



# VantagePoint Modelling Scenario Report

## BIOMASS FOCUS SCENARIO FOR NORTHAMPTONSHIRE

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<b>Scenario Type:</b>	Biomass Focus	<b>Date:</b>	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 Northamptonshire, 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 Northamptonshire Biomass Focus Scenario calculates that the focus on maximal use of Biomass in all three years will deliver sufficient carbon savings for Northamptonshire to achieve its carbon emissions reduction target in 2020. However, the CO<sub>2</sub> savings are still short of the 2035 interim emissions reduction target and the 2050 Climate Change Act Target.

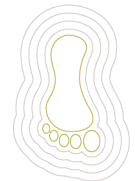


## CARBON DESCENT

Carbon Descent is an independent social enterprise and environmental trust with the experience, expertise and commitment to create strategies and deliver solutions that measurably reduce carbon footprints, creating a sustainable and equitable future for all.

Working in the key areas of energy, resource use, transport, the built environment and renewables for over 10 years, we partner with local authorities, private business, charities and communities to foster a low carbon world. We have wide experience of conducting energy and water audits, environmental assessments and technical feasibility studies, identifying carbon reduction measures, investigating the potential for renewable energy in new and existing developments and project management.

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.



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# **1 Introduction**

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## **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

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### 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 Northamptonshire, 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 Northamptonshire to meet its Climate Change Act carbon reduction targets in 2020, 2035 and 2050. This Biomass Focus scenario, therefore, also enables Northamptonshire 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 Northamptonshire 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 Northamptonshire – 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<sup>1</sup>, rising to a national potential of 548.4TWh by 2050<sup>2</sup>. 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.

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<sup>1</sup> DECC, *UK Biomass Strategy*, May 2007

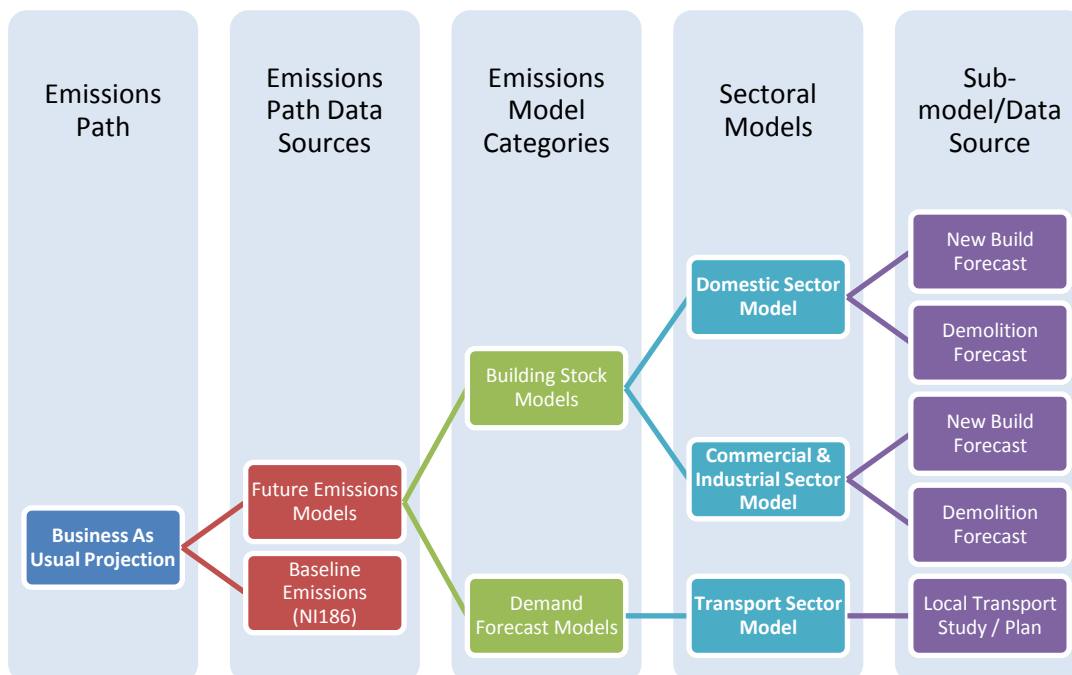
<sup>2</sup> DECC, *2050 Pathways Analysis Calculator Excel Model*, 2010 (set to Pathway Alpha)



## 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<sub>2</sub> 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<sup>2</sup> 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 Northamptonshire 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. The suite of national policies this represents have been mapped on to Northamptonshire.

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 if 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 projections up to 2050.

