2 scenarios under the policy scenario. The projections made under the underlying trends are also shown for comparison. As the projections show, the further policy initiatives could result in a substantial reduction in CO2 emissions.

By 2031, emissions under the RSS and P2 scenarios are 55% and 65% of the 2005 levels respectively. Under the P1 scenario CO2 emissions were trending upwards in the long term under the current policy environment. The impact of the further policies is to establish a clear downward trend.

Table 6.1 shows the profile of emissions by broad sector. It is clear that the transport sector remains the sector where reductions in emissions remain hardest to achieve. The impact of the additional policies is felt most in the household and commerce sectors. They are both the focus of key policy initiatives and as electricity is a more important source of energy for these sectors than it is typically for industry, they will also ‘benefit’ more from the further decarbonisation of UK electricity generation.

CHART 6.1: IMPACT OF ENHANCED POLICY ENVIRONMENT ON CO2 EMISSIONS IN THE EAST OF ENGLAND

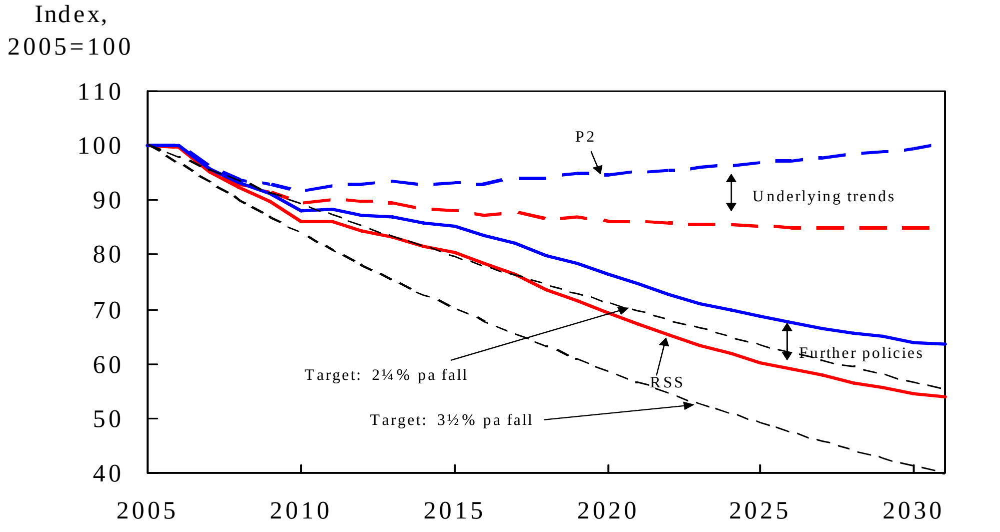


TABLE 6.1: CO2 EMISSIONS UNDER THE ENHANCED POLICY ENVIRONMENT

	2005	2010	2020	2031
				m tonnes C
RSS Scenario				
Industry	2.3	1.8	1.4	1.0
Commerce	2.2	1.7	1.2	0.6
Households	3.3	2.6	1.6	0.7
Transport	4.4	4.4	4.3	4.2
Total	12.2	10.6	8.5	6.6
Of which emissions associated with electricity consumption	3.6	2.7	1.6	0.5
P2 Scenario				
Industry	2.3	1.9	1.6	1.4
Commerce	2.2	1.8	1.3	0.7
Households	3.3	2.6	1.7	0.8
Transport	4.4	4.5	4.8	4.9
Total	12.2	10.8	9.3	7.8
Of which emissions associated with electricity consumption	3.6	2.7	1.6	0.5

The focus on improving energy efficiency within homes means that in the RSS scenario overall emissions from the domestic sector fall by 45% over 2005-20 and by up to 80% by 2031. In the P2 (and P1) scenario the scale of the reductions is less. Note that this impact is a result of the effect of more efficient use of energy rather than of additional trends towards alternative fuel sources or a further decarbonisation of national electricity generation from that assumed in the underlying policy environment.

6.2 Water use

Chart 6.2 illustrates the impact that the further policies could have on water demand in the region. They result in a strong downward trend in overall water use in the RSS scenario. They also provide an underlying downward trend with the stronger economic growth in the P2 scenario, albeit a modest one.

The impact of the further policies is to reduce the use of water by 15-20% by 2031 in both scenarios. This means in the RSS scenario overall water demand in 2020 and 2031 is some 170Ml/d and 315Ml/d lower than estimated in 2005. In the P2 scenario overall water demand in 2020 and 2031 is some 47Ml/d and 90Ml/d lower than estimated in 2005.

The greatest impact of the additional policies is on the domestic sector, as a result of the moves towards greater use of metering and an assumption that a clear downward trend in per capita water use (ie water efficiency) is established as a result of the policies. Significant improvements in water efficiency are required in order to take current practice to the level of per capita water use required by level 3 of the code for sustainable homes. Further, it is the improvements in water efficiency rather than increases in the use of metering that has the greatest impact on the demand for water.

CHART 6.2: GROWTH IN WATER USE UNDER ALTERNATIVE POLICY OPTIONS

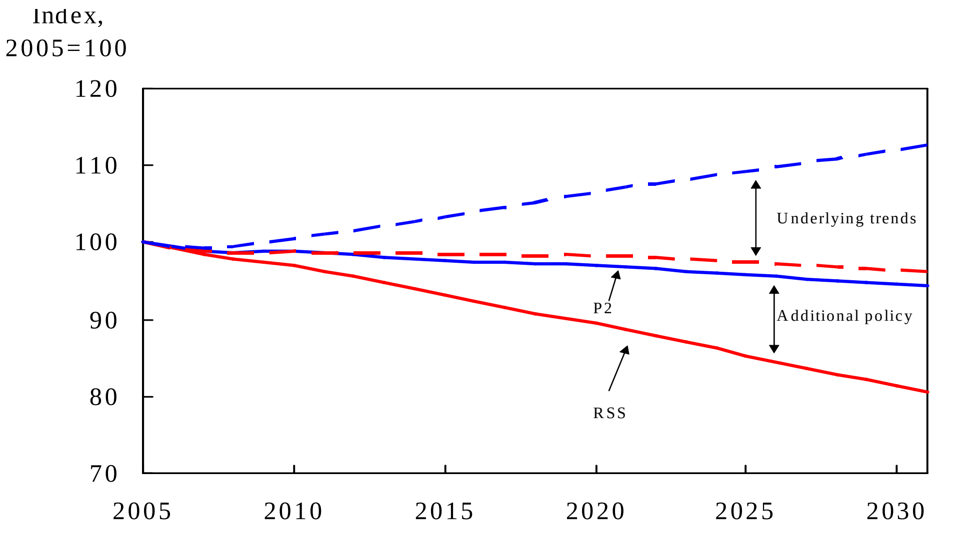


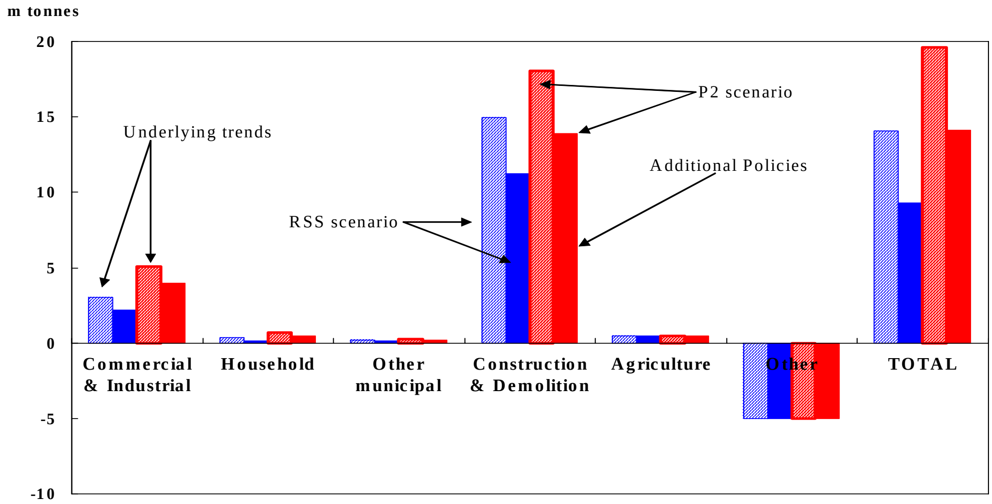
TABLE 6.2: WATER USE UNDER THE ENHANCED POLICY ENVIRONMENT

	2005	2010	2020	2031
				Ml/d
RSS Scenario				
Production	564	509	441	371
Services	137	137	134	129
Domestic	920	929	875	805
Total	1621	1574	1450	1304
P2 Scenario				
Production	564	528	506	488
Services	137	138	144	147
Domestic	920	936	923	895
Total	1621	1603	1574	1529

6.3 Waste arisings

Chart 6.3 illustrates the impact that the further policies could have on waste arisings in the region under the RSS and P2 economic scenarios. The policies focus primarily on reducing the waste from key industrial and service sectors, including construction. At the same time, a downward trend is assumed to occur in per capita household waste arisings.

