VantagePoint Modelling Scenario Report

BIOMASS FOCUS SCENARIO FOR DERBY CITY COUNCIL

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Scenario Type:	Biomass Focus	**Date:**	22/11/2011`

Purpose of Scenario Development

As part of the analysis of the East Midlands' emissions reductions, Carbon Descent has produced a Scenario that focuses heavily upon the maximal use of biomass in Derby City Council, while retaining a Low Carbon Transition Plan (LCTP) derived Measure deployment base. The Scenario delivered is a snapshot, which has been developed, based on current policy, therefore, it will be important to periodically update the Scenario as additional data becomes available and national policies are refined and updated. The periods chosen to be modelled are: 2020, 2035, and 2050.

Scenario Results

The Derby City Council Biomass Focus Scenario calculates that the LCTP combined with the focus on maximal use of Biomass will not deliver sufficient carbon savings for Derby City Council to achieve its carbon emissions reduction target in 2020. Moreover, the CO2 savings are still short of the 2035 interim emissions reduction target and the 2050 Climate Change Act Target.

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As awareness of climate change and the urgency to reduce our impact on the environment increases, Carbon Descent continue to help organisations take mitigation actions. By working with large organisations on strategies that reach thousands of people to working at the coal face directly with community members we understand the mechanisms and investment needed to create lasting behaviour change.

Table of Contents

1 Introduction **4**

1.1 COMMISSIONING BACKGROUND 4

1.2 THE LOW CARBON TRANSITION PLAN 4

1.3 THE PURPOSE OF THIS REPORT 4

2 Scenario **5**

2.1 REPORT STRUCTURE 5

2.2 DESCRIPTION 5

2.3 CONSTRAINTS OF THE MODEL 5

2.4 METHODOLOGY FOR BUSINESS AS USUAL 6

2.5 METHODOLOGY FOR DETERMINING DEPLOYMENT POTENTIALS 6

2.6 METHODOLOGY FOR DEPLOYMENT OF MEASURES 6

3 Results and Analysis **8**

3.1 KEY SCENARIO RESULTS 8

3.1.1 Business As Usual (BAU) 8

3.1.2 Scenario Savings Overview 8

3.1.3 Scenario System Graph 8

3.2 ANALYSIS & DISCUSSION 9

3.2.1 Effect of Business As Usual Emissions Growth 9

3.2.2 Sectoral Analysis 10

3.2.3 Energy Analysis 11

3.2.4 Measure-Specific Analysis 12

4 VantagePoint Outputs from Scenario **17**

Table of Figures

Figure 1: Scenario System Graph 9
Figure 2: Demand Sector Decarbonisation 11
Figure 3: Scenario Energy Performance 12
Figure 4: Effort Level for the Large Generation Sector 14
Figure 5: Effort Level for the Transport Sector 15
Figure 6: Effort Level for the Commercial & Industrial Sector 15
Figure 7: Effort Level for the Domestic Sector 16

Table of Tables

Table 1: Business As Usual (BAU) 8
Table 2: Scenario CO_2 Savings Overview 8
Table 3: Breakdown of savings achieved per Sector for all periods 10
Table 4: Notable Large Savings Summary for 2005-2020 13
Table 5: Notable Large Savings Summary for 2021-2035 13
Table 6: Notable Large Savings Summary for 2036-2050 13
Table 7: Scenario Deployment Potentials 18
Table 8: Scenario Resource Potentials 18
Table 9: Scenario Deployment 19
Table 10: Scenario CO2 savings by measure 21
Table 11: Scenario capital costs by measure 22

1 Introduction

1.1 Commissioning Background

This report has been produced on behalf of the East Midlands Regional Efficiency and Improvement Partnership with the aim of investigating the impact of the Low Carbon Transition Plan (LCTP) on the local authorities within the East Midlands. In particular, this scenario translates the policies encapsulated in the Government's Low Carbon Transition Plan into specific carbon reduction measures and technologies, which belong to the Transport, Domestic, Commercial and Industrial (C&I) and Large Generation sectors. The ultimate purpose of this study is to calculate whether the savings achieved from the LCTP will be sufficient for Derby City Council to meet its 2020 carbon reduction targets.

1.2 The Low Carbon Transition Plan

The LCTP details how 43 UK and EU policies aim to achieve emissions cuts of 18% on 2008 levels by 2020. According to the LCTP all major UK government departments have been allocated their own budget and have been tasked with producing their own carbon reduction plan. The LCTP aims for 40% of UK's electricity to be delivered from low carbon sources; this will be achieved through policies that will lead to 30% production of electricity from renewable and facilitation of the building of new nuclear power stations and funding up to 4 carbon capture and storage projects in power stations. Moreover it will aid the greening of the domestic sector by channeling some £3.2 billion to help households become more energy efficient, roll out smart meters to every household, steer "pay as you save" ways in which the savings on energy bills will be used to repay upfront costs, aid emerging clean energy cash back schemes so that energy consumers will be rewarded when they use low carbon sources and by opening a competition for 15 towns and villages to take a leading role in community green development and innovation. The plan also sets out a way to help more vulnerable energy consumers by creating mandated social price support at the earliest opportunity with increased resources compared to the current voluntary system, helping 90,000 homes by leading a community based approach to greening the domestic sector of low income areas and by increasing the level of Warm Front grants so the majority of eligible applicants can receive their energy saving measures without having to put in a payment themselves. Furthermore LCTP aims to establish UK as a leader in the green industry by investing in clean technologies and specifically by investing £120 million in offshore wind and an extra £60 million to establish UK's position as a global leader in marine energy. New projects will be supported in the transport sector in order to reduce the average car emissions by 40% compared to the 2007 levels and to deliver 10% of UK transport energy by renewable resources. LCTP also sets out a framework to reduce emissions from farming. Finally in order to increase energy security, gas imports will be 50% lower than would otherwise have been the case.

1.3 The purpose of this report

This report and associated scenario have been developed in order to explore how an increased use of biomass within the local authority area, could be used, in addition to the measures detailed within the LCTP, to meet targets in subsequent years. The biomass scenario is a specialist scenario in that it takes the deployment suggested by the LCTP and then increases only biomass technologies, until targets are met, or the potential of each technology reaches its maximum deployment. The purpose of this report is to explore the upper limits of specific technologies and outline the extra savings they may yield.

As with the LCTP report, the deployment mechanism that is utilised for each of the LCTP and biomass policies is not explored within this report.

2 Scenario

2.1 Report Structure

This report is designed to provide the key results and the majority of the understanding at the start, while the latter sections are used to provide additional, in-depth analysis and detailed data results. As such, there is no separate conclusion section at the end of this report – refer to the Title Page or Section 3.1 instead.

As such, Section 2 provides a basic description of the Scenario and modelling process, required in order to understand and interpret the results. This Section is augmented by the separate *Business as Usual Methodology* and *Deployment Potentials Methodology* reports, which detail the methodology and assumptions of the VantagePoint model setup work.

Section 3 first summarises the key results before engaging in sectoral and energy-based analysis of the scenario results, while the last part of this section provides more extensive Measure-specific detail. As such, the first two parts of Section 3 are the most relevant in terms of providing a broad understanding of the Scenario. For even greater detail, Section 4 provides the raw Scenario VantagePoint input and output data.