CO <sub>2</sub> comparison	2020	2035	2050
Baseline data (2005)	5600	5600	5600
Growth kt	730	1376	2124
Percentage growth from 2005	13%	25%	38%

Table 1: Business As Usual (BAU)

#### 3.1.2 Scenario Savings Overview

From the LCTP scenario, it is estimated that Northamptonshire's savings will be c1807.38ktCO<sub>2</sub> in period one which is 91% of the target savings. The LCTP therefore, delivers insufficient carbon savings for Northamptonshire 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 manages to meet the 2020 target but falls short of the 2035 interim target and the 2050 Climate Change Act target, undershooting them by 6% and 19% 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 <sub>2</sub> comparison	2005-2020	2021-2035	2036-2050
CO <sub>2</sub> savings targets (ktpa)	1992.13	4675.59	6409.29
Total CO <sub>2</sub> savings for the Scenario (ktpa)	3098.08	4375.99	5179.26
Comparison of targets vs. savings (ktpa)	1,106 (56%)	-300 (6%)	-1,230 (19%)

Table 2: Scenario CO<sub>2</sub> Savings Overview

#### 3.1.3 Scenario System Graph

Figure 1 shows the system graph of CO<sub>2</sub> 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<sub>2</sub> emissions on the vertical axis in kilotonnes of CO<sub>2</sub> 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 Northamptonshire 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).

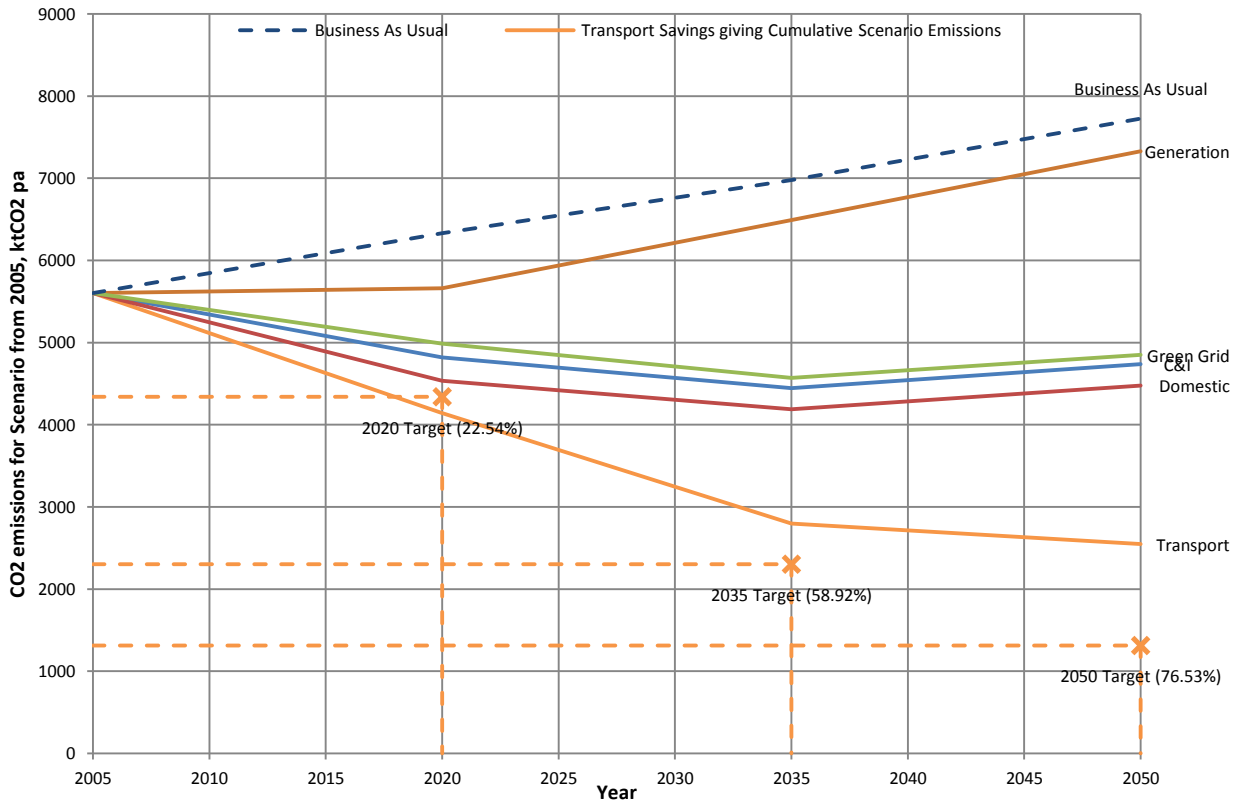


Figure 1: Scenario System Graph

## 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 ktCO<sub>2</sub>pa 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:

Sector	2020 Target Period		2035 Target Period		2050 Target Period	
	Savings ktCO <sub>2</sub> pa	As percentage of total savings	Savings ktCO <sub>2</sub> pa	As percentage of total savings	Savings ktCO <sub>2</sub> pa	As percentage of total savings
Domestic	283.68	13%	257.452	6%	263.662	5%
Commercial and Industrial	167.817	8%	126.309	3%	112.882	2%
Transport	392.574	18%	1391.088	30%	1928.212	37%
Large Generation	671.352	31%	489.011	10%	396.605	8%
Green Grid	673.623	31%	1918.986	41%	2477.904	48%

**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 Large Generation. 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.