CHART 6.3: CHANGE IN WASTE ARISINGS UNDER ALTERNATIVE POLICY ENVIRONMENT, 2005-31



The impact of the additional policies is not sufficient to stop waste arisings continuing to rise. It is assumed that the policies mean that industry achieves waste minimisation trends of ½-2% pa, with the stronger trends relating to hazardous waste (a relatively small portion of waste) and in those waste-intensive sectors that might be targeted (incl construction, food, chemicals, printing & publishing). In the RSS scenario, commercial & industrial waste is 90% lower in 2020 and 2031 than if the underlying

TABLE 6.3: PROJECTIONS OF WASTE ARISINGS IN THE EAST OF ENGLAND UNDER THE FURTHER POLICIES

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				000 tonnes			% pa
RSS Scenario							
Commercial & Industrial	6765	6545	7100	8969	-0.7	0.8	2.1
Household	2847	2916	2979	3000	0.5	0.2	0.1
Other municipal	167	185	237	342	2.1	2.5	3.4
Construction & Demolition	11600	12701	16087	22835	1.8	2.4	3.2
Agriculture	4574	4339	4740	5079	-1.0	0.9	0.6
Other	9185	6166	5331	4194	-7.7	-1.4	-2.2
TOTAL	35137	32852	36473	44419	-1.3	1.1	1.8
P2 Scenario							
Commercial & Industrial	6765	6703	7809	10736	-0.2	1.5	2.9
Household	2847	2940	3143	3335	0.6	0.7	0.5
Other municipal	167	188	257	396	2.4	3.2	4.0
Construction & Demolition	11600	12783	16960	25493	2.0	2.9	3.8
Agriculture	4574	4339	4740	5079	-1.0	0.9	0.6
Other	9185	6166	5331	4194	-7.7	-1.4	-2.2
TOTAL	35137	33118	38239	49232	-1.2	1.4	2.3

trends prevail (0.7m tonnes and 0.8m tonnes respectively). The relative impact in the P2 scenario is similar to that in the RSS scenario, equivalent to 0.8m tonnes and 1.1m tonnes in 2020 and 2031 respectively.

Compared to the outcome under the underlying trends, the further policies reduce household waste arisings in the RSS scenario by 0.1m tonnes by 2020 and 0.2m tonnes by 2031. However, overall levels of household waste continue to rise. They will do so unless policies can achieve reductions in per capita waste arisings at rates greater than the growth in the population (½% pa in the RSS scenario and just under 1% pa in the P2 scenario).

7 Conclusions

This study has examined the prospects for future resource use in the East of England under a number of alternative economic scenarios and considered the implications against future aspirations for resource use in the region. It has also provided evidence and identified further policies designed to reduce even more the environmental impact of economic growth. Outlined below are the conclusions from the analysis.

The study has focused on three indicators of resource use: CO2 emissions, water use and waste arisings. Of these, the data on water use in the region is the least robust. On the basis of existing underlying trends, we can expect that economic growth will be decoupled from resource use. However, it would tend to be a relative decoupling rather than an absolute decoupling. Use of some resources would continue to rise, but at a slower rate than the projected growth in the economy.

The draft RES proposed a challenging potential CO2 emissions reduction target of a 60% reduction on 1990 levels. This would not be met on the basis of current trends in energy use under any of the economic growth scenarios considered. However, the performance of the region in terms of CO2 emissions on the basis of underlying trends has to be seen in the context of future developments in the UK as a whole. Recent forecasts from CE indicate that under current policy (where it has been clearly defined) the UK would not achieve its target for a 20% reduction in CO2 emissions from their 1990 levels by 2020. The region will find it increasingly difficult, as one of the fastest-growing regions, to meet its targets if national targets are not to be met.

The outlook for future water demand depends greatly on the scale of growth in the region and in the trend in per capita water use. If per capita water use remains at its current level, then overall water demand under the RSS economic scenario remains broadly unchanged over the period. This water neutrality comes about as the increase in domestic water use associated with a rising population and increased demand from services (where output growth is quite strong) is compensated for by declining water use by industry (where long-term growth prospects are comparatively weak). However, within the region, the outcome is likely to be increased water demand in some areas and falling demand elsewhere. Sustainable levels of water use are governed by local conditions and it is important to remember that regional water neutrality would still represent an unacceptable level of water use in some areas.

The policy options identified to encourage further resource efficiency focus primarily on changing outcomes in the domestic and services sectors. However, policy opportunities are also presented for the electricity generation sector and transport. Where particular policies do focus on a particular resource use, it is understood that the effect will be to focus attention on the costs and waste associated with resource use generally, not just that which is the primary focus of the policy. The various policies identified for the region involve: reinforcing national policies to ensure that resulting action is more comprehensive than would otherwise be the case; lobbying national government for changes in policy and implementing regionally-specific policies.

The policy options identified for the region could lead to a significant impact on the resource use indicators. In particular, future water use and CO2 emissions would be put on clear downward trends, even if the economy grew as strongly as indicated under the P2 economic scenario.

The result of the additional policies modelled is to reduce CO2 emissions resulting from the RSS economic scenario to 55% of their 2005 level. The average rate of decline, 2¼% pa, is that which would result in a 60% reduction in emissions from 1990 levels. However, the challenge for achieving the required CO2 reductions appears greatest in the medium term. The ‘source’ of CO2 emissions most resistant to reduction is the transport sector.

A key element of the further policies is the continued decarbonisation of UK electricity generation, in part through clean technologies but also through increased renewables generation. The East of England is already an important source of renewable energy in the UK, accounting for the largest level of renewable generation outside of Scotland and the South East. This contribution will necessarily have to increase if targets for UK renewable generation are to be met.

Appendix A The REEIO Model

The REEIO model is a software tool that was originally developed by a consortium led by the Environment Agency involving a number of RDAs. More recently it has been supported through SCPnet.

Towards the end of 2007 Cambridge Econometrics (CE) and AEA Energy and Environment (AEA) were commissioned by SCPnet to update the REEIO models with more timely data on the environmental indicators. In particular the data on energy use and emissions to air in 2005 was to be included (moving the 'baseline' data on from 2003). The forecast horizon of REEIO was also extended to 2020 from 2015.

This project for EEDA was commissioned while the general update of the REEIO model was ongoing and has been undertaken using a provisional version of the software and data supplied by AEA.

A.1 The Scope of REEIO

REEIO was designed to provide a firm basis for sustainability appraisals, strategic environmental assessments and benchmarks for the ‘resource productivity’ of businesses and sectors.

The scope of REEIO is tightly focused on assessing the link between the economy and the sink and source functions of the environment (see Figure A.1). Further, REEIO is focused in which of these links it encompasses, considering only the impact of alternative patterns of economic growth on a number of key environmental pressures, waste, energy, emissions to air and the use of water.

A.2 The Structure of REEIO

Modelling the economy

The structure of the framework for modelling the economy is indicated in Figure A.2. The critical elements are the estimates of a full flow matrix of expenditure components for the region. At the model’s heart is an analysis of the extent to which regional output and employment by detailed industry depend on spending within the local area, or on markets outside the local area. The model follows the conventional System of National Accounts accounting structure, distinguishing consumers’ expenditure, investment, government consumption, intermediate purchases by industries and trade flows on the basis of information available locally and regionally.

Modelling the link to the environment

The impact on the key environmental pressures being considered is modelled using economic inputs[29]

[29] Further detail on the precise methods can be found in the REEIO Description and User Manual.

FIGURE A.1: THE SCOPE OF REEIO

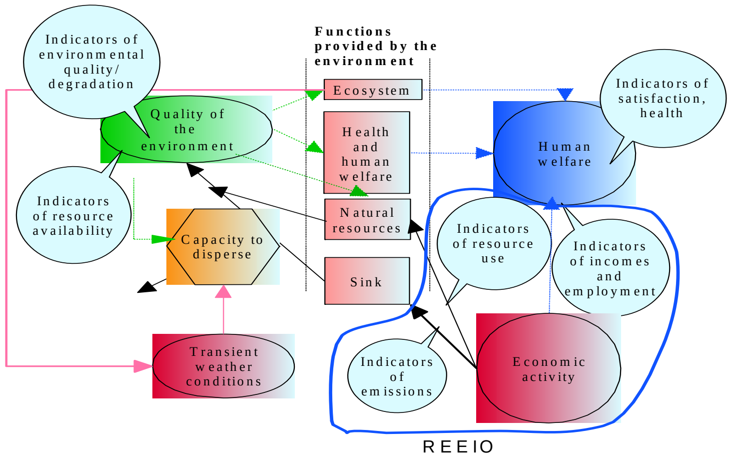
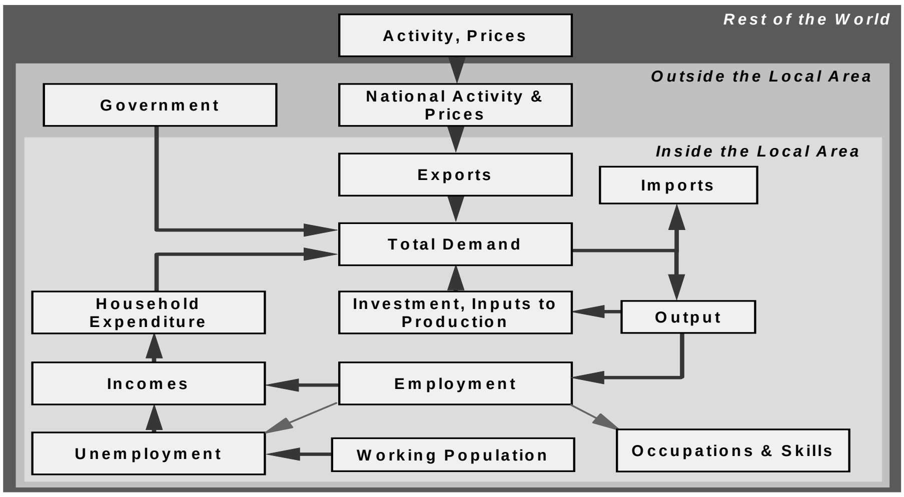


FIGURE A.2: MODELLING THE REGIONAL ECONOMY



Waste Production of industrial and commercial waste is projected on the basis of each industry's purchases of input products. Household waste is projected on the basis of population growth and the rate of growth in per capita household waste arisings. Associated projections for waste entering the various management routes are produced from the waste arising projections.