2.2 Description

As part of the analysis of the East Midlands' emissions reductions, Carbon Descent has produced a Scenario for Derby City Council, which has been outlined below. This Scenario has been developed in order to determine whether national policy, encapsulated in the LCTP and subject to the current understanding of technology, in combination with maximal deployment focus on the use of biomass in all its forms, will allow Derby City Council to meet its Climate Change Act carbon reduction targets in 2020, 2035 and 2050. This Biomass Focus scenario, therefore, also enables Derby City Council to investigate the impact of increasing the deployment of biomass measures beyond that prescribed by the LCTP. Reference to the independent LCTP Scenario Report for Derby City Council would allow the reader to compare the effectiveness of focusing on Biomass measures.

The chosen modelling years are: 2020, 2035 and 2050.

2.3 Constraints of the Model

The Biomass Focus Scenario is of course limited by the amount of biomass available to Derby City Council – the Biomass Resource Potential. That being said, the Biomass Resource Potential is allocated on a population basis upon a 2020 national potential of 284.935TWh[1], rising to a national potential of 548.4TWh by 2050[2]. The Biomass Resource Potential is provided in Table 8.

Moreover, the deployment in this Scenario does not exceed that prescribed by the LCTP for all non-biomass measures, and is maintained at that level for all periods beyond 2020.

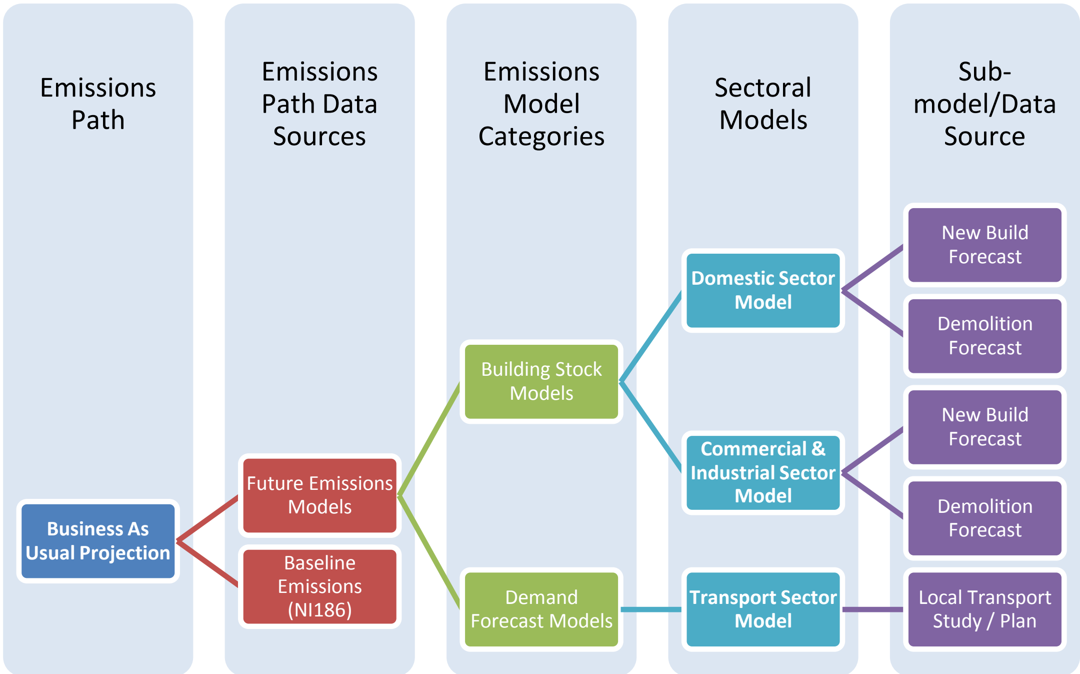
[1] DECC, *UK Biomass Strategy*, May 2007

[2] DECC, *2050 Pathways Analysis Calculator Excel Model*, 2010 (set to Pathway Alpha)

2.4 Methodology for Business as Usual

The Business As Usual (BAU) projection for emissions is calculated in accordance with the separate *Business as Usual Methodology* report. The BAU emissions projection up to 2050 is used as a reference 'no further intervention' CO_2 emissions case – typically led by energy demand growth – to which the emissions reductions Measures are applied during the Scenario modelling stage.

The BAU modelling process is portrayed diagrammatically below. The projection takes the current emissions from the NI186 as a basis in the starting year. It then forecasts emissions change in all three Sectors: Domestic, Commercial & Industrial (C&I) and Transport. Both the Domestic and C&I models are building-stock based – the Domestic model in terms of the number of dwellings, and the C&I model terms of m^2 of floorspace. For both, the pertinent questions relating to emissions growth are what the level of new build and demolition will be. The transport model is demand-based, typically extrapolating emissions using local transport demand growth forecasts.



2.5 Methodology for determining Deployment Potentials

The Deployment Potential for a given Measure was calculated wherever possible using pertinent local data or studies. Where this was not available, standard Carbon Descent methodology was applied to regional or national datasets in order to calculate the Deployment Potential. The methodology used for each Deployment Potential is given in the separate *Deployment Potentials Methodology* report. The Deployment Potentials for this particular Scenario are provided in Table 7 in Section 4.

2.6 Methodology for Deployment of Measures

The Scenario delivered provides an investigation of whether Derby City Council can meet its carbon emissions reduction targets under the conditions outlined below, subject to the current understanding of technology, and subject to current policies. It will be important to periodically update the Scenarios as additional data becomes available and national policies are refined and updated.

As this is a Biomass Focus Scenario, deployment for biomass measures follows a more aggressive path, according to a specific set of steps. For all non-biomass measures, deployment is kept in accordance with the LCTP and the suite of national policies this represents has been mapped on to Derby City Council.

In all three periods, biomass Measure deployment is increased so as to use up all available biomass resource. As mentioned in Section 2.3, the Biomass Resource Potential increases with time, and hence the deployment of biomass Measures is also able to increase.

Priority is given to Biomass CHP, as this is the most effective use of biomass, generating both electricity and heat. The heat from Biomass CHP is assumed to be used in a district heating system; the Community Heating Potential sets a limit to the amount of heat that can be used in such a scheme, therefore constraining biomass CHP. The Community Heating Potential is provided in Table 8.

Once the full Community Heating Potential is used up, secondary priority is given to the generation of electricity using biomass in a power only biomass system. This then fully utilises the remaining biomass resource; consequently, no further deployment of biomass boilers is assumed to occur than that prescribed under the LCTP.

Finally, this Scenario assumes that all road transport fuel consumption remaining after deployment of LCTP transport measures will be offset using biofuels, providing further significant savings from a biomass measure.

The actual measure deployment for this particular Scenario is provided in Table 9 in Section 4.

3 Results and Analysis

3.1 Key Scenario Results

3.1.1 Business As Usual (BAU)

When modelling emissions into the future it is important to understand the *doing nothing* position and how that may affect the magnitude of measure deployment. This is what is encapsulated within the BAU model that has been completed as part of this work. As noted above the methodology for our BAU is contained within a separate report, the reader should refer to this is more detail is required.

In most instances each local authority will have some growth in emissions over the next few years and may have significant estimates of emissions up to and including 2050. That being said caution is required when looking at the growth projects up to 2050.