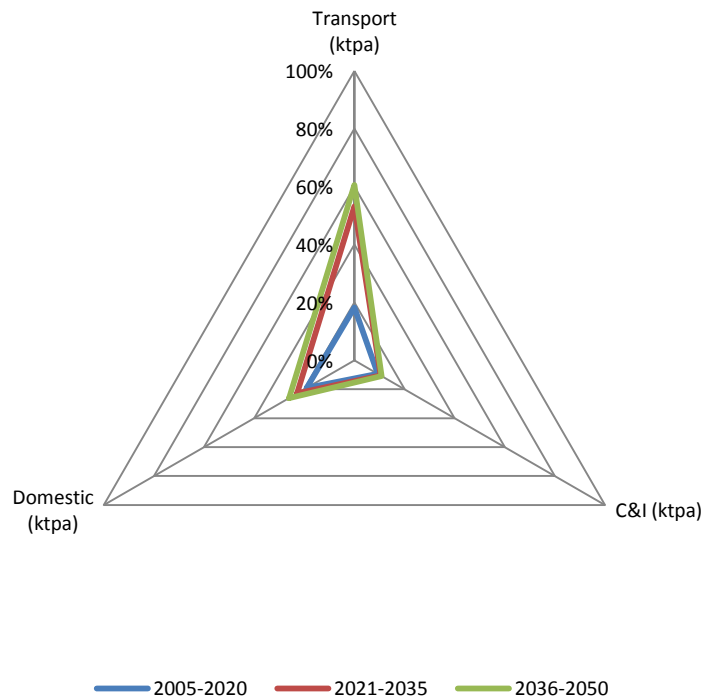


Figure 2: Demand Sector Decarbonisation

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 Northamptonshire'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 Northamptonshire'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.

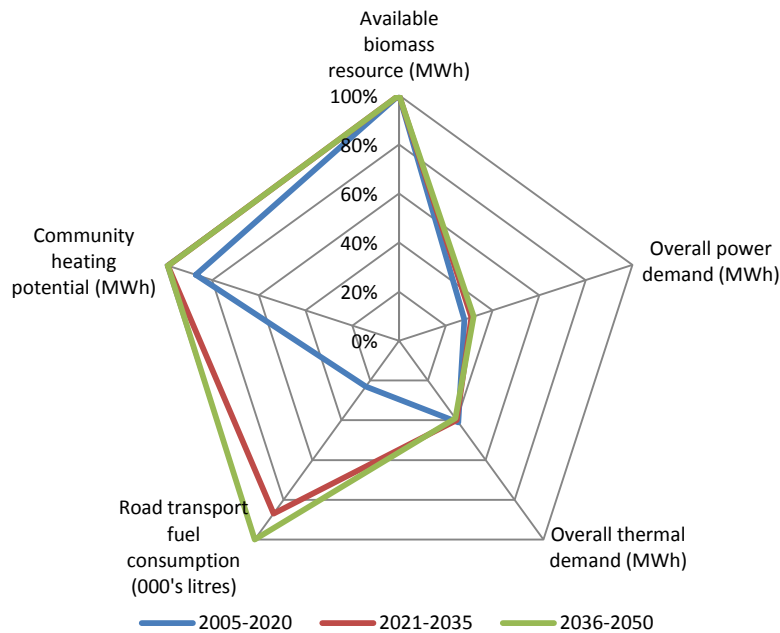


Figure 3: Scenario Energy Performance

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% in from the first period; the Community Heating Potential reaches some 90% in the first period and eventually reaches 100% in the second and final 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<sub>2</sub>-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 71% of the total CO<sub>2</sub> savings within the Scenario, or 78% 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	673.623	31%	34%
CHP biomass	475.318	22%	24%
Road transport efficiency improvements	240.754	11%	12%
Wind large	157.204	7%	8%
<b>Total</b>	<b>1546.899</b>	<b>71%</b>	<b>78%</b>

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	1918.986	46%	41%
Replace road transport fuels with biofuels	1095.099	26%	23%
CHP biomass	406.515	10%	9%
Road transport efficiency improvements	293.029	7%	6%
<b>Total</b>	<b>3713.629</b>	<b>89%</b>	<b>79%</b>

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	2477.904	48%	39%
Replace road transport fuels with biofuels	1567.954	30%	24%
CHP biomass	366.513	7%	6%
Road transport efficiency improvements	356.655	7%	6%
<b>Total</b>	<b>4769.026</b>	<b>92%</b>	<b>74%</b>

Table 6: Notable Large Savings Summary for 2036-2050

It is interesting to note that three out of four measures remain in the top across all periods and that, predictably, in every period the biomass measures are 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. Power Only Biomass' effort level is seen to reach its absolute effort levels between 2036 and 2050. The CHP Biomass eventually reaches some 85% of its effort levels.