Energy use The use of energy by fuel type is determined on the basis of the scale of activity (level of output, for industry sectors) of the fuel user and the relative price of fuels. The energy demands from power generation in the region are considered by explicit assumptions regarding specific plant capacities and utilisation.

Air emissions The projections for air emissions are determined in two parts. The energy-related emissions are determined on the basis of energy use by user and fuel. Emissions that are not energy-related are determined by an appropriate activity indicator.

Water use Water use is determined by modelling different components of overall demand separately. Non-household demand is determined by indicators of economic activity in particular industries that allow for the different water-using characteristics of the different sectors. Household demand for water is determined using by assumptions for per capita water use by metered and non-metered households and an assessment of the proportion of the population that will be within each group. The assumption for per capita water demand can in turn be informed by a more detailed analysis undertaken outside of REEIO, such as a 'micro-components' approach which uses assumptions for the penetration, use and water-using characteristics of different appliances and activities.

Classifications The REEIO model includes considerable detail. It identifies

- 41 industries
- 27 waste arisings streams
- 28 water users
- 45 fuel users
- 15 fuels
- 13 emissions (including the six GHGs)
- 7 modes of passenger vehicles
- 4 modes of freight vehicles

Treatment of air transport REEIO's fuel user classification identifies domestic air transport (take-off and landing in the UK) separately from international air transport. The convention adopted is that the energy/emissions to air data for domestic air transport includes that from both take-off/landing and cruise (national domestic cruise emissions have been apportioned to the regions according to the profile of take-off and landings and not which part of the UK they fly over) while data for international air transport relate only to take-off/landing.

Identifying the two types of air transport separately provides greater flexibility in selecting what components to report.

A.3 Application to this Study

Territorial and end-user emissions REEIO is designed to assess the impact of economic development within the region on key environmental pressures. In the case of emissions to air it identifies for each fuel user the emissions that result directly from its consumption of energy in the region. There are two key points to note from this, relating to the production and consumption of electricity, and to transport.

In relation to electricity generation, the data within REEIO identifies all the emissions resulting from the consumption of coal or gas (or other fuels) at power plants in the region even though some of the electricity generated will be consumed outside of the region. At the same time the data do not identify directly any emissions with the consumption of electricity in the region.

In the same way the emissions associated with transport are those emissions occurring in the region irrespective of whether the source vehicle either starts and/or ends its journey in the region. Emissions from through traffic are also included in the data.

The definition of the REEIO data in terms of territorial emissions has an implication for constructing the indicator for CO2 emissions chosen by EEDA, which is on a 'final user' basis. This means that the emissions associated with the consumption of electricity in the region should be apportioned back to the users of the electricity. At the same time emissions from power generation in the region should not be included (or else there would be double-counting).

The calculation of emissions associated with electricity consumption in the region has been performed outside of the REEIO software taking the REEIO results and estimates for the CO2-intensity of electricity generation in the UK as a whole from CE's Energy and the Environment publication and, where appropriate, other alternative scenarios for electricity generation in the UK.

Forecast horizon

As already mentioned, the forecast horizon within REEIO is to 2020. This study required the key resource use indicators be projected to 2031. This has been achieved by extrapolating the REEIO results from 2020 using alternative techniques. The methods adopted are less complex than those embodied within REEIO, but follow the same general approach used in REEIO. This typically means projecting from 2020, maintaining the full 'sector' detail from REEIO, by linking the economic projections for these period and trends in 'resource' efficiencies (eg energy/water/waste arising use per unit of output, CO2 emissions per unit of energy consumed) estimated over the last five years of the REEIO forecast.

Appendix B Developing the Policy Options

The draft RES includes a potential target for CO2 emissions and there is also commitment to include wider resource-use headline target. Policies directed at reducing resource use are often framed so that they consider more than a single resource issue. For example, setting increased environmental standards for new homes can simultaneously address energy use (setting insulation standards) and water use (requiring appliances that are installed to meet a set standard). In developing the policies for this study we have identified (and will subsequently model) their potential impact on each of the environmental indicators: CO_2 emissions, water use and waste arisings. However, a target based approach to the development of policies has only been possible for CO_2 emissions. The framework within which to identify/develop additional policies to help the region meet potential resource use targets has been agreed with EEDA.

The policy options that have been developed can be divided into two groups. Firstly those that can be seen as a natural extension of the current policy environment with an increase in current scope and targets and which could be viewed as less ‘controversial’. And secondly those which are more ‘radical’ in nature and would, we expect, be likely to face greater resistance to their introduction but at the same time, would produce greater resource use reductions than possible under the current policy framework.

B.1 Sector structure

The first dimension of the policy matrix is the sector of resource use and emission. The policy options are considered in relation to four broad sectors of emissions:

- domestic sector
  - resource use and emissions from existing homes and new developments
- transport sector
  - resource use and emissions from personal, business and public transport
- industrial and commercial sectors
  - resource use and emissions from business and industrial processes
- energy generation
  - major generation sites and smaller distributed energy generation.

These sectors correspond to the broad categories within the REEIO model.

The importance of carbon emissions is clear given that the draft RES includes a potential target for CO2 emissions. However, there is also a commitment to include wider resource-use headline targets in the RES. The sectors groups are structured to serve the development of policies to achieve the carbon emissions reduction target. However the domestic and the industrial & commercial sectors are also amenable to the development of water and waste policy.

Analysis of regional and local carbon emissions data shows that although overall the East of England has slightly lower carbon emissions per head than the UK average, the components of total carbon emissions are slightly different in the East of England than the rest of the UK. This split is probably expected given the characteristics of the

East of England. The region has a relatively small proportion of manufacturing and heavy industry, a relatively large population and dispersed settlements with relatively little public transport provision in or between the urban centres driving a high car dependency. This pattern of carbon emissions supports the analysis of policy options under the first three of the four broad sectors. The fourth sector, energy generation, is included because of the importance of electricity generation (both nationally and in the region) in influencing the chosen CO2 indicator.

B.2 Policy types

The second dimension of the policy matrix is the policy mechanisms. Each of the policy options considered are categorised by policy type. A general typology would be: regulatory or planning instruments, financial incentives or penalties, education and outreach programmes, voluntary agreements, research & development (R&D) programmes and other support programmes[30]. However, as a result of stakeholder feedback during the project the following classification of policy types was used:

- Encourage
  - through education and outreach e.g. campaigns to raise awareness of resource use issues.
- Incentivise
  - through financial incentives or penalties e.g. energy efficiency grants for homes, congestion charging for private cars in city centres and universal water metering system for domestic developments.
- Support
  - building capacity to change process or increase level of innovation e.g. providing business support such as through the BREW programme.
- Ration
  - by regulation and planning e.g. carbon cap and trade system,.
- Ban
  - through strict regulation e.g. complete ban of inefficient electricity equipment such as yellow incandescent light bulbs or ban of water inefficient toilet flush and taps mechanisms.

National, regional and local policy

The potential policy options include a combination of national and regional and local measures. The focus of the project is to identify regional and local responses to deliver sustainable growth in the East of England but we have already acknowledged that existing policies alone are unlikely to be sufficient. As a result, part of the regional role will be to identify policies that are necessary at the national level and to develop a regional mandate on which to lobby for their adoption. As a result, the twin track approach includes:

- Regional and local policy which can be directly influenced
- National policy which can be indirectly influenced through lobbying

[30] This typology is based on the International Energy Agency (IEA) database methodology.

B.3 Resources hierarchy

A third dimension of the policy matrix is the order in which policy options are considered. In order to ensure the most efficient ways of reducing resource use and carbon emissions are addressed first, resource hierarchies are used. To reflect the multi-resource focus of the study, an overall resource hierarchy has been developed, combining the elements of individual resource hierarchies.

To do this, we first present the separate resource hierarchies for energy, water and waste followed by the combined hierarchy.

Energy hierarchy

The energy hierarchy is relatively well established and used within policy development. The analysis set out in the Stern Review reflects the fact that the policy options related to energy should be ordered by the most efficient approach to reducing carbon emissions. That is:

- Energy conservation (reducing total energy demand)
- Energy efficiency
- Exploitation of renewable, sustainable resources
- Exploitation of non-sustainable resources using low/no-carbon technologies
- Exploitation of conventional resources as we do now.

Feedback from the stakeholder workshop suggested that within "Exploitation of conventional resources", as we do now we should acknowledge the need to prioritise those products and processes where alternatives are not currently available.