CO_2 comparison	2020	2035	2050
Baseline data (2005)	1678	1678	1678
Growth kt	295	555	815
Percentage growth from 2005	18%	33%	49%

Table 1: Business As Usual (BAU)

3.1.2 Scenario Savings Overview

From the LCTP scenario, it is estimated that Derby City Council's savings will be 510.39ktCO_2 in period one which is 76% of the target savings. The LCTP therefore, delivers insufficient carbon savings for Derby City Council in 2020. However, as can be seen from the Table below with the increased deployment of Biomass measures in all three periods, the Biomass Focus Scenario meets the 2020 target but falls short of the 2035 interim target and the 2050 Climate Change Act target, undershooting them by 11% and 17% respectively

The table below provides an overview of the Scenario savings for each period in relation to the savings required to meet the targets in each period.

CO_2 comparison	2005-2020	2021-2035	2036-2050
CO_2 savings targets (ktpa)	672.99	1543.34	2098.72
Total CO_2 savings for the Scenario (ktpa)	655	1372.67	1735.61
Comparison of targets vs. savings (ktpa)	-18 (3%)	-171 (11%)	-363 (17%)

Table 2: Scenario CO_2 Savings Overview

3.1.3 Scenario System Graph

Figure 1 shows the system graph of CO_2 savings for the Scenario. Cumulative savings per Sector from the BAU emissions case (dotted dark blue line) provides the final Scenario emissions projection (solid orange line) in relation to the Scenario targets (on a 2005 baseline).

The graph shows the CO_2 emissions on the vertical axis in kilotonnes of CO_2 saved per annum (ktpa). The horizontal axis indicates the modelling points between 2005 and 2050, as well as the emissions targets (recalculated to show the percentage savings required on a 2005 baseline). Following this the graph depicts a wedge display of cumulative savings down from the Business as Usual emissions case for each target period. From top to bottom, the savings have been grouped into the following wedges: ***Large Generation***, ***Green Grid*** (effectively the savings 'achieved' in Derby City Council by the national electricity grid becoming cleaner), ***Commercial & Industrial***, ***Domestic*** and ***Transport***. Transport, the final savings wedge, leads to the overall Scenario emissions (shown as a solid orange line).

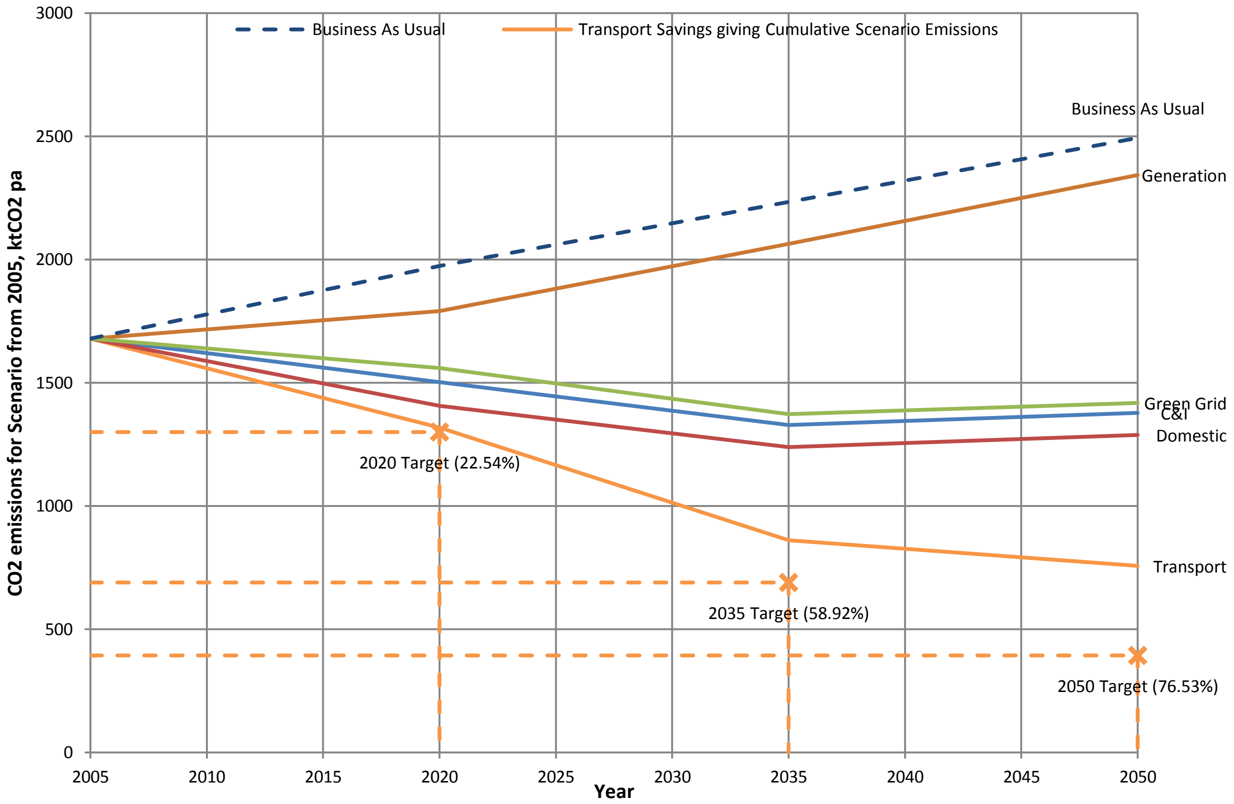


Figure 1: Scenario System Graph

3.2 Analysis & Discussion

3.2.1 Effect of Business As Usual Emissions Growth

Figure 1 shows that the Biomass Focus deployment alone does not meet the 2020 target. Due to the nature of the biomass Measures prioritised, the savings achieved by the Transport and Generation Sector increase during the first period, as this is where the main biomass measures sit. The Green Grid also increases its savings, as expected in every Scenario. This growth in savings from the Transport continues in the 2021-2050 period. Generation Sector savings decrease in the second and third periods, in part due to the diminishing returns of offsetting increasingly greener electricity with renewable electricity.

In all instances the savings assume that emissions growth under BAU (typically led by energy demand growth) will be as predicted. If growth is less than calculated within the BAU and as depicted on Figure 1, then it would bring the authority closer to its interim targets; in effect, the absolute savings target in ktCO2pa increases or decreases with greater or lesser BAU emissions growth, respectively. Consequently, greater or lesser emissions growth will move the final Scenario emissions projection up or down on Figure 1. This could affect whether or not targets are met.

3.2.2 **Sectoral Analysis**

The following section will analyse the carbon savings on a Sectoral basis. In conjunction with the Measure-Specific Analysis given in Section 3.2.4, as well as the raw Scenario deployment numbers provided in Section 4, an understanding can be gained from this section as to the effectiveness of decarbonisation efforts in each of the Sectors, and potentially where significant potential still exists for decarbonisation in order to meet the targets.

3.2.2.1 Sectoral Savings Breakdown

The savings are split between the Sectors in the following proportions:

	2020 Target Period		2035 Target Period		2050 Target Period	
Sector	Savings $ktCO_2pa$	As percentage of total savings	Savings $ktCO_2pa$	As percentage of total savings	Savings $ktCO_2pa$	As percentage of total savings
Domestic	96.188	15%	90.373	6%	89.706	5%
Commercial and Industrial	56.721	9%	43.974	3%	39.874	2%
Transport	88.053	13%	378.084	24%	531.089	31%
Large Generation	182.733	28%	170.15	11%	150.284	9%
Green Grid	231.3	35%	690.088	45%	924.659	53%

Table 3: Breakdown of savings achieved per Sector for all periods

From the Table, we can see that the greatest savings in the first period are achieved by the Green Grid followed by the Large Generation Sector. However in the following periods, where most biomass measures sit, the major savings achieved by the Green Grid, followed by the Transport Sector.