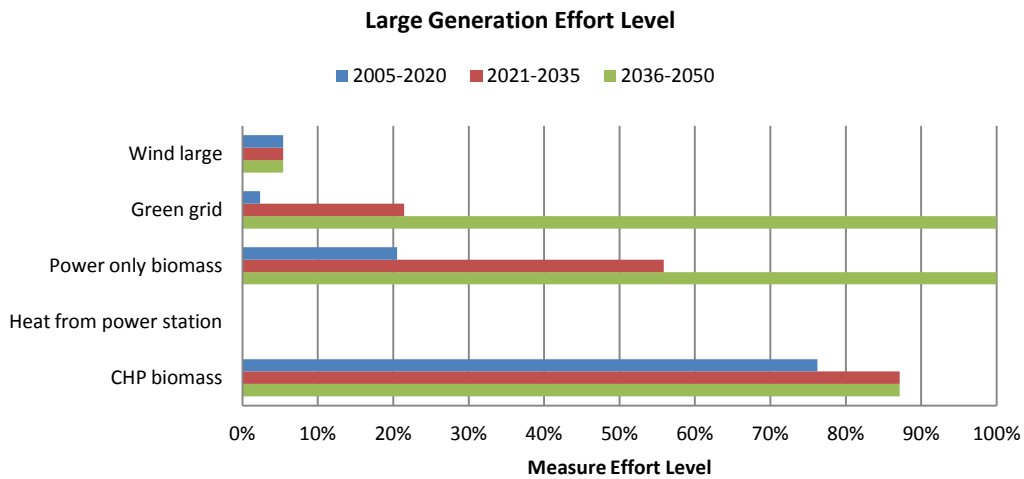


Figure 4: Effort Level for the Large Generation Sector

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.



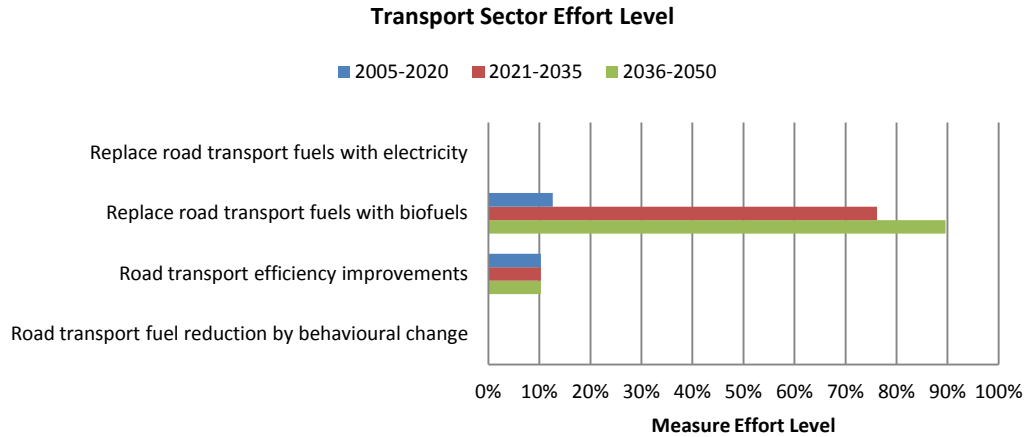


Figure 5: Effort Level for the Transport Sector

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, non domestic biomass boilers and energy efficient lighting.