Water hierarchy

Standard water hierarchies are not so well established but since the reduction of water use and management of water presents some different policy options to those associated with energy use and management, it is useful to examine water hierarchies separately. For the purposes of this study a water hierarchy has been developed with reference to the Envirowise water audit questionnaire as follows:

- Water demand reduction
- Water efficiency
- Water re-use (use of lower quality untreated water or recycled water)
- Water recovery and recycling

Waste hierarchy

The waste hierarchy mantra of – reduce, reuse, recycle - is one of the best known policy hierarchies with respect to waste. Recent developments have led to the addition of some key steps in this policy hierarchy. The current waste hierarchy used by Envirowise is as follows:

- Waste elimination
- Waste reduction
- Waste re-use
- Waste recycling
- Waste disposal

Combined resource hierarchy

The proposed combined resource hierarchy for developing and ordering policy options is therefore set out as follows:

- Resource use reduction
  - reduce demand for energy and water
- Resource use efficiency
  - use of more efficient electricity appliances, water efficient appliances

- Reuse resources
  - grey water systems, waste recovery, reduction of empty freight vehicle travel
- Exploitation of renewable, sustainable resources
  - use of biofuels and wind power
- Exploitation of non-sustainable resources using low/no-carbon technologies
  - more fuel efficient cars, carbon capture & storage
- Exploitation of conventional resources as we do now
  - priority given to processes where alternative technologies are not yet feasible or commercial

B.4 Framework for developing policy options

The broad sectors, the policy types and the policy hierarchy provide a matrix in which to develop policy options. The matrix is a framework for structuring policy options to ensure a systematic approach to the development of policy options is taken. The examples used to populate the matrix have been described at the policy level rather than at the level of individual schemes. The tables that follow summarises them setting out:

- the likelihood of each option being implemented along with the geographical dimension of the policy (National or Local/Regional)
- any issues that have arisen in making impact assumptions
- the risks associated with the policy
- the potential scale and likely timing of impact/uptake
- the potential resource savings: potential carbon saving, potential water saving and potential waste saving.

TABLE B.6 POLICY OPTIONS FOR THE DOMESTIC SECTOR

				Impact assumptions			
	Likelihood of implementation/ Geography of implementation	**Risks**	**Issues for making assumptions**	**Scale of impact / Timing of impact**	**Potential Carbon Saving Achieved**	**Potential Water Saving Achieved**	**Potential Waste Saving Achieved**
Expansion of current policy							
Environmental Standards Regulation on new development	High Local/Regional	Skills shortages in sustainable building	Housing completions in the East of England were 105,821 between 2001/02 and 2005/06 therefore an average of 21,164 per annum against a total target 478,000 in the existing plan and 508,000 that are set out in the governments proposed changes. Source: EERA AMR	All new developments in the region Immediate effect from point of adoption	Minimum of 25% improvement over the standard building regulations requirements Source: Code for Sustainable Homes Guidelines[1]	Maximum potable water consumption of 105 litres per person Source: Code for Sustainable Homes Guidelines[1]	
Retro-fitting existing homes – national campaign	High National	Lack of awareness/interest from the public	Impact of a national campaign on current homeowners Carbon and resource savings from home improvements	2% of homes from now until 2015 increasing to 5% of homes by 2030 Longer term effect from point of adoption	From 250 kg to 1 tonne of CO2 per year per loft insulation depending on depth of insulation Source: Energy Saving Trust[1] Current average carbon footprint of emissions generated from heating the home is 1.49 tons of carbon and 1.37 is emitted for other “household activities” such as lighting, household appliances etc.[1]	Current UK water consumption is at 343 litres per day including water used for industrial purposes[1] and domestic consumption per capita is currently 150 litres per day. UK Government targets for water consumption is for a reduction of between 13 and 20% by 2030[1]	

TABLE B.6 (cont/d) POLICY OPTIONS FOR THE DOMESTIC SECTOR

	Likelihood of implementation/ Geography of implementation	Risks	Issues for making assumptions	Scale of impact / Timing of impact	Impact assumptions: Potential Carbon Saving Achieved	Potential Water Saving Achieved	Potential Waste Saving Achieved
Expansion of current policy							
Household waste and recycling – pay as you throw	High Local/Regional	Public acceptance Risk of increase in fly-tipping	Waste savings to be achieved from such a scheme relative to current levels of recycling. Local/Regional policy would have greater impact if implemented alongside complementary national regulation on packaging for retailers and producers	All households Short term impact on recycling levels and medium to longer term effect on waste production from point of adoption			The UK Directive requires member states to cut the amount of biodegradable waste being sent to landfill sites by 65% compared to 1995 levels. This would require the UK to decrease the amount of waste going to landfill by 40%.[1] The East of England currently recycles 29% of its waste.[1]
Energy Efficiency regulation via planning for extensions	Medium Local/Regional	Lack of expertise/understanding of energy efficiency issues on part of residents applying for extensions	Number of new extensions being approved in the region each year and the potential carbon savings from energy efficiency regulation.	All new extensions Immediate effect from point of adoption	Estimation of carbon saving from home extensions: 10% for all extensions.		

TABLE B.6 (cont/d) POLICY OPTIONS FOR THE DOMESTIC SECTOR

					Impact assumptions		
	Likelihood of implementation/ Geography of implementation	**Risks**	**Issues for making assumptions**	**Scale of impact / Timing of impact**	**Potential Carbon Saving Achieved**	**Potential Water Saving Achieved**	**Potential Waste Saving Achieved**
Additions to current policy							
Minimum domestic resource efficiency standards requirement at point of sale	Low National	There are likely to be issues over the ability to pay for some sellers	Number of property sales and the level of the resource efficiency standard	All properties sold Immediate effect from point of adoption	As per retrofitting	As per retrofitting	
Minimum resource efficiency standards on products and appliances sold in the UK	Low National	Likely to require EU legislation	The rate of replacement of products and appliances	All new products and appliance purchases Immediate effect from point of adoption but likely to involve lengthy legislative process			

TABLE B.7 POLICY OPTIONS FOR THE TRANSPORT SECTOR

					Impact assumptions		
	Likelihood of implementation/ Geography of implementation	**Risks**	**Issues for making assumptions**	**Scale of impact / Timing of impact**	**Potential Carbon Saving Achieved**	**Potential Water Saving Achieved**	**Potential Waste Saving Achieved**
Expansions of current policy							
Local planning to encourage modal shift	High to medium Local/Regional	Political acceptance Availability of suitable transport alternatives	Need to estimate the potential impact of parking charges, limitations, congestion charging and road toll charging on the behaviour of vehicle users.	All vehicle users in urban travel to work area and on the strategic road and motorway network. Medium to long term effect from point of adoption	The London Congestion Charge has shown a reduction of 16% in vehicle use in the zone Source: Transport for London, Table 2-2, Congestion Charge Monitoring Report 2007.		
Encourage Business Travel Plans	High Local/Regional	Depends on willingness of employers to put in place the plans and invest in new facilities (showers, bike sheds, lockers, etc)	Potential number of businesses that would be willing to implement a travel plan and facilitate modal shift for their staff and the subsequent impact on staff behaviour.	All businesses who access guidance/support from their Local Authority Medium to long term effect from point of adoption			
Efficient Infrastructure use	Medium Regional	Technical issues in the establishment and operation	Estimate potential impact of the implementation of Vehicle Booking System on reduced congestion and resource use (CO2 emissions).	All freight companies who use the regional road system Immediate effect from point of adoption			
Local planning to encourage modal shift	High to medium Local/Regional	Political acceptance Availability of suitable transport alternatives	Need to estimate the potential impact of parking charges, limitations, congestion charging and road toll charging on the behaviour of vehicle users.	All vehicle users in urban travel to work area and on the strategic road and motorway network. Short to medium term effect from point of adoption	The London Congestion Charge has shown a reduction of 16% in vehicle use in the zone Source: Transport for London, Table 2-2, Congestion Charge Monitoring Report 2007.		

TABLE B.7 (cont/d) POLICY OPTIONS FOR THE TRANSPORT SECTOR

					Impact assumptions		
	Likelihood of implementation/ Geography of implementation	**Risks**	**Issues for making assumptions**	**Scale of impact / Timing of impact**	**Potential Carbon Saving Achieved**	**Potential Water Saving Achieved**	**Potential Waste Saving Achieved**
Expansion of current policy							
Improvement to infrastructure capacity	Medium to Low Local/Regional	Requires significant investment	Impact of improving infrastructure on freight transport to rail	Demand for rail freight affected by current capacity constraints. Current thousand tonnes of freight lifted in the East of England by road: 270,064 and by rail 9,130. Immediate effect from point of adoption			
Encourage fuel efficient car use	High National	Impact that a much higher car tax for most fuel inefficient cars would have on people's choice of car.	Number of car users who would switch to more fuel efficient car use.	Average CO_2 emissions from new cars (2004 figures): 171.4g/km.. EU target of 125g/km by 2015. More "environmentally-friendly" cars such as the Toyota Prius produce CO_2 emissions of 104g/km. Short to medium term effect from point of adoption			

TABLE B.7 (cont/d) POLICY OPTIONS FOR THE TRANSPORT SECTOR

				Impact assumptions			
	Likelihood of implementation/ Geography of implementation	**Risks**	**Issues for making assumptions**	**Scale of impact / Timing of impact**	**Potential Carbon Saving Achieved**	**Potential Water Saving Achieved**	**Potential Waste Saving Achieved**
Additions to current policy							
Significant scale alternative fuels pilot in the region	Low Local/Regional	Uncertainty of impact on international and national vehicles in the region and the sustainability of alternative fuel options	Number of vehicle users that would switch to alternative fuels	Medium to long term effect from point of adoption			
Major investment in mass transport systems	Low Local/Regional	Likely to require major public investment and long term commitments for public subsidy	The level of modal shift that could be achieved with improved public infrastructure	Dependent on particular schemes medium to long term effect from point of adoption			