3.2.2.2 Demand Sector Decarbonisation

Further analysis is provided in Figure 2. This figure shows to what extent the energy demand Sectors (Transport, C&I and Domestic) have been decarbonised in each period against the 2005 baseline. This is shown as the savings achieved in the Sector in each period as a percentage of the Sector emissions predicted under the BAU for each period. Consequently, it gives an indication of the success achieved by the relevant measure deployment in abating emissions from each demand Sector.

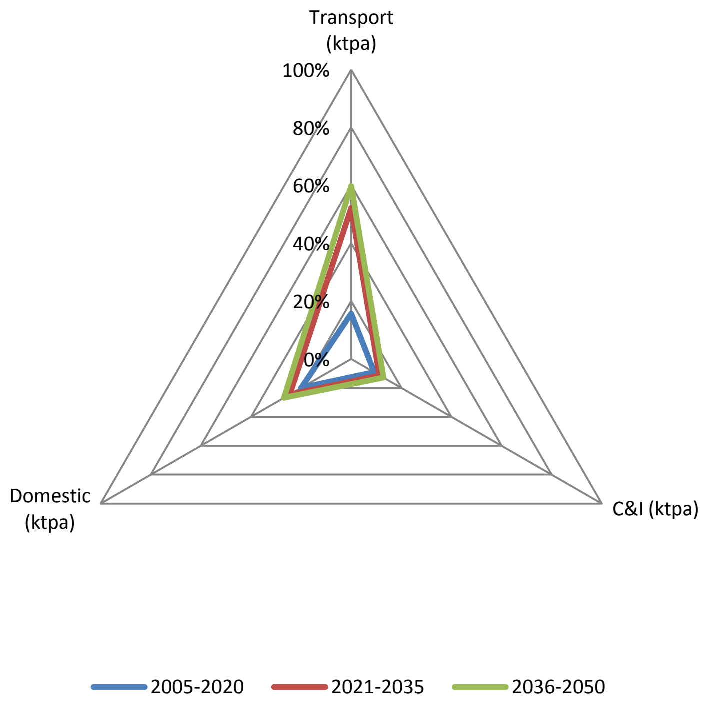


Figure 2: Demand Sector Decarbonisation

It is clear from the figure that under the Biomass Focus Scenario the decarbonisation of Transport happens very rapidly, reaching some 60% in the second period and increasing slightly in the final period. Full Transport decarbonisation does not occur because there are still assumed to be some carbon emissions associated with biofuels. Limited further Domestic Sector decarbonisation occurs beyond the approximately 20% reached in 2020. Counter intuitively, in absolute terms, Derby City Council's C&I savings decrease with time and its projected C&I emissions decrease even faster once the impact of the Green Grid has been taken into account. Consequently, the decarbonisation percentage increases.

3.2.3 **Energy Analysis**

Having considered the Scenario results from a carbon savings perspective, the following section takes an alternative view on the Scenario results by examining energy instead. In particular, energy demand may be split into the following categories: thermal demand and power demand, both measured in MWh, as well as transport fuel demand (whether conventional fossil fuel, biofuel or electricity, but all measured for convenience in thousands of fossil fuel litres). Two exploitable energy 'resources' are also included: biomass resource (MWh), and community heating potential (the amount of Derby City Council's heating demand that could be met by a district heating network).

Figure 3 considers the Scenario's energy performance, split into the categories defined above, giving the extent to which BAU energy demand has been offset under the Scenario, or the extent to which available energy resources have been utilised. In more detail, the graph shows, as a percentage of the predicted energy demand under Business as Usual, the extent to which energy demand has been displaced by the installed Measure deployment for the three energy demand categories. It also shows the utilisation of the two exploitable energy resource categories as a percentage of their Deployment Potentials.

It must be understood, however, that energy demand displacement does not necessarily translate into direct emissions reductions; for example, the Fuel Switch measure displaces a certain amount of domestic thermal demand, previously supplied by electric heating, with only marginally cleaner gas heating, giving limited carbon savings.

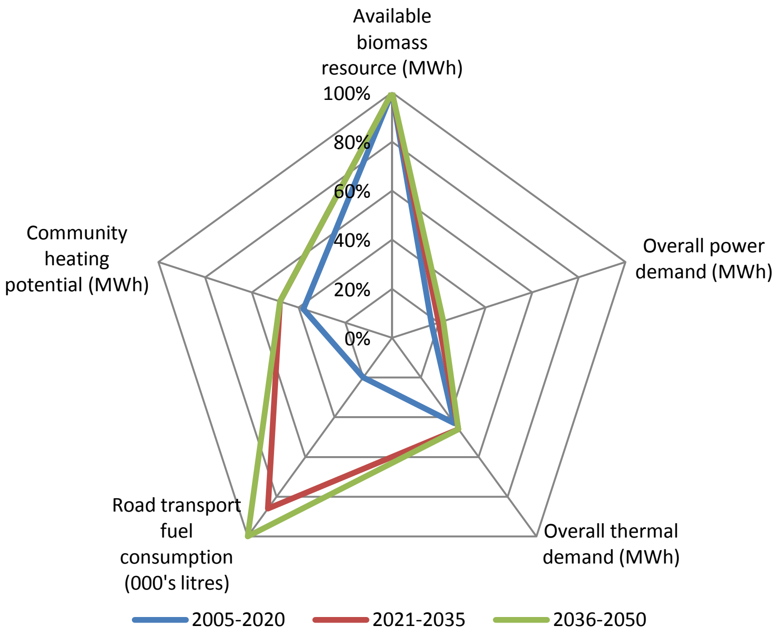


Figure 3: Scenario Energy Performance

As is usual under LCTP Scenarios, the overall 2020 demand displacement and resource utilisation is fairly poor – the LCTP is after all designed for 34% reduction target, and not more. However, under the Biomass Focus, a significant improvement in resource utilisation occurs due to the large increase in biomass Measure deployment. Hence, Biomass resource utilisation reaches 100% for all three periods. Further, biofuels ensure that all road transport fuel is offset with an alternative fuel type, or reduced by efficiency improvements, and this also reaches 100%. Furthermore, the power and heat generating measures – power only biomass or biomass combined heat and power (CHP) – achieve an increased offset of thermal and power demand in 2020, 2035 and 2050.

3.2.4 **Measure-Specific Analysis**

In this section, deployment and savings are examined on a Measure-by-Measure basis, considering the key sources of savings, discussing any Deployment Potentials that have been exceeded and finally reviewing the effort level of each Measure.

3.2.4.1 Notable large savings

In 2020, the four largest CO_2-saving Measures within the Scenario are provided in Table 4, and similarly the four largest measures are provided for 2035 in Table 5 and for 2050 in Table 6. These tables also show what percentage of the total Scenario savings are achieved by these four Measures. For example, in the case of 2020, the four Measures together account for 74% of the total CO_2 savings within the Scenario, or 72% of the target savings.