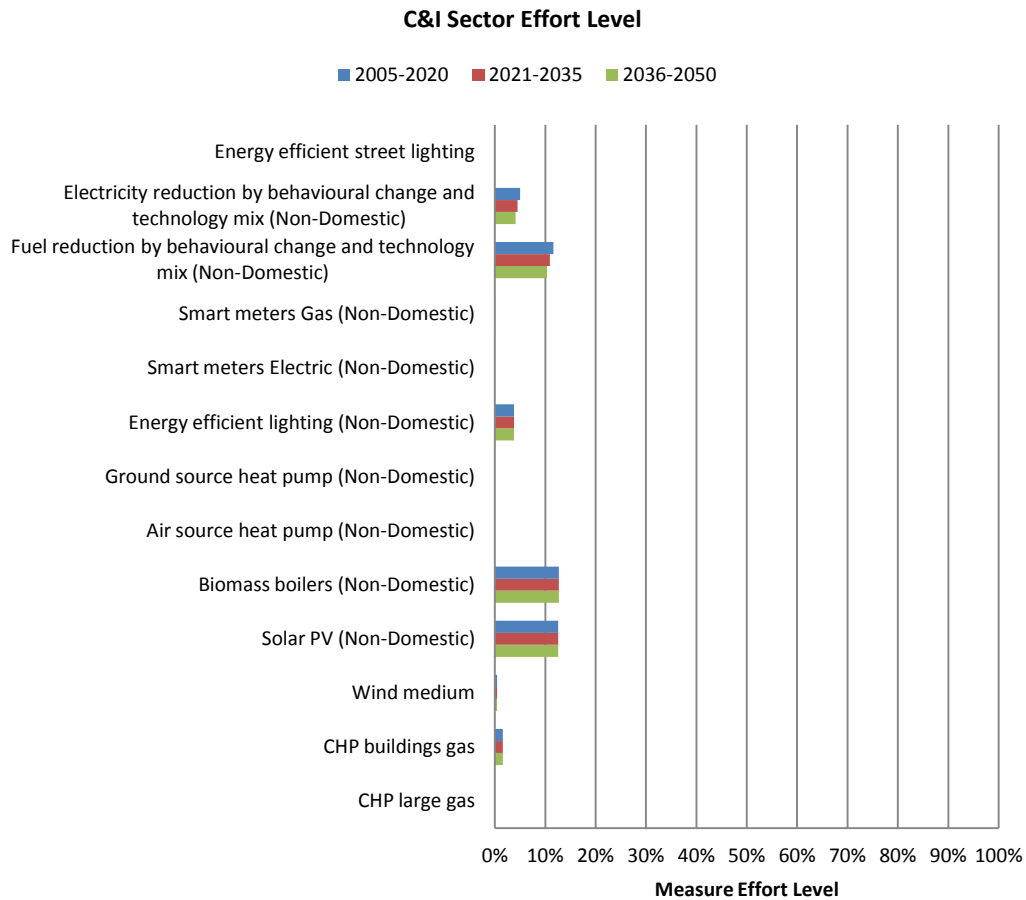


Figure 6: Effort Level for the Commercial & Industrial Sector





Finally, Figure 7 shows the deployment effort level undertaken in the Domestic Sector. Domestic Biomass Boilers show an increase in the final period. 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.