TABLE B.8 POLICY OPTIONS FOR THE INDUSTRIAL AND COMMERCIAL SECTOR

					Impact assumptions		
	Likelihood of implementation/ Geography of implementation	**Risks**	**Issues for making assumptions**	**Scale of impact / Timing of impact**	**Potential Carbon Saving Achieved**	**Potential Water Saving Achieved**	**Potential Waste Saving Achieved**
Extensions of current policy							
Incentivise Environmental Management systems and carbon clubs	Medium National	Political acceptance	Number of companies that would be likely to make positive environmental changes and their potential impact on resource use.	All businesses that would respond by making positive environmental changes as a result of a higher business rate and support/guidance to form carbon clubs. Immediate effect from point of adoption			
Regulate environmental standards for new commercial development	Medium National	Skills shortages in sustainable building	Number of new commercial buildings being built and the impact of environmental standards on resource use.	All new commercial developments Immediate effect from point of adoption	Estimate it would make new commercial buildings 15 to 20% more energy efficient.		
Integrate resource use advice into mainstream business support	Medium National and Local/regional	Business support services would need to potentially employ additional staff or train current staff and raise their own awareness of resource use issues before being able to support companies.	Number of businesses that access business support services and the impact of guidance and support on resource use on their environmental performance	All businesses that access mainstream business support Medium to long term effect from point of adoption	About 15% of SMEs that access business support		
Regional carbon reduction scheme	Medium Local/regional	Difficulty of attracting businesses to take part in a voluntary scheme that involves penalty charges when targets are missed.	Number of businesses who would be willing to take part in the voluntary carbon reduction scheme and quantity of carbon savings they would voluntarily commit to achieving.	All businesses taking part in the scheme. Immediate effect from point of adoption	About 1% of regional businesses to take part in the scheme.		

TABLE B.8 (cont/d) POLICY OPTIONS FOR THE INDUSTRIAL AND COMMERCIAL SECTOR

					Impact assumptions		
	Likelihood of implementation/ Geography of implementation	**Risks**	**Issues for making assumptions**	**Scale of impact / Timing of impact**	**Potential Carbon Saving Achieved**	**Potential Water Saving Achieved**	**Potential Waste Saving Achieved**
Additions to current policy							
Requirements for all VAT registered businesses to report energy, water use and waste production	Medium National	Commercial confidentiality	The extent to which reporting of resource use incentivised improved resource management or the improved targeting of support by the public sector	Medium to long term effect from point of adoption			
Requirement for all commercial landlords to develop a resource efficiency plan for its building stock	Medium National	Political acceptance Difficulty of checking compliance with the new Code of Practice	Estimate potential carbon, waste and water savings from a range of environmental improvement to a commercial building	All current commercial developments when lease is up for renewal Medium to long term effect from point of adoption	A typical office building could save 0.05 tonnes co2/m2 with bottom-line business benefits.	The Environment Agency estimates that by installing simple water saving devices, commercial businesses can save an average of 40% of their water use. Devices include: low flush toilets and urinals, spray taps, automatic shut off etc.	

TABLE B.9 POLICY OPTIONS FOR THE ENERGY GENERATION SECTOR

	Likelihood of implementation/ Geography of implementation	**Risks**	**Issues for making assumptions**	**Scale of impact / Timing of impact**	**Impact assumptions** **Potential Carbon Saving Achieved**	**Potential Water Saving Achieved**	**Potential Waste Saving Achieved**
Expansions of current policy							
Carbon Storage and Capture	Medium National	Barriers to commercial deployment not addressed		Third of UK generation by 2030 Long term effect from point of adoption	90%	n/a	n/a
UK nuclear policy	Medium National	Legislation subject to legal challenge		20GW in 2020 rising to 30-35GW by 2030 Long term effect from point of adoption	100% - assuming eliminates the need for increased fossil fuel capacity	n/a	n/a
Renewables obligation certificate	High National	Buy-out price is not sufficient to incentives increased renewables capacity		14% UK electricity supply from renewable sources by 2020 Medium to long term effect from point of adoption	80-100% depending on alternative technologies	n/a	n/a
Encourage and enable micro and distributed generation	Medium Local/Regional	Barriers to commercial deployment not addressed	Proportion of renewable energy within new generation capacity and the effect of reduced transportation losses	20% of regional electricity demand by 2020 Medium to long term effect from point of adoption	Proportion of the 15% reduction of domestic carbon emissions by 2050		
Additions to current policy							
Special planning status for renewable or distributed generation projects	Low National	Lack of local accountability politically unacceptable	Increase in delivery of renewable and distributed energy projects as a result of improved planning processes	Medium to long term effect from point of adoption			

Appendix C REEIO Results: baseline trends

CO2 Emissions

TABLE C1: CO2 EMISSIONS – REEIO BASELINE

	2005	2010	2020	2031	2005-10	2010-20	2020-31
			million tonnes C			% pa	
End User Basis							
Industry	2.3	1.9	1.7	1.5	-3.3	-1.6	-0.9
Commerce	2.2	1.8	1.6	1.6	-4.4	-0.8	-0.1
Households	3.3	2.8	2.8	2.9	-3.6	0	0.2
Transport	4.4	4.5	4.6	4.9	0.5	0.3	0.6
Total	12.2	11	10.7	10.9	-2.1	-0.3	0.2
Of which emissions associated with electricity consumption	3.6	2.8	2.7	2.9	-5	-0.4	0.6
Direct Source Basis							
Industry	1.8	1.6	1.3	1.1	-2.9	-1.9	-1.6
Commerce	0.6	0.5	0.5	0.5	-2.7	-0.6	0.1
Households	1.9	1.6	1.6	1.6	-2.6	-0.1	-0.3
Transport	4.3	4.4	4.6	4.9	0.5	0.3	0.6

TABLE C2: CO2 EMISSIONS – RSS SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
			million tonnes C			% pa	
End User Basis							
Industry	2.3	2	1.6	1.5	-3.0	-1.9	-0.8
Commerce	2.2	1.8	1.7	1.7	-4.3	-0.4	0.1
Households	3.3	2.7	2.7	2.7	-3.9	-0.2	0.1
Transport	4.4	4.4	4.5	4.5	0.3	0.2	-0.1
Total	12.2	10.9	10.6	10.4	-2.2	-0.4	-0.1
Of which emissions associated with electricity consumption	3.6	2.8	2.7	2.8	-5	-0.5	0.5
Direct source basis							
Industry	1.8	1.6	1.3	1.1	-2.6	-2.2	-1.5
Commerce	0.6	0.5	0.6	0.6	-2.3	0.4	0.2
Households	1.9	1.6	1.6	1.5	-2.9	-0.3	-0.4
Transport	4.3	4.4	4.5	4.5	0.4	0.2	-0.1

TABLE C3: CO2 EMISSIONS – P1 SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
			million tonnes C			% pa	
End User Basis							
Industry	2.3	2	1.8	1.7	-2.5	-1.4	-0.1
Commerce	2.2	1.8	1.8	1.9	-4.1	0.1	0.6
Households	3.3	2.8	2.8	3	-3.8	0.2	0.5
Transport	4.4	4.5	4.8	4.9	0.6	0.7	0.2
Total	12.2	11.1	11.2	11.6	-2	0.1	0.3
Of which emissions associated with electricity consumption	3.6	2.8	2.8	3.1	-4.9	-0.1	1
Direct source Basis							
Industry	1.8	1.6	1.4	1.3	-2.1	-1.6	-0.6
Commerce	0.6	0.5	0.6	0.6	-2.2	0.8	0.6
Households	1.9	1.6	1.6	1.6	-2.8	0.1	0
Transport	4.3	4.5	4.8	4.9	0.6	0.7	0.2

TABLE C4: CO2 EMISSIONS – P2 SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
			million tonnes C			% pa	
End User Basis							
Industry	2.3	2.1	1.9	2	-2.2	-0.8	0.5
Commerce	2.2	1.8	1.9	2	-4	0.3	0.7
Households	3.3	2.8	2.8	3	-3.7	0.3	0.6
Transport	4.4	4.5	5	5.2	0.8	0.9	0.4
Total	12.2	11.2	11.6	12.3	-1.8	0.4	0.5
Of which emissions associated with electricity consumption	3.6	2.8	2.9	3.3	-4.7	0.1	1.1
Direct source Basis							
Industry	1.8	1.5	1.4	1.3	-3.1	-1.2	-0.7
Commerce	0.6	0.5	0.5	0.5	-2.7	-0.4	-1.1
Households	1.9	1.5	1.1	0.7	-4	-3.2	-4.1
Transport	4.3	4.5	4.7	4.9	0.6	0.6	0.2

Water Use

Water Use

TABLE C.4 WATER USE UNDER ALTERNATIVE ECONOMIC SCENARIOS

	2005	2010	2020	2031	2005-10	2010-20	2020-31
			Ml/d			% pa	
REEIO Baseline							
Production	564	513.9	487.6	434.4	-1.8	-0.5	-1
Services	137.1	137.1	133.9	134.9	0	-0.2	0.1
Domestic	919.9	954.3	1021	1035.8	0.7	0.7	0.1
Total	1621	1605.3	1642.5	1605.1	-0.2	0.2	-0.2
RSS Scenario							
				Ml/d			% p
Production	564	515.2	474.7	424.6	-1.8	-0.8	-1
Services	137.1	138.4	144.5	146.9	0.2	0.4	0.2
Domestic	919.9	947.2	974.2	988.4	0.6	0.3	0.1
Total	1621	1600.8	1593.3	1560	-0.2	0	-0.2
P1 Scenario							
				Ml/d			% p
Production	564	525.9	508.9	485.6	-1.4	-0.3	-0.4
Services	137.1	139.5	152.4	163.3	0.4	0.9	0.6
Domestic	919.9	954.5	1024.3	1091	0.7	0.7	0.6
Total	1621	1620	1685.7	1739.9	0	0.4	0.3
P2 Scenario							
				Ml/d			% pa
Production	564	534.6	545.1	558	-1.1	0.2	0.2
Services	137.1	140.1	155	168	0.4	1	0.7
Domestic	919.9	954.8	1028	1098.9	0.7	0.7	0.6
Total	1621	1629.5	1728	1824.9	0.1	0.6	0.5