Measure	**CO2 Savings (ktCO2pa)**	**CO2 Savings as % of Total Scenario CO2 Savings**	**CO2 Savings as % of Target CO2 Savings**
Green grid	231.3	35%	34%
CHP biomass	168.472	26%	25%
Road transport efficiency improvements	54.001	8%	8%
Replace road transport fuels with biofuels	33.51	5%	5%
Total	**487.283**	**74%**	**72%**

Table 4: Notable Large Savings Summary for 2005-2020

Measure	CO2 Savings (ktCO2pa)	CO2 Savings as % of Total Scenario CO2 Savings	CO2 Savings as % of Target CO2 Savings
Green grid	690.088	50%	45%
Replace road transport fuels with biofuels	307.564	22%	20%
CHP biomass	160.447	12%	10%
Road transport efficiency improvements	69.819	5%	5%
Total	**1227.918**	**89%**	**80%**

Table 5: Notable Large Savings Summary for 2021-2035

Measure	CO2 Savings (ktCO2pa)	CO2 Savings as % of Total Scenario CO2 Savings	CO2 Savings as % of Target CO2 Savings
Green grid	924.659	53%	44%
Replace road transport fuels with biofuels	444.591	26%	21%
CHP biomass	144.889	8%	7%
Road transport efficiency improvements	85.638	5%	4%
Total	**1599.777**	**92%**	**76%**

Table 6: Notable Large Savings Summary for 2036-2050

It is interesting to note that all four measures remain in the top across all periods and that, predictably, in the second and final periods the biomass measures become dominant, namely biomass CHP and biofuels for road transport. However, as is usual for most Scenarios, the projected decarbonisation of the wider national electricity grid means that Green Grid is the Measure to provide the largest savings, consistently providing more than a third of all savings, in the two final periods.

3.2.4.2 Deployment Effort Levels

The following charts set out the effort levels for each Measure, grouped by Sector. The effort level is defined as the Measure Deployment divided by the Deployment Potential. Effectively, this gives an indication of the amount of effort that has been undertaken in relation to the complete utilisation of that Measure's Deployment Potential, giving an idea of the scale of savings that could still be achieved by further deployment. For the LCTP-defined Measures, deployment remains more or less constant across all periods (for these, where deployment changes this is usually due to Deployment Potentials changing with time).

The first effort level graph, Figure 4, shows how much focus has been given to Large Generation Measures in this Scenario. As usual, the Green Grid Measure increases strongly over time; the Green Grid Measure is modelled based upon the national grid decarbonisation projection made in DECC's 2050 Pathways Analysis work (Scenario Alpha), and is therefore, independent of either the LCTP or the Scenario's focus, remaining constant for each District across Scenario types. The Green Grid effort level is expressed as a percentage of its ultimate 2050 value.

Power only biomass and CHP biomass are considered Large Generation Measures and both clearly show a marked increase in deployment between 2020 and 2050. The Power only biomass eventually reaches some 90% of its effort levels, while CHP biomass is seen to reach nearly its absolute effort levels.

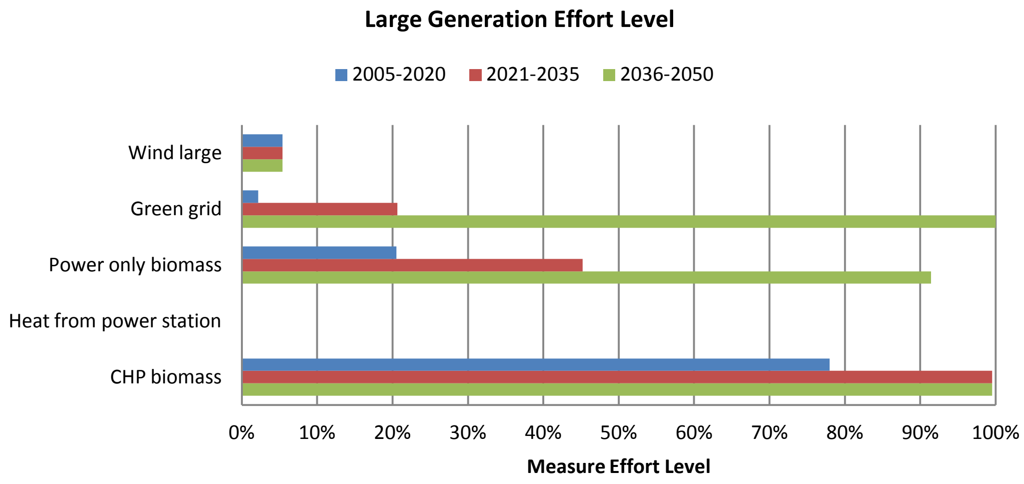


Figure 4: Effort Level for the Large Generation Sector

The next effort level graph, Figure 5, is for the Transport Sector Measures. Here, the LCTP translation results in road transport efficiency improvements and increased replacement of road transport fuel with biofuel in 2020. The Biomass Focus Scenario means that biofuel use is rapidly increased in the second period to nearly 80% and eventually reaches 90% in the final period, thereby offsetting all remaining fuel use as discussed in Section 0.

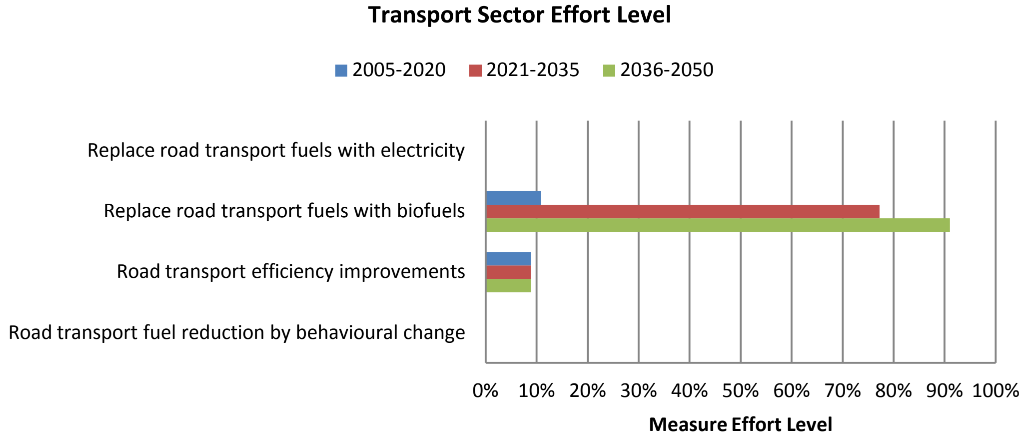


Figure 5: Effort Level for the Transport Sector

The Commercial and Industrial Sector effort levels are shown in Figure 6. Given the prioritisation of certain biomass Measures as discussed in Section 2.6, there is no additional deployment beyond that prescribed by the LCTP for the C&I Sector. The LCTP does, however, lead to a strong effort in non-domestic solar PV and non domestic biomass boilers.