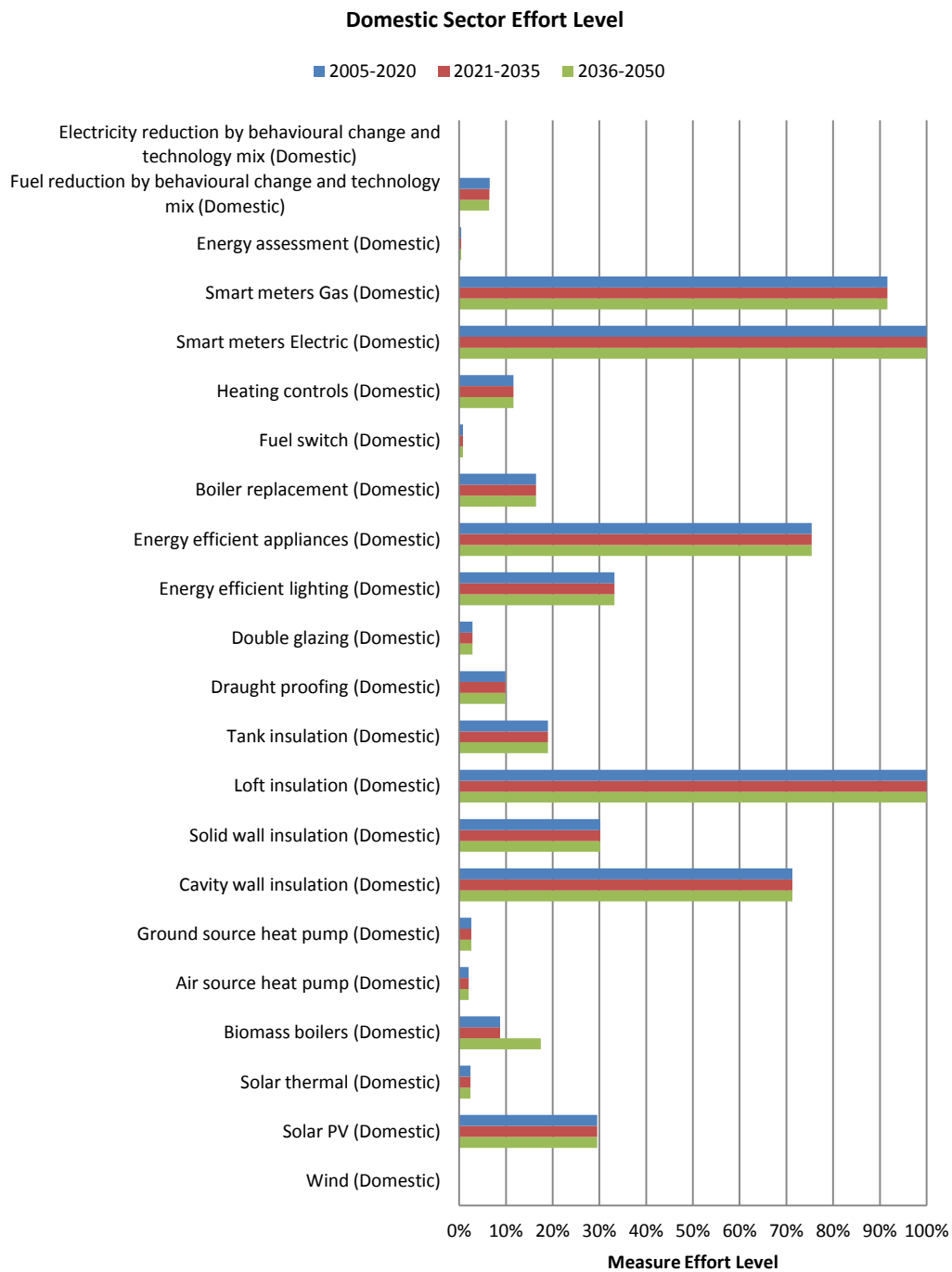


Figure 7: Effort Level for the Domestic Sector



## 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	87.359	87.359	87.359
CHP large gas	MWe	147.775	147.775	147.775
CHP buildings gas	MWe	193.224	193.224	193.224
Heat from power station	MWth	0	0	0
Power only biomass	MWe	87.359	87.359	87.359
Green grid	%	799.32	799.32	799.32
Wind large	MWe	3734.26	3734.26	3734.26
Wind medium	MWe	2240.47	2240.47	2240.47
Wind (Domestic)	Homes	0	0	0
Solar PV (Domestic)	Homes	66,035.00	66,035.00	66,035.00
Solar thermal (Domestic)	Homes	66,035.00	66,035.00	66,035.00
Biomass boilers (Domestic)	Homes	45,966.00	45,966.00	45,966.00
Air source heat pump (Domestic)	Homes	280,715.00	280,715.00	280,715.00
Ground source heat pump (Domestic)	Homes	137,075.00	137,075.00	137,075.00
Solar PV (Non-Domestic)	MWe	117	117	117
Biomass boilers (Non-Domestic)	MWth	49.125	49.125	49.125
Air source heat pump (Non-Domestic)	MWth	566.604	566.604	566.604
Ground source heat pump (Non-Domestic)	MWth	283.302	283.302	283.302
Cavity wall insulation (Domestic)	Homes	56,797.00	56,797.00	56,797.00
Solid wall insulation (Domestic)	Homes	73,623.00	73,623.00	73,623.00
Loft insulation (Domestic)	Homes	141,428.00	141,428.00	141,428.00
Tank insulation (Domestic)	Homes	23,626.00	23,626.00	23,626.00
Draught proofing (Domestic)	Homes	90,978.00	90,978.00	90,978.00
Double glazing (Domestic)	Homes	84,343.00	84,343.00	84,343.00
Energy efficient lighting (Domestic)	Lamps	7,191,554.00	7,191,554.00	7,191,554.00
Energy efficient appliances (Domestic)	Homes	280,715.00	280,715.00	280,715.00
Boiler replacement (Domestic)	Homes	123,958.00	123,958.00	123,958.00
Fuel switch (Domestic)	Homes	8,628.00	8,628.00	8,628.00
Heating controls (Domestic)	Homes	98,250.00	98,250.00	98,250.00
Smart meters Electric (Domestic)	Homes	295,139.00	295,139.00	295,139.00
Smart meters Gas (Domestic)	Homes	255,060.00	255,060.00	255,060.00
Energy assessment (Domestic)	Homes	280,715.00	280,715.00	280,715.00
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	6545	6545	6545
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	0.00	0.00	0.00
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	938,785.51	1,142,625.13	1,390,724.68
Replace road transport fuels with electricity	000's litres	938,785.51	1,142,625.13	1,390,724.68