Waste Arisings

TABLE C5: PROJECTIONS OF WASTE ARISINGS IN THE EAST OF ENGLAND UNDER ALTERNATICE ECONOMIC SCENARIOS

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				000 tonnes			% pa
REEIO Baseline							
Commercial & Industrial	6765	6591	7462	9265	-0.5	1.2	2
Household	2847	2975	3241	3356	0.9	0.9	0.3
Other municipal	167	186	232	330	2.2	2.2	3.3
Construction & Demolition	11600	12707	15949	22639	1.8	2.3	3.2
Agriculture	4574	4398	4889	5239	-0.8	1.1	0.6
Other	9185	7325	7920	6231	-4.4	0.8	-2.2
TOTAL	35137	34183	39693	47060	-0.5	1.5	1.6
				000 tonnes			% pa
RSS Scenario							
Commercial & Industrial	6765	6765	7817	9821	0.0	1.5	2.1
Household	2847	2953	3093	3202	0.7	0.5	0.3
Other municipal	167	189	250	361	2.5	2.9	3.4
Construction & Demolition	11600	13356	18705	26551	2.9	3.4	3.2
Agriculture	4574	4339	4740	5079	-1.0	0.9	0.6
Other	9185	6166	5331	4194	-7.7	-1.4	-2.2
TOTAL	35137	33768	39935	49207	-0.8	1.7	1.9
				000 tonnes			% pa
P1 Scenario							
Commercial & Industrial	6765	6862	8291	10999	0.3	1.9	2.6
Household	2847	2976	3252	3534	0.9	0.9	0.8
Other municipal	167	191	265	402	2.7	3.3	3.9
Construction & Demolition	11600	13408	19459	28928	2.9	3.8	3.7
Agriculture	4574	4339	4740	5079	-1.0	0.9	0.6
Other	9185	6166	5331	4194	-7.7	-1.4	-2.2
TOTAL	35137	33941	41337	53136	-0.7	2.0	2.3
				000 tonnes			% pa
P2 Scenario							
Commercial & Industrial	6765	6931	8628	11837	0.5	2.2	2.9
Household	2847	2977	3264	3559	0.9	0.9	0.8
Other municipal	167	192	271	418	2.8	3.5	4.0
Construction & Demolition	11600	13441	19720	29641	3.0	3.9	3.8
Agriculture	4574	4339	4740	5079	-1.0	0.9	0.6
Other	9185	6166	5331	4194	-7.7	-1.4	-2.2
TOTAL	35137	34046	41953	54728	-0.6	2.1	2.4

Appendix D Modelling the Policy Scenarios in REEIO

Set out below are the assumptions made to model the policy options set out in Chapter 4. It is mainly the case that the scenario seeks to quantify the impact of the policies identified that would work within the existing policy environment.

D.1 Policies focusing on the domestic sector

Impacts on energy/CO2 emissions

The following policies are identified:

- Environmental Standards Regulation on new development
- Retro-fitting existing homes – national campaign
- Household waste and recycling – pay as you throw
- Energy Efficiency regulation via planning for extensions
- Minimum domestic resource efficiency standards at point of sale
- Minimum resource efficiency standards on products and appliances sold in the UK

Of the policies above, that of retro-fitting existing homes and improving energy efficiency via planning for extensions can be viewed as policies that would reinforce the aspirations behind improving the energy efficiency of the existing housing stock set out in the Energy White Paper. CE's current assessment of the EWP is that these targets will not be met by current policy, but that if it were achieved then the effect would be that rates of domestic energy efficiency (as measured by energy efficiency per £ disposable income) would rise from 2½% pa to 2020 to 4½-6¼ pa, with the stronger growth occurring post 2015.

The scenario assumes that the impact of these two policies would be to achieve the outcome for domestic energy efficiency set out in the EWP.

The policy to improve the environmental standards regulation on new development is a policy that is working with current government wishes to incorporate the currently voluntary code for sustainable homes into law.

To model the impact of the higher efficiency of new homes requires an assessment of the relative efficiency of new homes compared to existing properties and an assessment of the number of new houses built. It is necessary to take account of the fact that the relative efficiency of new homes is likely to change over time as is the absolute energy efficiency of 'current' properties.

In modelling the scenario we assume that from now the energy requirements for heating in newbuild are 60% those of a 'standard' property (Part L building regulations), and that this falls to 45% from 2010 and reaches 35% from 2013 (Code 4). Housing starts was not a variable provided directly in the scenario results from the Oxford Economics model. Instead, we have proxied this by the annual change in another variable in the model, the demand for dwellings.

The last two policies listed above, requiring a minimum domestic resource efficiency standard at point of sale and having minimum resource efficiency standards on products and appliances sold in the UK are options that are outside the current policy environment. They have not been modelled in the scenario.

Impacts on water use

It is assumed that the policies focused primarily on achieving efficiencies in energy use will focus attention on the domestic use of all resources, including water. This will reinforce the actions of the water companies and Environment Agency in this area.

It is assumed as a result that the overall effect is a sustained trend reduction in per capita water use. By 2020 per capita water use is 8% lower than in 2006. The downward trend is established immediately, but quickens to average 0.7% pa over 2010-20[31].

Impacts on waste

Depending on the structure of the 'pay as you through' scheme, the impact may be greater in its influencing how waste is managed rather than the levels of waste arising in the first instance. The latter is influenced to a great extent by levels of consumption and decisions of producers in the way goods are packaged.

In the scenario we assume the net effect of the policies is to establish a long-term reduction in per capita household waste of ¼% pa. This outcome would mark a clear break from past trends. Over 2000-2006 the underlying rate of growth in per capita household waste in the region was 0.1% pa despite the considerable efforts being made to reduce levels of waste and encourage recycling.

D.2 Policies focusing on the transport sector

The following policies are identified:

- Local planning to encourage modal shift
- Encourage business travel plans
- Investment to ensure efficient use of infrastructure
- Improvement of infrastructure capacity
- Incentivise use of fuel efficient cars
- Local planning to encourage modal shift
- Regional alternative fuels pilot
- Major investment in mass transport systems

Impacts on energy/CO2 emissions

Local policies to encourage modal shift would include congestion charging, limiting levels of car parking in developments and raising car parking charges. The impact of such policies will be influenced if businesses also encourage changes.

The scenario does not model each of the separate policies influencing modal shift and instead develops assumptions for the overall impact of the package of measures. We can look to the experience of the congestion charge in London to give some guide to the potential impacts, but at the same time have to recognise that London is very different in terms of its density and in the scale of its non-road transport infrastructure.

The assumption is that these policies will have greatest impact on transport demand in urban areas. The effect of introducing congestion charging and associated measures in 2012 is a 7% reduction in both passenger kilometres travelled by car in urban areas and a similar reduction in freight vehicle kms travelled in these areas. Among passengers, almost a third of the reduction will represent a shift of journeys undertaken on foot or by cycle, or indeed journeys not being undertaken at all. Of the remaining reduction in car use, two-thirds (3% of total urban passenger kms) will

[31] The Environment Agency suggest that water efficiency of at least 8% on current levels could be achieved in existing buildings through rebuilds, refitting and redevelopments.

move onto buses, with the remainder moving to trains. The reduction in car use represents a reduction of 2% in the total number of passenger kms travelled by road in the region. The 7% reduction in freight vehicle kms moved by road in the scenario is modelled as being an increased volume of freight taken on each journey; ie that the total number of tonne kilometres will not change, but that the implied ‘occupancy’ of freight vehicles on roads will increase.

The scenario also includes measures to reflect the efficient use of existing infrastructure. The assumption is this results in a further shift of freight from road to rail (by 1% pa over 2009-13).

A national drive to increase take up of fuel efficient cars has also been included in the success scenario. This has been captured by a 1.15% annual fall in the fuel use by road vehicles, in line with available data.

D.3 Policies focusing on industry and services

Six additional policies were identified. Those that can be viewed as extensions of existing policies are:

- Incentivise Environmental Management systems and carbon clubs
- Regulate environmental standards for new commercial development
- Integrate resource use advice into mainstream business support
- Regional carbon reduction scheme

Those that would represent a departure from current policy are:

- requirement for all VAT-registered businesses to report on resource use
- requirement on all commercial landlords to develop resource efficiency plan for buildings

Impacts on energy/CO2 emissions

The policies are directed primarily on the service sector and, in a similar way to the policies affecting the domestic sector, are seen as reinforcing the targeted outcomes set out in the EWP. The scenario assumes that their joint impact is to achieve the outcome for commercial energy efficiency set out in the EWP. This results in energy efficiency averaging 3½-4% pa, compared to 2½-3% pa in the underlying trends scenario.

In estimating the impact of the regional carbon reduction scheme it is assumed that the equivalent of 1% of all sectors participate (based on level of output not number of companies) and those participating agree to achieve energy efficiency savings of 10% pa. The remainder of the sector make the savings outlined above.

Impact on water use

The effect of the underlying trends in water use is that the water intensity of output is expected to fall, in many sectors to 60-80% of their 2006 level by 2020, but that the increased level of economic activity prevents these efficiency improvements being reflected in falling water demand by the sectors.