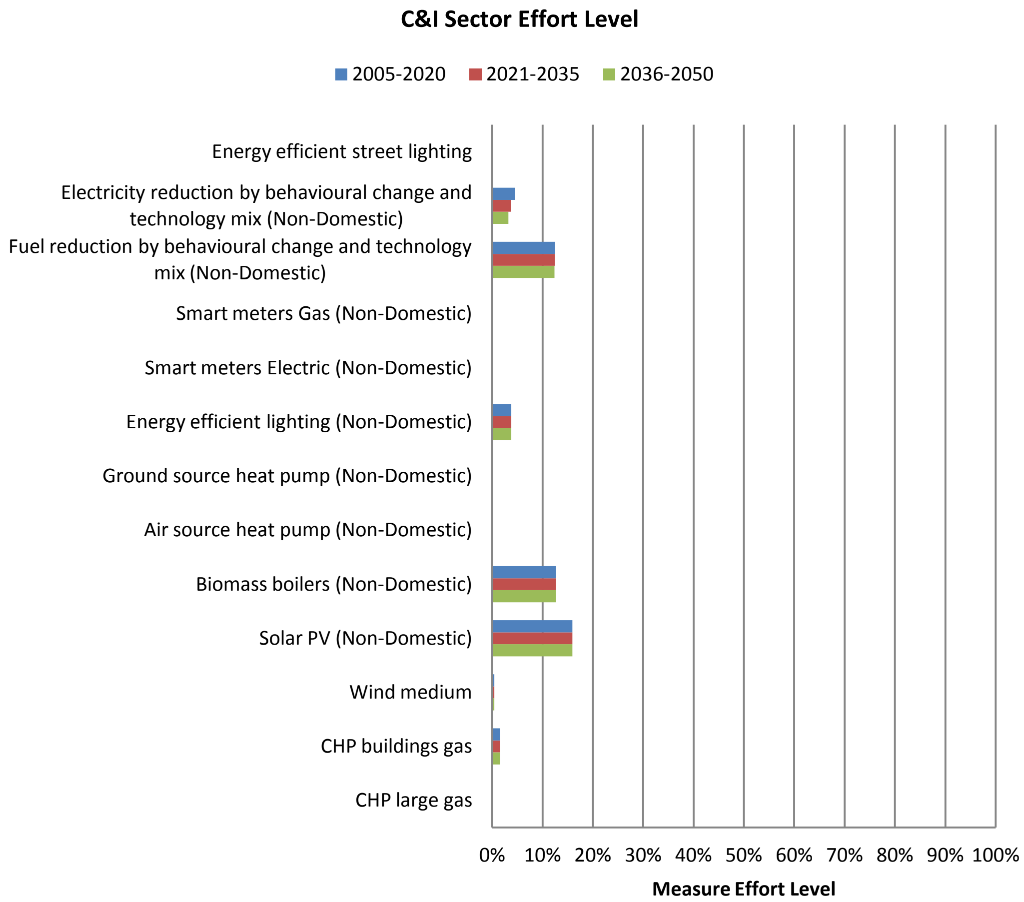


Figure 6: Effort Level for the Commercial & Industrial Sector

Finally, Figure 7 shows the deployment effort level undertaken in the Domestic Sector. Similarly to the C&I Sector, there is no additional deployment due to the Biomass Focus element of this Scenario. In Carbon Descent's experience, the LCTP prescribes the greatest deployment focus in this Sector. This is therefore, where higher effort levels can be found for this Scenario, particularly for the domestic energy efficiency and insulation measures, such as Cavity Wall Insulation, Smart Meters and Energy Efficient Appliances, Measures that the LCTP typically assumes will be more or less fully deployed by 2020. Domestic scale solar technologies also see relatively strong deployment focus.

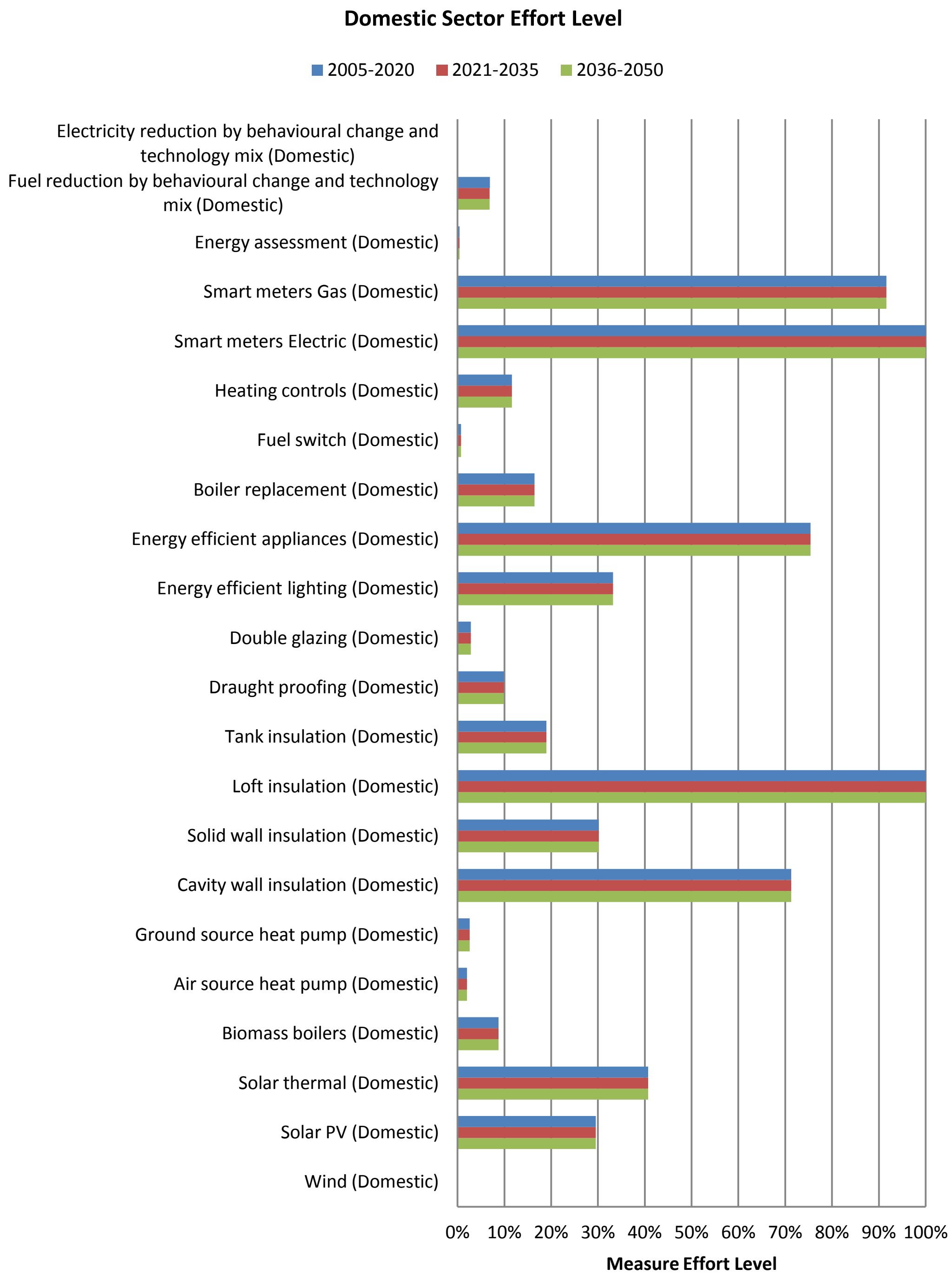


Figure 7: Effort Level for the Domestic Sector

4 VantagePoint Outputs from Scenario

This section of the report will provide the raw outputs as given by the VantagePoint software. This is the output used in the analysis above.

The Deployment Potentials within the Scenario are defined below and are used to provide an upper limit on the number of installations of each measure.