**Table 7: Scenario Deployment Potentials**

The following table provides the Resource Potentials used for Northamptonshire. 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	1,794,280	1,794,280	1,794,280
Biomass Resource Potential	MWe	3,119,692	4,562,002	6,004,313
Overall Power Demand	MWe	4,363,314	4,799,067	5,234,819
Overall Thermal Demand	MWe	7,890,175	8,710,189	9,071,277
road transport fuel Consumption	MWe	938,786	1,142,625	1,390,725

**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	66.6	76.13	76.13
CHP large gas	MWe	0	0	0
CHP buildings gas	MWe	2.988	2.988	2.988
Heat from power station	MWth	0	0	0
Power only biomass	MWe	17.916	48.793	87.359
Green grid	%	18.87	171.34	799.32
Wind large	MWe	201.071	201.071	201.071
Wind medium	MWe	8.961	8.961	8.961



Wind (Domestic)	Homes	0	0	0
Solar PV (Domestic)	Homes	19,505.00	19,505.00	19,505.00
Solar thermal (Domestic)	Homes	1,587.00	1,587.00	1,587.00
Biomass boilers (Domestic)	Homes	4,012.00	4,012.00	8,026.00
Air source heat pump (Domestic)	Homes	5,679.00	5,679.00	5,679.00
Ground source heat pump (Domestic)	Homes	3,534.00	3,534.00	3,534.00
Solar PV (Non-Domestic)	MWe	14.672	14.672	14.672
Biomass boilers (Non-Domestic)	MWth	6.234	6.234	6.234
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	40,491.00	40,491.00	40,491.00
Solid wall insulation (Domestic)	Homes	22,210.00	22,210.00	22,210.00
Loft insulation (Domestic)	Homes	141,428.00	141,428.00	141,428.00
Tank insulation (Domestic)	Homes	4,478.00	4,478.00	4,478.00
Draught proofing (Domestic)	Homes	8,984.00	8,984.00	8,984.00
Double glazing (Domestic)	Homes	2,411.00	2,411.00	2,411.00
Energy efficient lighting (Domestic)	Lamps	2,388,646.00	2,388,646.00	2,388,646.00
Energy efficient appliances (Domestic)	Homes	211,738.00	211,738.00	211,738.00
Boiler replacement (Domestic)	Homes	20,394.00	20,394.00	20,394.00
Fuel switch (Domestic)	Homes	67.00	67.00	67.00
Heating controls (Domestic)	Homes	11,390.00	11,390.00	11,390.00
Smart meters Electric (Domestic)	Homes	295,139.00	295,139.00	295,139.00
Smart meters Gas (Domestic)	Homes	233,682.00	233,682.00	233,682.00
Energy assessment (Domestic)	Homes	1,135.00	1,135.00	1,135.00
Fuel reduction by behavioural change and technology mix (Domestic)	%	6.533	6.463	6.393
Electricity reduction by behavioural change and technology mix (Domestic)	%	-5.1	-4.67	-4.31
Energy efficient lighting (Non-Domestic)	000's m2	246.571	246.571	246.571
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)	%	11.586	10.934	10.351
Electricity reduction by behavioural change and technology mix (Non-Domestic)	%	4.971	4.503	4.116
Energy efficient street lighting	Lamps	0.00	0.00	0.00
Road transport fuel reduction by behavioural change	%	0.104	0.104	0.104
Road transport efficiency improvements	%	10.296	10.296	10.296
Replace road transport fuels with biofuels	000's litres	118,721.96	870,300.19	1,246,089.30
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<sub>2</sub> savings. The full breakdown of Measures has been detailed in terms of their ktCO<sub>2</sub>pa reduction in each of the three periods.