In the scenario the combined effect on water use is assumed to be an increase in the water efficiency trends with the additional improvements stronger post 2010. Overall, water intensity of output is a further 5-8% lower than in the underlying trends scenario by 2020.

Impact on waste

The combined effect of the policies is assumed to be that industry and services improve their resource use (reduce the level of waste associated with their input material) by between ½-2% pa[32]. It is assumed that the rate of improvement is strongest in relation to hazardous waste, and that larger improvements are made in key waste-intensive sectors, including food, printing, chemicals and construction.

D.4 Policies focusing on electricity generation

The following policies are identified:

- Carbon capture and storage
- UK Nuclear policy
- Renewable Obligation Certificates (ROC)
- Encourage and enable micro and distributed generation
- Special planning status for renewable/distributed generation schemes

Impacts on energy/CO2 emissions

An alternative scenario has been constructed for UK electricity generation taking account of the three items listed above to identify the potential impact on the carbon-intensity of generation.

The scenario assumes that the capacity of the nuclear sector increases steadily over 2017-2030 by 2GW pa. In addition, a CCS demonstration project starts in 2017 which when seen to be successful leads to the capacity covered by CCS being extended by 500MW pa from 2030. Elsewhere in the sector, generation using non FGD- coal, mixed fuel and oil from the major power producers is taken off-line and in time FGD-coal generation is replaced with nuclear or retrofitted to CCS coal. There is no coal – fired generation other than with CCS after 2022, and generation from coal, oil and CCGT from autogenerators ceases in 2017. There are no new CCGT plants constructed from 2017 and generation at CCGT plants is reduced to match required generation, given the alternative sources already mentioned.

In the scenario the carbon-intensity of UK electricity generation falls by 80% over 2007-2031. The intensity of generation in 2031 is just 25% of that in the underlying trends scenario.

The effect of encouraging and enabling micro and 'locally' distributed generation is assumed to be that by 2031 10% of the region's electricity needs are met through such schemes, and that this generation has zero net carbon emissions. It is therefore less carbon intensive than electricity supplied through the national grid. Where the electricity is supplied through CHP schemes, the electricity generated is in addition to the provision of heat etc through the consumption of other fuels (with associated emissions).

[32] Such a rate of improvement is consistent with assumptions made in a previous resource efficiency study undertaken by ADAS for EEDA (Resource Efficiency Study In The East Of England, June 2005).

Appendix E REEIO Results: scenario results

CO2 Emissions

TABLE E1: CO2 EMISSIONS – REEIO ECONOMIC SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				million tonnes C			% pa
End User Basis							
Industry	2.3	1.8	1.5	1.1	-4.5	-2.2	-2.8
Commerce	2.2	1.7	1.1	0.6	-5	-4.2	-6.2
Households	3.3	2.6	1.6	0.8	-4.8	-4.5	-6.3
Transport	4.4	4.4	4.4	4.6	0.3	-0.1	0.5
Total	12.2	10.6	8.6	7.1	-2.9	-2.1	-1.8
Of which emissions associated with electricity consumption	3.6	2.7	1.5	0.5	-5.9	-5.5	-10.5
Direct sources							
Industry	1.8	1.5	1.2	0.9	-4.2	-2	-2.1
Commerce	0.6	0.5	0.4	0.4	-3.2	-1.8	-1.6
Households	1.9	1.5	1.1	0.7	-3.8	-3.4	-4.4
Transport	4.3	4.4	4.4	4.6	0.3	-0.1	0.5
Differences from underlying resource use trends							
			million tonnes C				pp
End User Basis							
Industry	0	-0.1	-0.2	-0.4	-1.2	-0.6	-1.9
Commerce	0	-0.1	-0.5	-1	-0.6	-3.4	-6.1
Households	0	-0.2	-1.2	-2.1	-1.2	-4.5	-6.5
Transport	0	-0.1	-0.2	-0.3	-0.2	-0.4	-0.1
Total	0	-0.4	-2.1	-3.8	-0.8	-1.8	-2
Of which emissions associated with electricity consumption	0	-0.1	-1.2	-2.4	-0.9	-5.1	-11.1
Direct sources							
Industry	0	-0.1	-0.1	-0.2	-1.3	-0.1	-0.5
Commerce	0	0	-0.1	-0.1	-0.5	-1.2	-1.7
Households	0	-0.1	-0.5	-0.9	-1.2	-3.3	-4.1
Transport	0	0	-0.2	-0.3	-0.2	-0.4	-0.1

TABLE E2: CO2 EMISSIONS – RSS ECONOMIC SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				million tonnes C			% pa
End User Basis							
Industry	2.3	1.8	1.4	1	-4.3	-2.6	-2.8
Commerce	2.2	1.7	1.2	0.6	-4.9	-3.7	-5.9
Households	3.3	2.6	1.6	0.7	-5.2	-4.9	-6.5
Transport	4.4	4.4	4.3	4.2	0.2	-0.2	-0.2
Total	12.2	10.6	8.5	6.6	-2.9	-2.2	-2.3
Of which emissions associated with electricity consumption	3.7	2.7	1.5	0.5	-5.9	-5.5	-10.5
Direct sources							
Industry	1.8	1.5	1.2	0.9	-4.04	-2.3	-2.0
Commerce	0.6	0.5	0.5	0.4	-2.9	-0.9	-1.6
Households	1.9	1.5	1	0.6	-4.2	-3.7	-4.6
Transport	4.3	4.4	4.3	4.2	0.2	-0.2	-0.2

Differences from underlying resource use trends

	2005	2010	2020	2031	2005-10	2010-20	2020-31
			million tonnes C				pp
End User Basis							
Industry	0.0	-0.2	-0.2	-0.5	-1.3	-0.7	-2.0
Commerce	0.0	-0.1	-0.5	-1.1	-0.6	-3.3	-6.0
Households	0.0	-0.1	-1.1	-2.0	-1.3	-4.7	-6.6
Transport	0.0	0.0	-0.2	-0.3	-0.1	-0.4	-0.1
Total	0.0	-0.3	-2.1	-3.8	-0.7	-1.8	-2.2
Of which emissions associated with electricity consumption	0.1	-0.1	-1.2	-2.3	-0.9	-5	-11
Direct sources							
Industry	0.0	-0.1	-0.1	-0.2	-1.4	-0.1	-0.5
Commerce	0.0	0.0	-0.1	-0.2	-0.6	-1.3	-1.8
Households	0.0	-0.1	-0.6	-0.9	-1.3	-3.4	-4.2
Transport	0.0	0.0	-0.2	-0.3	-0.2	-0.4	-0.1

TABLE E3: CO2 EMISSIONS – P1 ECONOMIC SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				million tonnes C			% pa
End User Basis							
Industry	1.8	1.5	1.3	1.1	-3.5	-1.8	-1.4
Commerce	0.6	0.5	0.5	0.4	-2.8	-0.5	-1.1
Households	1.9	1.5	1.1	0.7	-4.0	-3.3	-4.2
Transport	4.3	4.4	4.6	4.6	0.4	0.3	0.1
Total	12.2	10.7	9.0	7.3	-2.7	-1.7	-1.9
Of which emissions associated with electricity consumption	3.6	2.7	1.6	0.5	-5.8	-5.2	-10.2
Direct sources							
Industry	2.3	1.9	1.5	1.2	-3.8	-2.1	-2.2
Commerce	2.2	1.8	1.3	0.7	-4.7	-3.3	-5.5
Households	3.3	2.6	1.6	0.8	-5.0	-4.5	-6.1
Transport	4.4	4.5	4.6	4.7	0.4	0.3	0.1

Differences from underlying resource use trends

			million tonnes C				pp
End User Basis							
Industry	0.0	-0.1	-0.1	-0.2	-1.4	-0.2	-0.8
Commerce	0.0	0.0	-0.1	-0.2	-0.6	-1.3	-1.7
Households	0.0	-0.1	-0.5	-0.9	-1.2	-3.4	-4.2
Transport	0.0	-0.1	-0.2	-0.3	-0.2	-0.4	-0.1
Total	0.0	-0.4	-2.2	-4.3	-0.7	-1.8	-2.2
Of which emissions associated with electricity consumption	0.0	-0.1	-1.2	-2.6	-0.9	-5.1	-11.2
Direct sources							
Industry	0.0	-0.1	-0.3	-0.5	-1.3	-0.7	-2.1
Commerce	0.0	0.0	-0.5	-1.2	-0.6	-3.4	-6.1
Households	0.0	-0.2	-1.2	-2.2	-1.2	-4.7	-6.6
Transport	0.0	0.0	-0.2	-0.2	-0.2	-0.4	-0.1