Deployment Potentials	Units	2005-2020	2021-2035	2036-2050
CHP biomass	MWe	31.142	31.142	31.142
CHP large gas	MWe	124.793	124.793	124.793
CHP buildings gas	MWe	163.174	163.174	163.174
Heat from power station	MWth	0	0	0
Power only biomass	MWe	31.142	31.142	31.142
Green grid	%	298.28	298.28	298.28
Wind large	MWe	9.95	9.95	9.95
Wind medium	MWe	8.65	8.65	8.65
Wind (Domestic)	Homes	0	0	0
Solar PV (Domestic)	Homes	15,248.00	15,248.00	15,248.00
Solar thermal (Domestic)	Homes	15,248.00	15,248.00	15,248.00
Biomass boilers (Domestic)	Homes	8,101.00	8,101.00	8,101.00
Air source heat pump (Domestic)	Homes	98,588.00	98,588.00	98,588.00
Ground source heat pump (Domestic)	Homes	46,247.00	46,247.00	46,247.00
Solar PV (Non-Domestic)	MWe	30	30	30
Biomass boilers (Non-Domestic)	MWth	6.504	6.504	6.504
Air source heat pump (Non-Domestic)	MWth	75.021	75.021	75.021
Ground source heat pump (Non-Domestic)	MWth	37.511	37.511	37.511
Cavity wall insulation (Domestic)	Homes	23,066.00	23,066.00	23,066.00
Solid wall insulation (Domestic)	Homes	32,784.00	32,784.00	32,784.00
Loft insulation (Domestic)	Homes	52,564.00	52,564.00	52,564.00
Tank insulation (Domestic)	Homes	2,554.00	2,554.00	2,554.00
Draught proofing (Domestic)	Homes	9,836.00	9,836.00	9,836.00
Double glazing (Domestic)	Homes	30,309.00	30,309.00	30,309.00
Energy efficient lighting (Domestic)	Lamps	777,516.00	777,516.00	777,516.00
Energy efficient appliances (Domestic)	Homes	98,588.00	98,588.00	98,588.00
Boiler replacement (Domestic)	Homes	13,402.00	13,402.00	13,402.00
Fuel switch (Domestic)	Homes	933.00	933.00	933.00
Heating controls (Domestic)	Homes	34,506.00	34,506.00	34,506.00
Smart meters Electric (Domestic)	Homes	31,909.00	31,909.00	31,909.00
Smart meters Gas (Domestic)	Homes	24,562.00	24,562.00	24,562.00
Energy assessment (Domestic)	Homes	98,588.00	98,588.00	98,588.00
Fuel reduction by behavioural change and technology mix (Domestic)	%	100	100	100

Electricity reduction by behavioural change and technology mix (Domestic)	%	100	100	100
Energy efficient lighting (Non-Domestic)	000's m2	916	916	916
Smart meters Electric (Non-Domestic)	%	100.00	100.00	100.00
Smart meters Gas (Non-Domestic)	%	100.00	100.00	100.00
Fuel reduction by behavioural change and technology mix (Non-Domestic)	%	100	100	100
Electricity reduction by behavioural change and technology mix (Non-Domestic)	%	100	100	100
Energy efficient street lighting	Lamps	35,000.00	35,000.00	35,000.00
Road transport fuel reduction by behavioural change	%	100	100	100
Road transport efficiency improvements	%	100	100	100
Replace road transport fuels with biofuels	000's litres	244,696.13	316,374.80	388,053.46
Replace road transport fuels with electricity	000's litres	244,696.13	316,374.80	388,053.46

Table 7: Scenario Deployment Potentials

The following table provides the Resource Potentials used for Derby City Council. These are the limits to the amount of biomass available and the total amount of heat that could viably be provided by a district heating scheme.

Resource Potentials	Units	2005-2020	2021-2035	2036-2050
Community Heating Potential	MWe	1,515,236	1,515,236	1,515,236
Biomass Resource Potential	MWe	1,112,115	1,626,273	2,140,431
Overall Power Demand	MWe	1,498,150	1,725,792	1,953,435
Overall Thermal Demand	MWe	2,698,710	2,885,325	2,914,761
road transport fuel Consumption	MWe	244,696	316,375	388,053

Table 8: Scenario Resource Potentials

The following table provides the measure deployment used to build this specific Scenario – these are the installations assumed to be in place by the end of the relevant period.

Deployment	Units	2005-2020	2021-2035	2036-2050
CHP biomass	MWe	24.29	31	31
CHP large gas	MWe	0	0	0
CHP buildings gas	MWe	2.524	2.524	2.524
Heat from power station	MWth	0	0	0
Power only biomass	MWe	6.387	14.077	28.475
Green grid	%	6.48	61.62	298.28
Wind large	MWe	0.536	0.536	0.536
Wind medium	MWe	0.035	0.035	0.035
Wind (Domestic)	Homes	0	0	0

Solar PV (Domestic)	Homes	4,504.00	4,504.00	4,504.00
Solar thermal (Domestic)	Homes	6,209.00	6,209.00	6,209.00
Biomass boilers (Domestic)	Homes	707.00	707.00	707.00
Air source heat pump (Domestic)	Homes	1,994.00	1,994.00	1,994.00
Ground source heat pump (Domestic)	Homes	1,192.00	1,192.00	1,192.00
Solar PV (Non-Domestic)	MWe	4.781	4.781	4.781
Biomass boilers (Non-Domestic)	MWth	0.825	0.825	0.825
Air source heat pump (Non-Domestic)	MWth	0	0	0
Ground source heat pump (Non-Domestic)	MWth	0	0	0
Cavity wall insulation (Domestic)	Homes	16,444.00	16,444.00	16,444.00
Solid wall insulation (Domestic)	Homes	9,890.00	9,890.00	9,890.00
Loft insulation (Domestic)	Homes	52,564.00	52,564.00	52,564.00
Tank insulation (Domestic)	Homes	484.00	484.00	484.00
Draught proofing (Domestic)	Homes	971.00	971.00	971.00
Double glazing (Domestic)	Homes	866.00	866.00	866.00
Energy efficient lighting (Domestic)	Lamps	258,249.00	258,249.00	258,249.00
Energy efficient appliances (Domestic)	Homes	74,363.00	74,363.00	74,363.00
Boiler replacement (Domestic)	Homes	2,205.00	2,205.00	2,205.00
Fuel switch (Domestic)	Homes	7.00	7.00	7.00
Heating controls (Domestic)	Homes	4,000.00	4,000.00	4,000.00
Smart meters Electric (Domestic)	Homes	31,909.00	31,909.00	31,909.00
Smart meters Gas (Domestic)	Homes	22,503.00	22,503.00	22,503.00
Energy assessment (Domestic)	Homes	399.00	399.00	399.00
Fuel reduction by behavioural change and technology mix (Domestic)	%	6.926	6.871	6.817
Electricity reduction by behavioural change and technology mix (Domestic)	%	-4.93	-4.69	-4.47
Energy efficient lighting (Non-Domestic)	000's m2	34.526	34.526	34.526
Smart meters Electric (Non-Domestic)	%	0.00	0.00	0.00
Smart meters Gas (Non-Domestic)	%	0.02	0.02	0.02
Fuel reduction by behavioural change and technology mix (Non-Domestic)	%	12.52	12.43	12.34
Electricity reduction by behavioural change and technology mix (Non-Domestic)	%	4.498	3.753	3.219
Energy efficient street lighting	Lamps	0.00	0.00	0.00
Road transport fuel reduction by behavioural change	%	0.089	0.089	0.089
Road transport efficiency improvements	%	8.86	8.86	8.86
Replace road transport fuels with biofuels	000's litres	26,631.28	244,428.13	353,326.50
Replace road transport fuels with electricity	000's litres	0.00	0.00	0.00

Table 9: Scenario Deployment

For the Scenario deployment provided above, VantagePoint calculates the CO_2 savings. The full breakdown of Measures has been detailed in terms of their ktCO_2pa reduction in each of the three periods.