CO2 Saved by Measure	Units	2005-2020	2021-2035	2036-2050
CHP biomass	ktCO2pa	475.318	406.515	366.513
CHP large gas	ktCO2pa	0	0	0
CHP buildings gas	ktCO2pa	6.129	5.747	5.705
Heat from power station	ktCO2pa	0	0	0
Power only biomass	ktCO2pa	38.83	33.177	16.441
Green grid	ktCO2pa	673.62	1,918.99	2,477.90
Wind large	ktCO2pa	157.204	49.319	13.651
Wind medium	ktCO2pa	4.204	1.319	0.365
Wind (Domestic)	ktCO2pa	0	0	0
Solar PV (Domestic)	ktCO2pa	14.73	4.62	1.28
Solar thermal (Domestic)	ktCO2pa	0.62	0.58	0.58
Biomass boilers (Domestic)	ktCO2pa	12.10	11.42	22.80
Air source heat pump (Domestic)	ktCO2pa	7.60	13.17	15.31
Ground source heat pump (Domestic)	ktCO2pa	6.21	8.66	9.65
Solar PV (Non-Domestic)	ktCO2pa	4.452	1.397	0.387
Biomass boilers (Non-Domestic)	ktCO2pa	7.151	6.645	6.548
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	26.08	24.61	24.57
Solid wall insulation (Domestic)	ktCO2pa	57.09	53.86	53.78
Loft insulation (Domestic)	ktCO2pa	52.99	50.00	49.92
Tank insulation (Domestic)	ktCO2pa	0.74	0.70	0.70
Draught proofing (Domestic)	ktCO2pa	2.40	2.27	2.26
Double glazing (Domestic)	ktCO2pa	1.71	1.61	1.61
Energy efficient lighting (Domestic)	ktCO2pa	11.09	3.48	0.96
Energy efficient appliances (Domestic)	ktCO2pa	29.00	9.10	2.52
Boiler replacement (Domestic)	ktCO2pa	15.72	14.84	14.81
Fuel switch (Domestic)	ktCO2pa	0.17	-0.06	-0.14
Heating controls (Domestic)	ktCO2pa	0.39	0.37	0.37
Smart meters Electric (Domestic)	ktCO2pa	9.27	2.91	0.81
Smart meters Gas (Domestic)	ktCO2pa	4.01	3.79	3.78
Energy assessment (Domestic)	ktCO2pa	0.11	0.09	0.09
Fuel reduction by behavioural change and technology mix (Domestic)	ktCO2pa	60.5	60.511	60.508
Electricity reduction by behavioural change and technology mix (Domestic)	ktCO2pa	-28.845	-9.052	-2.508
Energy efficient lighting (Non-Domestic)	ktCO2pa	1.408	0.442	0.122
Smart meters Electric (Non-Domestic)	ktCO2pa	0.00	0.00	0.00



Smart meters Gas (Non-Domestic)	ktCO <sub>2</sub> pa	0.39	0.36	0.36
Fuel reduction by behavioural change and technology mix (Non-Domestic)	ktCO <sub>2</sub> pa	94.633	94.884	95.104
Electricity reduction by behavioural change and technology mix (Non-Domestic)	ktCO <sub>2</sub> pa	49.45	15.513	4.294
Energy efficient street lighting	ktCO <sub>2</sub> pa	0.00	0.00	0.00
Road transport fuel reduction by behavioural change	ktCO <sub>2</sub> pa	2.432	2.96	3.603
Road transport efficiency improvements	ktCO <sub>2</sub> pa	240.754	293.029	356.655
Replace road transport fuels with biofuels	ktCO <sub>2</sub> pa	149.39	1,095.10	1,567.95
Replace road transport fuels with electricity	ktCO <sub>2</sub> pa	0.00	0.00	0.00

Table 10: Scenario CO<sub>2</sub> savings by measure

In addition to the ktCO<sub>2</sub>pa 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	384615	271381.688	141194.419
CHP large gas	£k	0	0	0
CHP buildings gas	£k	2581.632	1936.224	0
Heat from power station	£k	0	0	0
Power only biomass	£k	103464.9	236511.243	358807.933
Green grid	£k	0.00	0.00	0.00
Wind large	£k	301608	0	0
Wind medium	£k	26883	0	0
Wind (Domestic)	£k	0	0	0
Solar PV (Domestic)	£k	123,612.94	0.00	0.00
Solar thermal (Domestic)	£k	6,348.00	0.00	0.00
Biomass boilers (Domestic)	£k	28,886.40	0.00	28,900.80
Air source heat pump (Domestic)	£k	39,753.00	0.00	0.00
Ground source heat pump (Domestic)	£k	35,340.00	0.00	5,521.88
Solar PV (Non-Domestic)	£k	58688	0	0
Biomass boilers (Non-Domestic)	£k	2294.112	1075.365	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	15,390.63	0.00	4,809.57
Solid wall insulation (Domestic)	£k	83,287.50	0.00	78,082.03
Loft insulation (Domestic)	£k	40,476.69	0.00	12,648.97
Tank insulation (Domestic)	£k	146.93	69.97	0.00
Draught proofing (Domestic)	£k	1,532.90	729.95	0.00
Double glazing (Domestic)	£k	9,644.00	6,027.50	3,013.75
Energy efficient lighting (Domestic)	£k	2,388.65	0.00	0.00
Energy efficient appliances (Domestic)	£k	194,534.29	92,635.38	0.00



Boiler replacement (Domestic)	£k	55,797.98	0.00	0.00
Fuel switch (Domestic)	£k	278.05	0.00	0.00
Heating controls (Domestic)	£k	1,252.90	0.00	0.00
Smart meters Electric (Domestic)	£k	68,177.11	0.00	0.00
Smart meters Gas (Domestic)	£k	66,132.01	0.00	0.00
Energy assessment (Domestic)	£k	113.50	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	6164.275	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