TABLE E4: CO2 EMISSIONS – P2 ECONOMIC SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				million tonnes C			% pa
End User Basis	2.3	1.9	1.6	1.4	-3.5	-1.6	-1.5
Industry	2.2	1.8	1.3	0.7	-4.5	-3.1	-5.4
Commerce	3.3	2.6	1.7	0.8	-5	-4.4	-6
Households	4.4	4.5	4.8	4.9	0.6	0.6	0.2
Transport	12.2	10.8	9.3	7.8	-2.5	-1.4	-1.6
Total	2.3	1.9	1.6	1.4	-3.5	-1.6	-1.5
Of which emissions associated with electricity consumption	3.6	2.7	1.6	0.5	-5.6	-5	-10
Direct sources	1.8	1.5	1.4	1.3	-3.1	-1.2	-0.7
Industry	0.6	0.5	0.5	0.5	-2.7	-0.4	-1.1
Commerce	1.9	1.5	1.1	0.7	-4	-3.2	-4.1
Households	4.3	4.5	4.7	4.9	0.6	0.6	0.2
Transport	1.8	1.5	1.4	1.3	-3.1	-1.2	-0.7
Differences from underlying resource use trends							
			million tonnes C				pp
End User Basis							
Industry	0.0	-0.2	-0.3	-0.6	-1.3	-0.8	-2.0
Commerce	0.0	0.0	-0.6	-1.3	-0.5	-3.4	-6.1
Households	0.0	-0.2	-1.1	-2.2	-1.3	-4.7	-6.6
Transport	0.0	0.0	-0.2	-0.3	-0.2	-0.3	-0.2
Total	0.0	-0.4	-2.3	-4.5	-0.7	-1.8	-2.1
Of which emissions associated with electricity consumption	0	-0.1	-1.3	-2.8	-0.9	-5.1	-11.1
Direct sources							
Industry	0.0	-0.2	-0.1	-0.2	-1.4	-0.2	-0.9
Commerce	0.0	0.0	-0.1	-0.1	-0.5	-1.3	-1.8
Households	0.0	-0.1	-0.6	-1.0	-1.3	-3.4	-4.2
Transport	0.0	0.0	-0.3	-0.3	-0.2	-0.3	-0.2

Water Use

TABLE E.5 WATER USE UNDER REEIO ECONOMIC SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				Ml/d		% pa	
Production	564	508	453	379	-2.1	-1.1	-1.6
Services	137	135	124	118	-0.2	-0.9	-0.5
Domestic	920	936	917	843	0.3	-0.2	-0.8
Total	1621	1579	1494	1340	-0.5	-0.5	-1.0
Differences from underlying resource use trends							
				Ml/d			pp
Production	0	-6	-35	-55	-0.3	-0.6	-0.6
Services	0	-2	-10	-17	-0.2	-0.7	-0.6
Domestic	0	-19	-104	-193	-0.4	-0.9	-0.9
Total	0	-27	-148	-265	-0.3	-0.7	-0.8

TABLE E.6 WATER USE UNDER RSS ECONOMIC SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				Ml/d		% pa	
Production	564	509	441	371	-2.0	-1.4	-1.6
Services	137	137	134	129	-0.1	-0.2	-0.4
Domestic	920	929	875	805	0.2	-0.6	-0.8
Total	1621	1574	1450	1304	-0.6	-0.8	-1.0
Differences from underlying resource use trends							
				Ml/d			pp
Production	0	-6	-34	-54	-0.2	-0.6	-0.6
Services	0	-2	-10	-18	-0.3	-0.6	-0.6
Domestic	0	-19	-99	-184	-0.4	-0.9	-0.9
Total	0	-27	-143	-256	-0.4	-0.8	-0.8

TABLE E.7 WATER USE UNDER P1 ECONOMIC SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				Ml/d		% pa	
Production	564	520	473	424	-1.6	-0.9	-1.0
Services	137	138	142	143	0.1	0.3	0.1
Domestic	920	936	920	888	0.3	-0.2	-0.3
Total	1621	1593	1534	1455	-0.3	-0.4	-0.5
Differences from underlying resource use trends							
				Ml/d			pp
Production	0	-6	-36	-62	-0.2	-0.6	-0.6
Services	0	-2	-11	-20	-0.3	-0.6	-0.5
Domestic	0	-19	-104	-203	-0.4	-0.9	-0.9
Total	0	-27	-151	-285	-0.3	-0.8	-0.8

TABLE E.8 WATER USE UNDER P2 ECONOMIC SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				Ml/d		% pa	
Production	564	528	506	488	-1.3	-0.4	-0.3
Services	137	138	144	147	0.2	0.4	0.2
Domestic	920	936	923	895	0.4	-0.1	-0.3
Total	1621	1603	1574	1529	-0.2	-0.2	-0.3
Differences from underlying resource use trends							
				Ml/d			pp
Production	0	-7	-39	-71	-0.2	-0.6	-0.5
Services	0	-2	-11	-21	-0.2	-0.6	-0.5
Domestic	0	-19	-105	-204	-0.3	-0.8	-0.9
Total	0	-27	-155	-296	-0.3	-0.8	-0.8

Waste Arisings

TABLE E9: PROJECTIONS OF WASTE ARISINGS IN REEIO BASELINE ECONOMIC SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				000 tonnes			% pa
Commercial & Industrial	6765	6377	6761	8438	-1.2	0.6	2.0
Household	2847	2938	3122	3144	0.6	0.6	0.1
Other municipal	167	182	219	313	1.8	1.9	3.3
Construction & Demolition	11600	12084	13717	19471	0.8	1.3	3.2
Agriculture	4574	4398	4889	5239	-0.8	1.1	0.6
Other	9185	7325	7920	6231	-4.4	0.8	-2.2
TOTAL	35137	33305	36628	42836	-1.1	1.0	1.4
Differences from underlying resource use trends							
				000 tonnes			pp
Commercial & Industrial	0	-215	-702	-826	-0.7	-0.6	0.0
Household	0	-37	-120	-212	-0.3	-0.3	-0.2
Other municipal	0	-4	-12	-17	-0.4	-0.3	0.0
Construction & Demolition	0	-623	-2232	-3168	-1.0	-1.0	0.0
Agriculture	0	0	0	0	0.0	0.0	0.0
Other	0	0	0	0	0.0	0.0	0.0
TOTAL	0	-878	-3065	-4224	-0.6	-0.5	-0.2

Note(s): Data does not include powerstation ash and sewage sludge

TABLE E10: PROJECTIONS OF WASTE ARISINGS IN REEIO RSS ECONOMIC SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				000 tonnes			% pa
Commercial & Industrial	6765	6545	7100	8969	-0.7	0.8	2.1
Household	2847	2916	2979	3000	0.5	0.2	0.1
Other municipal	167	185	237	342	2.1	2.5	3.4
Construction & Demolition	11600	12701	16087	22835	1.8	2.4	3.2
Agriculture	4574	4339	4740	5079	-1.0	0.9	0.6
Other	9185	6166	5331	4194	-7.7	-1.4	-2.2
TOTAL	35137	32852	36473	44419	-1.3	1.1	1.8
Differences from underlying resource use trends							
				000 tonnes			pp
Commercial & Industrial	0	-221	-717	-852	-0.7	-0.7	0.0
Household	0	-37	-114	-202	-0.2	-0.3	-0.2
Other municipal	0	-4	-13	-18	-0.4	-0.4	0.0
Construction & Demolition	0	-655	-2618	-3716	-1.1	-1.0	0.0
Agriculture	0	0	0	0	0.0	0.0	0.0
Other	0	0	0	0	0.0	0.0	0.0
TOTAL	0	-915	-3461	-4788	-0.5	-0.6	-0.1

Note(s): Data does not include powerstation ash and sewage sludge

TABLE E11: PROJECTIONS OF WASTE ARISINGS IN P1 ECONOMIC SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				000 tonnes			% pa
Commercial & Industrial	6765	6637	7520	10019	-0.4	1.3	2.6
Household	2847	2939	3132	3311	0.6	0.6	0.5
Other municipal	167	187	251	382	2.3	3.0	3.9
Construction & Demolition	11600	12751	16736	24879	1.9	2.8	3.7
Agriculture	4574	4339	4740	5079	-1.0	0.9	0.6
Other	9185	6166	5331	4194	-7.7	-1.4	-2.2
TOTAL	35137	33018	37709	47864	-1.2	1.3	2.2
Differences from underlying resource use trends							
				000 tonnes			pp
Commercial & Industrial	0	-225	-771	-980	-0.7	-0.6	0.0
Household	0	-37	-120	-223	-0.3	-0.3	-0.3
Other municipal	0	-4	-14	-21	-0.4	-0.3	0.0
Construction & Demolition	0	-657	-2723	-4048	-1.0	-1.0	0.0
Agriculture	0	0	0	0	0.0	0.0	0.0
Other	0	0	0	0	0.0	0.0	0.0
TOTAL	0	-923	-3628	-5272	-0.5	-0.7	-0.1

Note(s): Data does not include powerstation ash and sewage sludge.

TABLE E12: PROJECTIONS OF WASTE ARISINGS IN P2 ECONOMIC SCENARIO

	2005	2010	2020	2031	2005-10	2010-20	2020-31
				000 tonnes			% pa
Commercial & Industrial	6765	6703	7809	10736	-0.2	1.5	2.9
Household	2847	2940	3143	3335	0.6	0.7	0.5
Other municipal	167	188	257	396	2.4	3.2	4.0
Construction & Demolition	11600	12783	16960	25493	2.0	2.9	3.8
Agriculture	4574	4339	4740	5079	-1.0	0.9	0.6
Other	9185	6166	5331	4194	-7.7	-1.4	-2.2
TOTAL	35137	33118	38239	49232	-1.2	1.4	2.3
Differences from underlying resource use trends							
				000 tonnes			pp
Commercial & Industrial	0	-228	-820	-1102	-0.7	-0.7	0.0
Household	0	-37	-120	-224	-0.3	-0.2	-0.3
Other municipal	0	-4	-14	-22	-0.4	-0.3	0.0
Construction & Demolition	0	-659	-2760	-4148	-1.0	-1.0	0.0
Agriculture	0	0	0	0	0.0	0.0	0.0
Other	0	0	0	0	0.0	0.0	0.0
TOTAL	0	-928	-3714	-5496	-0.6	-0.7	-0.1

Note(s): Data does not include powerstation ash and sewage sludge