CO2 Saved by Measure	Units	2005-2020	2021-2035	2036-2050
CHP biomass	ktCO2pa	168.472	160.447	144.889
CHP large gas	ktCO2pa	0	0	0
CHP buildings gas	ktCO2pa	4.968	4.684	4.673
Heat from power station	ktCO2pa	0	0	0
Power only biomass	ktCO2pa	13.843	9.572	5.359
Green grid	ktCO2pa	231.30	690.09	924.66
Wind large	ktCO2pa	0.418	0.131	0.036
Wind medium	ktCO2pa	0.017	0.005	0.001
Wind (Domestic)	ktCO2pa	0	0	0
Solar PV (Domestic)	ktCO2pa	3.40	1.07	0.30
Solar thermal (Domestic)	ktCO2pa	2.37	2.24	2.24
Biomass boilers (Domestic)	ktCO2pa	2.10	1.98	1.98
Air source heat pump (Domestic)	ktCO2pa	2.57	4.54	5.29
Ground source heat pump (Domestic)	ktCO2pa	2.04	2.87	3.21
Solar PV (Non-Domestic)	ktCO2pa	1.451	0.455	0.126
Biomass boilers (Non-Domestic)	ktCO2pa	0.881	0.83	0.827
Air source heat pump (Non-Domestic)	ktCO2pa	0	0	0
Ground source heat pump (Non-Domestic)	ktCO2pa	0	0	0
Cavity wall insulation (Domestic)	ktCO2pa	10.43	9.84	9.83
Solid wall insulation (Domestic)	ktCO2pa	25.03	23.62	23.59
Loft insulation (Domestic)	ktCO2pa	19.39	18.30	18.28
Tank insulation (Domestic)	ktCO2pa	0.08	0.07	0.07
Draught proofing (Domestic)	ktCO2pa	0.26	0.24	0.24
Double glazing (Domestic)	ktCO2pa	0.60	0.57	0.57
Energy efficient lighting (Domestic)	ktCO2pa	1.20	0.38	0.10
Energy efficient appliances (Domestic)	ktCO2pa	10.19	3.20	0.89
Boiler replacement (Domestic)	ktCO2pa	1.67	1.58	1.58
Fuel switch (Domestic)	ktCO2pa	0.02	-0.01	-0.01
Heating controls (Domestic)	ktCO2pa	0.14	0.13	0.13
Smart meters Electric (Domestic)	ktCO2pa	1.00	0.31	0.09
Smart meters Gas (Domestic)	ktCO2pa	0.38	0.36	0.36
Energy assessment (Domestic)	ktCO2pa	0.04	0.03	0.03
Fuel reduction by behavioural change and technology mix (Domestic)	ktCO2pa	21.685	21.684	21.683
Electricity reduction by behavioural change and technology mix (Domestic)	ktCO2pa	-8.403	-2.636	-0.729
Energy efficient lighting (Non-Domestic)	ktCO2pa	0.197	0.062	0.017
Smart meters Electric (Non-Domestic)	ktCO2pa	0.00	0.00	0.00

Smart meters Gas (Non-Domestic)	ktCO2pa	0.36	0.34	0.34
Fuel reduction by behavioural change and technology mix (Non-Domestic)	ktCO2pa	32.415	32.441	32.463
Electricity reduction by behavioural change and technology mix (Non-Domestic)	ktCO2pa	16.429	5.155	1.426
Energy efficient street lighting	ktCO2pa	0.00	0.00	0.00
Road transport fuel reduction by behavioural change	ktCO2pa	0.542	0.701	0.86
Road transport efficiency improvements	ktCO2pa	54.001	69.819	85.638
Replace road transport fuels with biofuels	ktCO2pa	33.51	307.56	444.59
Replace road transport fuels with electricity	ktCO2pa	0.00	0.00	0.00

Table 10: Scenario CO2 savings by measure

In addition to the ktCO_2pa savings per measure, where known, the indicative capital expenditure has been outlined in the table below. The costs are for each period and are not cumulative.

Capital Expenditure	Units	2005-2020	2021-2035	2036-2050
CHP biomass	£k	140274.75	117654.797	62702.423
CHP large gas	£k	0	0	0
CHP buildings gas	£k	2180.736	1635.552	0
Heat from power station	£k	0	0	0
Power only biomass	£k	36884.925	65156.873	120166.345
Green grid	£k	0.00	0.00	0.00
Wind large	£k	802.5	0	0
Wind medium	£k	108	0	0
Wind (Domestic)	£k	0	0	0
Solar PV (Domestic)	£k	28,544.10	0.00	0.00
Solar thermal (Domestic)	£k	24,836.00	0.00	0.00
Biomass boilers (Domestic)	£k	5,090.40	0.00	0.00
Air source heat pump (Domestic)	£k	13,958.00	0.00	0.00
Ground source heat pump (Domestic)	£k	11,920.00	0.00	1,862.50
Solar PV (Non-Domestic)	£k	19124	0	0
Biomass boilers (Non-Domestic)	£k	303.6	142.313	0
Air source heat pump (Non-Domestic)	£k	0	0	0
Ground source heat pump (Non-Domestic)	£k	0	0	0
Cavity wall insulation (Domestic)	£k	6,250.36	0.00	1,953.24
Solid wall insulation (Domestic)	£k	37,087.50	0.00	34,769.53
Loft insulation (Domestic)	£k	15,043.82	0.00	4,701.19
Tank insulation (Domestic)	£k	15.88	7.56	0.00
Draught proofing (Domestic)	£k	165.68	78.89	0.00
Double glazing (Domestic)	£k	3,464.00	2,165.00	1,082.50
Energy efficient lighting (Domestic)	£k	258.25	0.00	0.00
Energy efficient appliances (Domestic)	£k	68,321.01	32,533.81	0.00

Boiler replacement (Domestic)	£k	6,032.88	0.00	0.00
Fuel switch (Domestic)	£k	29.05	0.00	0.00
Heating controls (Domestic)	£k	440.00	0.00	0.00
Smart meters Electric (Domestic)	£k	7,370.98	0.00	0.00
Smart meters Gas (Domestic)	£k	6,368.35	0.00	0.00
Energy assessment (Domestic)	£k	39.90	0.00	0.00
Fuel reduction by behavioural change and technology mix (Domestic)	£k	0	0	0
Electricity reduction by behavioural change and technology mix (Domestic)	£k	0	0	0
Energy efficient lighting (Non-Domestic)	£k	863.15	0	0
Smart meters Electric (Non-Domestic)	£k	0.00	0.00	0.00
Smart meters Gas (Non-Domestic)	£k	0.00	0.00	0.00
Fuel reduction by behavioural change and technology mix (Non-Domestic)	£k	0	0	0
Electricity reduction by behavioural change and technology mix (Non-Domestic)	£k	0	0	0
Energy efficient street lighting	£k	0.00	0.00	0.00
Road transport fuel reduction by behavioural change	£k	0	0	0
Road transport efficiency improvements	£k	0	0	0
Replace road transport fuels with biofuels	£k	0.00	0.00	0.00
Replace road transport fuels with electricity	£k	0.00	0.00	0.00

Table 11: Scenario capital costs by measure